COMSOL Multiphysics

Model Manager Reference Manual

6.0

Model Manager Reference Manual

Version: COMSOL 6.0

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Introduction

Read this guide to learn how to use the Model Manager, a set of tools for helping you with version control of models and auxiliary data files. The Model Manager is available directly from the COMSOL Desktop® and includes comprehensive functionality for saving, searching, organizing, and sharing models and files saved in a Model Manager database. A database can either be stored locally on your computer for personal use, or accessed remotely from a server for collaborative use.

In this chapter:

About the Model Manager

In this section:

- What Can You Do with the Model Manager?
- Where Do I Access the Documentation?

What Can You Do with the Model Manager?

When working with a simulation model for an extended period of time, you will inevitably have a need to keep a backup of old file versions around. You may, for example, want to recover an older version in case your current modeling work goes astray, or perhaps you want to use an older version as a template for a completely new model. Your solution to this may vary from something as straightforward as saving files with different filenames on your local hard drive, saving to a file-based version control system, or by uploading files to a product lifecycle management (PLM) system provided by your organization. If you are working on models in a collaborative setting, you are also used to sharing files with your coworkers, for example via email, by placing them on a shared file system, or by allowing your coworkers to download them from a centralized version control system or PLM system.

As the amount of simulation models and data grows, you and your coworkers might find yourselves spending a large part of your time just managing these models and data. This may involve working with multiple tools and software — keeping you away from your main modeling and simulation work. Some of the challenges and concerns you might face are:

- Efficient storage of models. Store only relevant data for the purpose of archiving and future retrieval, all while keeping disk space usage manageable.
- Automatic extraction of model metadata. Extract metadata when saving simulation models so that you and others may later find them, without requiring manual data entry for keywords and other search terms.
- Reuse of models. Use previously saved simulation models and data as building blocks when creating new models, perhaps generating an extensive library of reusable parts.

- Track and compare changes to models over time. Get an automatic audit trail for your simulation models to compare and restore older versions, or to reproduce modeling steps.
- Access control. Control who can find, open, and save simulation models and data.

The Model Manager comes with a set of tools for addressing these points — all while staying within the COMSOL Desktop modeling environment. From the COMSOL Desktop, you can create a new database on your own computer to keep track of your private models and auxiliary data files, or you and your colleagues may share such models and files by uploading them to a server database accessed via a Model Manager server.

A Model Manager database is tailor-made for the storage needs of a model built in COMSOL Multiphysics®. The Model Manager makes sure to never store duplicates of simulation data when saving multiple versions of the same model. You can also delete built, computed, and plotted data that may instead be reproduced from the model as needed.

The powerful Model Manager search syntax enables you to search deep into models based on their properties, features, settings, and other metadata. You may, for example, perform search queries answering:

- Which models use a Time Dependent study step?
- Which models have a Length parameter between 5 cm and 15 cm?
- Which models were last modified by me?

The Model Manager also comes with standard version control tools such as viewing the version history of models and auxiliary data files, automatically detecting version conflicts when saving, and comparing versions with each other. You can, for example, open an older version to create a completely new model with its own split-off version history, or see all the changes made to a model from one version to the next.

You can work on an existing model in a database by creating a draft of the model. The draft is version controlled in its own right, enabling you to experiment with various simulation ideas without polluting the version history of the original model. Once you have finished your draft work, you may choose to either keep it as a new version of the original model or discard it.

More advanced version control tools such as branching, merging, and reverting are also available. Branching enables you, for example, to work on an entire collection of models and auxiliary data files in isolation, while at the same time postponing the decision whether or not your changes are worth preserving. Reverting enables you, for example, to restore models and auxiliary data files that you have previously deleted, perhaps by accident.

For Model Manager server databases, you can control who can access models and auxiliary data files by setting permissions. You can, for example, set which users are permitted to open or save a particular model, or set which users are permitted to search and see a collection of models.

Where Do I Access the Documentation?

A number of internet resources have more information about COMSOL, including licensing and technical information. The electronic documentation, topic-based (or context-based) help, and the application libraries are all accessed through the COMSOL Desktop.

!	If you are reading the documentation as a PDF file on your computer, the blue links do not work to open an application or content referenced in a different guide. However, if you are using the Help system in COMSOL Multiphysics, these links work to open other modules, application examples, and documentation sets.

CONTACTING COMSOL BY EMAIL

For general product information, contact COMSOL at info@comsol.com.

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To receive technical support from COMSOL for the COMSOL products, please contact your local COMSOL representative or send your questions to support@comsol.com. An automatic notification and a case number are sent to you by email. You can also access technical support, software updates, license information, and other resources by registering for a COMSOL Access account.

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COMSOL Application Gallery	www.comsol.com/models
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Support Knowledge Base	www.comsol.com/support/knowledgebase

Overview of the Manual

This *Model Manager Reference Manual* contains information that helps you get started with the Model Manager in the COMSOL Multiphysics product. The information in this guide is specific to this functionality. Instructions on how to use COMSOL in general are included with the *COMSOL Multiphysics Reference Manual*.

As detailed in the section Where Do I Access the Documentation?, this information can also be searched from the COMSOL Multiphysics software **Help** system.

Instructions on how to configure a Model Manager server is found in the *Model Manager Server Manual*.

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To help you navigate through this guide, see the Contents and Index.

TOOLS

The Model Manager Tools chapter has an overview of the tools available in the COMSOL Desktop and includes information about Adding Databases, Databases in the COMSOL Modeling Environment, and The Model Manager Workspace.

SEARCH

The Searching and Filtering chapter gives a detailed description of the search and filtering capabilities in a Model Manager database, including the The Model Manager Search Syntax.

VERSION CONTROL

The Advanced Version Control chapter introduces more advanced tools for version control management offered by the Model Manager, including Branching, Merging, and Reverting.

EXAMPLES

The Working with Models in Databases chapter showcases how the Model Manager tools can be integrated in your modeling workflow via a short tutorial.

GLOSSARY

The Glossary chapter gives a summary of various concepts and terms specific to a Model Manager database.

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Model Manager Tools

This chapter provides an overview of the tools available in the Model Manager to help you save, search, organize, and share models and auxiliary data files stored in a Model Manager database. To quickly get started with models in databases, see also the tutorial Example: Modeling Using Version Control.

In this chapter:

- Introduction
- Adding Databases
- Databases in the COMSOL Modeling Environment
- The Model Manager Workspace
- Overview of a Model Manager Database
- Browsing Databases
- Organization of Models and Files
- Basic Version Control
- Bulk Operations
- User Management
- Access Control

- Maintenance
- Database Administration

Introduction

The Model Manager includes an extensive set of tools for working with models and auxiliary data files stored in databases. These tools are integrated into the COMSOL Desktop modeling environment (the Model Builder, the Application Builder, and the Physics Builder), allowing you to seamlessly switch between models and auxiliary data files stored on the file system and in Model Manager databases.

In this, and in many other chapters, the term *model* will be used as a catch-all that also includes applications and physics. The term *auxiliary data file* is a catch-all for other files that models may depend on, including, for example, CAD and interpolation data. See also Glossary.

Some of the key Model Manager tools that you will encounter in your everyday modeling workflow are:

- Opening a model from a database from the **Open** window. See Opening Models from Databases to learn how you can search for models to open in databases.
- Saving a model to a database from the **Save** window. See Saving Models to Databases to learn how you save your modeling work as a new version in a database.
- Reusing components, materials, and physics from other models via the **Select Model** window. See Inserting Components, Materials, and Physics from Databases to learn how you can copy such parts from models stored in databases.
- Selecting auxiliary data files as model input in the **Select File** window. See Selecting Auxiliary Data Files in Databases to learn how you reference an auxiliary data file stored in a database from a model.
- Accessing older versions of a model from the **Versions** window. See The Versions Window for the COMSOL Desktop Model to learn how you can access previously saved versions of your model, including opening a version, restoring a version, or comparing two versions with each other.

You can quickly get started with the Model Manager by creating a new database stored locally on your computer. See Adding Databases and New Local Database to learn how you can create such a database directly from within the COMSOL Desktop.

The Model Manager is supported on the same platforms as COMSOL Multiphysics®: Windows®, Linux®, and macOS.

If you have installed a Model Manager server, you can also connect to its server database from within the COMSOL Desktop — see Connecting to a Server Database. Read more about installing and configuring a Model Manager server in the *Model Manager Server Manual*.

The Model Manager comes with a dedicated workspace for database-specific tools such as browsing, organizing, and administrating your databases. See The Model Manager Workspace and further sections in this chapter to learn, for example, how you can browse and administrate your configured databases in The Databases Window, search for models and auxiliary data files in The Model Manager Window, and see settings, features, properties, and other metadata of your saved models in The Settings Window.

The Model Manager tools are default enabled in the COMSOL Desktop environment. You can hide all Model Manager functionality via the **Preferences** dialog box by clearing the **Enable Model Manager** check box under **Settings** on the **Model Manager** page. A program restart is required.

Adding Databases

The COMSOL Desktop supports connecting to both a *local database* stored on the same computer that COMSOL Multiphysics is running on, as well as to a *server database* accessed via a Model Manager server. You can connect to as many databases as you like, and COMSOL Multiphysics will remember connected databases between program sessions.

A local database is intended for single-user use and is the recommended database when you want to keep your own models and auxiliary data files under version control, without necessarily intending for others to see and work with them. It can also be useful when you just want to try out the various features that Model Manager offers. A server database is intended for multiple-user use and is the recommended database when you are working on models and auxiliary data files in a collaborative setting.

Support for creating local databases is included with the COMSOL Multiphysics installation and requires no additional modules, software, or running processes. A server database requires a running Model Manager server, which can either be started on the same computer as COMSOL Multiphysics or on another computer that COMSOL Multiphysics has network access to.

See the *Model Manager Server Manual* for configuring a Model Manager server.

To add a new database, do one of the following:

- In the **Open** window, the **Save** window, the **Select File** window, or the **Select Model** window, choose **Add Database** ( ) from the list of options.
- In the Model Manager workspace, click the **Add Database** button ( ) in the **Database** section on the **Home** toolbar.

In this section:

- The Add Database Window
- New Local Database
- Opening a Local Database
- Connecting to a Server Database

The Add Database Window

From the **Add Database** window:

- Click the **New Local Database** button ( ) to create a new Model Manager database that will be stored locally on your computer.
- Click the **Open Local Database** button ( ) to add an existing Model Manager database stored locally on your computer.
- Click the **Connect to Server Database** button ( ) to connect to a server database via a Model Manager server.

- New Local Database
- Opening a Local Database
- Connecting to a Server Database

New Local Database

To create a new local database on your computer:

1. Under **Database name**, write the name of the new database as stored on the file system.

   The database name can only contain characters that are valid for a directory name and filename. The name will also be used as the initial label of the database in the COMSOL Desktop, although this label can later be changed — see Database Configurations.

2. Under **Databases directory**, write the path to the parent directory that will contain the new database. You can also keep the suggested, prefilled directory path.

   The database itself will be created as a subdirectory inside this directory.

3. Click the **Add Database** button ( ) to create the new database.

Creating a database on a network drive is not supported and COMSOL Multiphysics will report an error if it detects a path to such a file system.

The field under **Databases directory** contains a prefilled default directory path appropriate for the underlying operating system. You can change this default from the **Preferences** dialog box in the **Databases directory** field under **Local databases** on the **Model Manager** page.

A LOCAL DATABASE ON THE FILE SYSTEM

The created database consists of a directory with the name specified by the **Database name** field, located within the parent directory specified by the field under **Databases directory** in the **New Local Database** window. This database directory contains:

- An SQLite® database file with the same name as the directory. Its file extension is `mphdb`.
- A `resources` directory containing files whose file sizes are deemed too large to store directly inside the SQLite® database file. These files can, for example, be built, computed, and plotted data generated by models, or auxiliary data files such as CAD and interpolation data.
- An `index` directory containing files used by Model Manager for searching and filtering.

Local databases can be backed up using any regular backup software used for backing up the workstation. Make sure to include all files and directories: the SQLite® database file, the `resources` directory, and the `index` directory.

Opening a Local Database

You can add an already existing database to the COMSOL Desktop. This is useful, for example, if you want to move a local database created on an old computer to a new computer.

From the **Open** dialog box, browse to and choose the SQLite® database file for the database you want to add. Click the **Open** button to add the database.

Model Manager will check that the `resources` directory and the `index` directory for the database, as described in A Local Database on the File System, are found next to the database file. If it fails to find these directories, or if it fails to connect to the database, the **Open Local Database** window is shown.

1 Write the path to the SQLite® database file under **Database file**.

2. Write the path to the `resources` directory under **Resources directory**.
3. Write the path to the `index` directory under **Search index directory**.
4. Write a label for the database under **Label**.
5. Click the **Add Database** button (☑) to add the existing database.

> ⚠ Adding a database from a network drive is not supported and COMSOL Multiphysics will report an error if it detects a path to such a file system.

OPENING A LOCAL DATABASE FROM MULTIPLE COMSOL MULTIPHYSICS PROCESSES

You can access the same local database from multiple COMSOL Multiphysics program sessions, as long as the database is not placed on a network drive. There are, however, a few caveats to keep in mind:

- Changes saved from one COMSOL Multiphysics program session may not be visible to other program sessions.
- Some advanced search and filter functionality, as described in Searching and Filtering, will only be available to the first program session that connects to the local database. Other program sessions use a simplified search.

> ! Use a server database accessed via a Model Manager server when working in a multiple-user environment.

Connecting to a Server Database

You can connect to a server database via a Model Manager server.

1. Write the server address to the Model Manager server under **Server**.
2. Select the **Require secure connection** check box if the network connection is made using a secure connection, with transport layer security provided by HTTPS (as opposed to plain HTTP). A warning message is shown if the check box is cleared.
3. Write your user credentials used to authenticate with the Model Manager server under **User**. You can opt to remember the provided password between program sessions by selecting the **Remember password** check box. The password will be stored in an encrypted form on the local file system.
4. Write a label for the server database under **Label**.

5 Click the **Connect** button (☑) to connect to the Model Manager server.

!	You are strongly recommended to connect to the Model Manager server using a secure connection, with transport layer security provided by HTTPS. Clearing the **Require secure connection** check box will send all data, including your credentials, in an unencrypted cleartext format. See the *Model Manager Server Manual* for configuring a Model Manager server to run behind a reverse proxy using such a secure connection.

💡	To connect to a Model Manager server running on, for example, port `8181` on the same computer as COMSOL Multiphysics, write `localhost:8181` under **Server**.

Databases in the COMSOL Modeling Environment

The Model Manager tools are fully integrated with the COMSOL Desktop modeling environment — wherever you interact with models and auxiliary data files on the file system, there is typically equivalent functionality for interacting with such models and files in a database. In this section you will find details on where and how you typically encounter the Model Manager tools in the COMSOL Desktop:

- Opening Models from Databases
- Saving Models to Databases
- Saving Drafts of Models
- Inserting Components, Materials, and Physics from Databases
- Selecting Auxiliary Data Files in Databases
- The Versions Window for the COMSOL Desktop Model
- Comparing Models Saved in Databases
- Auxiliary Data From Databases

Opening Models from Databases

From the **Open** window, you can find and open versions of models from one of your configured databases (see Adding Databases). Choose the database that you want to open a model from in the list of options. Choose **Add Database** (🗄) if you want to add a new database.

The **Open** window is shown with a list of models saved in the database. Select a model and click the **Open** button (📂) to open the model in the COMSOL Desktop. If a model is also an application, you can click **Run** (▶) to launch and run the application directly.

The Open Window in the *COMSOL Multiphysics Reference Manual*

- Opening Models
- Running Applications

FINDING MODELS TO OPEN

You find models to open by writing search expressions in the search field and clicking the **Search** button. You can write plain search words and any number of filter expressions using The Model Manager Search Syntax. Plain search words will match on the title, description, tags, and filename of a model.

You can also apply separate Item and Content Filters via The Filter Dialog Box. Select a filter from the **Add Filter** menu button (▼) in the toolbar to open the dialog box. Applied filters are shown below the search field — see The Applied Filters Toolbar.

You search among the latest versions of models by default. Each entry in the result list contains the title of the model in that version, the time when the version was saved, and the name of the user that saved the version. The search result is sorted on title, with a maximum of 100 models initially included in the result list. Click the **Show More** button (≡↓) to include more matches.

Searching and Filtering

THE OPEN WINDOW TOOLBAR

The toolbar above the search field contains the following toolbar buttons:

- Click the **Refresh** button (↻) to refresh the search result while keeping the search expression and applied filters unchanged.
- Click the **Show More** button (≡↓) to include more matching models in the search result.
- Click the **Reset** button (↶) to clear the current search expression and applied filters.
- Click the **Add Filter** menu button (▼) to apply a filter.

SELECT LOCATION IN DATABASE

You can change which model versions to search for by selecting another *location* — see Searching Versions and Locations. Click the link button above the search field to open The Select Location Dialog Box to select which location to search. The link button is hidden if there is only one location available in the database, which is the default for a new database.

Saving Models to Databases

From the **Save** window, you can save a new version of the model opened in the COMSOL Desktop to one of your configured databases. Choose the database that you want to save a model to in the list of options. Choose **Add Database** ( ) if you want to add a new database.

The Save Window in the *COMSOL Multiphysics Reference Manual*

The **Save** window can appear with four different headers depending on the model's presence in the selected database:

- **Save new**: The opened model has never before been saved to the database. A new model will be created in the database with an associated first version.
- **Save version**: The database contains previously saved versions of the opened model. A new version of an existing model will be saved to the database.
- **Save version from draft**: The opened model is a draft version. A new version of the regular model that the draft was created from will be saved to the database.
- **Save new from draft**: The opened model is a draft version, but the regular model that the draft was created from does not exist in the database. This may happen if you, or another user, permanently deletes the regular model in the database while the draft is open in the COMSOL Desktop, or if you decide to save the draft to another database. As for **Save new**, a new model will be created in the database with an associated first version.

Saving Drafts of Models

To save a new model version:

1 Write the title for the model version in the **Title** field.

This title is kept in sync with the corresponding field in the **Presentation** section in the root node's **Settings** window. The title cannot be left empty.

2 Write an optional save comment in the **Comments** field.

You can later read these save comments from The Versions Window and the The Commits Window.

3 Change the target branch for the save by clicking the **Location** link button and selecting another branch in The Select Location Dialog Box.

The **Location** link button is hidden if the database only contains a single branch, which is the default for a new database.

4 Click the **Save** button (💾) to save a new version of the model.

If you want to force the creation of a new model instead, click on the expand button next to the **Save** button (💾) and select **Save as New** (💾) — see also Splitting a Model History in Two.

Only changing the title of a model already saved in a database does *not* mean that you will create a new model. While providing a descriptive title helps you with later finding it in the database, it has no bearing on the database identity of the model.

SAVE INFORMATION

The **Information** panel displays additional information concerning the save. When saving a new version of an existing model in the database, this includes both when, and by whom, various versions were saved:

- **Latest version**: The most recent version of the model being saved. The latest version depends on the target branch set in the **Location** field.
- **Current version**: The version that the current model in the COMSOL Desktop was opened from. Only shown for **Save version** if the current version is not the same as the latest version — see also Save Conflicts.
- **Current draft version**: The version that the current draft in the COMSOL Desktop was opened from. Only shown for **Save new from draft**.

The panel can also contain information messages (ⓘ) that may be of interest, as well as warning messages (⚠) signaling, for example, that the opened model is in conflict with the latest version.

Save Conflicts

When the **Save** window is shown, Model Manager will make a preemptive check that the model being saved is not in conflict with the latest, saved, version in the database. Such a conflict can arise if:

- The latest version saved in the database is not the same version that the model in the COMSOL Desktop was opened from. Your coworker may, for example, have opened the same model as you, made some changes, and then saved before you now try to save it.
- The latest version saved in the database is not be the same version as a draft was originally created from. You and your coworker may, for example, have both started working on two separate drafts, and then your coworker saved their draft back to the original model before you now try to save it back to the same model. See also Saving Drafts of Models.
- The model in the COMSOL Desktop has been deleted on the target branch before you now try to save it.

Clicking the **Save** button ( ) while there are save conflicts opens a dialog box asking if you want to save anyway. Click **Save** to ignore all conflicts, or **Cancel** for closing the dialog box without saving. You can also click **Compare with Latest** ( ) to open the **Comparison Result** window to compare the opened COMSOL Desktop model with the latest version in the database. See also Comparing the Opened Model in the COMSOL Desktop With the Latest Version.

PERMISSION CHECK

When saving to a server database via a Model Manager server, Model Manager will check that you fulfill the permission requirements to save a new version of the model. This involves checking that you are permitted to:

- Save in the repository containing the target branch.
- Save in the target branch.
- Save versions of the model.

Only the first two requirements apply when creating a new model in the database.

Permission Levels

A preemptive permission check is performed when the **Save** window is shown. If the check fails, a link button ( ) that opens a dialog box explaining why it failed is shown next to the **Save** button ( ) — see The Permission Requirements Dialog Box.

Saving Drafts of Models

To save a *draft* of the model opened in the COMSOL Desktop, go to the **File** menu and select **Save Draft** ( ). You can also press the keyboard shortcut Ctrl+S.

The **Save Draft** ( ) option is only available if the model is opened from, or last saved to, a database.

The keyboard shortcut Ctrl+S either saves the current model to the file system, or as a draft in the database, depending on where the model was last saved. The file system is the default for unsaved models.

A draft model behaves in exactly the same way as a *regular* model in the database, except that a draft offers a streamlined way of saving it back as a new version of the model it originated from.

Working with a draft in the COMSOL Desktop typically involves these steps:

1. Open a regular model from a database.
2. From the **File** menu, select **Save Draft** ( ), or press Ctrl+S, to save a first version of a new draft of the opened model.
3. Work on the draft, intermittently selecting **Save Draft** ( ) or pressing Ctrl+S to save additional draft versions.
4. From the **File** menu, select **Save as Version** ( ). Click **Save** ( ) to save the opened draft as a new version of the original model. Click **Save as New** ( ) to create a new model from the draft. See also Saving Models to Databases.

Drafts

Inserting Components, Materials, and Physics from Databases

From the **Select Model** window, you can find and select models stored in a database to insert one of their components, physics, or materials into the model opened in the COMSOL Desktop. Choose the database that you want to select from in the list of options. Choose **Add Database** ( ) if you want to add a new database.

The **Select Model** window is opened when you, for example, click:

- **Insert Components From** ( ) in the **Add Component** menu in Model Builder's **Home** toolbar.
- **Insert Physics From** ( ) in the **Insert Physics** menu in Model Builder's **Physics** toolbar.
- **Import Materials From** ( ) in Model Builder's **Materials** toolbar.

The **Select Model** window for a database offers identical search and filter functionality as the **Open** window — see Opening Models from Databases. Click the **Select** button (+) once you have found and selected the sought-after model to insert from.

The Versions Window for the COMSOL Desktop Model

The **Versions** window in the **Model Builder** workspace shows the history of the model opened in the COMSOL Desktop when that model is opened from a database or was last saved to a database. You can use the **Versions** window to, for example, quickly get an overview of recently saved versions, compare what was changed between two versions, open older versions, or even restore an older version as the latest version.

From the **Windows** menu ( ) in the **Layout** section of Model Builder's **Home** toolbar, select **Versions** ( ) to open the **Versions** window.

The window contains a table with versions of the model sorted in chronological order, most recent first. At most 100 versions are initially shown. Click the **Show More** button ( ) to include older versions in the table. The version that is opened in the COMSOL Desktop is highlighted in bold.

The table columns are:

- The type column — the type of the model represented by an icon. See Item Types and Save Types.
- The **Title** column — the title set for the model in that version.

- The **Saved** column — the time when the version was saved.
- The **Saved By** column — the name of the user that saved the version.
- The **Branch** column — the target branch the version was saved on. There is only a single branch, default named **Main**, when creating a new database.
- The **Comments** column — the optional comment provided when the version was saved.

THE VERSIONS WINDOW TOOLBAR

The toolbar above the table contains the following toolbar buttons:

- Click the **Refresh** button ( ) to refresh the table in case a new version has been saved. The table will automatically refresh if you save a new version to the database from the COMSOL Desktop, but the same is not true if one of your coworkers saves.
- Click the **Show More** button ( ) to show more versions in the table.
- Click the **Version Details** button ( ) to open The Version Details Dialog Box containing more information on a specific version.
- Click the **Open** button ( ) to open a selected version in the COMSOL Desktop.
- Click the **Run** button ( ) to launch and run a selected version in the COMSOL Desktop. Only enabled if the selected version is an application.
- Click the **Compare** button ( ) to compare a selected version with the model opened in the COMSOL Desktop. Select two versions to compare them with each other. See Comparing Models Saved in Databases.
- Click the **Restore Version** button ( ) to save the selected version as a new latest version of the model. See also Restore Version.

If you right-click a model version, you can also:

- Select **Copy Location** ( ) to copy a text string with a URI that uniquely identifies the model version in the database to the clipboard.
- Select **Permanently Delete Version** ( ) to permanently delete the model version in the database. This cannot be undone. See also Permanently Deleting a Version.

SPLITTING A MODEL HISTORY IN TWO

When you create a new model from an existing model, for example by saving a new draft or selecting **Save as New** ( ) in the **Save** window, the Model Manager database stores a reference to the *origin model* from the new model (or rather, the version of the original model). You can think of the new model as being *split off* from the original model, such that the new model receives its own identity and version history.

The **Versions** window helps you keep track of a model's potential origin by including the versions of the latter up to the source version that the new model was created from in the window's table — see Figure 2-1 for a schematic representation.

You are likely to first encounter this split-off in the **Versions** window when saving a new draft from a regular model — see Saving Drafts of Models. The top table rows correspond to the versions of the saved draft. The remaining table rows are the versions of the regular model that the draft originated from.

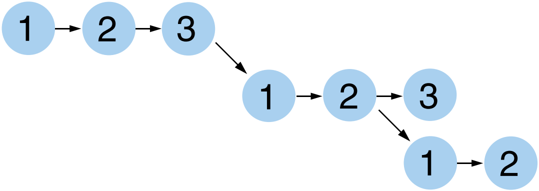


Figure 2-1: A schematic of the version history of three models, with the chronological order of versions read from left to right. The first version of the middle model was created from the third version of the top model, and the first version of the bottom model was created from the second version of the middle model. The version history of the top model includes three versions, that of the middle model includes six versions, and that of the bottom model includes seven versions. The history of the bottom model does not include the third version of the middle model as that was saved after the bottom model was split off.

Comparing Models Saved in Databases

The **Comparison Result** window enables you to compare versions of models stored in databases. In this section, you will see four different ways you can encounter comparisons involving such models:

- Comparing Two Versions From a Model's History
- Comparing Two Models
- Comparing a Version With the Opened Model in the COMSOL Desktop
- Comparing the Opened Model in the COMSOL Desktop With the Latest Version

Comparing Models and Applications in the *COMSOL Multiphysics Reference Manual*

COMPARING TWO VERSIONS FROM A MODEL'S HISTORY

If you select two model versions in the **Versions** window and click **Compare** (⚖), the **Comparison Result** window will open with the older version shown on the left, labeled as **Older Version**, and the newer version on the right, labeled as **Newer Version**. The versions need not belong to the same model: the older version may, for example, belong to an origin model of the newer version's model — see Splitting a Model History in Two. Since model versions are immutable in the database, it is not possible to merge or override any shown differences in the opened **Comparison Result** window.

