Matlab-Simulink

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About the Tutorial

MATLAB (Matrix Laboratory) is a programming language developed by a computer software company MathWorks. Simulink is a simulation and model-based design environment for dynamic and embedded systems, which are integrated with MATLAB. Simulink is also developed by MathWorks. This tutorial is designed to give students fluency in MATLAB Simulink. Problem-based examples have also been given in simple and easy way to make your learning fast and effective.

Audience

This tutorial has been prepared for the beginners to help them understand basic to advanced functionality of MATLAB Simulink. After completing this tutorial you will find yourself at a moderate level of expertise in using Simulink from where you can take yourself to next levels.

Prerequisites

We assume you have a little knowledge of any computer programming and understand concepts like variables, constants, expression, statements, etc. If you have done programming in any other high-level programming language like C, C++ or Java, then it will be very much beneficial and learning MATLAB Simulink will be like a fun for you.

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1. MATLAB Simulink – Introduction

Simulink is a simulation and model-based design environment for dynamic and embedded systems, which are integrated with MATLAB. Simulink was developed by a computer software company MathWorks.

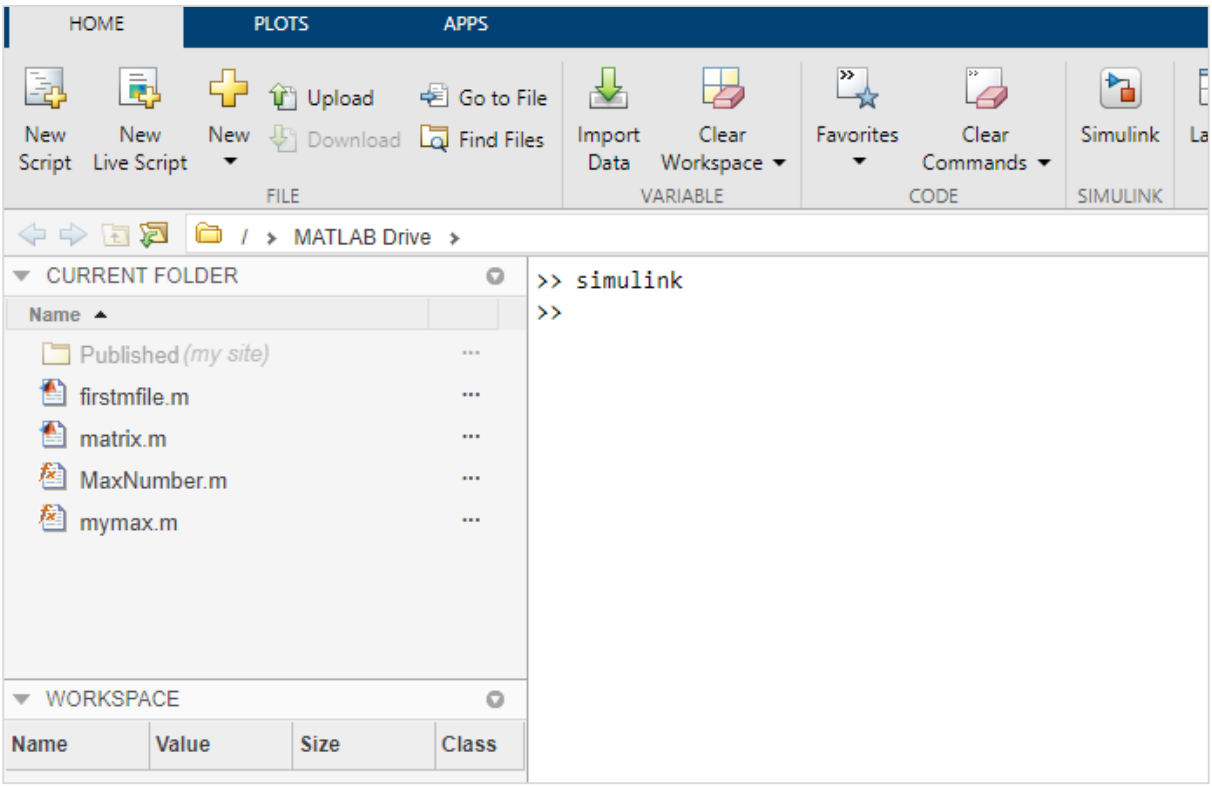
It is a data flow graphical programming language tool for modelling, simulating and analysing multi-domain dynamic systems. It is basically a graphical block diagramming tool with a customisable set of block libraries.