COMPARING TWO MODELS

If you select two models in The Model Manager Window or The Databases Window and click **Compare** (⚖), the **Comparison Result** window will open with one of the models labeled as **First** and the other as **Second**. The compared versions depend on the context where the models were selected. Selecting two models when Searching in Branches will compare the latest versions of each respective model. Selecting when Searching in Snapshots and Commits will compare the versions that were the latest at the time of the corresponding commit. Similar to when comparing two versions from a model's history, it is not possible to merge or override any shown differences in the opened **Comparison Result** window.

COMPARING A VERSION WITH THE OPENED MODEL IN THE COMSOL DESKTOP

If you select a single model version and click **Compare** (⚖), the **Comparison Result** window will open with a comparison between the model opened in the COMSOL Desktop, labeled **Opened**, and the selected version, labeled **Saved**.

Right-click the top node in the **Differences** tree and select **Merge Changes to Opened** (⚖) to merge all changes marked as *incoming* (that is, changes to the model tree made in the selected model version) into the desktop model. All changes marked as *outgoing* (that is, changes made to the model tree in the desktop model) are left alone.

Right-click any node in the **Differences** tree and select **Override Difference in Opened** (⚖) to write all changes in that node to the opened model, regardless if any changes are incoming or outgoing, effectively reverting any changes you have made in the desktop model.

COMPARING THE OPENED MODEL IN THE COMSOL DESKTOP WITH THE LATEST VERSION

If you encounter a version conflict when trying to save a new version of the model opened in the COMSOL Desktop, you can open the **Comparison Result** window with a comparison between the desktop model, labeled **Opened**, and the latest version of the model being saved, labeled **Latest Version** — see also Save Conflicts. Similar to Comparing a Version With the Opened Model in the COMSOL Desktop, you can merge changes and override differences into the desktop model to include those changes you want to keep from the latest version.

Auxiliary Data From Databases

The **Auxiliary Data** window includes auxiliary data files stored in a database that are referenced in the opened model. For such files, you can:

- Show all versions of the auxiliary data file in The Versions Window in the Model Manager workspace. Click the **Show Source Location** button (📁) in the toolbar. This is useful, for example, if you want to see potentially newer versions for the file in the database.
- Update the file reference to the latest version of the file in the database. Click the **Update to Latest Version** button (↻) in the toolbar.

You can also see the current status of a referenced file version in the database:

- **Database not connected** — the status could not be determined as the database is not connected. Right-click a table row and select **Connect to database** (🔗), or open the Model Manager workspace and activate the database from the **Database** section of the **Home** toolbar — see Activating a Database.
- **Up to date** — the referenced file version is the latest version.
- **Newer versions exist** — a later version exist on the same branch as the referenced file version.
- **Not authorized to access item** — you do not meet the current permission requirements for accessing the file. See Permission Levels.
- **Not available in database** — the referenced file version has been permanently deleted in the database.

You can import auxiliary data files stored on the file system into the same database as the model, thereby placing them under version control. Select the files you want to import in the table and click **Import to Database** ( ) in the toolbar — see Importing Files.

You can also save a new version of a referenced file already present in the database by updating it from The Settings Window in the Model Manager workspace — see File

Settings. Select the file in the **Auxiliary Data** window's table and click the **Update to Latest Version** button ( ) to use your new version in the model.

The Auxiliary Data Window in the *COMSOL Multiphysics Reference Manual*

Selecting Auxiliary Data Files in Databases

From the **Select File** window, you can find and select auxiliary data files from one of your configured databases to reference them from the model opened in the COMSOL Desktop. Choose the database that you want to select files from in the list of options. Choose **Add Database** ( ) if you want to add a new database.

The **Select File** window is, for example, opened when you select **Browse From** ( ) for a file data source.

The **Select File** window for a database offers similar search and filter functionality as the **Open** and **Select Model** windows, although adapted for searching auxiliary data files. The **Target** field indicates where in the model tree the file source reference will be set. Click **Select** (+) once you have found and selected a file source to reference in the result list.

FINDING AUXILIARY DATA FILES TO REFERENCE

You find auxiliary data files to reference by writing search expressions in the search field and clicking the **Search** button. You can write plain search words and any number of filter expressions using The Model Manager Search Syntax. Plain search words will match on the title, description, tags, and filename of an auxiliary data file. The search can be restricted by an explicit file type filter set in the list next to the search field.

You can also apply separate Item Filters via The Filter Dialog Box. Select a filter from the **Add Filter** menu button ( ) in the toolbar to open the dialog box. Applied filters are shown below the search field — see The Applied Filters Toolbar.

You search among the latest versions of files by default. Each entry in the result list contains the title of the file in that version, the time when the version was saved, and the name of the user that saved the version. The search result is sorted on title, with a maximum of 100 files initially included in the result list. Click the **Show More** button ( ) to include more matches.

THE SELECT FILE WINDOW TOOLBAR

The toolbar above the search field contains the following toolbar buttons:

- Click the **Refresh** button (↻) to refresh the search result while keeping the search expression and applied filters unchanged.
- Click the **Show More** button (≣↓) to include more matching files in the search result.
- Click the **Reset** button (↰) to clear the current search expression and applied filters.
- Click the **Add Filter** button (▼) to apply a filter.

SELECT LOCATION IN DATABASE

You can change which file versions to search for by selecting another *location* — see Searching Versions and Locations. Click the link button above the search field to open The Select Location Dialog Box to select which location to search. The link button is hidden if there is only one location available in the database, which is the default for a new database.

The Model Manager Workspace

Apart from the Model Manager tools integrated with the Model Builder, Application Builder, and Physics Builder workspaces — see Databases in the COMSOL Modeling Environment — the Model Manager comes with a dedicated workspace for database-specific tasks. In this section, you will find a brief overview of this workspace. Later sections will discuss each part of the workspace in more depth.

- Opening the Model Manager Workspace
- The Home Toolbar
- The Database Toolbar
- The Model Manager Workspace Windows

Opening the Model Manager Workspace

To open the Model Manager workspace, click the **Model Manager** ( ) button in the **Workspace** section of the **Home** toolbar in either the Model Builder workspace, the Application Builder workspace (if running on Windows®), or the Physics Builder workspace. You can also press the keyboard shortcut Ctrl+Shift+J. The COMSOL Desktop switches to display the toolbar for the Model Manager, as well as opens windows belonging to the Model Manager workspace. A connection attempt is made to the most recently used database upon opening the workspace.

To return from the Model Manager workspace to one of the other workspaces, click on the corresponding button in the **Workspace** section of the Model Manager's **Home** toolbar. You can also press Ctrl+Shift+M for Model Builder and Ctrl+Shift+A for Application Builder.

The Home Toolbar

The **Home** toolbar contains buttons for the more commonly performed tasks in the Model Manager workspace.

THE WORKSPACE SECTION

This section contains buttons for switching to other workspaces in the COMSOL Desktop:

- The **Model Builder** button ( ) or **Physics Builder** button ( ), depending on if a model or physics is opened in the COMSOL Desktop. You can also use the keyboard shortcut Ctrl+M.
- The **Application Builder** button ( ) if running on Windows®. You can also use the keyboard shortcut Ctrl+A.

THE DATABASE SECTION

This section contains buttons for adding databases, switching the active database in the Model Manager workspace, as well as importing and exporting items in a database.

- The **Activate Database** button, to refresh the active database in the workspace. Click the lower part of the button and select one of the databases to set it as active. See Activating a Database.
- The **Add Database** button ( ), to open the **Add Database** window for adding a new database. See The Add Database Window.
- The **Import** button ( ), to import files from the file system into a database. See Importing Files.
- The **Export** button ( ), to export items from a database to the file system. See Exporting Items.
- The **New Tag** button ( ), to create a new tag in a database. See Creating New Tags.

THE ITEM SECTION

This section contains buttons that target items in the database — that is, models, auxiliary data files, and tags.

- Click the **Open** button ( ) to open a model in the COMSOL Desktop. See Opening Models.
- Click the **Run** button (▶) to launch and run an application in the COMSOL Desktop. See Running Applications.
- Click the **Preview File** button ( ) to open an auxiliary data file using the default application for its file type. See Previewing Files.
- Click the **Compare** button ( ) to compare models in the **Comparison Result** window. See Comparing Models.

- Click the **Delete** button (🗑) to delete items. This action is not permanent and can be reverted. See Deleting Items.
- Click the **Delete Permanently** button (✖) to permanently delete all versions of one or more items. This action cannot be undone. See Permanently Deleting Models and Files.

THE LAYOUT SECTION

The **Layout** section contains the following functionality for opening and rearranging windows in the Model Manager workspace:

- The **Windows** menu (🗗), for opening windows that are closed by default.
- The **Reset Desktop** button (⟳), to reset the desktop layout to its default state.

The Database Toolbar

The **Database** toolbar contains buttons for tasks common to a database shared between multiple users — that is, a server database accessed via a Model Manager server.

THE DATABASE SECTION

This section contains the same **Activate Database** button and **Add Database** button also available in the **Database** section on The Home Toolbar. The **Databases** button (🗄) toggles the visibility of The Databases Window.

THE REPOSITORY SECTION

This section contains buttons for Advanced Version Control functionality:

- The **Repository** button (📂), to add a new repository in a database. See Adding Repositories.
- The **Branch** button (⑂), to create a new branch from an existing branch, snapshot, or commit. See Creating a New Branch.
- The **Snapshot** button (📷), to record a point-in-time snapshot of all items with respect to a particular commit. See Recording Snapshots.
- The **Merge** button (⑂), to merge modifications of items with respect to a source location into a target branch. See Merging.

THE PERMISSIONS SECTION

The **Permissions** section contains buttons for controlling access to various objects in the database, including setting ownership and permission requirements:

- Click the **Owner** button ( ) to set the user that owns a particular database object. See Transfer Ownership.
- Click the **Permissions** ( ) button to set the permission requirements for a particular database object. See Granting Permissions.
- Click the **Permission Template** ( ) button to create a new template of predefined permission requirements that can be reused for database objects. See Creating your own Permission Templates.

THE USERS SECTION

This section contains buttons for managing users and groups:

- The **User** button ( ), to add a new user in the database. See Adding Users.
- The **Group** button ( ), to add a new group in the database. See Adding Groups.

THE MAINTENANCE SECTION

This section contains buttons for performing maintenance operations in the database:

- The **Cleanup** button ( ), to optimize database storage by performing data deduplication and cleanup of unused data present after permanent deletions. See Database Cleanup.
- The **Compact** button ( ), to optimize a local database by compacting the database file. See Compacting Local Databases.

The Model Manager Workspace Windows

When you open the Model Manager workspace, you will see two windows in the COMSOL Desktop by default:

- The Model Manager Window — used primarily to search for models and auxiliary data files.
- The Settings Window — used to show settings for various database objects, as well as update and save them in the database. See also Overview of a Model Manager Database.

You can always restore the COMSOL Desktop to this layout by clicking the **Reset Desktop** button ( ) in the **Layout** section of The Home Toolbar. From the **Windows** menu ( ) in the same section, you can open the following optional windows in the workspace:

- The **Comparison Result** window — used to compare model versions saved in the database. See also Comparing Models Saved in Databases.
- The Databases Window — used to browse, organize, and administrate your configured databases via The Databases Tree.
- The Commits Window — used to view the commit history of a branch, optionally filtered to only include commits that involve a particular item.
- The Versions Window — used to view the version history of an item with respect to a branch.
- The Maintenance Window — used to perform maintenance operations for an item.
- The References Window — used to view relations between models and auxiliary data files. See also Auxiliary Data From Databases.

The **Model Manager** window and the **Databases** window play a special role in the Model Manager workspace — whichever has focus determines the target for the buttons in The Home Toolbar and The Database Toolbar. You may, for example, have selected one model in the **Databases** window and another model in the **Model Manager** window. The window that has focus determines which model is opened if you click the **Open** button ( ) in the **Item** section of the **Home** toolbar.

The selection in the **Model Manager** window and the **Databases** window also determines what is shown in the **Settings**, **Commits**, **Versions**, **Maintenance**, and **References** windows, again depending on which one of these two former windows has focus.

> You can turn off the automatic selection linking in the **Settings**, **Commits**, **Versions**, **Maintenance**, and **References** windows by clicking the **Link with Selection** button ( ) in their respective toolbars. Click once more to turn on the linking.

The selection in the **Databases** window determines the searched location in the **Model Manager** window. If you select a branch tree node in The Databases Tree, for example, the **Model Manager** window will automatically switch to search with respect to that branch — see also Searching Versions. Similarly, if you change the searched location via The Select Location Dialog Box in the **Model Manager** window, the corresponding tree node is selected in The Databases Tree.

Overview of a Model Manager Database

You will encounter several concepts and terms when working with Model Manager databases that are specific to the Model Manager tools. This section contains a guide to these concepts and terms — you may want to skip ahead to the next section, Browsing Databases, and refer back to this section as needed. See also the Glossary.

In this section:

- Models
- Files
- Tags
- Items
- Commits
- Branches
- Snapshots
- Locations
- Repositories
- Users
- Groups
- Permission Templates

A common feature of the objects described in this section is that they all have an underlying key that uniquely identifies them in the database. Unlike, for example, changing the filename of a file on the file system, you can safely change the label, name, and title of any database object without worrying about, for example, that other objects lose references they might have to the renamed object.

Models

You can create a *model* in a Model Manager database by either saving the model opened in the COMSOL Desktop or by importing a model directly from the file system.

- Saving Models to Databases
- Importing Files

Every time you save a model, a new *model version* is created. This does not mean that a full copy of the model is saved anew in the database — Model Manager is able to reuse any data it finds unmodified between versions. This includes the model tree itself, any binary data used for geometries, meshes, solutions, and result plots, as well as any other data that the model may use. Once saved, a model version cannot be modified (except for the deletion of generated data that can be recreated from the model, that is, Built, Computed, and Plotted Data). You can be confident that what you save to the database will always be returned when opening the model version again, given that you open it in the same COMSOL Multiphysics version as the model version was originally saved in.

> There is a subtle distinction between a model and all the versions of the model in a database. You set Access Control on the models themselves, while you open, save, search, and organize versions of the models. The same remark applies to any of the Items in a Model Manager database.

ITEM TYPES

Model versions come in three different *item types*:

- **Model** ( ), which is the standard type obtained, for example, when creating a new model from the Model Builder.
- **Application** ( ), which is a model that also has an application UI as defined in the Application Builder.
- **Physics** ( ), which is the type obtained when saving from the Physics Builder.

You may notice that a model can start out as the first type for its first couple of versions, but then transition into the second type once you save a version in which you have added an application UI. The opposite transition will occur if you save a version in which you have removed an application UI.

SAVE TYPES

Models can be created in the database as two different *save types*:

- **Regular** (represented by one of the icons for Item Types)
- **Draft** ( )

Regular Models

A regular model is one that has been created in the database by saving a new model via the **Save** window or by importing a model directly from the file system. You can think of a regular model as the main result of your modeling work. Each version represents a clear transition in which you made enough progress that it is worth keeping the version around for future reference. Perhaps you want to go back to one of the older model versions and from that create a completely new model (with its own set of model versions), or perhaps the model version that you save corresponds to a step in which your modeling work is completed, and it is time for your coworker to take over.

Drafts

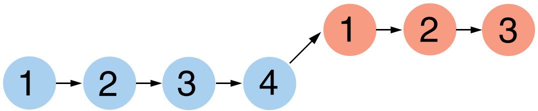
A draft model is one that has been created by going to the **File** menu and selecting **Save Draft** (✎), or by pressing Ctrl+S, when a regular model is opened in the COMSOL Desktop.

Saving Drafts of Models

A draft model is version controlled in the same way as a regular model: The first time you select **Save Draft**, a new draft model is created in the database. Selecting **Save Draft** after that will save new versions of that *same* draft model. You may think of a draft as a transient model used for saving intermediate changes, without muddying the version history of the original model.

The draft is automatically set with a **Private** permission template when you create a new draft in a server database accessed via a Model Manager server — see Predefined Permission Templates. Only you, as its owner, will be able to open or save the draft, although other users may still see it in search results.

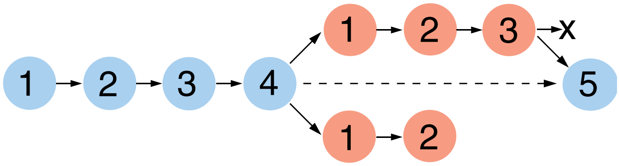
The database stores a reference between the draft and the version of the regular model the draft originated from. This is analogous to how regular models created from existing models via **Save as New** in the **Save** window remembers their origin — see Splitting a Model History in Two. The stored reference enables Model Manager, for example, to automatically discover if a newer version has been saved of the regular model *after* the draft was created — see Save Conflicts.



A schematic of a possible history of a regular model and a draft model created from the former. Starting from the left, four model versions of a regular model have been saved. A draft was then created from the fourth version, after which three versions of the draft have been saved.

Once you are finished with your draft, you can open the **Save** window and save the current draft as a version of the original model. The draft will be automatically deleted in the process, although this deletion is not permanent — you can, for example, find the deleted draft via the The Commit Details Dialog Box for the corresponding commit.

You can create multiple drafts from the same regular model, each draft having its own identity and version history, by repeatedly opening a version of a regular model and pressing Ctrl+S. You and your coworker may, for example, both start working on your own drafts of the same regular model, perhaps with the intention of combining your work once you are finished.



A schematic of a possible history of a regular model and two drafts models saved in a database. The middle row starting from the left represents four model versions of a regular model. From the fourth model version, two drafts (bottom and top rows) have been independently created. Two versions of the bottom row draft, and three versions of the top row draft, have been saved. The top row draft's latest version has then been saved back to the original regular model as a fifth version, automatically deleting the top row draft in the process (represented by the x-mark). The bottom draft may have been discarded, awaiting, for example, its owner to manually delete it.

MODEL SETTINGS

The **Settings** window for a model shows settings for a specific version of the model. Update any of the settings and click the **Save** button (💾) to save a new version of the model. You can write an optional save comment. Click **OK** to save.

The Version Section

This section displays the following fields:

- **Location**. The location in the database in which the model version is saved. See Locations.
- **Saved**. The time when the model version was saved.
- **Saved by**. The display name of the user that saved the model version.
- **Saved in**. The COMSOL Multiphysics version that the model version was saved in.
- **Title**. The title of the model in the saved version.

  The title is the same as shown in the **Title** field in the **Presentation** section in the root node's **Settings** window for a model opened in the COMSOL Desktop.
- **Filename**. The filename used by the model version if exporting it to the file system.
- **Update from**. An optional field in which the path to a file on the file system can be specified to save a new version of the model from that file.

  a Click the **Browse** button.

  b Select a file on the file system and click the **Open** button.

  c Click the **Save** button (💾).

  You can update from any model file that can be opened in COMSOL Multiphysics. The saved model version will first be converted to the current COMSOL Multiphysics version.
- **Description**. The description of the model in the saved version.

  The description is the same as shown in the **Description** field in the **Presentation** section in the root node's **Settings** window for a model opened in the COMSOL Desktop

The Contents Section

This section displays the model tree as it looked when the model version was saved to the database. Use the **Collapse** button (≡↑) and **Expand** button (≡↓) to collapse and expand nodes in the tree. Select a node in the tree and click **Details** (≡) in the section's toolbar to open the **Details** dialog box containing node field values and setting field values for the selected model tree node.

The **Node** table in the **Details** dialog box shows the values for the properties of a node. The available properties will differ between node types. The **Settings** table shows all settings of the node.

You can find models in the database by searching on the node properties and settings shown in the **Details** dialog box for a model tree node. See Content Filters and The Model Manager Search Syntax.

The Tags Section

This section displays a tree of all available Tags that can be set on the model, with the check boxes for the assigned tags selected. Click **Clear Tags** ( ) to clear all selections. See also The Tag Tree.

Files

You can import files that are not models into a database. Any file that is not recognized as a COMSOL Multiphysics file (that is, with the file extension `mph`) or a Physics Builder file (that is, with the file extension `mphphb`) is referred to as an *auxiliary data file*, or *file* ( ), in a Model Manager database.

Importing Files

Auxiliary data files are version controlled similarly as Models in the database. For example, when you import from the file system, a new file is created in the database with an associated first version. You can update an existing file in the database by selecting a file on the file system, and saving it as a new version from the File Settings window.

You may wonder why COMSOL Multiphysics simulation models and auxiliary data files are two different concepts in a Model Manager database, when they are all “just files” when stored on a file system. The main reason for the distinction is their respective storage characteristics and supported functionality. The known internal structure of a model enables efficient data reuse between versions, as well as searching deep within a model’s content using The Model Manager Search Syntax. An auxiliary data file is stored in the database as a chunk of binary or text data whose content is opaque to Model Manager.

FILE SETTINGS

The **Settings** window for a file shows settings for a specific version of the file. Update any of the settings and click the **Save** button (💾) to save a new version of the file. You can write an optional save comment. Click **OK** to save.

The Version Section

This section displays the following fields:

- **Location**. The location in the database in which the file version is saved. See Locations.
- **Saved**. The time when the file version was saved.
- **Saved by**. The display name of the user that saved the file version.
- **Filename**. The filename used when exporting the file version to the file system.
- **File size**. The size of the file.
- **Update from**. An optional field in which the path to a file on the file system can be specified to save a new version of the file in the database.
  - **a** Click the **Browse** button.
  - **b** Select a file on the file system and click the **Open** button.
  - **c** Click the **Save** button (💾).
- **Description**. The description of the file in the saved version.

The Tags Section

This section displays a tree of all available Tags that can be set on the file, with the check boxes for the assigned tags selected. Click **Clear Tags** (🗑) to clear all selections. See also The Tag Tree.

Tags

A *tag* (🏷) is used to label and organize models, files, and even other tags in the database — see Tagging Models and Files to learn more. Tags can be created by importing them from folders on the file system or by manually creating new tags from within the Model Manager workspace.

- Importing Files
- Creating New Tags

Similar to Models and Files, tags are version controlled in the database. Whenever you save a tag in the database, a new tag version is created. Unlike versions of models and files, however, versions of tags do not have any underlying content associated with them.

TAG SETTINGS

The **Settings** window for a tag shows settings for a specific version of the tag. Update any of the settings and click the **Save** button (💾) to save a new version of the tag. You can write an optional save comment. Click **OK** to save.

The Version Section

This section displays the following fields:

- **Location**. The location in the database in which the tag version is saved. See Locations.
- **Saved**. The time when the tag version was saved.
- **Saved by**. The display name of the user that saved the tag version.
- **Title**. The title of the tag in the saved version.

The Tags Section

This section displays a tree of all available tags that can be set on the tag, with the check boxes for the assigned tags selected. Click **Clear Tags** (🗑) to clear all selections. See also The Tag Tree.

Items

Models, Files, and Tags are collectively referred to as *items* in a Model Manager database. Items share many common features and functionality, including:

- Items are version controlled. Every time you save an item, a new version is created in the database.
- Items can be labeled and organized in the database by Adding and Removing Tags and by Organizing Items in Repositories.
- Items can be imported and exported from and to the file system via Bulk Operations.
- Item versions can be found via Searching and Filtering.
- Items support Advanced Version Control such as Branching, Reverting, and Merging.

Commits

A *commit* ( ) is a set of related changes made to Items — that is, Models, Files, and Tags — within a single database save operation. This includes anything from saving item versions, changing the assigned tags of items, or deleting items, to creating a new branch, merging into a branch, and reverting a commit. The changes are saved to the database as a “unit” and, as such, can also be *reverted* as a unit.

A commit saved in the database includes:

- The branch that the commit was saved to — see Branches.
- The time when the commit was saved.
- The user that saved the commit.
- An optional commit comment provided by the user.
- The set of related changes made to items in the commit.

Given a particular commit, you can browse and search the versions of items that were the *latest versions* at the time of that commit. A schematic representation of this is shown in Figure 2-2: In the first commit, a first version of a model A and a model B were saved. In the second commit, a second version of model A was saved, a first version of a tag T was saved, and model B was tagged by T. In the third commit, model A was deleted and a second version of model B was saved. The database can be browsed and searched with respect to each of the three commits, with each big circle surrounding what you will find.

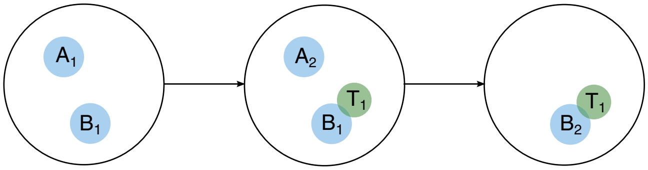


Figure 2-2: A schematic of three hypothetical commits (big circles) saved in a database. You can browse and search versions and tag assignments with respect to any one of these commits.

A synonym to commit often found in other version control systems is *revision*.

- Locations
- Basic Version Control
- Searching Versions

Branches

A *branch* ( ) is a chronologically ordered sequence of Commits saved in the database. The sequence of commits form a history of everything that has happened to Items in the database.

An important commit in a branch is the one saved most recently — that is, the *latest commit* on the sequence. When browsing and searching the database with respect to this commit, you will find the latest versions of models and files as well as their latest assigned tags.

The branch itself is typically used as a representative for the latest item versions (that is, the version found for the most recent commit) in Model Manager:

- Expand a branch node ( ) in The Databases Tree to browse the latest versions of all items, given that **Items** is selected in the **Show** menu ( ) in The Databases Window Toolbar.
- Select a branch in The Select Location Dialog Box to search the latest model and file versions in the **Open**, **Select File**, **Select Model**, and **Model Manager** windows. This is also the default choice in these windows.
- Select a branch in The Select Location Dialog Box to export the latest versions from the **Export** dialog box.

You can create a new branch from an existing parent branch by *branching off* from a particular source commit. This introduces an alternative commit history that runs in parallel with that of the parent branch — see Branching.

When referring to the latest versions of items in a Model Manager database, it is always understood as being with respect to a particular branch.

Creating a New Branch

DEFAULT BRANCH

An initial, default, branch ( ) is automatically created for a new database. This is the branch that save actions use by default.

You can change the default branch in case you have created multiple branches. Select the corresponding branch tree node in the **Databases** tree, right-click, and select **Set Default Branch** ( ).

BRANCH SETTINGS

The **Settings** window for a branch shows:

- **Database**. The label of the database that the branch belongs to.
- **Repository**. The name of the repository that the branch belongs to.
- **Name**. The name of the branch.
- **Search**. The item data that can be searched on the branch. See Searching in Branches.

Clicking the **Save** button ( ) saves the **Name** and **Search** fields for the branch.

Snapshots

A *snapshot* ( ) is a reference to a particular commit on a branch.

- Commits
- Branches

The snapshot itself is typically used as a representative, or *recording*, of the latest versions of items at the time of the commit:

- Expand a snapshot node ( ) in The Databases Tree to browse the recorded item versions, given that **Items** is selected in the **Show** menu ( ) in The Databases Window Toolbar.

- Select a snapshot in The Select Location Dialog Box to search the recorded model and file versions in the **Open**, **Select File**, **Select Model**, and **Model Manager** windows.
- Select a snapshot in The Select Location Dialog Box to export the recorded versions from the **Export** dialog box..

Recording Snapshots

SNAPSHOT SETTINGS

The **Settings** window for a snapshot shows:

- **Database**. The label of the database that the snapshot belongs to.
- **Repository**. The name of the repository that the snapshot belongs to.
- **Date**. The timestamp of the commit that the snapshot references.
- **Name**. The name of the snapshot.

Clicking the **Save** button (💾) saves the **Name** field for the snapshot.

Locations

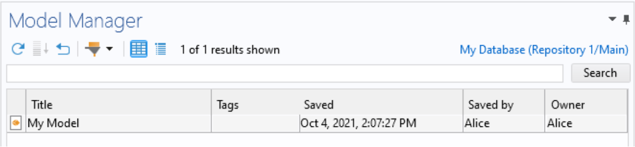
Commits, Branches, and Snapshots are all known as *commit locations*, or *locations,* in Model Manager. Each location is a commit in its own right or acts as a representative of a particular commit:

- **Branch**. The most recent commit saved on the chronologically ordered sequence of commits.
- **Snapshot**. The commit that the snapshot references.

A branch location is probably the most common, and useful, of the three types. By browsing and searching with respect to such a location, you are guaranteed to see the latest versions of items on that branch.

THE SELECT LOCATION DIALOG BOX

You can select a branch or, depending on context, snapshot from the **Select Location** dialog box. You open the dialog box by clicking on a *location link button*, seen here in the upper-right corner of The Model Manager Window:



Title	Tags	Saved	Saved by	Owner
My Model		Oct 4, 2021, 2:07:27 PM	Alice	Alice

The text of a location link button is shown with the name of a branch or snapshot. A commit is shown with its date. Typically the label of the database and the name of the repository are also included in the text, such that the text format is `Database (Repository/Location)`.

In the tree in the **Select Location** dialog box, expand nodes until you reach a branch or snapshot leaf node, select it, and click **OK**. If **Deleted Branches** or **Deleted Snapshots** has been selected in the **Show** menu ( ) in The Databases Window Toolbar, such branches or snapshots will also be available for selection.

Repositories

A *repository* ( ) is a container for a collection of items and their versions in the database. When the database is created, a first repository is automatically added for you.

You would typically add more repositories to the database if you want to restrict access to a collection of items for a particular set of Users and Groups. By Granting Permissions on the repository, you can, for example, restrict who is able to browse and search the item versions in the repository.

Each repository contains one or more branches. Whenever you add a new repository, an initial Default Branch in that repository is created.

Adding Repositories

REPOSITORY SETTINGS

The **Settings** window for a repository shows:

- **Database**. The label of the database that the repository belongs to.
- **Name**. The name of the repository.
- **Default Branch Name**. The name of the repository’s Default Branch.

Clicking the **Save** button (💾) saves the **Name** field for the repository.

Users

A *user* (👤) is someone who has connected to a Model Manager database. For a local database, the user is created with the user account name on your computer. For a server database, the user is created using the credentials you provide when connecting to the Model Manager server — see Connecting to a Server Database.

USER SETTINGS

The **Settings** window for a user shows:

- **Database**. The label of the database that the user belongs to.
- **Name**. The username of the user.
- **Display Name**. An alternative name used for display purposes.
- **Group Memberships**. The groups in the database that the user is a member of.

Clicking the **Save** button (💾) saves the display name and the group memberships for the user.

Group Memberships

Click **Add** to add the user as a member to a group in the database. In the **Search** dialog box, type a name or display name for groups and click the **Search** button. Select groups in the search result table and click **OK**.

Select groups in the **Group Memberships** list and click **Remove** to remove group memberships from the user.

Click the **Save** button (💾) to save any changed group memberships to the database.

🔍	Managing Users

Groups

A group (👥) is a collection of users and other groups. You typically create groups to more easily manage permissions common to several users in the database.

GROUP SETTINGS

The **Settings** window for a group shows:

- **Database**. The label of the database that the group belongs to.
- **Name**. The name of the group.
- **Display Name**. An alternative name used for display purposes.
- **Group Members**. The users, and other groups, in the database that are members of the group.

Clicking the **Save** button (💾) saves the display name and the group members for the group.

Group Members

Click **Add** to find a user, or another group, in the database to add as a member to the current group. In the **Search** dialog box, type a name or display name for users and groups and click the **Search** button. Select users and groups in the search result table and click **OK**.

Select users and groups in the **Group Memberships** list and click **Remove** to remove group members from the group.

Click the **Save** button (💾) to save any changed group members to the database.

Group membership is transitive: if a user is a member of a group, which in turn is a member of another group, the user is considered a member of the latter group as well.

Managing Groups

Permission Templates

A *permission template* (🛡) is a saved list of permission assignments for a set of users and groups that you can apply to database objects. You can, for example, use a permission template to reuse the same permissions for a large collection of models, only having to update in one place — the permission template itself — in case you want to change these permissions.

Model Manager comes with three Predefined Permission Templates, descriptively named Public, Protected, and Private, for each of the database objects that you can control access to. You can also create custom permission templates for Models and Files — see Creating your own Permission Templates.

Reusing Permission Assignments Using Permission Templates

PERMISSION TEMPLATE SETTINGS

The **Settings** window for a permission template shows:

- **Database**. The label of the database that the permission template belongs to.
- **Name**. The name of the permission template.
- **Type**. The object type that the permission template can be applied to. Either **Model** or **File**.
- A table containing the permission assignments of the permission template.

Clicking the **Save** button (💾) saves the **Name** field and permission assignments for the permission template.

Permission Assignments

Click **Add** to add permissions for a user or group to the permission template. In the **Add** dialog box, type a name or display name for users and groups and click the **Search** button. Select the user or group you want to add in the search result table. You can also select the special **Everyone** or **Owner** options — see Everyone and Owner. At the bottom of the dialog box, select the permissions to assign the selection. Click **OK** to add the permission assignment.

Select a row in the permission assignment table and click **Edit** to change the permissions for the selection. Click **Remove** to remove the selection from the table.

Click the **Save** button (💾) to save any changed permission assignments to the database.

Browsing Databases

For models and auxiliary data files stored on the file system, there is typically only one way to browse them — what you see is what you get. Taking the same approach in a Model Manager database could, however, quickly become confusing and hard to navigate — models with hundreds of versions may take up an entire search result, making models with only a few versions harder to find. As the title of a model rarely changes, you would also have to meticulously compare dates when opening a model version to know you are working off the most recent.

In this section, you will learn how various windows in the Model Manager workspace can be used to browse and search in useful subsets of model and file versions in your databases — including browsing and searching the latest versions of items, listing the version history of a particular item, listing the history of all changes made to items, as well as navigating the relationships between different versions.

- The Model Manager Window
- The Databases Window
- The Settings Window
- The Commits Window
- Activating a Database
- The Versions Window
- The References Window
- Opening Models
- Running Applications
- Previewing Files
- Comparing Models

The Model Manager Window

Use the **Model Manager** window to find versions of Models and Files with respect to different Locations by writing search and filter expressions in the search field and clicking the **Search** button. You can write plain search words and any number of filter expressions using The Model Manager Search Syntax. Plain search words will match on the title, description, tags, and filename of models and files.

You can also apply separate Item and Content Filters via The Filter Dialog Box. Select a filter from the **Add Filter** menu button (▼) in the toolbar to open the dialog box. Applied filters are shown below the search field — see The Applied Filters Toolbar.

The searched location is initially set to the Default Branch in a repository, which means that the latest versions of models and files are searched. Click the top-right link button to select another location in The Select Location Dialog Box.

The search result is sorted on title, with a maximum of 100 models and files initially included in the result. You can switch the presentation of the search result between either a Table View or a Tree View. Click the **Show More** button ( ) to include more matches.

Searching and Filtering

If Model Manager detects that a commit has been saved on a searched branch, an information message ( ) is displayed at the bottom of the **Model Manager** window. This includes both commits made by you from within the COMSOL Desktop, as well as commits made by your coworkers if connected to a server database. Click **Refresh** ( ) to see any updated results.

THE MODEL MANAGER WINDOW TOOLBAR

The toolbar in the **Model Manager** window contains the following toolbar buttons:

- Click the **Refresh** button ( ) to refresh the search result while keeping the search expression and applied filters unchanged.
- Click the **Show More** button ( ) to include more matching models and files in the search result.
- Click the **Reset** button ( ) to clear the current search expression and applied filters.
- Click the **Add Filter** button ( ) to apply a filter.
- Click the **Table** button ( ) to view the search result in a table.
- Click the **Tree** button ( ) to view the search result in a tree.

TABLE VIEW

The *table view* of the search result shows matching model and file versions in a table with columns:

- The type column — the type of the model or file represented by an icon. See Item Types and Save Types.
- The **Title** column — the title set for the model or file in that version.
- The **Tags** column — the tags set for the model or file with respect to the searched location.
- The **Saved** column — the time when the version was saved.
- The **Saved By** column — the name of the user that saved the version.
- The **Owner** column — the name of the user that owns the model or file.

You can append more search results at the bottom of the table until all matching models and files have been fetched by repeatedly clicking the **Show More** button (≣↓) in the toolbar.

TREE VIEW

The *tree view* of the search result shows matching model and file versions in a tree, such that the tags of matching models and files are displayed at their corresponding position in the The Tag Tree. Each model or file node shows the title set for the version, the time when the version was saved, and the name of the user that saved the version.

You can append more search results to the tag tree until all matching models and files have been fetched by repeatedly clicking the **Show More** button (≣↓) in the toolbar.

There is a subtle difference between the tags tree shown in the tree view of the **Model Manager** window and that shown in The Databases Tree. For the former tree, you only see the tags (including ancestor tags) set for models and files that are found in the *shown* search result. This means that more and more tags may show up at a specific level when you repeatedly click **Show More** (≣↓). Tags that are not assigned to any models or files will never show up. For the latter tree, you always see all tags at a fixed level when you expand a node.

The Databases Window

The **Databases** window shows a tree with all databases you have added in the COMSOL Desktop. You typically use the tree to browse and administrate the content of databases, including, for example, edit Database Configurations, add Repositories, create Branches, record Snapshots, and, for server databases, manage Users and Groups.

Click the **Step In** button (↳☰) to show a subtree of the tree in the window. You can continue stepping into nodes until only leaf nodes are visible. Click **Step Back** (⬅) to return one step, or **Step Home** (☰) to show the whole tree. You can toggle the visibility and appearance of various nodes in the **Show** menu (👁) and the **Item Tree Node Text** menu (☰).

TOGGLING THE DATABASES WINDOW

Click the **Databases** button (🗄) on the **Database** toolbar to toggle the visibility of the **Databases** window.

THE DATABASES WINDOW TOOLBAR

The toolbar in the **Databases** window contains the following toolbar buttons:

- Click the **Step Home** button (☰) to show all nodes in the **Databases** window's tree; that is, to return to the default tree view after stepping into nodes.
- Click the **Step Back** button (⬅) to show the nodes previously shown before stepping into a node.
- Click the **Step In** button (↳☰) to only show the child nodes, and their descendants, of a selected node in the **Databases** window's tree.
- Click the **Refresh** button (↻) to refresh the child nodes of the selected node.
- Click the **Show** menu (👁) to set visibility options for nodes.
- Click the **Item Tree Node Text** menu (☰) to set text options for nodes corresponding to models and files.

THE DATABASES TREE

The top nodes in the **Databases** window's tree are the Database Configurations of all databases that have been added to the COMSOL Desktop: local databases and server databases accessed via a Model Manager server.

The child nodes to the databases configurations consist of all Repositories you are authorized to see, as well as a **Security** node ( ) containing child nodes related to user management. The **Security** node is hidden for a local database.

Each repository node contains a **Branches** node ( ) and a **Snapshots** node ( ). The **Branches** node and the **Snapshots** node contain all Branches and Snapshots, respectively, you are authorized to see.

Each of the branch and snapshot nodes contain the latest versions of Items — that is, Models, Files, and Tags — with respect to the corresponding commit. For a branch node, these are the latest item versions at present, while for a snapshot, these are the item versions that were the most recent ones at the snapshot's timestamp — see also Locations.

The items are further organized into a subtree based on their assigned tags with respect to the corresponding commit — see also The Tag Tree. You may think of the branch node or snapshot node as representing a root tag in this subtree.

Select **Items** in the **Show** menu button ( ) to see item versions under branch and snapshot nodes.

The **Security** node contains a **Users** node ( ), a **Groups** node ( ), and a **Permission Templates** node ( ). Each one contains, respectively, all Users, Groups, and custom Permission Templates in the database.

Right-click a node and select **Refresh** ( ) to refresh all child nodes of that node. You may find this useful, for example, to see changes made in a server database from another COMSOL Multiphysics program session, perhaps run by your coworker.

Deleting and Restoring Unversioned Database Objects

You can delete Repositories, Branches, Snapshots, Users, Groups, and Permission Templates by right-clicking their corresponding tree nodes and selecting **Delete** ( ). This deletion is not permanent but rather marks them as hidden in the COMSOL Desktop by default.

Clicking **Show** ( ) enables you to show deleted (hidden) nodes in the tree. You can right-click such nodes and select **Restore** ( ) to remove their hide-marker, making them visible again everywhere in the COMSOL Desktop. The options set via the **Show** toolbar button also determines the visibility of deleted repositories, branches, and snapshots in The Select Location Dialog Box.

Permission templates can also be permanently deleted. Right-click and select **Delete Permanently** (✖). This requires that the permission template is not assigned to any items.

The Settings Window

The **Settings** window shows settings for the database object selected in The Databases Window or The Model Manager Window (depending on which window is focused). Click **Link with Selection** ( ) to disable this automatic linking. You can still update the **Settings** window with a new database object by right-clicking the object and selecting **Settings** ( ).

You use the **Settings** window to see what is saved for an object in the database and update the object by changing its fields and clicking **Save** ( ). In contrast to the **Settings** windows in the Model Builder, the Application Builder, or the Physics Builder workspaces, changes made in the window are not automatically saved to the database. The **Reset** button ( ) will be enabled when there are unsaved changes to an object shown in the **Settings** window.

Remember to click **Save** ( ) to save any changes made to an object in the **Settings** window.

Model Manager will try to remember unsaved changes for an object during the program session: If you change some fields for a database object, select another database object in the **Databases** window or the **Model Manager** window (so that the **Settings** window is updated), and then return to the first database object, your unsaved changes for the object will be reapplied — allowing you to save the changes to the database at your convenience. Model Manager will also show a warning dialog box if you have unsaved changes when the **Settings** window is updated with a new database object.

You can disable the warning for unsaved changes — clear the **Warn if the Settings window contains unsaved changes** check box in the **Preferences** dialog box under **Settings window** on the **Model Manager** page.

When you click the **Save** button (💾) for a model, file, or tag, a dialog box is shown in which you can provide an optional comment. Click **OK** to save a new version of the item. If you have made any changes in the tag tree in the **Tags** section, the assigned tags of the item are also updated. Clicking **Save** for any other database object immediately saves the changes to the database.

- Model Settings
- File Settings
- Tag Settings
- Branch Settings
- Snapshot Settings
- Repository Settings
- User Settings
- Group Settings
- Permission Template Settings

THE SETTINGS WINDOW TOOLBAR

The toolbar in the **Settings** window contains the following toolbar buttons:

- Click the **Link with Selection** button (☷) to enable or disable whether to automatically update the **Settings** window based on the current selection in the **Databases** window or the **Model Manager** window (which ever had focus last).
- Click the **Save** button (💾) to write any changes made in the **Settings** window to the database.
- Click the **Reset** button (↶) to reload the shown object in the **Settings** window from the database, thereby discarding any pending changes you have in the window. The button is disabled if no changes have been detected.

The Commits Window

You use the **Commits** window to view the history of all Commits belonging to a branch. Click the link button to select another branch in The Select Location Dialog Box.

The commits are shown in a table with the 100 most recent commits initially fetched from the database. Click **Show More** (≣↓) to append older commits to the table. If the branch was created from another branch, older commits on the parent branch are also included in the table. The table columns are:

- The **Date** column — the time when the commit was saved.
- The **User** column — the name of the user that saved the commit.
- The **Branch** column — the name of the branch that the commit belongs to.
- The **Comments** column — the optionally provided comments when the commit was saved.

The commit history shown in the table follows the current selection in The Databases Window or The Model Manager Window (depending on which window is focused). If you select a particular item, only commits involving that item are shown in the table; otherwise, all commits on the branch are shown. Click **Link with Selection** ( ) to disable the automatic linking. You can still update the **Commits** window with a new database object by right-clicking the object and selecting **Commits** ( ), when available.

THE COMMITS WINDOW TOOLBAR

The toolbar in the **Commits** window contains the following toolbar buttons:

- Click the **Refresh** button ( ) to refresh the table to see any new commits that have been saved on the branch. The table will automatically refresh if you save a new commit to the branch from the COMSOL Desktop.
- Click the **Show More** button ( ) to include older commits in the table.
- Click the **Link with Selection** button ( ) to enable or disable whether to automatically update the **Commits** window based on the current selection in the **Databases** window or the **Model Manager** window (which ever had focus last).
- Click the **Commit Details** button ( ) to open The Commit Details Dialog Box.
- Click the **Branch** button ( ) to open The Create Branch Dialog Box to branch off from the selected commit.
- Click the **Snapshot** button ( ) to record a snapshot for the selected commit.
- Click the **Merge** button ( ) to open The Merge Window to merge all changes made up to the selected commit to a target branch.
- Click the **Revert** button ( ) to open The Revert Window for the selected commit.

If you right-click a commit in the table, you can also

- Select **Export** ( ) to export all versions of items that were the latest versions at the time of the commit to the file system — see Exporting Items.
- Select **Search in Commit** ( ) to set the selected commit as the location in The Model Manager Window. You can then search among all versions of items that were the latest versions at the time of the commit. See also Searching in Snapshots and Commits.

THE COMMIT DETAILS DIALOG BOX

The **Commit Details** dialog box summarizes the set of related item changes saved in a commit.

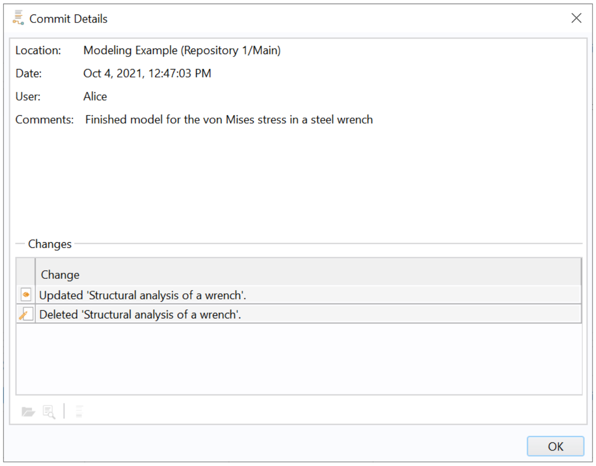
- The **Location** shows the database, repository, and branch that the commit was saved to.
- The **Date** shows the time when the commit was saved.
- The **User** shows the name of the user that saved the commit.
- The **Comments** shows the optionally provided comments when the commit was saved.
- The **Changes** table shows a table with the set of related item changes made in the commit.

> When you click **Revert** ( ) for a commit, the inverse of the set of changes shown in the **Changes** table can be applied from The Revert Window.

From the toolbar for the **Changes** table, you can:

- Click the **Open** button ( ) to open the latest version of a model at the time of the commit. Only enabled for a change that involved a model.
- Click the **Preview File** button ( ) to open the latest version of a file using the default application for its file type. Only enabled for a change that involved a file.
- Click the **Version Details** button ( ) to open The Version Details Dialog Box containing more information on a version.

See Figure 2-3 for an example of commit details taken from the tutorial Example: Modeling Using Version Control in which a draft has been saved back as a new version of its original model.



Commit Details

Location: Modeling Example (Repository 1/Main)
Date: Oct 4, 2021, 12:47:03 PM
User: Alice
Comments: Finished model for the von Mises stress in a steel wrench

Changes

Change
Updated 'Structural analysis of a wrench'.
Deleted 'Structural analysis of a wrench'.

Figure 2-3: The Commit Details dialog box for a commit in which a new version has been saved of a model, and a draft has been deleted.

Activating a Database

You can select one of your configured databases from the menu in the **Database** section on the **Home** toolbar to *activate* it in the Model Manager workspace. This will:

- Automatically connect to the database if it was not already connected. You may be prompted for credentials if connecting to a server database.
- Set the location in The Model Manager Window and The Commits Window to a default branch from a repository in the database.
- Select the default branch in a repository in The Databases Tree.

The Versions Window

The **Versions** window in the Model Manager workspace shows the version history of an item — that, is a model, file, or tag — with respect to a branch. These correspond to a subset of Commits on the branch in which the item was either added or updated. Click the link button to select another branch in The Select Location Dialog Box.

The version history shown in the window follows the current item selection in The Databases Window or The Model Manager Window (depending on which window is focused). Click **Link with Selection** ( ) to disable this automatic linking. You can still update the **Versions** window with a new item by right-clicking and selecting **Versions** ( ).

The versions are shown in a table sorted in chronological order At most 100 versions are initially shown. Click the **Show More** button ( ) to show more versions in the table. If the branch was created from another branch, older versions saved on the parent branch are also included in the table. If the viewed model is opened in the COMSOL Desktop, the corresponding model version row is highlighted in bold in the table. As for The Versions Window for the COMSOL Desktop Model, when viewing the version history of a model, the history of any origin model is also appended to the table — see Splitting a Model History in Two.

The table columns are:

- The type column — the type of the item represented by an icon.
- The **Title** column — the title set for the item in that version.
- The **Saved** column — the time when the version was saved.
- The **Saved By** column — the name of the user that saved the version.
- The **Branch** column — the target branch of the commit in which the version was saved.
- The **Comments** column — the optional comment provided when the version was saved.

THE VERSIONS WINDOW TOOLBAR

The toolbar in the **Versions** window contains the following toolbar buttons:

- Click the **Refresh** button ( ) to refresh the table in case any new versions have been saved. The table will automatically refresh if you save a new version on the branch from the COMSOL Desktop.
- Click the **Show More** button ( ) to include older versions in the table.
- Click the **Link with Selection** button ( ) to enable or disable whether to automatically update the **Versions** window based on the current selection in the **Databases** window or the **Model Manager** window (which ever had focus last).
- Click the **Version Details** button ( ) to open The Version Details Dialog Box containing more information on the version.
- Click the **Open** button ( ) to open a selected model version in the COMSOL Desktop.

- Click the **Run** button (▶) to launch and run a selected version in the COMSOL Desktop. Only enabled if the selected version is an application.
- Click the **Preview File** button ( ) to open a selected file version using the default application for its file type.
- Click the **Compare** button ( ) to compare a selected model version with the model opened in the COMSOL Desktop. Select two model versions to compare them with each other.
- Click the **References** button ( ) to open The References Window to view all references between the selected version and other item versions.
- Click the **Restore Version** button ( ) to save the selected version as a new latest version of the model. See Restore Version.

If you right-click a version in the table, you can also

- Select **Export** ( ) to export the version to the file system — see Exporting Items.
- Select **Export to New Local Database** ( ) to export the version to a new local database — see Export to New Local Database.
- Select **Branch** ( ) to create a new branch from the commit that the version was saved in.
- Select **Snapshot** ( ) to record a snapshot of the commit that the version was saved in.
- Select **Copy Location** ( ) to copy a text string with a URI that uniquely identifies a model or file version in the database to the clipboard.
- Select **Permanently Delete Version** ( ) to permanently delete a model or file version in the database. This cannot be undone. See also Permanently Deleting a Version.
- Select **Settings** ( ) to update the **Settings** window with the version. You may find this useful to see settings for a version not available when searching with respect to a branch or snapshot.

THE VERSION DETAILS DIALOG BOX

The **Version Details** dialog box shows further details for an item version. The following is shown for all items:

- **Location** — the database, repository, and branch that the version was saved to.
- **Saved** — the time when the version was saved.
- **Saved By** — the name of the user that saved the version.

- **Title** — the title set on the item in the saved version.
- **Comments** — the optional comments provided when the version was saved.

For a model version:

- **Saved in** — the COMSOL Multiphysics versions that the model version was saved in.
- **Save Type** — if the model is a regular model or a draft model.
- **Item Type** — if it is a model, application, or physics.
- **Filename**. The filename used by the model version when exporting it to the file system.
- **Description**. The description of the model in the saved version.

For a file version:

- **Filename**. The filename used by the file version when exporting it to the file system.
- **File size**. The size of the file.
- **Description**. The description of the file in the saved version.

The References Window

You use the **References** window to view and browse file versions that are *referenced* from a particular model version or, conversely, model versions that are *referencing* a particular file version. You may find this useful as it enables you to discover model-file relationships without first having to open a model in the COMSOL Desktop.

The file versions listed in the **References** window for a model version are the subset of entries in the **Auxiliary Data** window whose **Source** column point to the database.

The references shown in the window follows the current model or file selection in The Databases Window or The Model Manager Window (depending on which window is focused). Click **Link with Selection** ( ) to disable this automatic linking. You can still update the **References** window with a new model or file by right-clicking and selecting **References** ( ).

You can view either referenced versions or referencing versions by clicking **Show Referenced Versions** ( ) or **Show Referencing Versions** ( ), respectively. If you open the window for a selected model version, referenced versions are shown by default. For a selected file version, referencing versions are shown. The title of the selected version is shown at the top of the window.

The referenced or referencing versions are shown in a table sorted in chronological order. At most 100 versions are initially shown. Click the **Show More** button (↓) to include older versions in the table. If a model version is opened in the COMSOL Desktop, the corresponding model version row is highlighted in bold in the table. The table columns are:

- The type column — the type of the item represented by an icon.
- The **Title** column — the title set for the item in that version.
- The **Reference Type** column — describes the relation between a model version and a file version as an **Input file**.
- The **Saved** column — the time in which the version was saved.
- The **Saved By** column — the name of the user that saved the version.
- The **Repository** column — the repository that the version belongs to.
- The **Branch** column — the target branch in which the version was saved.
- The **Comments** column — the optional comment provided when the version was saved.

You can iteratively explore how different item versions depend on each other by repeatedly selecting a row in the table and clicking **References** ( ).

> **!** The database protects the *referential integrity* between item versions: a file version referenced by a model version cannot be permanently deleted, as long as both versions are saved in the same database.

THE REFERENCES WINDOW TOOLBAR

The toolbar in the **References** window contains the following toolbar buttons:

- Click the **Refresh** button (⟳) to refresh the table in case any new version references have been created. The table will automatically refresh if you save a new version to the database from the COMSOL Desktop.
- Click the **Show More** button (↓) to include references to older versions in the table.
- Click the **Link with Selection** button ( ) to enable or disable whether to automatically update the **References** window based on the current selection in the **Databases** window or the **Model Manager** window (which ever had focus last).

- Click the **Version Details** button ( ) to open The Version Details Dialog Box containing more information on the version.
- Click the **Open** button ( ) to open a selected model version in the COMSOL Desktop.
- Click the **Run** button ( ) to launch and run a selected version in the COMSOL Desktop. Only enabled if the selected version is an application.
- Click the **Preview File** button ( ) to open a selected file version using the default application for its file type.
- Click the **Compare** button ( ) to compare a selected model version with the model opened in the COMSOL Desktop. Select two model versions to compare them with each other.
- Click the **References** button ( ) to show version references for the selected version.
- Click the **Show Drafts** button ( ) to enable or disable whether to include version references that are drafts.
- Click the **Show Referenced Versions** button ( ) to show versions that are referenced by the viewed version (as indicated by the title next to the toolbar). This is the default choice when viewing a model version.
- Click the **Show Referencing Versions** button ( ) to show versions that are referencing the viewed version (as indicated by the title next to the toolbar). This is the default choice when viewing a file version.

If you right-click a version in the table, you can also

- Select **Export** ( ) to export the version to the file system — see Exporting Items.
- Select **Export to New Local Database** ( ) to export the version to a new local database — see Export to New Local Database.
- Select **Branch** ( ) to create a new branch from the commit that the version was saved in.
- Select **Snapshot** ( ) to record a snapshot of the commit that the version was saved in.
- Select **Copy Location** ( ) to copy a text string with a URI that uniquely identifies a model or file version in the database to the clipboard.

- Select **Permanently Delete Version** ( ) to permanently delete a version in the database. This cannot be undone. See also Permanently Deleting a Version.

  You will only be able to perform this deletion for versions that are not referenced by other versions.
- Select **Settings** ( ) to update the **Settings** window with the version.

Opening Models

You can open a model version in the COMSOL Desktop from The Model Manager Window or The Databases Tree by double-clicking a model version or by selecting a model version and clicking **Open** ( ) in the **Item** section of the **Home** toolbar. You can also double-click or click **Open** from the toolbars of other windows in the Model Manager workspace that show model versions.

When you try to open a model version from the **Model Manager** window and the searched location is set to a branch, or from the **Databases tree** under a branch node, Model Manager first checks if any newer versions of drafts of the model exist on the same branch. If so, The Open Dialog Box is shown in which you can choose to open one of these newer draft versions instead. This helps you, for example, from accidentally creating a new draft when one is already ongoing — perhaps created by one of your coworkers.

THE OPEN DIALOG BOX

The **Open** dialog box shows a tree of model versions that may be of particular interest when opening a model version. The root node is the latest version of the model initially selected. Child nodes are the latest versions of drafts created from that model. Select one of the nodes and click **Open** to open a model version in the COMSOL Desktop.

PREVENTING SIMULTANEOUS ACCESS

While Model Manager has no concept of automatically *locking* a model for exclusive access by a single user, you can achieve the same effect via permissions — see Granting Permissions. You can, for example, assign the **Open model** permission or **Save model** permission exclusively to yourself so that only you can open or save versions of a model.

If a simulation model is being developed in a collaborative setting, and you want to guarantee that only one person is modifying the model at a time, assign a **Protected** permission template and hand over the model by changing its owner — see Owners.

OPENING A MODEL ON A CLUSTER

You can open a model stored in a database on a cluster as long as the cluster's root node can connect to the database. In the **Preferences** dialog box, select **From intermediate file** in the **Load model on nonroot nodes** list under **Cluster** on the **Model Manager** page to only require that the root node can connect. Select **Direct from database** in case also nonroot nodes can connect.

When **From intermediate file** is selected, the model is first saved as a temporary file on the root node's file system and then transfered to all nonroot nodes. When **Direct from database** is selected, all nodes load the model directly from the database without any intermediate step.

NETWORK CONNECTION ISSUES

When you open a model from a database, binary data such as meshes, geometries, solutions, and result plots are only loaded on-demand. This reduces, for example, unnecessary bandwidth usage when connected to a server database via a Model Manager server.

If you experience network connection issues when COMSOL Multiphysics needs to load binary data from the database, you will be asked to save any ongoing modeling work as a recovery on the file system. The model can be opened from recovery once the network connection is reestablished.

Running Applications

Click **Run** (▶) in the **Item** section of the **Home** toolbar to launch and run an application version (A) from The Model Manager Window or The Databases Tree. You can also click **Run** from the toolbars of other windows in the Model Manager workspace that show application versions.

Similar to when Opening Models, Model Manager first checks if any newer versions of drafts of the application exist on the same branch. If so, The Run Dialog Box is shown in which you can choose to run one of these newer draft versions instead.

THE RUN DIALOG BOX

The **Run** dialog box shows a tree of versions that may be of particular interest when running an application version. The root node is the latest version of the application initially selected. Child nodes are the latest versions of drafts created from that application. Select one of the nodes and click **Run** to launch and run an application version in the COMSOL Desktop.

Previewing Files

You can preview an auxiliary data file by opening it with the default application for its file type. Double-click a file version, or select a file version in The Model Manager Window or The Databases Tree and click **Preview File** ( ) in the **Item** section of the **Home** toolbar. You can also click **Preview File** from the toolbars of other windows that show file versions in the Model Manager workspace.

Comparing Models

You can compare the model opened in the COMSOL Desktop with a model version from the The Model Manager Window or The Databases Tree by selecting the version and clicking **Compare** ( ) in the **Item** section of the **Home** toolbar. You can compare two model versions with each other by selecting two versions and clicking **Compare** ( ). You can also click **Compare** from the toolbars of other windows that show model versions in the Model Manager workspace.

Comparing Models Saved in Databases

Organization of Models and Files

Model Manager supports two means of organizing models and files in a database — assigning Tags to them and placing them in Repositories. The first helps you with search and workflow management, the second with access control.

In this section:

- Tagging Models and Files
- Organizing Items in Repositories

Tagging Models and Files

You can assign Tags to, or *tag*, your models and auxiliary data files to help you with organizing them in the database. You can even assign tags to the tags themselves, thereby getting a tree structure of tags — see The Tag Tree. In this regard, tags may remind you of folders on the file system. But tags go beyond that:

- You can find models and files by searching on their assigned tags. You can even find such items by searching on *ancestor* tags — that is, tags assigned to the item's tags themselves. For example, if you create a tag `Interpolation Functions` and add it under the tag `Project A`, you may tag auxiliary data files by the former and then find them by searching on the latter.
- You can assign multiple tags to a model, file, or even to a tag itself.
- The tag assignments are version controlled independently. A new commit is saved on the branch when you add or remove assigned tags to an item — see Adding and Removing Tags. This has the benefit that:
    - You can track changes to the assigned tags of items over time, giving you an organizational history. Perhaps you introduce tags for different stages in your modeling workflow, say `In Progress`, `To Review`, `Approved`, and `Needs More Work`.
    - You can revert any changed tag assignments from The Revert Window.
    - You can search items based on their tag assignments at a particular time by Searching in Snapshots and Commits. Perhaps you want to find all items that had

a particular tag, say `In Progress`, a month ago, or merely see what the tag tree looked like. When Searching in Branches, you search the present tag assignments.

- The settings for tags are version controlled. If you change the title of a tag and click **Save** ( ) in the **Settings** window, a new version of the tag is created. Any tag assignments involving the saved tag will, however, be left unchanged.

CREATING NEW TAGS

Click **New Tag** ( ) in the **Database** section of the **Home** toolbar to open the **New Tag** dialog box. The **Location** field shows the database, repository, and branch that the new tag will be created in.

1. Write the title for the new tag in the **Title** field.
2. Under **Tags**, select the *parent* tags from The Tag Tree that will be assigned to the new tag. Leaving all nodes in the tree cleared will create the new tag under the root. The tree is empty when you create your first tag.
3. In the **Comments** field, write an optional comment for the associated commit.
4. Click **OK** to save the first version of the new tag in the database.

If a tag version is selected in The Databases Tree or The Model Manager Window when you click **New Tag** ( ), that tag will also be initially selected in the tree in the **New Tag** dialog box.

You can see your new tag under the branch node in The Databases Tree if you have selected **Items** when clicking **Show** ( ) in the **Databases** windows toolbar. You can also see it in the tag tree in the **Tags** section in the **Settings** window for an item.

!	You will not be able to see the new tag in The Model Manager Window until you assign your tag to a model or file, and that model or file is returned in a search result.

THE TAG TREE

Since tags can be assigned to other tags, items in a Model Manager database can be represented as nodes in a tree structure. Items assigned a particular tag appear as child nodes to the tag node. You can find a particular item in multiple positions in the tree as items can be assigned more than one tag. You may think of items not assigned any tags at all as placed under a hidden *root* tag. In The Databases Tree, these items appear as children under the nodes of Branches and Snapshots.

> To help you with identifying the regular model that a draft originated from, the draft node is placed as a child node to the regular model node in the tag tree, whenever both the model and draft share the same assigned tag. See also Save Types.

ASSIGNING TAGS TO ITEMS

To assign tags to an item, do one of the following:

- Select tags in the **Tags** section in the **Settings** window of Models, Files, or Tags, and click **Save** (💾).
- Right-click an item and select **Tags** (🏷) to assign tags via the **Tags** dialog box — see also Adding and Removing Tags.
- Select to import folders as tags when bulk importing files from the file system — see Importing Files.

All three options create a commit. The first and last option also save a new version of the item. The middle option does not.

Organizing Items in Repositories

You can create multiple Repositories if you want to group your models and files into separate containers in the database. You may, for example, want to set up permissions that differ between various collections of models — perhaps hiding sensitive models from all but a select group of users.

> **!** Keep in mind that you cannot simultaneously search models and files placed in different repositories. This may be good from an access control viewpoint but bad for discoverability.

ADDING REPOSITORIES

Click **Repository** (📂) in the **Repository** section of the **Home** toolbar to open the **Add Repository** dialog box. The **Database** field shows the label of the database in which the repository will be created.

1 Write the name of the new repository in the **Name** field.

2 Write the name of the initial, default, branch in the **Default branch name** field — see Default Branch.

3 You can provide an optional comment for the initial commit that will be saved when the branch is created in the **Comments** field.

4 You can set up permissions for the new repository in the **Permissions** field. This field is only shown if connected to a server database via a Model Manager server. See Granting Permissions.

5 Click **OK** to add the repository.

The added repository appears as a new child node to the corresponding database node in The Databases Tree.

Basic Version Control

You modify items — that is, models, files, and tags — in the database by saving a *commit* on a branch. The set of changes in such a commit can be categorized as:

- Added, updated, and restored items — these are changes that save new versions of items.
- Added and removed tags — these are changes that modify the assigned tags of an item.
- Deleted items — these are changes that effectively hide items on a branch.

Commits involving the first category of changes have a direct correspondence with the table entries in The Versions Window — each version is saved in a commit. The latter two categories, which do not save new versions, only appear in The Commits Window.

You can provide an optional *commit comment* when saving a new commit. Oftentimes a comment describing the changes is already suggested. The comments can later be read, for example, from the **Commits** window and from the **Versions** window.

In this section:

- Saving Versions
- Adding and Removing Tags
- Deleting Items
- Recording Snapshots

Advanced Version Control

Saving Versions

There are various ways in which you can save a new version of an item, both within the Model Manager workspace and from one of the other workspaces. You can, for example, save a new version of the model opened in the COMSOL Desktop from the **File** menu by clicking **Save Draft** ( ), **Save as Version** ( ), or **Save To** ( ) — see Saving Models to Databases.

In the Model Manager workspace, you can save a new version by clicking **Save** (💾) in the **Settings** window. For a model this will, for example, update the model's title, description, and filename, but leave the model tree, as well as any binary data like meshes, geometries, and solutions, unchanged. Other examples of saving versions include:

- Importing files on the file system into the database — see Importing Files.
- Creating a new tag — see Creating New Tags
- Renaming an item — see Rename Item
- Restoring an older item version as a new latest version — see Restore Version.
- Merging updated items from a source branch to a target branch — see Merging.
- Reverting a commit that included added, updated, or deleted items — see Reverting.

⚠ You generally want to avoid saving a new version of the model opened in the COMSOL Desktop from the Model Manager workspace. Otherwise you will get Save Conflicts when trying to save a new version of the desktop model.

Creating a New Branch does not save new versions of the items included on the new branch — each item version on the new branch is initially the same as that on the parent branch.

RENAME ITEM

From The Model Manager Window or the The Databases Tree, right-click and select **Rename** ( ), or press the keyboard shortcut F2, to change the title of an item via the **Rename Item** dialog box. The **Location** field shows the database, repository, and branch that the item will be renamed on.

1. Write the new title for the item in the **Title** field.
2. Write an optional comment in the **Comments** field.
3. Click **OK** to save the renamed item as a new version in the database.

RESTORE VERSION

You can restore an older version in the version history of an item as the new latest version. This enables you to, for example, recover an older model version without first having to open it in the COMSOL Desktop and manually save it as a new version via **Save as Version** ( ).

From The Versions Window, click **Restore Version** ( ) to open the **Restore Item Version** dialog box. The **Location** field shows the database, repository, and branch that the item version will be restored to. The title of the restored version is shown in the **Title** field.

1. Write an optional comment in the **Comments** field.
2. Click **OK** to perform the restore.

Adding and Removing Tags

You can modify the assigned tags of an item without saving a new version. This is useful if you, for example, want to change the tags of the model that is opened in the COMSOL Desktop without introducing Save Conflicts.

From The Model Manager Window or the The Databases Tree, right-click an item and select **Tags** ( ) to open the **Tags** dialog box. The **Location** field shows the database, repository, and branch in which the assigned tags will be modified. The **Title** field is the title of the item in its latest version.

1. Under **Tags**, select and clear tags that will be added and removed, respectively. Leaving all nodes in the tree cleared will remove all tags from the item and place the item under the root tag — see also The Tag Tree.
2. Write an optional comment in the **Comments** field.
3. Click **OK** to save the new tag assignment to the database.

Deleting Items

You can delete items in the database without permanently losing them. In this way you can still access these items via older Commits and Snapshots, without having to see them when you search among the latest versions of items.

DELETING MODELS AND FILES

Select one or more models and files and click **Delete** ( ) in the **Item** section of the **Home** toolbar to open the **Delete Item** dialog box. You can also press the Del key. The **Location** field shows the database, repository, and branch that the items will be deleted on. All items that will be deleted are shown in a table under **Items**.

1. Write an optional comment in the **Comments** field.

2 Click **OK** to delete the items in the database.

As with all commits, the deletion targets a specific branch. If you have created other branches that include the selected items, the items will remain visible on those branches.

To find a previously deleted model or file, either set the searched location to a snapshot created before the item was deleted in The Model Manager Window, or find a commit in The Commits Window saved before the item was deleted, right-click it, and select **Search in Commit** (🔍). In both cases you can find the item by searching on its title in the **Model Manager** window.

DELETING TAGS

Select a tag and click **Delete** (🗑) in the **Item** section of the **Home** toolbar to open the **Delete Tag** dialog box. The **Location** field shows the database, repository, and branch that the tag will be deleted on. The **Title** field shows the title of the latest version of the title.

1 In the **Tagged Items** field:

- Select **Remove Tag** to remove the tag from any tagged items. Items that only had the deleted tag will be placed under the root node in The Tag Tree.
- Select **Add nearest ancestor tag** to remove the tag from any tagged items, and assign the parent tags to the deleted tag to these items instead.

2 Write an optional comment in the **Comments** field.

3 Click **OK** to delete the tag and assign new tags to tagged items as needed.

Recording Snapshots

You can save a reference to a particular commit in a repository by recording a snapshot. You may, for example, find snapshots useful when:

- You have reached a stage in your modeling workflow where a collection of model versions and file versions on a branch have reached a finished state. Via the snapshot, you can easily find all these versions in the future.
- You repeatedly want to browse in the database based on how it looked at the time of the commit. See Searching in Snapshots and Commits.

Recorded snapshots are shown under the **Snapshots** node in The Databases Tree. Click **Show** ( ) in the **Databases** windows toolbar and select **Items** to see the correspondingly recorded item versions.

Click **Snapshot** ( ) in the **Repository** section of the **Home** toolbar to open The Record Snapshot Dialog Box. When The Model Manager Window is focused and the searched location is a branch, the latest versions will be recorded. The same is true when The Databases Window has focus and a node in a branch subtree is selected.

Snapshots

THE RECORD SNAPSHOT DIALOG BOX

The **Location** field shows the database, repository, and branch where the snapshot is recorded. The **Date** field shows the time of the corresponding commit that will be referenced by the snapshot.

1 Write a name for the new snapshot in the **Name** field.
2 You can set up permissions for the new snapshot in the **Permissions** field. This field is only shown if connected to a server database via Model Manager server. See Granting Permissions.
3 Click **OK** to record the new snapshot.

The recorded snapshot appears as a new child node to the **Snapshots** node in The Databases Tree.

Bulk Operations

Model Manager supports bulk import and bulk export of models and auxiliary data files to and from the file system.

In this section:

- Importing Files
- Exporting Items

Importing Files

You can import models and auxiliary data files from the file system directly into a database without, for example, having to open each model in the COMSOL Desktop and manually save it. You can also choose to preserve any folder organization you made on the file system by importing folders as Tags. Files inside a folder will then be tagged by the corresponding tag.

! Imported models will be converted to the current COMSOL Multiphysics version.

Click **Import** ( ) in the **Database** section of the **Home** toolbar to open the **Import** dialog box. A **Target Location** for the imported files will be automatically suggested based on the current selection in The Databases Window or The Model Manager Window (depending on which window is focused). You can change the target by clicking the link button and choose another branch in The Select Location Dialog Box.

- Click **Add Folder** ( ) to add a folder containing files to import. Files in subfolders will also be included.
- Click **Add File** ( ) to add a file to import.
- Click **Exclude File** ( ) to exclude selected files from being imported.

The files to import are shown in a table with columns:

- The type column — the type of file to import based on its file extension represented by an icon. The types are ( ) for `mph`, ( ) for `mphphb`, and ( ) for any other file extension.

- The **File** column — the filename of the file to import.
- The **Source** column — the directory path to the folder that was selected if added via **Add Folder** or the file path if added via **Add File**.

Click **OK** to begin the import. Clicking **Stop** in the progress window stops the import, but already imported files are not deleted from the database. You can see a summary of the import in the **Messages** window in the Model Builder workspace once the import finishes.

IMPORT OPTIONS

The import procedure can be configured under **Options** in the **Import** dialog box.

Select the **Include auxiliary files found in imported models** check box to automatically import referenced files located on the file system that are found inside an imported model. The model will be automatically updated so that it references the corresponding file version in the database.

In the **Tags** field:

- Select **None** to not assign any tags to imported files.
- Select **Import subfolders as tags** to also import all subfolders found under a directory path in the **Source** column as Tags. Imported models and files found in these subfolders will be tagged by the corresponding tags.
- Select **Use existing tags** to select tags to assign to imported models and files among tags already present in the database.

> Importing a large number of files with a complicated folder structure and auxiliary file dependencies may require a bit of planning to get the desired result. You are encouraged to first create a throwaway local database in which you can experiment with your import — perhaps clicking **Stop** when only a subset of your files have been imported.

> Model Manager will detect and skip *duplicate* files, that is files with the same filename and file content. This includes both files that you have explicitly added to the table in the **Import** dialog box, as well as referenced auxiliary files if you have selected **Include auxiliary files found in imported models**. If duplicate files are located in different subfolders, and you have selected **Import subfolders as tags**, the imported files will still be assigned tags corresponding to all those subfolders.

IMPORT TO TARGET TAG

You can import models and auxiliary data files into the database so that all items are placed under a specific tag in The Tag Tree.

Right-click a tag and select **Import** ( ). The **Import** dialog box opens with the title of the selected tag shown in a **Target tag** field. You add folders and files to import in exactly the same way as above — the only difference is that **Use existing tags** is not available under **Tags**.

Exporting Items

You can export models and auxiliary data files from the database to the file system. Any tag organization you have made can be preserved on the file system by exporting tags as subfolders. Models and auxiliary data files tagged by a specific tag will be exported to the corresponding subfolder.

Click **Export** ( ) in the **Database** section of the **Home** toolbar to open the **Export** dialog box. The **Source Location** field shows the location from which versions of items will be exported. Click the link button or **Browse** button in the **Target folder** field to select a folder on the file system to which the items will be exported.

The models and files that will be exported are shown in a table with a type column and an **Item** column with the title of the item. The items in the table depend on the current selection in The Databases Window or The Model Manager Window depending on which window that is focused:

- Selecting a location — that is, a branch, snapshot, or commit — gives the latest versions of all items with respect to the corresponding commit of the location — see also Locations.

- Selecting tags gives the latest versions of all items that are assigned those tags or are assigned a tag with a selected tag as an ancestor in The Tag Tree.
- Selecting models or files gives their latest version with respect to the corresponding commit of the browsed location.

Select table rows and click **Exclude** ( ) to exclude items in the table from being exported. Click **OK** to begin the export. You can see a summary of the export in the **Messages** window in the Model Builder workspace once the export finishes.

EXPORT OPTIONS

The export procedure can be configured under **Options** in the **Export** dialog box.

Select the **Include auxiliary files found in exported models** check box to automatically export any referenced files located in the database that are found inside an exported model. The model will be automatically updated so that it references the corresponding file on the file system.

Select the **Export tags as subfolders** check box to export tags assigned to exported items as subfolders on the file system, with exported files placed inside these subfolders.

> If you select **Export tags as subfolders,** and an exported item version has multiple tags, only one of these tags will be exported as a subfolder (the first one when sorting tag titles alphabetically). This includes items that you have explicitly added to the table in the **Export** dialog box and any referenced auxiliary files if you have selected **Include auxiliary files found in exported models**.

User Management

Model Manager comes with tools for managing users, as well as groups of users, in a server database accessed via a Model Manager server.

In this section:

- Managing Users
- Managing Groups

> All user management functionality is either hidden or disabled for a local database in the Model Manager workspace.

Managing Users

You can manage Users in a Model Manager server database from the Model Manager workspace. This is useful, for example, when you want to see all users that have been active in the database or add users as members to Groups for easier Access Control management.

When you connect and authenticate with a Model Manager server, a new user will be automatically created in the database.

ADDING USERS

There may be situations where you want to add a new user to the server database before the user has connected for the first time. One example is when you preemptively want to grant them permissions to various database objects.

Click **User** (👤) in the **Users** section on the **Database** toolbar to open the **Add User** dialog box. The **Database** field shows the label of the database in which the user will be added.

1 Write the username of the user in the **Name** field. This username should match the one used when authenticating with the Model Manager server.

2 Write an alternative display name for the new user in the **Display Name** field. This is the name that will primarily be shown in the user interface.

3 All existing groups that the new user will be a member of is shown as a list under **Group memberships**.

   a Click **Add** to open the **Search** dialog box in which you can search for groups via their names and display names.

   b Select groups in the table and click **OK** to add them to the list.

   Select groups in the list and click **Remove** to remove them from the list.

4 Click **OK** in the **Add User** dialog box to add the user to the database.

The added user appears as a new child node to the **Users** node under **Security** in The Databases Tree.

!	The username in the **Name** field is the same one used to authenticate with the Model Manager server.

Managing Groups

You can manage Groups of users in a Model Manager server database from the Model Manager workspace. You can, for example, see all groups in the database or add a new group to the database.

ADDING GROUPS

Click **Group** ( ) in the **Users** section on the **Database** toolbar to open the **Add Group** dialog box. The **Database** field shows the label of the database in which the group will be added.

1 Write the name of the group in the **Name** field.

2 Write a display name for the new group in the **Display Name** field. This is the name that will primarily be shown in the user interface.

3 You can add existing users or other groups as members to the new group under **Group members**.

   a Click **Add** to open the **Search** dialog box in which you can search for users and groups via their names and display names.

   b Select users and groups in the table and click **OK** to add them to the list.

   Select users and groups in the list and click **Remove** to remove them from the list.

4 Click **OK** in the **Add Group** dialog box to add the group to the database.

The added group appears as a new child node to the **Groups** node under **Security** in The Databases Tree.

Access Control

You can set up permissions to control access to items stored in a server database accessed via a Model Manager server. You can define these at various levels in The Databases Tree — from coarse-grained permissions set on Repositories to fine-grained permissions set on individual Models and Files.

When you authenticate with a Model Manager server, the server matches the provided username with a user stored in the database. Your user, as well as any groups that you are a member of, are checked whenever you perform a database action that requires authorization. The one exception is if you authenticate using a special *root administrator* account, in which case authorization checks automatically pass.

In this section, you will find answers to:

- Who can set permissions? See Owners.
- How are permissions set? See Granting Permissions
- What permissions can be set for database objects? See Permission Catalog.
- How do permissions combine to control access to models and files? See Permission Levels.
- How can the same permission assignments be reused between different database objects? See Reusing Permission Assignments Using Permission Templates.

All access control functionality is either hidden or disabled for a local database in the Model Manager workspace.

Owners

You control who can set permissions on database objects via *ownerships* — every object has an owner, which is one of the Users in the database. Except for root administrators, only the owner can change a database object's permissions. The user that creates an object is automatically set as its initial owner.

TRANSFER OWNERSHIP

You can transfer the ownership of a database object to another user if you own the object, or if you are authenticated as a root administrator.

Click **Owner** ( ) in the **Permissions** section of the **Database** toolbar. The **Owner** dialog box is opened for the current selection in The Databases Window or The Model Manager Window (depending on which window is focused).

The **Database** field shows the label of the database that the object belongs to, the **Name** field shows the name of the object, and the **Current owner** field shows the username of the user that owns the object. Under **New Owner**, write the name or display name of the user to transfer ownership to in the search field. Click **Search**. Select one of the users in the table and click **OK** to save the new ownership.

Granting Permissions

You can grant permissions to the following database objects:

- Repositories
- Branches
- Snapshots
- Models
- Files
- Tags

There is also a set of global permissions for the database itself — see Granting Database Permissions.

You can change the permissions for a database object if you own the object, or if you are authenticated as a root administrator.

Click **Permissions** ( ) in the **Permissions** section of the **Database** toolbar. The **Permissions** dialog box is opened for the current selection in The Databases Window or The Model Manager Window (depending on which window is focused).

The **Database** field shows the label of the database that the object belongs to, the **Name** field shows the name of the object, and the **Current owner** field shows the username of the user that owns the object.

1 In the **Permissions** list:

   a Select **None** to not set any permission requirements on the database object. See also Permission Levels to learn how an object may still be protected by a parent object in The Databases Tree.

   b Select **Public**, **Protected**, or **Private** to set one of the Predefined Permission Templates.

   c Select one of the previously created permission templates — see Creating your own Permission Templates.

   d Select **Custom** to set up Custom Permissions for the database object.

2 Click **OK** to save the permissions for the database object.

CUSTOM PERMISSIONS

Selecting **Custom** in the **Permissions** field enables you to customize the permissions for a database object. Granted permissions and their grantees — that is, users or groups — are shown in a table with the following columns:

- The type column — the type of the grantee represented by an icon.
- The **Name** column — the name of the grantee.
- The **Permissions** column — all granted permissions.

Click the **Add** button to add another user or group with a set of permissions.

1 In the opened **Add** dialog box, write the names or display names of users and groups in the search field. Click **Search**.

2 Select a user or group in the table.

3 Under **Permissions**, select the permissions to grant the user or group. Use **Select all** to grant all permissions.

4 Click **OK** to add the granted permissions and the grantee to the table.

Select a row in the table and click the **Edit** button to modify already granted permissions. In the opened **Edit** dialog box, select and clear the **Permissions** check boxes accordingly.

Click the **Remove** button to remove a grantee from the table.

The set of grantees and corresponding granted permissions is known as an *access-control list* (ACL).

EVERYONE AND OWNER

You can grant permissions to a special group, **Everyone**, that automatically includes all users. Use this when you, for example, want to grant a subset of permissions to all users but restrict another subset of permissions to only some users and groups.

The user that is the owner of a database object can be implicitly granted permissions by adding an **Owner** from the **Add** dialog box. Use this when you, for example, want to make sure that the permissions are transfered to the correct user when ownership is changed — see Transfer Ownership.

GRANTING DATABASE PERMISSIONS

You can grant permissions for actions that target the database itself. You can think of this as delegating a few administrative tasks that would otherwise be restricted to root administrators. Only root administrators can grant database permissions.

Right-click a database node in The Databases Tree and select **Database Permissions** (🛡) to open the **Database Permissions** dialog box. The **Database** field shows the label of the database.

You add, edit, and remove granted permissions and their grantees in a table in the same way as when selecting **Custom** in the **Permissions** field for a database object, except that Everyone and Owner are not available — see Custom Permissions.

Permission Catalog

This section contains a catalog of all permissions available for database objects.

DATABASE

PERMISSION	DESCRIPTION
Add repositories	Allowed to create a new repository.
Cleanup	Allowed to perform maintenance operations that involves various cleanup jobs (for example, data deduplication).
Delete computed data	Allowed to delete built, computed, and plotted data of models.
Index	Allowed to perform maintenance operations on search indexes.
Manage security	Allowed to create, delete, edit, and restore users, groups, and permission templates.
Permanently delete items	Allowed to permanently delete versions of models and files.
See disk space usage	Allowed to see the disk space usage of models.

TABLE 2-1: ALL AVAILABLE PERMISSIONS FOR THE DATABASE ITSELF.

REPOSITORY

PERMISSION	DESCRIPTION
Create branch	Allowed to create a new branch inside the repository.
Delete repository	Allowed to delete the repository.
Record snapshot	Allowed to record a new snapshot inside the repository.
Restore repository	Allowed to restore the repository when deleted.
Save in repository	Allowed to save commits as well as perform any other save operation inside the repository. This is, for example, a necessary permission for saving branches, snapshots, and item versions inside the repository.
Save repository	Allowed to save the repository itself to, for example, rename it.
See repository	Allowed to see the repository in the user interface. This is, for example, a necessary permission for browsing items inside the repository.
Set default branch	Allowed to set the default branch inside the repository.

TABLE 2-2: ALL AVAILABLE PERMISSIONS FOR REPOSITORIES.

BRANCH

PERMISSION	DESCRIPTION
Delete branch	Allowed to delete the branch.
Restore branch	Allowed to restore the branch when deleted.
Save in branch	Allowed to save commits as well as perform any other save operation inside the branch. This is, for example, a necessary permission for saving item versions on the branch.
Save branch	Allowed to save the branch itself to, for example, rename it or change search capabilities.
See branch	Allowed to see the branch in the user interface. This is, for example, a necessary permission for browsing all item versions on the branch.

TABLE 2-3: ALL AVAILABLE PERMISSIONS FOR BRANCHES.

SNAPSHOT

PERMISSION	DESCRIPTION
Delete snapshot	Allowed to delete the snapshot.
Restore snapshot	Allowed to restore the snapshot when deleted.
Save snapshot	Allowed to save the snapshot itself to, for example, rename it.
See snapshot	Allowed to see the snapshot in the user interface. This is, for example, a necessary permission for browsing the latest item versions with respect to the snapshot's referenced commit.

TABLE 2-4: ALL AVAILABLE PERMISSIONS FOR SNAPSHOTS.

MODEL

PERMISSION	DESCRIPTION
Delete model	Allowed to delete the model.
Open model	Allowed to open the model's versions.
Save model	Allowed to save versions of the model.

TABLE 2-5: ALL AVAILABLE PERMISSIONS FOR MODELS.

FILE

PERMISSION	DESCRIPTION
Delete file	Allowed to delete the file.
Download file	Allowed to download the file’s versions.
Save file	Allowed to save versions of the file.

TABLE 2-6: ALL AVAILABLE PERMISSIONS FOR FILES.

TAG

PERMISSION	DESCRIPTION
Delete tag	Allowed to delete the tag.
Save tag	Allowed to save versions of the tag.

TABLE 2-7: ALL AVAILABLE PERMISSIONS FOR TAGS.

Permission Levels

When Model Manager authorizes a database action that targets item versions on a branch, it consults up to three levels of protection — the repository that the items belong to, the branch the item versions belong to, and, possibly, the items themselves. An analogous level consultation is done for item versions recorded by a snapshot.

PERMISSION COMBINATIONS FOR BRANCHES

The necessary permission combinations for possible database actions that target item versions on a branch are summarized as follows:

ACTION	REPOSITORY	BRANCH	ITEM
Browse and search item versions	See repository	See branch	N/A
Open a model in the COMSOL Desktop	See repository	See branch	Open model
Download auxiliary data	See repository	See branch	Download file
Assign tags to items	Save in repository	Save in branch	N/A
Save a new model version	Save in repository	Save in branch	Save model
Save a new file version	Save in repository	Save in branch	Save file
Save a new tag version	Save in repository	Save in branch	Save tag
Delete a model	Save in repository	Save in branch	Delete model

ACTION	REPOSITORY	BRANCH	ITEM
Delete a file	Save in repository	Save in branch	Delete file
Delete a tag	Save in repository	Save in branch	Delete tag

TABLE 2-8: NECESSARY PERMISSION COMBINATIONS FOR PERFORMING POSSIBLE DATABASE ACTIONS THAT TARGET ITEMS ON A BRANCH.

An important takeaway from Table 2-8 is that if you grant a **See repository** permission and a **See branch** permission to users, they will be able to see settings of all models and files with versions on the branch via, for example, The Model Manager Window, The Databases Window, or the The Versions Window. If some models contain sensitive information exposed through, for example, the **Contents** section in the Model Settings, you must restrict access to the repository or branch to protect it. Limiting who can open an individual model should not be relied upon to keep its inner workings secret.

You may wonder why access to models and auxiliary data files cannot be controlled via their assigned tags? After all, tags have many similarities with folders on the file system, and access to files on the file system can typically be controlled via folder permissions. The motivation is twofold:

- Models and files can have several tags, that is, they can appear in multiple places in The Tag Tree.
- Tag assignments are version controlled via commits — see Adding and Removing Tags.

This makes it hard to reason about the access granted to a model or file. An item could perhaps be protected under one tag’s permissions but exposed under another tag’s. An item could be protected under a tag at the present time, but older versions may be exposed in the commit history if the item was previously tagged by another tag with less restrictive permissions.

PERMISSION COMBINATIONS FOR SNAPSHOTS

The necessary permission combinations for possible database actions that target the item versions recorded by a snapshot are summarized as follows (there are no database actions that save to the database):

ACTION	REPOSITORY	SNAPSHOT	ITEM
Browse and search item versions	See repository	See snapshot	N/A
Open a model in the COMSOL Desktop	See repository	See snapshot	Open model
Download auxiliary data	See repository	See snapshot	Download file

TABLE 2-9: NECESSARY PERMISSION COMBINATIONS FOR PERFORMING POSSIBLE DATABASE ACTIONS THAT TARGET THE ITEM VERSION RECORDED BY A SNAPSHOT.

THE PERMISSION REQUIREMENTS DIALOG BOX

Model Manager performs a preemptive authorization check whenever you open a window or dialog box that is intended for saving to the database. If the check fails, a link button (ⓘ) whose button text summarizes why the check failed is shown.

Click the link button to open a dialog box with the necessary permission requirements shown in a table. Select the **Show only nongranted required permissions** check box to only see permission requirements that you lack.

Reusing Permission Assignments Using Permission Templates

You can create your own Permission Templates to reuse permission assignments for different database objects. This saves you the tedious work of manually granting the same set of permissions to users and groups for multiple database object. Creating your own permission templates also allow you to propagate permission requirement changes to multiple database objects by only updating the permissions in one place — the permission assignments of the permission template itself.

! Updating the permission assignments for a permission template affects not only future applications of the template but also the permissions of database objects to which the template has already been applied.

PREDEFINED PERMISSION TEMPLATES

Model Manager comes with three predefined permission templates for each of the database object types — **Public**, **Protected**, and **Private**. Dividing the permissions in the Permission Catalog into *read* permissions and *write* permissions:

PERMISSION TEMPLATE NAME	GRANTED READ PERMISSIONS	GRANTED WRITE PERMISSIONS
Public	Everyone	Everyone
Protected	Everyone	Owner
Private	Owner	Owner

TABLE 2-10: THE PERMISSIONS GRANTED FOR THE PREDEFINED PERMISSION TEMPLATES.

CREATING YOUR OWN PERMISSION TEMPLATES

You can create new permission templates for models or files in the Model Manager workspace.

Click **Permission Template** (🛡) in the **Permissions** section of the **Database** toolbar to open the **Add Permission Template** dialog box. The **Database** field shows the label of the database in which the template is added.

1 Write the name of the permission template in the **Name** field.

2 Select whether to add a **Model** or **File** permission template in the **Type** field.

3 You add, edit, and remove granted permissions and their grantees in a table in the same way as when selecting **Custom** in the **Permissions** field for a database object — see Custom Permissions.

4 Click **OK** to add the new permission template to the database.

The added permission template appears as a new child node to the **Permission Templates** node under **Security** in The Databases Tree.

Maintenance

One of the biggest challenges with archiving simulation data is the inevitable growth of disk space usage, regardless if simulation data is stored in a database or on the file system. Oftentimes you will not be able to persist some, or all, of the Built, Computed, and Plotted Data generated by your models due to the sheer amount of storage capacity that would be needed.

In this section, you will find various ways in which Model Manager can help you keep the size of your databases under control via maintenance operations. Performing these maintenance operations for a server database accessed via a Model Manager server typically requires that you have authenticated using a root administrator account or have been granted the relevant database permissions — see Granting Database Permissions.

- Built, Computed, and Plotted Data
- Permanently Deleting Models and Files
- The Maintenance Window

Built, Computed, and Plotted Data

One of the most significant contributions to the overall disk space required for storing your models comes from generated simulation data. This includes built geometries and meshes, computed solutions, and results plots — *built, computed, and plotted data* for short. For large models, it is often unfeasible to keep this data around for longer periods of time, preferring instead to regenerate the data by opening and recomputing a model in COMSOL Multiphysics.

There are two ways in which you can avoid storing built, computed, and plotted data in your databases:

- Exclude the data altogether when saving a version of the model to the database. See the Save section of The Root Settings Windows in the *COMSOL Multiphysics Reference Manual*.
- Delete the data from all versions of a model in the **Estimated Disk Space Usage** dialog box. See Estimated Disk Space Usage.

You can see the COMSOL Multiphysics version that a model version was saved in from the **Saved in** field in Model Settings. This is useful when you want to regenerate built, computed, or plotted data for a model version whose data is no longer present in the database.

Permanently Deleting Models and Files

You can permanently delete all versions of models and files in a Model Manager database by clicking the **Delete Permanently** button (✗) in the **Item** section of the **Home** toolbar. You will be asked to confirm that you want to permanently delete all versions of the current selection of items in the The Databases Window or The Model Manager Window (depending on which window is focused). Any drafts that were created from selected models will also be permanently deleted.

Beware that this action cannot be undone. If you only intend to permanently delete all drafts of a model, and not the model itself, use the **Permanently Delete All Drafts** button ( ) in The Maintenance Window.

PERMANENTLY DELETING A VERSION

You can permanently delete a single version of a model or file by right-clicking the version in The Versions Window or The Maintenance Window and selecting **Permanently Delete Version** ( ). This is useful if a particular version is unsuitable to keep in the database.

Since Model Manager does not duplicate unchanged data when saving versions of a model, you may often find that permanently deleting a single version does not reclaim much disk space.

The Maintenance Window

The **Maintenance** window in the Model Manager workspace shows all versions in all repositories and branches that an item has been saved to and that you are authorized to see. You can use the window to get an overview of the total footprint that a model makes in a database.

The set of versions shown in the window follows the current item selection in The Databases Window or The Model Manager Window (depending on which window is focused). Click **Link with Selection** ( ) to disable this automatic linking. You can still update the **Maintenance** window with a new item by right-clicking and selecting **Maintenance** ( ).

The versions are shown in a table sorted in chronological order. At most 100 versions are initially shown. Click the **Show More** button ( ) to include older versions in the table. If the viewed model is opened in the COMSOL Desktop, the corresponding model version row is highlighted in bold in the table. The table columns are:

- The type column — the type of the item represented by an icon.
- The **Title** column — the title set for the item in that version.
- The **Saved** column — the time when the version was saved.
- The **Saved By** column — the name of the user that saved the version.
- The **Repository** column — the repository that the version was saved in.
- The **Branch** column — the target branch of the commit in which the version was saved.
- The **Comments** column — the optional comment provided when the version was saved.

When viewing the **Maintenance** window for a model, all versions of all drafts of the model are also included.

Viewing the table in the Maintenance window as “the version history” of a model can sometimes be misleading. Since versions of a model’s drafts are included in the table, and these drafts may have been worked on in parallel by multiple users, going from one version to the next in the table may not represent how the model has evolved over time. A similar observation holds when a model has been saved on multiple branches. The true version history of a model is best viewed in The Versions Window.

THE MAINTENANCE WINDOW TOOLBAR

The toolbar in the **Maintenance** window contains the following toolbar buttons:

- Click the **Refresh** button ( ) to refresh the table in case any new versions have been saved. The table will automatically refresh if you save a new version to the database from the COMSOL Desktop.
- Click the **Show More** button ( ) to include older versions in the table.
- Click the **Link with Selection** button ( ) to enable or disable whether to automatically update the **Maintenance** window based on the current selection in the **Databases** window or the **Model Manager** window (which ever had focus last).
- Click the **Version Details** button ( ) to open The Version Details Dialog Box containing more information on the version.
- Click the **Estimated Disk Space Usage** button ( ) to open the **Estimated Disk Space Usage** dialog box — see Estimated Disk Space Usage.
- Click the **Open** button ( ) to open a selected model version in the COMSOL Desktop.
- Click the **Run** button ( ) to launch and run a selected version in the COMSOL Desktop. Only enabled if the selected version is an application.
- Click the **Preview File** button ( ) to open a selected file version using the default application for its file type.
- Click the **Compare** button ( ) to compare a selected model version with the model opened in the COMSOL Desktop. Select two model versions to compare them with each other.
- Click the **References** button ( ) to show version references for the selected version.
- Click the **Export to New Local Database** button ( ) to export the version to a new local database — see Export to New Local Database.
- Click the **Show Drafts** button ( ) to include the versions of all drafts of a model in the table.
- Click the **Permanently Delete All Drafts** button ( ) to permanently delete all drafts created from a model.
- Click the **Permanently Delete Selected Version** button ( ) to permanently delete a selected version in the table.
- Click the **Permanently Delete All Versions** button ( ) to permanently delete all versions of a model or file. For a model, all versions of all drafts created from the model will also be permanently deleted.

If you right-click a version in the table, you can also

- Select **Export** ( ) to export the version to the file system — see Exporting Items.
- Select **Branch** ( ) to create a new branch from the commit that the version was saved in.
- Select **Snapshot** ( ) to record a snapshot of the commit that the version was saved in.
- Select **Copy Location** ( ) to copy a text string with a URI that uniquely identifies a model or file version in the database to the clipboard.
- Select **Restore Version** ( ) to save the selected version as a new latest version of the model. See Restore Version.
- Select **Settings** ( ) to update the **Settings** window with the version.

EXPORT TO NEW LOCAL DATABASE

You can export a single model version to a new local database by clicking the **Export to New Local Database** button ( ) in the **Maintenance** window's toolbar. Select a name for the database directory in the **New Local Database** dialog box and click **Save**. You can then open the created database in the COMSOL Desktop — see Opening a Local Database.

ESTIMATED DISK SPACE USAGE

The **Estimated Disk Space Usage** dialog box contains an estimate on the total disk space used by all versions of a model, including all versions of drafts created from the model.

The upper part shows statistics on the model when including all its drafts. The bottom part shows statistics for only the drafts. The **Versions** field shows the total number of versions on all branches. The **Data** field is the estimated disk space usage for all versions, and the **Computed Data** field is the estimated disk space usage for Built, Computed, and Plotted Data.

> Summing the estimated disk space usage of several models may result in an overestimate as identical files used by different models are never duplicated in the database, but will still be included in the usage estimate for each model.

- Click the **Permanently Delete All Versions** button to permanently delete all versions of the model, including all versions of all drafts created from the model.

- Click the **Permanently Delete Drafts** button to permanently delete all drafts created from the model.
- Click one of the **Delete Computed Data** buttons to permanently delete all Built, Computed, and Plotted Data of either all versions of the model, including all versions of all drafts created from the model, or only from all drafts created from the model.

Database Administration

In this section you will find details on how you can administrate your configured databases within the Model Manager workspace.

- Database Configurations
- Database Cleanup
- Compacting Local Databases
- Updating Search Index

Database Configurations

You can manage added databases in the COMSOL Desktop from the top nodes in The Databases Tree. Right-click and select **Delete Configuration** (✕) to remove an added database from the COMSOL Desktop. This will only delete the configuration for the database, not the database itself.

DATABASE SETTINGS

The **Settings** window for a database shows its configuration in the COMSOL Desktop. Click the **Save** button ( ) to update the current configuration.

The General Section

This section shows the label of the database in the **Label** field.

The Storage Section

This section is only shown for a local database. The fields are:

- **Database file**. The path to the SQLite® database file on the file system.
- **Resources directory**. The path to the resources directory on the file system.
- **Search index directory**. The path to the search index directory on the file system.

A Local Database on the File System

Click the **Show in System Explorer** button ( ) to open the database directory in the system explorer native to the operating system. Click the **Compact** button ( ) to compact the database file — see Compacting Local Databases.

The Connection Section

This section is only shown for a server database accessed via a Model Manager server. The fields are:

- **Server**. The server address to the Model Manager server.
- **Require secure connection**. Selected if the network connection is made using a secure connection, with transport layer security provided by HTTPS (as opposed to plain HTTP). A warning message is shown if the check box is cleared.
- **Username**. The username used when connecting to the server.
- **Password**. The password used when connecting to the server. The current password is not accessible.
- **Remember password**. Selected if the password is remembered between program sessions. The password is stored in an encrypted form on the local file system.

Connecting to a Server Database

COMSOL Desktop disconnects from a connected Model Manager server when you click the **Save** button ( ) in the **Settings** window. You can reestablish the connection by, for example, activating the database in the Model Manager workspace — see Activating a Database.

Click the **Test Connection** button ( ) to test if the filled-in values in the **Connection** section can be used to successfully connect to the Model Manager server.

Database Cleanup

When you permanently delete models or files in the database, some unused data may remain in the database. Click **Cleanup** ( ) in the **Maintenance** section of the **Home** toolbar to instruct Model Manager to perform a cleanup of such data. This may take a few seconds up to several minutes depending on the size of the database.

Compacting Local Databases

You can optimize a local database by clicking **Compact** ( ) in the **Maintenance** section of the **Home** toolbar to open the **Compact** dialog box. The **File size** field shows the current size of the SQLite® database file, and the **Estimated file size after compacting** field shows the estimated size after the file has been compacted. Click **OK** to compact the file. This may take a few seconds up to several minutes depending on the size of the database file.

A Local Database on the File System

Updating Search Index

Model Manager uses a specialized *search index* when searching and filtering items with respect to a branch. Under normal program execution, Model Manager automatically pushes any updates made to items in the database to this search index, both for a local database and for a server database. This push may fail, however — for a Model Manager server, for example, due to intermittent network issues when the Model Manager server process tries to communicate with the process managing the search index.

You can manually trigger the push of changes to the search index, thereby letting the search index catch up with any changes made in the database. Right-click a database node in The Databases Tree and select **Index** ( ) to push changes made on all branches. Do the same for a branch node to only push changes made on that branch.

3

Searching and Filtering

In this chapter you will learn how to search for models and auxiliary data files in a Model Manager database. You will see how you can match such items by performing both full text searches, as well as by applying various filter criteria. You will also learn how you can search "deep" within the model tree, matching models on their node properties, parameters, features, and other settings.

In this chapter:

Searching Versions

Whenever you search for models and files in a Model Manager database, you search among a select subset of versions. There are two possibilities:

- You search among the latest versions at the present time.
- You search among the versions that were the latest at some particular time in the past.

These two correspond to searching with respect to the following Locations in a database:

- Searching in Branches
- Searching in Snapshots and Commits

In this section you will learn how the search capabilities of Model Manager differ when searching these locations.

Searching in Branches

Select a branch in The Select Location Dialog Box to search among the latest versions of models and files in that branch. This is also the default location when you choose a database from the list on the left in the **Open**, **Select File**, and **Select Model** windows, or when Activating a Database in the Model Manager workspace.

> The link button to open The Select Location Dialog Box is hidden in the **Open**, **Select File**, and **Select Model** windows when a database only contains a single branch and no snapshots.

Which search tools are available when searching among the latest versions of models and files is determined by the value selected in the **Search** list found in the **Settings** window for a branch — see Branch Settings. Select **Item fields and content** to enable the full Model Manager search functionality for the branch. Select **Only text and tags** to limit the search to the same capabilities as when Searching in Snapshots and Commits.

The **Item fields and content** value is the preferred and default selection for the main branch in a repository. You can then use all the search tools available in Model Manager, including applying Item and Content Filters from The Filter Dialog Box and writing custom filter queries using the The Model Manager Search Syntax. There is, however, a cost in terms of disk space usage by the corresponding search index — see also Updating Search Index. You may want to select **Only text and tags** when:

- You create a new branch off the main branch that contains only a few models and files. Finding a particular model or file is then a matter of simply browsing a short list of items — that is, no advanced searching is required.
- You create a new branch off the main branch on which models and files will rarely be added or updated. Advanced searching can then be performed on the main branch — selecting the corresponding version on the new branch may then be done, for example, from The Versions Window or from The Maintenance Window.

When Opening a Local Database from Multiple COMSOL Multiphysics Processes, search will be limited to that used when Searching in Snapshots and Commits for all processes except the first one to connect.

Searching in Snapshots and Commits

Select a snapshot in The Select Location Dialog Box, or right-click a commit and select **Search in Commit** (🔍) in The Commits Window, to search among the versions of models and files that were the latest at the commit date. You may find this useful if, for example, you want to find a version of an old model or file that has been deleted, or if you perhaps want to see how the branch was organized with tags at the time of the commit.

Searching versions in a snapshot or commit is limited as compared to Searching in Branches. You can perform full text searches by selecting **Text** or search on the titles of assigned tags by selecting **Tags** from the list next to the **Search** button in The Model Manager Window. Other search windows offer only full text search. You can also apply a separate filter on file type extensions from a list in the **Select File** window. Other Item and Content Filters or the The Model Manager Search Syntax are not available.

The **Add Filter** button (▼) is disabled in the **Open**, **Select File**, **Select Model**, and **Model Manager** windows’ toolbars when you search with respect to a snapshot or commit.

Full Text Search

A fast way for you to find models and files in a Model Manager database is to write individual search words, separated by spaces, in the input fields of the **Open**, **Select File**, **Select Model**, or **Model Manager** windows and click the **Search** button. In this section, you will learn how Model Manager performs a *full text search* to match these search words against fields shown in The Settings Window for models and files.

In this section:

- Combining Full Text Search Words
- Matched Fields

Search words match in a case-insensitive way when searching in Model Manager.

Combining Full Text Search Words

Model Manager combines all search words that you write with `AND`-logic. In practical terms this means that the models and files included in a returned search result are such that all search words matched in the searched fields.

An example from the **Application Libraries** window: If you import `busbar.mph` found under **COMSOL Multiphysics>Multiphysics** into a database, it may, for example, have the following fields:

- **Title**: Electrical Heating in a Busbar
- **Description**: This example analyzes the resistive heating of a busbar designed to conduct direct current.
- **Tags**: Multiphysics

You can find this model by writing some or all of the search words: `busbar example multiphysics`. The first word, `busbar`, matches on a word in the title and the description, the second word, `example`, matches a word in the description, and the last word, `multiphysics`, matches an assigned tag.

You can use a *wildcard* asterisk character in a search word to match zero or more arbitrary characters when searching in a branch with **Item fields and content** configured — see Searching in Branches. Appending, for example, a wildcard to a search word will match that word against the beginning of a word or the whole word in the searched text. See also Wildcard Matching.

You can also match on phrases — that is, multiple words in a sequence — by enclosing search words in quotation marks. Searching on “`conduct direct current`” will match in the description in the above example, while other permutations of these search words will not match. See also Phrase Matching.

Leading and trailing punctuation markers — for example, dots and hyphens — are ignored when searching words in a field of type Text Field. That is why the trailing dot in `current` can be omitted.

Including a wildcard asterisk character or using phrase quotation marks have no special meaning when Searching in Branches with **Only text and tags** configured or when Searching in Snapshots and Commits. Model Manager will, however, automatically append an *implicit* wildcard to each search word in those cases.

Matched Fields

The fields matched against in a full text search differ slightly depending on the search capabilities of the searched location.

- Searching in Branches
- Searching in Snapshots and Commits

MATCHING ITEM FIELDS AND CONTENT

Full text search words match the following Model Settings and File Settings when **Item fields and content** is configured for a branch:

- The **Title** field of a model or file.
- The **Description** field of a model or file.

- The **Filename** field of a model or file.
- The title of assigned **Tags**. Either tags assigned directly to an item or an ancestor to such a tag in The Tag Tree.

Unlike when Matching Only Text and Tags, the full text search does not match against the file type extension of a file. You can, however, search on such extensions using a File Type filter.

MATCHING ONLY TEXT AND TAGS

Full text search words match the following Model Settings and File Settings when **Only text and tags** is configured for a branch or when searching in a snapshot or in a commit:

- The **Title** field of a model or file.
- The **Description** field of a model or file.
- The **Filename** field of a model or file.
- The file type extension of a file as defined by its **Filename** field.

Selecting **Tags** instead of the default **Text** in the list next to the **Search** button in The Model Manager Window matches search words on the title of assigned tags — either tags assigned directly to an item or an ancestor to such a tag in The Tag Tree.

Item and Content Filters

In this section you will learn how to apply the predefined filters available from the **Filter** dialog box. To learn how to write your own custom filters, see The Model Manager Search Syntax.

- Field Types
- The Filter Dialog Box
- Item Filters
- Content Filters
- The Applied Filters Toolbar

Filters match in a case-insensitive way in Model Manager.

Field Types

The Item Filters and Content Filters that are available in the Model Manager search tools can be categorized based on the types of fields that they match on. These *field types* affect, for example, how the field values specified in filters are interpreted when searching the database.

- Text Field
- Keyword Field
- Date Field
- Numeric Field
- Boolean Field
- Selection Field

TEXT FIELD

A filter on a *text field* matches search words in a text. Individual “words” in the text are obtained by splitting on spaces, punctuation markers, and other delimiter characters. Examples of text fields are the title and description of a model or file.

KEYWORD FIELD

A filter on a *keyword field* matches a search word against a string value. Keyword fields are typically found for short, name-like, search data, such as the filename of a model or file.

To include spaces in a keyword field's value, precede each space using a backslash character — see Escaping Reserved Characters.

If you omit the backslash character before a space in the value for a keyword field, the value will be interpreted as two words combined with boolean `AND`-logic — see Basic Field Expressions. The search word `electrical heating busbar.mph` for a filename field is equivalent to `electrical AND heating AND busbar.mph` — an expression that can never match the filename of a model (a model can have at most one filename). Write `electrical\ heating\ busbar.mph` instead.

DATE FIELD

A filter on a *date field* matches against a date and time value. You can specify the date and time format according to the localization rules for the language set in the COMSOL Desktop or according to the ISO-8601 standard format. An example of a date field is the last modified timestamp of a model or file.

The following are all valid date and time values for a date filter matching August 24, 2021, 2:30 p.m. when running the COMSOL Desktop with language set to `English`:

- `8/24/21`
- `8/24/21, 2:30:00 PM`
- `2021-08-24`
- `2021-08-24T14:30:00`

Dates and times can either be matched exactly or as an interval. The intervals can be open on one or both sides. See also Range Matching.

NUMERIC FIELD

A filter on a *numeric field* matches on a real or complex scalar value. An example of a numeric field is the last computation time of a study, or a numerical setting or parameter value. The unit to use for dimensioned scalar values depends on the context.

Numeric fields can either be matched exactly or by specifying intervals for the real and imaginary parts separately. The intervals can be open on one or both sides. See also Range Matching.

BOOLEAN FIELD

A filter on a *boolean field* matches on either `true` or `false`. An example is whether or not a 1D or 2D component is axisymmetric.

SELECTION FIELD

A filter on a *selection field* is a specialized filter that involves selecting values from a predetermined set. Examples include Item Types and Save Types of models or the user that last modified a model or file.

The Filter Dialog Box

You can apply filters to a model and file search from the **Filter** dialog box. Click the **Add Filter** button ( ) from the toolbar of the **Open**, **Select File**, **Select Model**, or **Model Manager** windows. Select one of the Item Filters or Content Filters in the menu. The **Filter** dialog box is opened with fields and options appropriate for the selected filter.

The **Filter** field shows the name of the selected filter. The other input fields depend on which of the filters you selected.

Select among the Filter Options under **Options** to quickly modify how the filter's field values will be combined and interpreted. You can see a preview of the corresponding filter query expression written using The Model Manager Search Syntax under **Filter query preview.**

Spaces entered in an input field for a Text Field in the **Filter** dialog box will be automatically replaced by boolean `OR` operators by default — note the generated filter query expression under **Filter query preview**. This is in contrast to when writing a custom filter query using The Model Manager Search Syntax in which spaces are interpreted as boolean `AND` if no boolean operator is explicitly written.

Spaces entered in an input field for a Keyword Field in the **Filter** dialog box will be automatically escaped — see Escaping Reserved Characters.

Click the **Customize filter query** button ( ) to replace the filter query with your own customized query.

Click **OK** to apply the field values as a new filter.

FILTER OPTIONS

You can modify how filters are applied in the **Filter** dialog box by selecting one of the filter options under **Options**.

Select **Prefix match** to automatically append a wildcard to each search word in a Text Field or at the end of a Keyword Field. See also Wildcard Matching.

> You include a wildcard by writing an asterisk character in a search word. The wildcard will match any number of arbitrary characters.

Select **Match all terms** to replace the `OR`-logic used between search words in an input field for a Text Field or selected check boxes in a Selection Field with `AND`-logic.

Select **Match whole phrase** to require that the search words match a sequence of words (that is, a *phrase*) in a Text Field or Keyword Field. See also Phrase Matching.

> You match search words as a phrase by enclosing them in quotation marks.

Select **Negate match** to require that the specified field values do *not* match any models or files in the search result. See also Negated Matching.

Item Filters

Item filters match on field values typically found in the **Version** section and **Tags** section for Model Settings and File Settings.

- Item Title
- Item Description
- Item Tag
- Item Type
- Save Type
- Last Modified
- Last Modified By
- Filename
- File Type
- Owner

ITEM TITLE

The **Item Title** filter (☰) is a Text Field filter that matches on the title of a model or file. You may find this filter useful when the searched title is a word commonly found also in descriptions and tags, such that performing a Full Text Search would yield too many results.

ITEM DESCRIPTION

The **Item Description** filter ( ) is a Text Field filter that matches on the description of a model or file. Similar to an Item Title filter, you may find this useful when the searched description is also a common title or tag.

ITEM TAG

The **Item Tag** filter ( ) is a Selection Field filter that matches on the assigned tags of a model or file. Select one or more tags in The Tag Tree shown in the **Filter** dialog box. Click **Clear Tags** ( ) to clear all selections — the filter will then match on all items.

> You will notice that the generated filter query under **Filter query preview** does not show the titles of the tags, but rather their unique keys in the database. This is to ensure that you find exactly the items tagged by the selected tag, and not items tagged by a tag that happen to share the same title.

ITEM TYPE

The **Item Type** filter ( ) is a Selection Field filter on the Item Types of a model or file (the latter only has one). Select among **Model**, **Application**, **Physics**, and **File**.

SAVE TYPE

The **Save Type** filter ( ) is a Selection Field filter on the Save Types of a model or file (the latter only has regular as save type). Select among **Regular** and **Draft**.

LAST MODIFIED

The **Last Modified** filter ( ) is a Date Field filter for when the latest version was saved. Write a start date in the **From** field and an end date in the **To** field. Leave one or both input fields empty to not set a corresponding bound.

LAST MODIFIED BY

The **Last Modified By** filter ( ) is a Selection Field filter on the user that saved the latest version. Write the name or display name of a user in the **Name** field. Spaces in names are automatically escaped with backslashes.

FILENAME

The **Filename** filter (🗎) is a Keyword Field filter on the filename used by a model or file when exported to the file system.

FILE TYPE

The **File Type** filter (🗎) is a combined Selection Field and Keyword Field filter on the file extension of a file. Select a file extension from the **Predefined** field, or manually type file extensions, separated by spaces, in the **Manual** keyword field.

> Unlike other Keyword Field filters in the **Filter** dialog box, in which spaces are escaped with backslash, spaces between file extensions will instead be automatically replaced with boolean `OR` operators.

OWNER

The **Owner** filter (👤) is a Selection Field filter on the current owner of a model or file. Write the name or display name of a user in the **Name** field. Spaces in names are automatically escaped with backslashes.

Content Filters

Content filters match on values in the The Contents Section of Model Settings — that is, on node properties, parameters, features, and other settings in the model tree of a model.

- Parameter
- Setting
- Space Dimension
- Physics
- Study Step
- Node Type
- Label
- Name
- Tag
- Created
- Author
- Version
- Comment
- Last Modified
- Last Modified By

> Searching Nodes and Settings in the Model Tree

PARAMETER

The **Parameter** filter (Pi) is a combined Keyword Field, Text Field, and Numeric Field filter on parameters in a **Parameters** node. You can create a filter by combining:

- The parameter name as a Keyword Field in the **Name** field.
- The parameter description as a Text Field in the **Description** field.
- The parameter expression, including units, as a Keyword Field in the **Value** field.
- The parameter value, excluding units, as a real scalar Numeric Field in the **From** and **To** range fields. Leave one or both input fields empty to not set a corresponding bound.

The parameter value uses the unit system as set in the model when it was saved to the database.

Parameters in the *COMSOL Multiphysics Reference Manual*

SETTING

The **Setting** filter ( ) is a combined Keyword Field and Text Field filter on general settings found in the **Settings** window for a node. You can create a filter by combining:

- The name of a setting as a Keyword Field in the **Name** field. This is an identifier of the setting that is not visible in the Model Builder, Application Builder, or Physics Builder **Settings** windows. You can find the name of a particular setting in the **Name** column in the **Details** dialog box for a node in The Contents Section.
- The description of a setting as a Text Field in the **Description** field.
- The value of a setting as a Keyword Field in the **Value** field.
- The value of a setting when accessed via the COMSOL API as a Keyword Field in the **API value** field.

Not all node settings can be searched in the database. You can see which settings are available by, for example, finding a model that has the node type you want to search, select the node in The Contents Section, click the **Details** button (≡), and examine the rows in the **Settings** table in the opened **Details** dialog box.

SPACE DIMENSION

The **Space Dimension** filter ( ) is a Selection Field filter on the space dimension of a **Component** node. Select among **3D**, **Axial Symmetry (2D)**, **2D**, **Axial Symmetry (1D)**, **1D**, and **0D**.

The Component Node in the *COMSOL Multiphysics Reference Manual*

PHYSICS

The **Physics** filter ( ) is a Selection Field filter on physics interfaces used by a model. You select physics interfaces you want to filter on from a tree. Select a space dimension in the **Show available physics for** field to filter the tree on physics interfaces available for that dimension. You can also filter the tree by writing the name of a physics interface and clicking the **Search** button.

The Physics Nodes in the *COMSOL Multiphysics Reference Manual*

STUDY STEP

The **Study Step** filter ( ) is a Selection Field filter on study steps used by a model. Select the study steps you want to filter on from the shown list.

Study and Study Step Types in the *COMSOL Multiphysics Reference Manual*

NODE TYPE

The **Node Type** filter ( ) is a combined Text Field and Keyword Field filter for finding models with nodes of a particular type. You can create a filter be combining:

- The node type as shown in the user interface as a Text Field in the **Type** field.
- The node type as used in the COMSOL API as a Keyword Field in the **API type** field.
- The node class as used in the COMSOL API as a Keyword Field in the **API class** field.

Click the **Model Tree Node Text** button ( ) and select **Type** to see a node's type in the Model Builder tree.

You typically include a filter on the **API type** or **API class** fields to narrow the search when the **Type** field alone matches too wide.

NODE PROPERTIES

You can filter on node properties as shown in the **Properties** window for a node.

Label

The **Label** filter (abc) is a Text Field filter on a node's label.

Name

The **Name** filter (ABC) is a Keyword Field filter on a node's name.

Tag

The **Tag** filter (ABC) is a Keyword Field filter a node's tag.

Created

The **Created** filter (📅) is a Date Field filter for when the node was created.

Author

The **Author** filter (👤) is a Keyword Field filter on the node's **Author** field in the **Properties** window.

> The value in a node's **Author** field is written as a general string value in the **Properties** window and need not correspond to any Users in a database.

Version

The **Version** filter (ABC) is a Keyword Field filter on the node's **Version** field in the **Properties** window.

> The value in a node's **Version** field is written as a general string in the **Properties** window and does not correspond to any particular model version in a database.

Comment

The **Comment** filter (💬) is a Text Field filter on the node's **Comments** field in the **Properties** window.

Last Modified

The **Last Modified** filter (📅) is a Date Field filter for when the node was last modified. Except for the root node, this field is only available from the model object via the COMSOL API. Only a subset of all node types automatically update this value.

Last Modified By

The **Last Modified By** filter (👤) is a Keyword Field filter on the last modified by value accessible from the model object via the COMSOL API. Only a subset of all node types automatically update this value.

The Applied Filters Toolbar

All applied filters are shown in a toolbar above the search result in the **Open**, **Select File**, **Select Model**, and **Model Manager** windows, with each filter represented by a button. The button text is a short summary of the filter.

Click a filter button and select **Edit** (✎) to edit an existing filter via The Filter Dialog Box. Select **Remove** (🗑) to remove a filter.

The Model Manager Search Syntax

The filter functionality in Model Manager is based on a tailor-made search syntax adapted for searching deep within a COMSOL Multiphysics simulation model. You may have seen examples of this syntax already in the **Filter query preview** field in The Filter Dialog Box. The syntax enables you to write filter queries that find models whose node properties, parameters, features, and other settings satisfy arbitrarily complex constraints. As an example, you can write a custom filter query that matches all models that have an axisymmetric 2D component, for which the component uses a particular physics interface and a particular material.

In this section, you will learn how you can formulate such custom filter queries. Via examples of gradually increasing complexity, you will see how to write simple expressions for filters on single fields, how you can combine such field expressions using boolean logic, and finally how you can nest field expressions based on the nested node hierarchy in the model tree. The section ends with a complete listing of all available field expressions in the Model Manager search syntax.

- Basic Field Expressions
- Combining Expressions
- Searching Nodes and Settings in the Model Tree
- Search Syntax Catalog

The Model Manager search syntax is only available when Searching in Branches and with **Item fields and content** configured.

The examples in this section will exclusively refer to Models. You can also write analogous custom filter queries for Files using the item field expressions in the Search Syntax Catalog.

Basic Field Expressions

A filter consists of one more *field expressions* combined with boolean operators — for example, `AND`, `OR`, and `NOT` — and other grouping operators. Each field expression specifies which *field* is searched and the *field value* being searched on. The field also has a particular type which dictates how the field value will be interpreted by Model Manager — see Field Types.

You write a field expression using an @-notation of the general form:

```
@<field-name>:<field-value>
```

with *<field-name>* equal to the name of one of the available fields in Table 3-1, and *<field-value>* the value being filtered on. Write, for example,

```
@title:busbar
```

to find all models whose title contain the word busbar. To match on several search words, enclose the words with parentheses. Write

```
@title:(electrical busbar)
```

to find all models whose title contain both the words electrical and busbar.

A space between two search words is automatically interpreted as a boolean AND in the Model Manager search syntax. The above is thus equivalent to:

```
@title:(electrical AND busbar)
```

Write

```
@title:(electrical OR busbar)
```

if you want to find all models whose title contain either electrical *or* busbar.

You may have noticed that spaces in the input field for a Text Field in The Filter Dialog Box are automatically replaced by a boolean OR in the corresponding **Filter query preview**. Select **Match all terms** under **Options** to change this to AND instead.

Field expressions can be written for other Field Types than a simple Text Field. Write

```
@lastModified:9/17/21
```

to find all models last modified on September 17, 2021 using a Date Field.

You can write the field name in a case-insensitive way. Thus @lastmodified:9/17/21 works fine.

You can enter a custom filter query either directly in the search field in the **Open**, **Select File**, **Select Model**, and **Model Manager** windows, or apply it as a separate filter in The

Applied Filters Toolbar by first clicking the **Customize filter query** button (✏) from The Filter Dialog Box.

If you want to combine full text search with a custom filter query, write the former first. The following is valid:

```
electrical busbar @description:example
```

and matches on all models with a title, description, filename, or assigned tags containing the words `electrical` and `busbar`, and that has a description containing the word `example`. The following is not valid:

```
electrical @description:example busbar
```

and results in an error message.

!	Write all plain search words first, followed by zero or more custom filter queries.

CONTROLLING PRECEDENCE USING PARENTHESES

A boolean `AND` takes precedence over a boolean `OR` in the Model Manager search syntax. The filter

```
@title:(electrical AND busbar OR tuning AND fork)
```

matches models whose title either contains both `electrical` and `busbar`, or whose title contain both `tuning` and `fork`. You can override this operator precedence with parentheses. Write

```
@title:(electrical AND (busbar OR tuning AND fork))
```

to match all models whose title contain `electrical`, and either the single word `busbar` or the two words `tuning` and `fork`.

WILDCARD MATCHING

You can use an asterisk character as a *wildcard* symbol that matches on zero or more arbitrary characters. The filter:

```
@title:electric*
```

matches on all models whose title begin with electric.

You can match on all models that have *any* value set for a field by using a single wildcard symbol. Write

```
@description:*
```

to find all models with a nonempty description. This can also be written using the special ANY symbol:

```
@description:ANY
```

which may feel more intuitive.

> You can use a wildcard symbol anywhere in a search word. Placing it at the start (that is, a *postfix* search) may, however, result in slow query times. The exception is when the field value only contains a single wildcard symbol, and nothing else.

> Wildcard matching on search words that include punctuation markers — for example, periods, commas, colons, and hyphens — may lead to surprising results when used in a full text search or in a Text Field filter due to how the search splits text into word tokens. You are recommended to avoid using wildcards for such search words. A Keyword Field filter does not have this limitation.

PHRASE MATCHING

You can match on phrases — that is, multiple words in a sequence — by enclosing them in quotation marks. Write

```
@title:”electrical heating”
```

to match on models whose title contains `electrical` followed by `heating`. You can also combine phrase search with ordinary search. Write

```
@title:(”electrical heating” busbar)
```

to match on models whose title contains `electrical` followed by `heating`, as well as the word `busbar`, for example, `Electrical Heating in a Busbar`.

> Wildcard Matching inside a phrase is not supported.

NEGATED MATCHING

You can reverse the match logic using the special NOT symbol. Write

```
@title:(NOT busbar)
```

to find all models whose title does *not* contain the word `busbar`. The `NOT` symbol takes precedence over both `AND` and `OR`, although you can override this precedence with parentheses. Write

```
@title:(NOT (electrical busbar))
```

to find all models whose title does not contain the words `electrical` and `busbar`.

You can exclude the parentheses if the `NOT` is followed by a single word. Thus `@title:NOT busbar` is equivalent to the first example.

RANGE MATCHING

A filter on a Date Field and a Numeric Field can be written as inclusive ranges. Write

```
@lastModified:[9/1/21 TO 9/30/21]
```

to find all models last modified for the month of September in 2021. Use a wildcard symbol for unbounded ranges. The filter

```
@lastModified:[* TO 8/31/21]
```

matches on all models that have not been modified after August 2021.

ESCAPING RESERVED CHARACTERS

Some characters serve special purposes in the Model Manager search syntax and are considered *reserved characters*. If you want to search on words that contain these characters, precede them by a backslash. Write

```
@tag:(\[In Progress\])
```

to match all models assigned the tag with title `[In Progress]`. The enclosing parentheses are necessary as there are two search words, `[In` and `Progress]`.

The ten reserved characters are:

```
{ } ( ) [ ] " : \ SPACE
```

The last one is a common pitfall when writing a filter on a Keyword Field that matches a string containing a space character. Write

```
@filename:electrical\ heating\ busbar.mph
```

to match a model with filename `electrical heating busbar.mph`. Parentheses are not necessary here because the value is considered as one search word when escaping the two space characters.

Combining Expressions

You can combine any number of field expressions to form more complicated filters. Write

```
@title:busbar @description:example
```

to find all models whose title contain the word `busbar` and whose description contain the word `example`. As for search words in the field value of a single field expression, a space character between two field expressions is interpreted as a boolean `AND`. Write

```
@title:busbar OR @description:example
```

to combine the two field expressions with a boolean `OR`.

You can also use parentheses to control operator precedence. Write

```
@saveType:draft AND (@owner:Alice OR @lastModifiedBy:Alice)
```

to find all drafts that are either owned *or* were last modified by user Alice.

Searching Nodes and Settings in the Model Tree

You can find models by matching on their node properties, features, and settings in the model tree. You use a similar search syntax for field expressions involving these nodes as when searching on general item fields — see Basic Field Expressions.

In this section you will learn how to write basic filter queries that match on models with a particular node or setting, as well as advanced filter queries that match on models in which a particular node or setting is nested within other nodes.

BASIC NODE FIELD EXPRESSIONS

You write a basic *node field expression* filter using an `@`-notation of the general form:

```
@node{@<field-name>:<field-value>}
```

with *`<field-name>`* equal to the name of one of the available fields in Table 3-2 and *`<field-value>`* the value being filtered on. Write, for example,

```
@node{@type:rotor}
```

to find all models with nodes of a type that contains the word `rotor`. With this, you can, for example, find models that have a Frozen Rotor study step, or models that have a Beam Rotor interface. Write

```
@node{@type:(beam AND rotor)}
```

to narrow the search to the latter models.

You can leave out the boolean AND as Model Manager automatically adds this whenever there is a space between two search words or two field expressions.

You can match a node on several properties, features, and settings by combining several expressions within @node{…}. Write

```
@node{@type:(beam rotor) @comment:"Use axial vibration"}
```

to find a model with a Beam Rotor interface for which a certain comment has been written in the **Comments** field in the **Properties** window for the node — see also Phrase Matching.

A node field expression can also be combined with item field expressions, as well as with other node field expressions. Write

```
@lastModifiedBy:Alice @node{@type:(beam rotor)}
```

to find models with a Beam Rotor interface that were last modified by user Alice.

USING NAMED NODES

Oftentimes you want to find models with a node of a particular type. One challenge that you then face is that the **Type** field for a Node Type may match wider than you perhaps anticipated. Writing

```
@node{@type:(time dependent)}
```

will match on Time Dependent study steps. But it will also match on Time-Dependent Solvers, which may not be what you wanted. Write

```
@node{@apiClass:StudyFeature @type:(time dependent)}
```

to only match on the study step.

You can find the **API class**, as well as all other node fields, of a particular node in the **Node** table in the **Details** dialog box opened from The Contents Section. These often have a technical name that may be challenging to remember. To help you with this, Model Manager comes with a set of predefined *named nodes* that work as aliases. You will match on only a Time Dependent study step by writing

```
@studyStep{@type:(time dependent)}
```

A complete listing of all named nodes is given in Table 3-4.

You use an **API type** field expression when a named node is not enough to distinguish types. Writing

```
@physics{@type:(electric currents)}
```

will match on models with an Electric Currents interface. But it will also match on models with an Electric Currents in Layered Shells interface. Write

```
@physics{@apiType:ConductiveMedia}
```

to only match the former physics interface.

BASIC SETTING FIELD EXPRESSIONS

You write a basic *setting field expression* filter using an `@`-notation of the general form:

```
@setting{@<field-name>:<field-value>}
```

with *`<field-name>`* equal to the name of one of the available fields in Table 3-3 and *`<field-value>`* the value being filtered on. As for node field expressions, you can include several expressions within `@setting{…}`. Write, for example,

```
@setting{@description:Length @value:9\[cm\]}
```

to find all models with a setting **Length** having value `9[cm]` — see also Escaping Reserved Characters. When the setting is a scalar, you can also match on a range of values:

```
@setting{@description:Length @scalarReal:[0.05 TO 0.15]}
```

The scalar length values are written in the unit system of the model, unlike the textual length value in the previous example that matched on the exact string including the unit name.

You can find the available settings of a particular node under **Setting** in the **Details** dialog box opened from The Contents Section. You may find it useful, for example, to include a filter on the **Name** setting field whenever the **Description** setting field matches too wide.

NESTED NODE AND SETTING MATCHING

You can write custom filter queries that match on settings for a particular node by nesting `@setting{…}` within `@node{…}`, or within any of the names nodes. Write

```
@parameters{@setting{@description:Length @scalarReal:0.09}}
```

to match a parameter setting on a **Parameters** node.

There is no limit on the number of setting field expressions you can include. Write, for example,

```
@parameters{@created:[9/1/21 TO 9/31/21]
@setting{@description:Length @scalarReal:0.09}
@setting{@description:Width @scalarReal:0.05}}
```

to find models with a **Parameters** node created in September 2021, such that the node has a **Length** parameter with value `9[cm]` and a **Width** parameter with value `5[cm]`.

You can also nest two or more node field expressions inside each other. Write, for example,

```
@component{@spaceDimension:2 @physics{@apiType:ConductiveMedia}}
```

to find all models with a **2D** component that contains an Electric Currents interface.

! The Model Manager search syntax supports nesting node field expressions five levels deep in the model tree.

Search Syntax Catalog

In this section, you will find a summary of all field expressions and symbols available in the Model Manager search syntax:

- Table 3-1 contain item field expressions that match on basic fields of models and files.
- Table 3-2 contain node field expressions that match on node types and properties.
- Table 3-3 contain setting field expressions that match on node settings.
- Table 3-4 contain the various expressions used to write plain and nested node and setting filters.
- Table 3-5 contain symbols available in the search syntax.

💡 If you are uncertain of what field values are available for a Selection Field, write any value and press Enter. Model Manager will show an error dialog containing supported values.

SYNTAX	TYPE	DESCRIPTION
@title:...	Text	Matches on the title of an item.
@description:...	Text	Matches on the description of an item.

SYNTAX	TYPE	DESCRIPTION
@tag:…	Text	Matches on the titles of tags assigned to an item.
@tagKey:…	Selection	Matches on the unique keys of tags assigned to an item.
@itemType:…	Selection	Matches on the item type of an item.
@saveType:…	Selection	Matches on the save type of an item.
@lastModified:…	Date	Matches on the last modified date of an item,
@lastModifiedBy:…	Selection	Matches on the name or display name of the user that last modified an item. Escape spaces in names with backslash.
@filename:…	Keyword	Matches on the filename used when exporting an item to the file system.
@fileType:…	Keyword	Matches on the file type extension of a file.
@owner:…	Selection	Matches on the name or display name of the user that owns the item. Escape spaces in names with backslash.

TABLE 3-1: FIELD EXPRESSIONS FOR ITEM FIELDS.

SYNTAX	TYPE	DESCRIPTION
@label:…	Text	Matches on the label of a node.
@name:…	Keyword	Matches on the name of a node.
@tag:…	Keyword	Matches on the tag of a node.
@type:…	Text	Matches on the node type as shown in the user interface.
@apiClass:…	Keyword	Matches on the class of a node in the COMSOL API.
@apiType:…	Keyword	Matches on the node type as represented in the COMSOL API.
@created:…	Date	Matches on the date when the node was created.
@author:…	Text	Matches on the author property of a node.
@lastModified:…	Date	Matches on the last modified date of a node.
@lastModifiedBy:…	Text	Matches on the last modified by property of a node.
@version:…	Text	Matches on the version property of a node.
@comment:…	Text	Matches on the comment property of a node.

SYNTAX	TYPE	DESCRIPTION
@lastComputationTime:…	Numeric	Matches on the last computation time of a **Study** node in seconds.
@spaceDimension:…	Numeric	Matches on the spatial dimension of a **Component** or **Geometry** node.
@axisymmetric:…	Boolean	Matches on the axisymmetric property of a **Component** or **Geometry** node.

TABLE 3-2: FIELD EXPRESSIONS FOR NODE FIELDS.

SYNTAX	TYPE	DESCRIPTION
@name:…	Keyword	Matches on the identifier name of a setting.
@description:…	Text	Matches on the description of a setting.
@value:…	Keyword	Matches on the value of a setting.
@apiValue:…	Keyword	Matches on the value of a setting as represented in the COMSOL API.
@scalarReal:…	Numeric	Matches on the real part of a scalar setting value.
@scalarImag:…	Numeric	Matches on the imaginary part of a scalar setting value.

TABLE 3-3: FIELD EXPRESSIONS FOR SETTING FIELDS..

SYNTAX	API CLASS	DESCRIPTION
@model{…}	Model	Matches on the root node of a model.
@parameters{…}	ModelParamGroup	Matches on a **Parameters** node.
@component{…}	ModelNode	Matches on a **Component** node.
@study{…}	Study	Matches on a **Study** node.
@results{…}	Results	Matches on the **Results** node.
@physics{…}	Physics	Matches on a **Physics** node.
@geometry{…}	GeomSequence	Matches on a **Geometry** node.
@material{…}	Material	Matches on a **Material** node.
@mesh{…}	MeshSequence	Matches on a **Mesh** node.
@studyStep{…}	StudyFeature	Matches on a **Study Step** node.
@nodeGroup{…}	NodeGroup	Matches on a **Node Group**.
@node{…}	N/A	Matches on an arbitrary node.
@setting{…}	N/A	Matches on a node setting.

TABLE 3-4: NODE AND SETTING EXPRESSIONS.

SYNTAX	DESCRIPTION
*	A wildcard in a search word.
AND	Combines two field values or field expressions with a boolean AND.
OR	Combines two field values or field expressions with a boolean OR.
NOT	Negates a field value or field expression.
ANY	An alias for a field value containing a single wildcard.
(…)	Enclosing field values or field expressions.
{…}	Enclosing expressions inside a node or setting filter.
[… TO …]	A field range value.
"…"	Quotation marks enclosing a sequence of search words as a phrase.

TABLE 3-5: SYMBOLS IN THE MODEL MANAGER SEARCH SYNTAX.

4

Advanced Version Control

In this chapter, you will learn how you can experiment with a collection of models and auxiliary data files in a Model Manager database by creating an alternative, perhaps private, commit history. If your experiments are successful, you can then incorporate the updated models and files as new versions in the main commit history. You will also learn how to undo changes in your commit history.

In this chapter:

- Branching
- Merging
- Reverting

Branching

In this section you will see how you can create an alternative commit history in a repository by creating a new branch from an existing branch, also known as *branching off* from the existing branch. You may, for example, find branching useful when:

- You and your team of coworkers save your ongoing work on models and auxiliary data files on a branch private to the team, and then publish the finished work on a branch shared with your organization. Perhaps there are multiple teams publishing to this latter branch.
- You start a project involving one or more models and auxiliary data files already present in the database, but you are uncertain what the end result is going to be. Perhaps the modifications you plan to make will result in new versions of the existing models, or perhaps you want to create entirely new models. Perhaps you decide to discard the modifications altogether. By branching, you can postpone these decisions until the project is finished.
- You want to experiment with a single model in a way that is hidden from other users. You therefore forgo the more lightweight, and recommended, way of Saving Drafts of Models — opting to create a branch that uses a **Private** permission template,

Prefer Repositories over Branches if you want to create independent silos of models and auxiliary data files.

In this section:

- The Branch as a Sequence of Commits
- Creating a New Branch

The Branch as a Sequence of Commits

An initial branch is automatically created when you add a new repository in a database. This is especially true for the initial repository automatically added when you create a new database. Any set of changes to items — that is, model, files, and tags — are saved in commits on this branch. See Basic Version Control for more details.

You may think of a branch as a sequence, or history, of such commits. Each commit identifies a collection of versions that were the most recently saved, or latest, at the time of the commit. Any particular version could have been saved in that particular commit, or in a previous commit. Each commit also identifies the tag assignments to items at the time of the commit. By comparing the collections of item versions, as well as the assigned tags of items, present in two different commits, Model Manager can infer all item changes done in-between the first commit and the second commit. See Figure 2-2 for a schematic representation of a branch containing three commits.

Use The Select Location Dialog Box, or click branch nodes ( ) in the The Databases Tree, to switch between branches in The Model Manager Workspace Windows.

Creating a New Branch

You can select any commit on a branch to create a new branch from that *source commit*. This starts a new sequence of commits that runs in parallel with the first sequence. When the branch is created, the collections of versions and assigned tags will be identical in the source commit and on the new branch. But as soon as you start saving new versions and reassigning tags, the branches will diverge. See Figure 4-1, which is a continuation of Figure 2-2, for a schematic representation.

The Branch as a Sequence of Commits

- Prefer saving a draft over creating a new branch if all you want to do is experiment with a model, without necessarily affecting its version history. See Saving Drafts of Models.
- Prefer using **Save as New** ( ) if you want to create a copy of a model. Changes to the copy can later be merged to the original model via the **Comparison Result** window. See Saving Models to Databases and Comparing a Version With the Opened Model in the COMSOL Desktop.

A good mental picture is to think of a tree in which the initial branch is the trunk of the tree, with an initial commit saved at the base of the trunk (at the ground), and successive commits stacked on top of each other. Other branches created off the main branch correspond to tree branches shooting out from the trunk. A repository can be thought of as the tree itself.

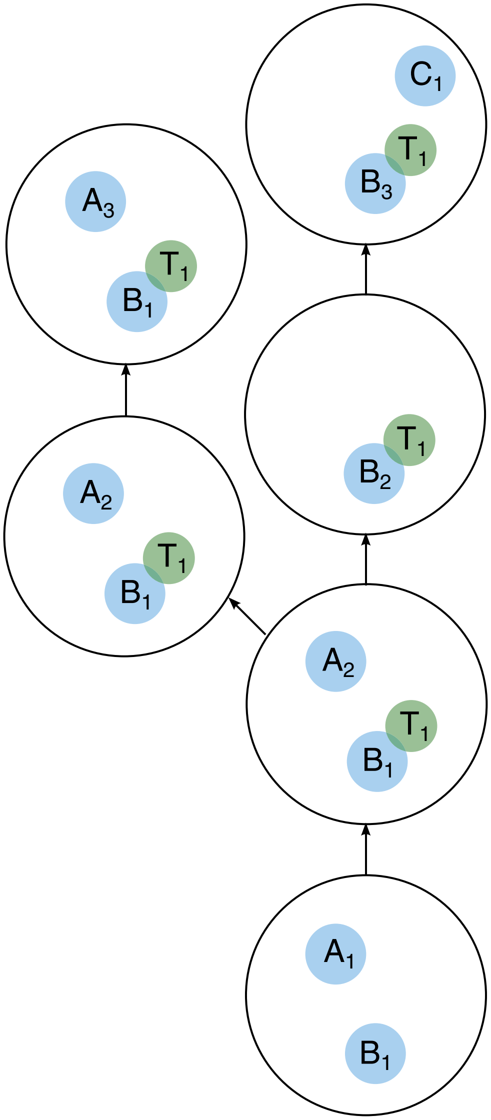


Figure 4-1: A schematic representation of a repository containing two branches. A second branch has been created off the main branch's second commit. In the third commit on the main branch, the model A was deleted. On the new branch's second commit, a new version of model A was instead saved. Browsing the latest versions on the main branch will return model versions B_3 and C_1. Browsing on the new branch will return A_3 and B_1.

To create a branch from a particular source commit, do one of the following:

- Select a branch node ( ) in the The Databases Tree and click the **Branch** button ( ) in the **Repository** section of the **Database** toolbar. The source commit is the latest commit on the branch.
- Select a snapshot node ( ) in the The Databases Tree and click the **Branch** button ( ) in the **Repository** section of the **Database** toolbar. The source commit is the commit that the snapshot references.
- Select a commit table row in the The Commits Window and click the **Branch** button ( ) in the window's toolbar.

In all cases, The Create Branch Dialog Box is opened.

> Creating a new branch is a fairly cheap operation in a Model Manager database in terms of actual data storage. No data is copied except for the small amount of metadata necessary for determining which items are initially present on the branch. There is, however, a cost in terms of disk space usage if a search index is created for the branch — see also Searching in Branches.

PARTIAL BRANCHES

You can create a *partial branch* that contains a subset of all items that were present in the source commit. Select models and files in The Databases Tree or The Model Manager Window to include those items in the new branch. Select tags to include all items that are tagged by the selected tag. All tag assignments present in the source commit will be mirrored on the new branch as well.

THE CREATE BRANCH DIALOG BOX

You create the new branch from the **Create Branch** dialog box. The **Database** field shows the database in which the branch is created, and the **Repository** field shows the repository that the source commit and new branch both belong to.

1. Write the name of the new branch in the **Name** field.
2. Write an optional comment for the initial commit that will be made for the new branch in the **Comments** field.
3. Select **Item fields and content** in the **Search** list for complete search and filter support on the new branch; otherwise, select **Only text and tags** — see also Searching in Branches.

4 In the **Selection** list:

- Select **All** to include all items from the source commit.
- Select **Current selection** to only include the items whose versions were selected when the dialog box was opened. The selected item versions are displayed in a table under the **Selection** field. Select a table row and click the **Exclude** button (⊘) to exclude the item from the new branch.
- Select **Empty** to create a branch that does not include any initial items at all.

5 You can set up permissions for the new branch in the **Permissions** field. This field is only shown if connected to a server database via a Model Manager server. See Granting Permissions.

6 Click **OK** to create the new branch in the database.

The created branch appears as a new child node to the **Branches** node in The Databases Tree.

An empty branch is, for example, useful if you only intend to create new models on the branch. You can later merge these models to the source branch.

An initial commit is always made on a new branch. If you open The Commit Details Dialog Box for this commit you will see that the **Changes** table is, however, empty — no new versions or tag assignments are saved in the database in that initial commit.

Merging

After you have created a new branch and made changes to items on that branch, you will eventually want to transfer these changes back to its parent branch. In this section, you will learn how you can *merge* such changes to a branch.

- Merging Changes to a Target Branch
- The Merge Window

Merging Changes to a Target Branch

You merge item changes to a *target branch* by first selecting a source commit on a *source branch*. Changes made on the source branch up to and including the source commit will be made available for merging into the target branch. The merge itself will create a new commit on the target branch that includes all item changes you decided to merge.

> To make two branches “equal” to each other in terms of their latest item versions, you first need to merge all changes from the latest commit on the first branch to the second branch, and then repeat this in the opposite direction.

To merge from a particular source commit, do one of the following:

- Select a branch node ( ) in the The Databases Tree and click the **Merge** button ( ) in the **Repository** section of the **Database** toolbar. The source commit is the latest commit on the branch.
- Select a snapshot node ( ) in the The Databases Tree and click the **Merge** button ( ) in the **Repository** section of the **Database** toolbar. The source commit is the commit that the snapshot references.
- Select a commit table row in the The Commits Window and click the **Merge** button ( ) in the window’s toolbar.

In all cases, The Merge Window is opened with a suggested target branch.

The Merge Window

You use the **Merge** window to select and merge item changes made on a source branch, up to a particular source commit, to a target branch.

Merging Changes to a Target Branch

The **Source** field shows the location corresponding to the source commit for which the window was opened. Click the link button to select a new branch or snapshot as source in The Select Location Dialog Box. The **Target** field shows the location corresponding to the target branch for the merge. Click the link button to select another branch.

The window contains a table with item changes made on the source branch that are not present in the target branch. The table columns are:

- The type column — the type of the changed item represented by an icon.
- The **Source Change** column — a description of the item change.
- The **Conflicting Target Changes** column — one or more changes on the target branch that are incompatible, or *in conflict*, with the source change.
- The **Selection** column — an icon representing whether to include the source change ( ), ignore the source change ( ), or if there is a conflict (⚠).

Click the **Merge Changes** button ( ) to open The Merge Dialog Box after you have decided which changes to merge and resolved any merge conflicts.

Resolving Merge Conflicts

THE MERGE WINDOW TOOLBAR

The toolbar in the **Merge** window contains the following toolbar buttons:

- Click the **Refresh** button (↻) to refresh the table in case any new commits have been saved on the target branch.
- Click the **Take Source** button ( ) to include a source change in the merge. This is the default choice.

- Click the **Keep Target** button ( ) to ignore a source change, keeping the target as is.
- Click the **Merge Changes** button ( ) to open the The Merge Dialog Box.

RESOLVING MERGE CONFLICTS

When you work with a collection of items with versions on multiple branches, you will inevitably encounter conflicting changes when merging from a source branch to a target branch. Such merge conflicts can arise, for example, when:

- Versions of the same item have been saved on both branches.
- An item has been saved on one branch but has been deleted on the other branch.
- An item has been assigned a tag on one branch, but that tag has been deleted on the other branch.

Merge conflicts are indicated in the **Selection** icon column by (⚠). Select the table row and click the **Take Source** button ( ) to overwrite all conflicting changes on the target branch with the corresponding source change. Click the **Keep Target** button ( ) to keep the target unchanged by skipping the source change.

Merging Conflicting Model Updates

The all or nothing choice for including a source change may be too coarse when a model has been updated on both branches. The model version on the source branch and the model version on the target branch can contain independent updates to the model tree, and it would then makes sense to incorporate both updates in a *merged model version* on the target branch. You can proceed as follows:

1 Open the model version on the target branch in the COMSOL Desktop.

2 Select the model version on the source branch in The Model Manager Window and click the **Compare** button (⚖) in the **Item** section of the **Home** toolbar.

   The **Comparison Result** window is opened with a comparison between the model in the COMSOL Desktop — that is, the target model version — and the selected source model version.

3 Merge the changes you want to keep from the source model version into the opened model using the merge functionality in the **Comparison Result** window.

4 From the **File** menu, select **Save as Version** ( ).

5 Save a new version of the model to the target branch from the **Save** window. This becomes the merged model version.

6 Click the **Refresh** button (↻) in the **Merge** window's toolbar to recompute source and target branch changes.

7 If there is still a conflict between the source branch and target branch for the model update, which is expected, select the row and click the **Keep Target** button ( ) to keep the merged model version on the target.

If there is more than one update conflict between a model version on the source branch and the target branch, repeat these steps for each one. Once finished, finish the merge by clicking **Merge Changes** ( ).

THE MERGE DIALOG BOX

The **Merge** dialog box gives you a final chance to either go through with the merge or cancel it (except for any manually merged model versions already saved on the target branch — see Merging Conflicting Model Updates). The **Source location** field shows the location of the source commit, and the **Target location** field shows the target branch. You can write an optional comment in the **Comments** field for the commit created by the merge.

The table shows all changes that will be applied to the target branch by the merge commit. These changes may differ from the original source changes shown in the **Merge** window depending on which changes were included, which were skipped, and potential merge conflict resolutions.

Click **OK** to merge the changes in the database.

!	Once a source commit has been merged into a target branch, any changes on the source branch that were skipped will not show up in the **Merge** window the next time you open the window for a newer source commit. To include such older source changes, manually perform them on the target branch.

💡	You may find the number of source changes in the **Merge** window overwhelming if there has been many commits on the source branch. One solution is to first merge from an older commit on the source branch, and then progressively work yourself up to the latest commit. One drawback is that this requires more than one merge commit on the target branch, which may unnecessarily pollute the commit history on that branch.

Reverting

In this section, you will learn how to undo some or all of the changes saved in a commit. This is valuable, for example, when you want restore a previously deleted model or file, revert to the version of an item that existed before a commit, or even revert a merge.

- Reverting Changes on a Branch
- The Revert Window

Reverting Changes on a Branch

When you revert a commit on a branch, Model Manager takes the set of changes done in the commit and computes the corresponding reverse changes. These changes are then saved as a new commit on the branch. A created item will be deleted, a deleted item will be recreated, and an updated item will be replaced by its previous version. A tag added to an item will be removed, and a tag removed from an item will be added.

There is a subtle difference between restoring a version — see Restore Version — and reverting a commit in which a version was saved. When selecting and restoring a version, you save *that* version as the new latest version. When selecting and reverting a commit, you save the version that *preceded* the commit's version as the new latest version.

Select a commit table row in The Commits Window and click the **Revert** button ( ) in the toolbar to open The Revert Window for the selected commit.

The Revert Window

You use the **Revert** window to select and apply changes to a branch such that they revert changes made in a commit.

Reverting Changes on a Branch

The window contains a table with the reverting item changes. The table columns are:

- The type column — the type of the item to change represented by an icon.
- The **Change to Apply** column — a description of the reverting item change.
- The **Conflicting Latest Changes** column — one or more later changes on the branch that are incompatible, or *in conflict*, with a reverting change.
- The **Selection** column — an icon representing whether to apply the reverting change (→), ignore the change (←), or if there is a conflict (⚠).

Click the **Apply Revert** button ( ) to open The Apply Revert Dialog Box after you have decided which changes to apply and resolved any revert conflicts.

Resolving Revert Conflicts

THE REVERT WINDOW TOOLBAR

The toolbar in the **Revert** window contains the following toolbar buttons:

- Click the **Refresh** button (↻) to refresh the table in case any new commits have been saved on the branch.
- Click the **Take Change to Apply** button (→) to apply a reverting change to the branch.
- Click the **Keep Latest Change** button (←) to skip a reverting change, keeping the latest change as is.
- Click the **Apply Revert** button ( ) to open the The Apply Revert Dialog Box.

RESOLVING REVERT CONFLICTS

When you revert a commit on a branch, you may discover that the reverse changes are in conflict with the current item versions on the branch. Such revert conflicts can arise, for example, when:

- Reverting a commit in which an item version was saved, but a newer version of the item exists on the branch.
- Reverting a commit in which an item version was saved, but the item has been deleted on the branch in a newer commit.
- Reverting a commit in which an item was assigned a tag, but the tag has itself been deleted on the branch in a newer commit.

Revert conflicts are indicated in the **Selection** icon column by (⚠). Select the table row and click the **Take Change to Apply** button (→) to overwrite all conflicting latest changes on the branch with the corresponding reverting change. Click the **Keep Latest Change** button (←) to keep the target unchanged by skipping the reverting change.

Resolving Conflicting Model Versions

Unlike merging from a source branch to a target branch, you may see less need to manually merge the model trees of conflicting model versions when reverting a commit on a branch — see Merging Conflicting Model Updates. Nevertheless, you can proceed as follows:

1 Open the older model version you want to revert to in the COMSOL Desktop.

2 Select the latest model version on the branch in The Model Manager Window and click the **Compare** button (⚖) in the toolbar.

   The **Comparison Result** window is opened with a comparison between the model in the COMSOL Desktop — that is, the older model version to revert to — and the latest model version.

3 Merge the changes you want to keep from the latest model version into the opened model using the merge functionality in the **Comparison Result** window.

4 From the **File** menu, select **Save as Version** ().

5 Save a new version of the model to the branch from the **Save** window — this becomes the reverted model version. There will inevitably be Save Conflicts with the latest model version. Choose to ignore them.

6 Click the **Refresh** button (↻) in the **Revert** window's toolbar to recompute changes.

7 If there is still a conflict between the version being reverted to and the latest version for the model, which is expected, select the row and click the **Keep Latest Change** button (←) to keep the latest model version.

If there is more than one conflict between an older model version being reverted to and a latest model version, repeat these steps for each one. Once finished, finish the revert by clicking **Apply Revert** ().

THE APPLY REVERT DIALOG BOX

The **Apply Revert** dialog box gives you a final chance to either go through with the revert or cancel it (except for any manually reverted model versions already saved on the target branch — see Resolving Conflicting Model Versions). The **Location** field shows the branch on which the revert is made. You can write an optional comment in the **Comments** field for the commit created by the revert.

The table shows all changes that will be applied to the branch by the revert commit. These changes may differ from the original changes shown in the **Revert** window depending on which changes were included, which were skipped, and potential revert conflict resolutions.

Click **OK** to apply the changes in the database.

5

Working with Models in Databases

This chapter showcases some of the Model Manager tools available in the COMSOL Desktop using a streamlined version of the tutorial *Example 1: Structural Analysis of a Wrench* found in *Introduction to COMSOL Multiphysics*. You are encouraged to first work through that tutorial if you are new to the COMSOL Multiphysics software.

Example: Modeling Using Version Control

This section introduces some of the Model Manager tools you will typically encounter when working with models and auxiliary data files saved in databases. The section uses the example of modeling the structural integrity of a wrench, which you may already be familiar with from *Example 1: Structural Analysis of a Wrench* in *Introduction to COMSOL Multiphysics*.

- Creating the Database
- Model Wizard Setup
- Saving a First Version
- Saving More Versions
- Working With a Draft of the Model
- Comparing Versions
- Excluding Built, Computed, and Plotted Data
- Importing Auxiliary Data to the Database
- The Model Manager Workspace

Creating the Database

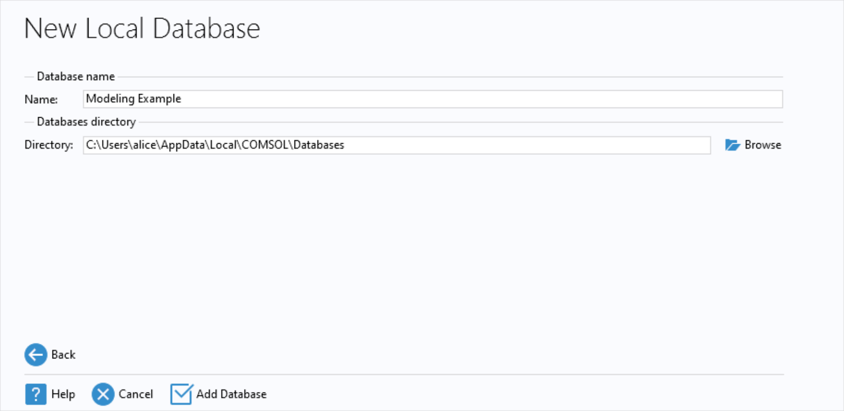
You are strongly recommended to create a new local database when working through the steps of this tutorial.

1 From the **File** menu, select **Open From** ().

2 In the **Open** window, choose **Add Database** ( ) in the list of options.

3 In the **Add Database** window, choose **New Local Database** ( ).

4 In the **New Local Database** window, write `Modeling Example` as the name for the new database in the **Name** field.



New Local Database

Database name

Name: Modeling Example

Databases directory

Directory: C:\Users\alice\AppData\Local\COMSOL\Databases

5 Click **Add Database** (☑).

A progress window is displayed informing you that the database is being creating on the file system. Once finished, the **Open** window is shown with the newly created database selected in the list.

From the **Open** window, you can search the database for models to open. At the moment your database is empty. Click **Cancel** (☒).

Adding Databases

Model Wizard Setup

You will use the **Model Wizard** to quickly get started with a new model for the wrench.

1 From the **File** menu, select **New**. Choose **Model Wizard** in the **New** window.

2 In the **Select Space Dimension** window, choose 3D.

3 In **Select Physics**, select **Structural Mechanics>Solid Mechanics (solid)** ( ). Click **Add**. Click **Study** (➜) to continue.

4 In **Select Study**, click **Stationary** ( ) under **Preset Studies**. Click **Done** (☑).

A new 3D solid mechanics model using a stationary study is initialized in the COMSOL Desktop.

Saving a First Version

Now is a good time to place your new model under *version control* by saving it to your database.

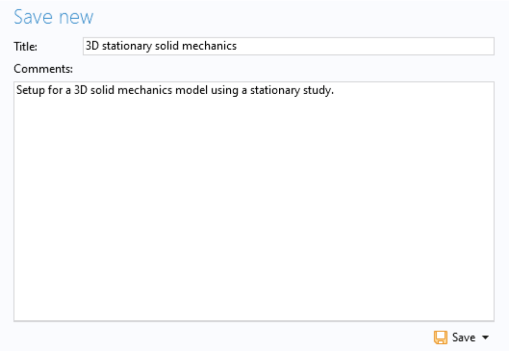
1 From the **File** menu, select **Save To** ( ).

2 In the **Save** window, choose your newly created database, `Modeling Example`, in the list of options.

The **Save** window shows the selected database set as the target for the save. The header reads **Save new** as the model is not yet present in the database.

3 Write `3D stationary solid mechanics` in the empty **Title** field.

4 You can write an optional comment describing what you are saving in the **Comments** field. Write `Setup for a 3D solid mechanics model using a stationary study.`



Save new

Title: 3D stationary solid mechanics

Comments:

Setup for a 3D solid mechanics model using a stationary study.

5 Click the **Save** button ( ).

A first version of the model is now saved in the database.

Saving Models to Databases

Click the root node in the **Model Builder** window. The **Title** field in the **Presentation** section of the **Settings** window has been updated with the title you gave when saving.

Saving More Versions

The model uses a geometry that was previously created and stored in the COMSOL native CAD format `mphbin`.

1 In the **Model Builder** window, right-click **Geometry 1** ( ) and select **Import** ( ).

2 In the **Settings** window for **Import**, from the **Source list**, select **COMSOL Multiphysics file**.

3 Click **Browse** ( ) and locate the file `wrench.mphbin` in the application library folder of the COMSOL installation folder. Its default location in Windows® is

```
C:\Program Files\COMSOL\COMSOL60\Multiphysics\applications\
COMSOL_Multiphysics\Structural_Mechanics\wrench.mphbin
```

Double-click to add, or click **Open**.

4 Click **Import** ( ) to display the geometry in the **Graphics** window.

5 Select **Geometry 1** ( ) and click the **Build All** button ( ) in the **Settings** window.

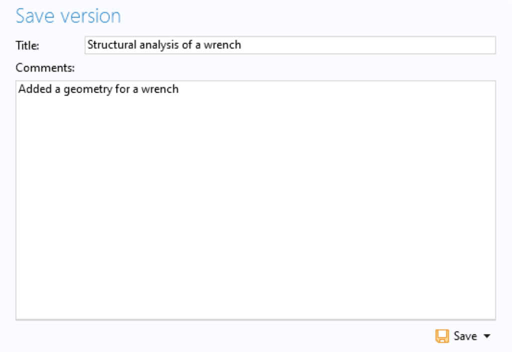
With a geometry added to the model, save a second version:

1 From the **File** menu, select **Save as Version** ( ).

The **Save** window opens with your database preselected in the list of options. The header reads **Save version** as the model already exists in the database. The same title you gave when saving the first version is suggested also for this second version.

2 In the **Title** field, change the title to `Structural analysis of a wrench`.

3 Write `Added a geometry for a wrench` in the **Comments** field.



Save version

Title: Structural analysis of a wrench

Comments:

Added a geometry for a wrench

4 Click the **Save** button ( ).

You now have two versions of the model saved in your database.

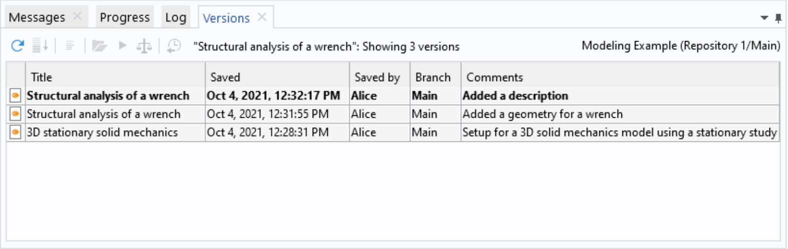
Add a description to your model and save a third version:

1. Click the root node in the Model Builder window.
2. In the **Description** field under the **Presentation** section, write `Analysis of the mechanical stress level in a wrench`.
3. From the **File** menu, select **Save as Version** ( ).
4. Write `Added a description` in the **Comments** field. Click **Save** ( ).

THE VERSIONS WINDOW

You have, up to this point, saved three versions of your model in the database.

From the **Windows** menu ( ) in the **Layout** section of Model Builder's **Home** toolbar, select **Versions** ( ) to open the **Versions** window. You will see your three versions in a table. The top table row is highlighted in bold as it is opened in the COMSOL Desktop.



"Structural analysis of a wrench": Showing 3 versions

Modeling Example (Repository 1/Main)

Title	Saved	Saved by	Branch	Comments
Structural analysis of a wrench	**Oct 4, 2021, 12:32:17 PM**	**Alice**	**Main**	**Added a description**
Structural analysis of a wrench	Oct 4, 2021, 12:31:55 PM	Alice	Main	Added a geometry for a wrench
3D stationary solid mechanics	Oct 4, 2021, 12:28:31 PM	Alice	Main	Setup for a 3D solid mechanics model using a stationary study

You can open an older version from the **Versions** window:

1. Select the bottom row in the table and click the **Open** button ( ) in the toolbar. You can also double-click the row. Select **No** if you are asked to save any unsaved changes.

   The first version is opened in the COMSOL Desktop. There is no **Import** ( ) node under the **Geometry 1** ( ) node, and the **Description** field is empty.
2. Select the middle row in the table and click **Open** ( ).

   The second version is opened in the COMSOL Desktop — the import node is now present under the geometry node, but the **Description** field is still empty.

3 Select the top row in the table and click **Open** ( ).

The third, and latest, version is opened in the COMSOL Desktop.

The Versions Window for the COMSOL Desktop Model

Working With a Draft of the Model

It may have crossed your mind that saving a new model version requires several steps — especially as compared to just pressing Ctrl+S for a model opened from the file system. You need to open the **Save** window, perhaps think of a comment describing your changes (although the comment is not required), and then click the **Save** button ( ). You might even realize after saving multiple versions that your modeling work has gone in the wrong direction. You would then have a *version history* cluttered with unwanted versions.

A more lightweight option when working on a model is to save a *draft* of the model. You can save versions of this draft without affecting the original model. Once you are happy with your draft, you can save it back as a new version of the original model. You may of course choose to discard your draft altogether — instead opening the original model and, perhaps, starting a new draft.

STARTING A DRAFT

You are going to continue the modeling of the wrench using a draft. Make sure that you have opened the latest (top) version in the **Versions** window.

Add a generic steel material for the wrench and save your work as a new draft.

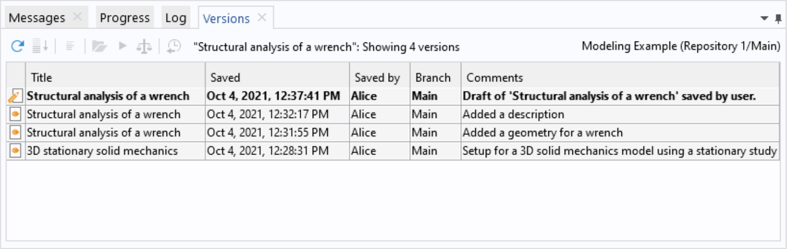
1 Right-click **Component 1>Materials** ( ) and select **Add Material from Library** ( ).

2 In the **Add Material** window, click to expand the **Built-In** folder. Scroll down to find **Structural steel**, right-click, and select **Add to Component 1**.

3 Close the **Add Material** window.

4 From the **File** menu, select **Save Draft** ( ). You can also press the keyboard shortcut Ctrl+S.

You have created a first version of a draft of the model. You can see this *draft version* as a new row in the **Versions** window on top of the three versions of the original model. The draft version uses a separate pen icon ( ) to distinguish it from the *regular versions* ( ). Note that the regular versions belong to the original model, not the draft itself — they are included in the table to make it easier for you to track where the draft originated from.



"Structural analysis of a wrench": Showing 4 versions

Modeling Example (Repository 1/Main)

Title	Saved	Saved by	Branch	Comments
Structural analysis of a wrench	**Oct 4, 2021, 12:37:41 PM**	**Alice**	**Main**	**Draft of 'Structural analysis of a wrench' saved by user.**
Structural analysis of a wrench	Oct 4, 2021, 12:32:17 PM	Alice	Main	Added a description
Structural analysis of a wrench	Oct 4, 2021, 12:31:55 PM	Alice	Main	Added a geometry for a wrench
3D stationary solid mechanics	Oct 4, 2021, 12:28:31 PM	Alice	Main	Setup for a 3D solid mechanics model using a stationary study

Saving Drafts of Models

SAVING ADDITIONAL DRAFT VERSIONS

Specify the load applied to the wrench and save your draft changes.

1 Select **Parameters 1** ( ) in the **Model Builder** window.

2 In the **Settings** window's **Parameters** table, enter these settings:

- In the **Name** column, enter `F`.
- In the **Expression** column, enter `150[N]`.
- In the **Description** column, enter `Applied Force`.

3 From the **File** menu, select **Save Draft** ( ).

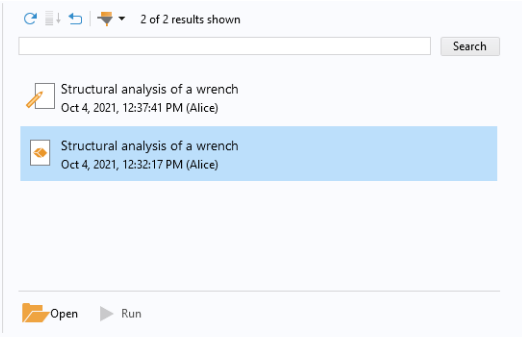
Selecting **Save Draft** a second time creates a second version of your draft — the **Versions** window now shows two draft versions and three regular versions. As for the regular versions of the original model, you can inspect an older draft version by selecting the row in the table and clicking **Open** ( ).

A draft is a model in its own right in the database — existing side by side with the original model. You can switch back and forth between them in the COMSOL Desktop simply by opening one or the other. To demonstrate this:

1 From the **File** menu, select **Open From** ( ).

2 In the **Open** window, choose your database, `Modeling Example`, in the list of options.

The **Open** window shows the latest version of the draft ( ) and the latest version of the original model ( ) in a search result.



2 of 2 results shown

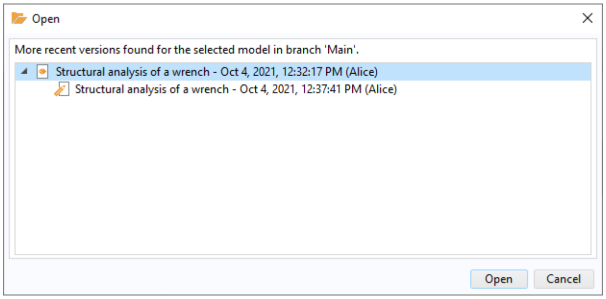
Search

Structural analysis of a wrench
Oct 4, 2021, 12:37:41 PM (Alice)

Structural analysis of a wrench
Oct 4, 2021, 12:32:17 PM (Alice)

3 Select the version of the original model ( ) and click the **Open** button ( ).

Model Manager detects that there is an ongoing draft of the original model with a draft version newer than the latest version of the model. A dialog box is shown in which you can choose to open that draft version instead.



Open

More recent versions found for the selected model in branch 'Main'.

Structural analysis of a wrench - Oct 4, 2021, 12:32:17 PM (Alice)
  Structural analysis of a wrench - Oct 4, 2021, 12:37:41 PM (Alice)

4 Select the top node in the tree in the dialog box and click **Open** to open the original model. The latest version of the model is opened in the COMSOL Desktop — neither the **Structural steel** node nor the **Parameters** setting is present in the model tree, as expected.

Opening Models from Databases

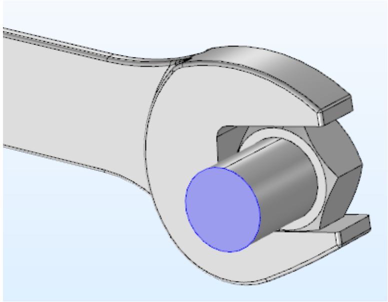
You could at this point continue working with the original model, thereby implicitly discarding your draft work. The draft itself can be manually deleted from the database at some later time.

Choosing instead to continue with your draft, open its latest version again:

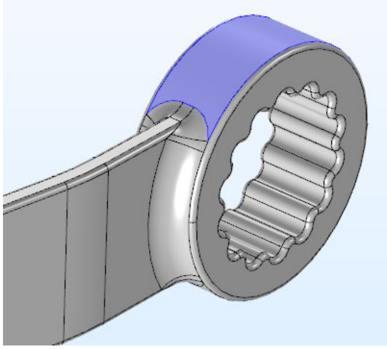
1 From the **File** menu, select **Open From** ().
2 In the **Open** window, choose your database in the list of options.
3 Select the draft version () and click **Open** ().

Finish the component setup by defining boundary conditions and mesh settings:

1 Right-click **Solid Mechanics (solid)** () and select **Fixed Constraints** ().
2 In the **Graphics** window, rotate the geometry and select the front surface of the partially modeled bolt. The **Boundary** number in the **Selection** list is **35**.



3 Right-click **Solid Mechanics (solid)** () once more and select **Boundary Load** ().
4 Select the top socket face (boundary 111) in the **Graphics** window.

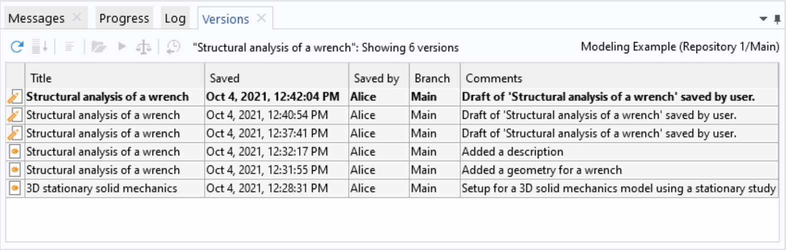


5 In the **Settings** window for **Boundary Load**, under **Force**, select **Total force** as the **Load type** and enter `-F` in the text field for the **z** component.

6 Select **Mesh 1** ( ). In the **Settings** window for **Mesh**, under **Physics-Controlled Mesh**, select **Finer** from the **Element size** list.

7 Click the **Build All** ( ) button in the **Settings** window.

With the basic setup finished, select **Save Draft** ( ) to save a third draft version.



"Structural analysis of a wrench": Showing 6 versions

Modeling Example (Repository 1/Main)

Title	Saved	Saved by	Branch	Comments
Structural analysis of a wrench	**Oct 4, 2021, 12:42:04 PM**	**Alice**	**Main**	**Draft of 'Structural analysis of a wrench' saved by user.**
Structural analysis of a wrench	Oct 4, 2021, 12:40:54 PM	Alice	Main	Draft of 'Structural analysis of a wrench' saved by user.
Structural analysis of a wrench	Oct 4, 2021, 12:37:41 PM	Alice	Main	Draft of 'Structural analysis of a wrench' saved by user.
Structural analysis of a wrench	Oct 4, 2021, 12:32:17 PM	Alice	Main	Added a description
Structural analysis of a wrench	Oct 4, 2021, 12:31:55 PM	Alice	Main	Added a geometry for a wrench
3D stationary solid mechanics	Oct 4, 2021, 12:28:31 PM	Alice	Main	Setup for a 3D solid mechanics model using a stationary study

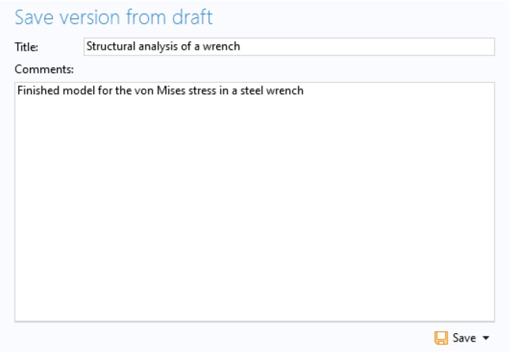
FINISHING YOUR DRAFT

With the component setup finished, it is time to save your draft work back to the original model:

1 From the **File** menu, select **Save as Version** ( ).

The **Save** window opens with your database preselected in the list. The header reads **Save version from draft** as a new version of the original model will be saved from the draft.

2 Write `Finished model for the von Mises stress in a steel wrench` in the **Comments** field.


Save version from draft

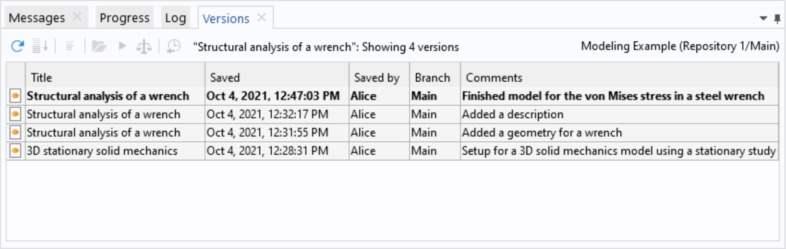
Title: Structural analysis of a wrench

Comments:

Finished model for the von Mises stress in a steel wrench

3 Click the **Save** button ( ).

Open the **Versions** window to see that all draft versions are now gone and replaced by your new, fourth, version of the original model.



Messages Progress Log Versions

"Structural analysis of a wrench": Showing 4 versions

Modeling Example (Repository 1/Main)

Title	Saved	Saved by	Branch	Comments
Structural analysis of a wrench	**Oct 4, 2021, 12:47:03 PM**	**Alice**	**Main**	**Finished model for the von Mises stress in a steel wrench**
Structural analysis of a wrench	Oct 4, 2021, 12:32:17 PM	Alice	Main	Added a description
Structural analysis of a wrench	Oct 4, 2021, 12:31:55 PM	Alice	Main	Added a geometry for a wrench
3D stationary solid mechanics	Oct 4, 2021, 12:28:31 PM	Alice	Main	Setup for a 3D solid mechanics model using a stationary study

The draft is automatically deleted when you save it back to the original model. This deletion is not permanent though — see Deleting Items and references therein to learn how you may recover your draft versions.

Comparing Versions

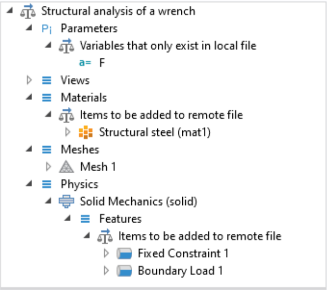
You can see all changes made to the model when you saved it from your draft.

1 Right-click the second row from the top in the **Versions** window and select **Compare** (⚖).

The **Comparison Result** window is opened with a comparison between the current model in the COMSOL Desktop and the selected version.

2 In the **Comparison Result** window, click the **Expand All** button (≡↓) in the toolbar.

3 The expanded tree shows, for example, the force parameter, the steel material, the mesh settings, and the two boundary conditions, added from your draft.



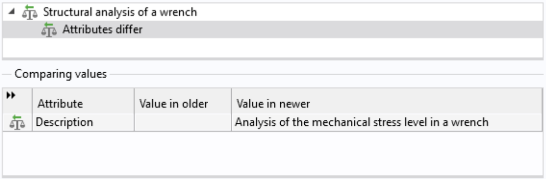
```
Structural analysis of a wrench
  Parameters
    Variables that only exist in local file
      F
  Views
  Materials
    Items to be added to remote file
      Structural steel (mat1)
  Meshes
    Mesh 1
  Physics
    Solid Mechanics (solid)
      Features
        Items to be added to remote file
          Fixed Constraint 1
          Boundary Load 1
```

You can also compare two versions with each other:

1. Select the second and third rows in the **Versions** window, right-click either one, and select **Compare** ().

   The **Comparison Result** window is updated with a comparison between these two versions.

2. Expand the tree and select the **Attributes differ** child node. In the **Comparing values** table you will find the description you added in the third model version.



Structural analysis of a wrench
Attributes differ

Comparing values

Attribute	Value in older	Value in newer
Description		Analysis of the mechanical stress level in a wrench

3. Close the **Comparison Result** window.

Comparing Models Saved in Databases

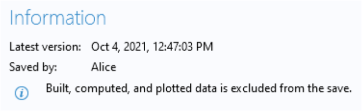
Excluding Built, Computed, and Plotted Data

Right-click **Study 1** () and select **Compute** ( ) to solve the model. When the computation finishes after a few seconds, the von Mises stress is displayed in a default Volume plot in the **Graphics** window.

Storing simulation data generated by a model can require a large amount of disk space usage. For such data that is reproducible, for example *built, computed, and plotted data*, it may be undesirable, or even impossible due to sheer size, to save it in the database.

1. Select the root node in the **Model Builder** window.
2. In the **Settings** window, under **Built, computed, and plotted data** in the **Save** section, select **Exclude** in the **In database** list. You can leave the **On file** list as is.
3. From the **File** menu, select **Save as Version** ().

   The **Save** window opens for your database with the message `Built, computed, and plotted data is excluded from the save` shown under **Information**.



Information

Latest version: Oct 4, 2021, 12:47:03 PM
Saved by: Alice
Built, computed, and plotted data is excluded from the save.

4 Write `Saved without generated simulation data` in the **Comments** field.

5 Click **Save** ( ).

The model remains in its solved state in the COMSOL Desktop after the save. Go to the **File** menu, select **Revert to Saved** ( ), and click **Yes** in the dialog box that appears. The latest saved version is opened. You can reproduce the, by now, lost solution by right-clicking **Study 1** ( ) and selecting **Compute** ( ).

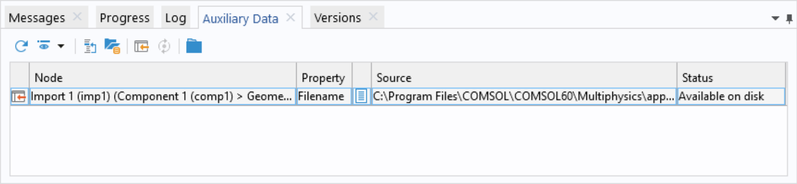
Built, Computed, and Plotted Data

Importing Auxiliary Data to the Database

You may have noticed that, while the model is version controlled in the database, the same is not true for the CAD *input file*. You can import the file to the database as follows:

1 From the **Windows** menu ( ) in the **Layout** section on the **Home** toolbar, select **Auxiliary Data** to open the **Auxiliary Data** window.

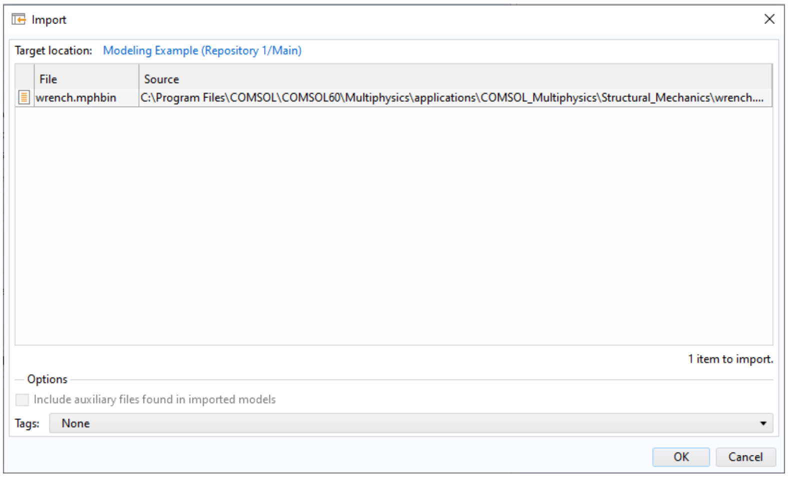
The **Auxiliary Data** window shows a table with input files used by nodes in the model tree. In this case, a single row for the CAD file used by the **Import** ( ) node is shown.



Node	Property	Source	Status
Import 1 (imp1) (Component 1 (comp1) > Geome...	Filename	C:\Program Files\COMSOL\COMSOL60\Multiphysics\app...	Available on disk

2 Select the table row, right-click, and select **Import to Database** ( ).

3 The **Import** dialog box shows the file `wrench.mphbin` in a table.



Import

Target location: Modeling Example (Repository 1/Main)

File	Source
wrench.mphbin	C:\Program Files\COMSOL\COMSOL60\Multiphysics\applications\COMSOL_Multiphysics\Structural_Mechanics\wrench....

1 item to import.

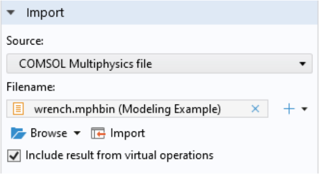
Options

□ Include auxiliary files found in imported models

Tags: None

4 Click **OK** to import the file into the database.

Select the **Import** ( ) node in the **Model Builder** window. The **Filename** field in the **Import** section in the **Settings** window now shows a reference to the file uploaded in the database.



Import

Source:

COMSOL Multiphysics file

Filename:

wrench.mphbin (Modeling Example)

☑ Include result from virtual operations

Finish by saving the model to the database:

1 From the **File** menu, select **Save as Version** ( ).

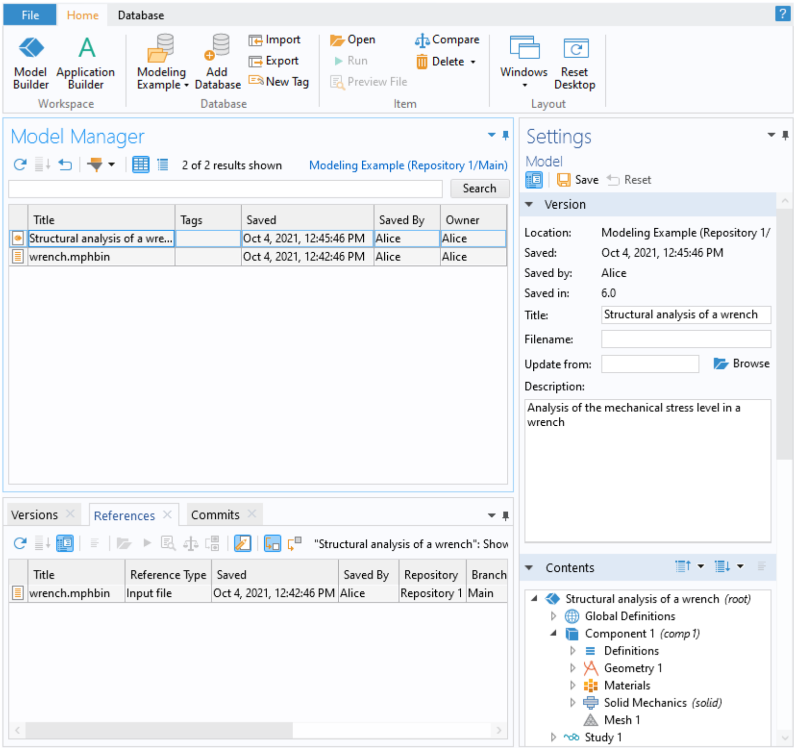
2 Write `Referenced CAD file from database` in the **Comments** field. Click **Save** ( ).

Auxiliary Data From Databases

The Model Manager Workspace

This concludes this short introductory tutorial. You are encouraged to further explore your database in The Model Manager Workspace — a workspace in the COMSOL Desktop dedicated to database-specific tasks.

Click the **Model Manager** (📋) button in the **Workspace** section of the **Home** toolbar in Model Builder to open the Model Manager workspace. The COMSOL Desktop switches to display the toolbar for the Model Manager, as well as opens windows belonging to the workspace. You will find the latest versions of your model and CAD file in The Model Manager Window.



2 of 2 results shown   Modeling Example (Repository 1/Main)

Title	Tags	Saved	Saved By	Owner
Structural analysis of a wre...		Oct 4, 2021, 12:45:46 PM	Alice	Alice
wrench.mphbin		Oct 4, 2021, 12:42:46 PM	Alice	Alice

Location: Modeling Example (Repository 1/
Saved: Oct 4, 2021, 12:45:46 PM
Saved by: Alice
Saved in: 6.0
Title: Structural analysis of a wrench
Filename:
Update from:
Description:
Analysis of the mechanical stress level in a wrench

"Structural analysis of a wrench": Show

Title	Reference Type	Saved	Saved By	Repository	Branch
wrench.mphbin	Input file	Oct 4, 2021, 12:42:46 PM	Alice	Repository 1	Main

- Structural analysis of a wrench *(root)*
  - Global Definitions
  - Component 1 *(comp1)*
    - Definitions
    - Geometry 1
    - Materials
    - Solid Mechanics *(solid)*
    - Mesh 1
  - Study 1

To learn more on what you can do in the workspace, you can, for example:

- Select the model and expand the model tree in the The Contents Section of The Settings Window. You will find that you can browse the content of a model without opening it.

- Search for your model by applying various Item and Content Filters, for example, a Physics filter on a Solid Mechanics interface ( ), or a Parameter filter for the applied force `150[N]`.
- Right-click the model and select **References** ( ) to see the database relationship between the model and the CAD file in The References Window.
- Right-click the CAD file and select **Versions** ( ) to see all versions of the file — currently only one — in The Versions Window.
- Right-click the model and select **Commits** ( ) to open The Commits Window. Double-click the third table row from the top. You will see details on the commit in which a new version of the original model was saved from your draft, and the draft itself was deleted.

6

Glossary

This Glossary of Terms contains terms related to databases and version control as they relate to the Model Manager tools in the COMSOL Multiphysics® software and documentation. For references to further information about a term, see the index.

Glossary of Terms

access-control list A list of granted permissions and their grantees — that is, users and groups — assigned to a database object.

auxiliary data file A version-controlled file stored in a database that is neither a model or application file (`mph`) nor a physics file (`mphphb`). Typically abbreviated as just *file* in Model Manager.

boolean field The type for a field whose value is either `true` or `false`.

branch A sequence of commits in a database, ordered chronologically by their commit date to form a *commit history*. A special commit is the most recent one on the branch, and the branch itself often acts as a representative of this commit. The most recent commit, and thus the branch itself, also identifies the latest versions of items.

New branches can be created by *branching off* from any commit on a *parent branch*, thereby starting an alternative commit history. Changes made on a new branch can be *merged* back to its parent branch.

built, computed, and plotted data Generated simulation data that can be recreated from a model as needed. Includes built geometries and meshes, computed solutions, and plotted results.

commit A set of related item changes that have been saved to a database. The changes may involve adding and updating items, assigning tags to items, and deleting items. The changes are saved to the database as a “unit” and, as such, can also be *reverted* as a unit.

Each commit is associated with a date and time when the changes were saved, that is the *commit date*, the user that saved the changes, and an optional save comment. Each commit also identifies the set of item versions that were the *latest versions* at the time of the commit, as well as all tag assignments present at that time. Given a particular commit, such item versions and tag assignments can be browsed and searched in the database.

content filter A search filter on model content — that is, node properties, parameters, features, and other settings in the model tree of a model.

database configuration The configuration values used to connect to a local database or a server database accessed via a Model Manager server.

date field The type for a field whose value is a date and time.

draft model A transient model meant for intermediate modeling work, and whose versions are saved as a separate version history *split off* from that of its *origin* model. Once a draft has been completed, it can be saved back as a new version of the model it originated from.

everyone A special group of users that all users automatically are members of. Can be used when assigning permissions to database objects.

file A shorthand for an auxiliary data file.

item A model, auxiliary data file, or tag stored in a database.

item filter A search filter on general item settings and metadata. This includes, for example, the time when the item was last modified, the user that last modified the item, and the item's assigned tags.

item type Type distinguishing a model, application, or physics in a database.

group A collection of users and other groups.

keyword field The type for a field whose value is a string. Typically found for short, name-like search data such as filenames or node names.

local database A database stored on the same computer as the COMSOL Multiphysics process runs on. Meant for single-user use.

(commit) location A branch, commit, or snapshot in the database. Each location is either a commit in its own right or acts as a natural representation of a commit — the most recent commit for a branch and the referenced commit for a snapshot.

Browsing or searching items in a database is always done with respect to a fixed location. The encountered item versions are the ones that were the latest at the time of the commit. For a branch, which is the default location, these item versions are the latest at the present time.

merge The operation of applying item changes made in one branch to another branch.

model A COMSOL Multiphysics simulation model, application, or physics stored in a database.

negated match Reverse the matching criterion of a filter.

numeric field The type for a field whose value is a real or complex scalar.

origin model A model that another model "originates" from — a concept arising, for example, when creating a new model from an existing model or when saving a new draft.

owner The user that owns a database object. Such a user can set permission requirements for accessing the object.

permission template A reusable template of permissions granted to users and groups.

phrase match Require that search words match a sequence of words in a text.

regular model The standard type for models saved to a database.

repository A container for a collection of items and their versions in the database.

revert The operation of undoing a set of changes made in a commit.

root administrator A special account with a Model Manager server that always passes permission requirement checks.

save type Type distinguishing a regular model from a draft model.

selection field The type for a field whose value belongs to a predetermined set of values.

server database A database accessed via a Model Manager server. Meant for multiple-user use.

snapshot A reference to a commit in a database. The item versions and tag assignments that were the latest at the time of the commit are *recorded* in the snapshot.

tag Version-controlled metadata that can be assigned to models, auxiliary data files, and even other tags. Useful for finding and organizing items in a database.

text field The type for a field whose value is a text.

user A user that has connected to a Model Manager database.

version The result when creating, updating, or restoring an item in a database.

wildcard match Use a placeholder in a search word that matches zero or more arbitrary characters.

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