Furthermore, it allows you to incorporate MATLAB algorithms into models as well as export the simulation results into MATLAB for further analysis.

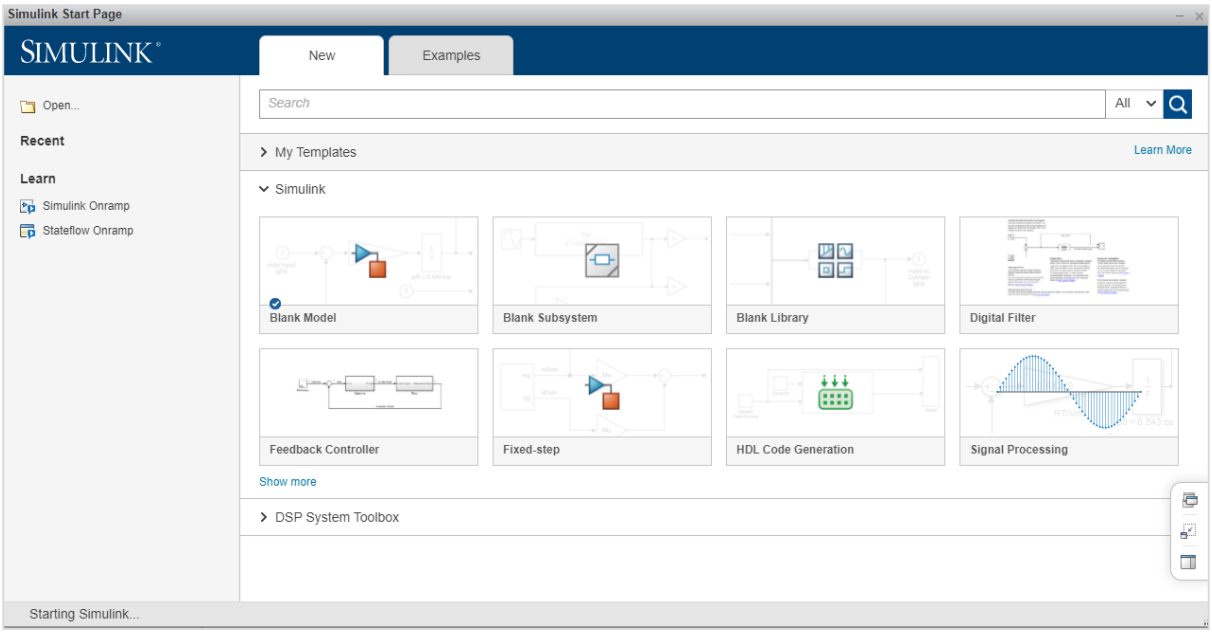
Simulink supports the following:

- System-level design.
- Simulation.
- Automatic code generation.
- Testing and verification of embedded systems.

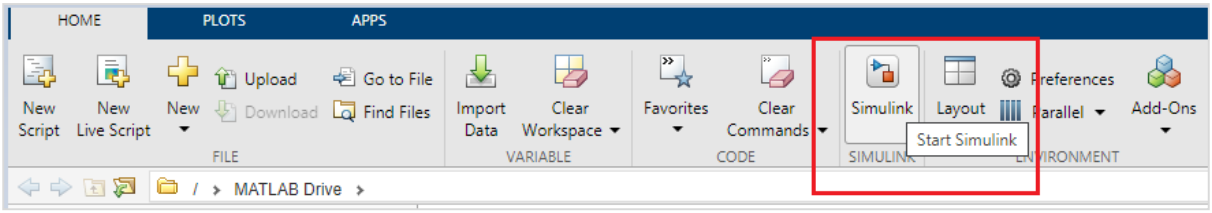
To get started with Simulink, type simulink in the command window as shown below:



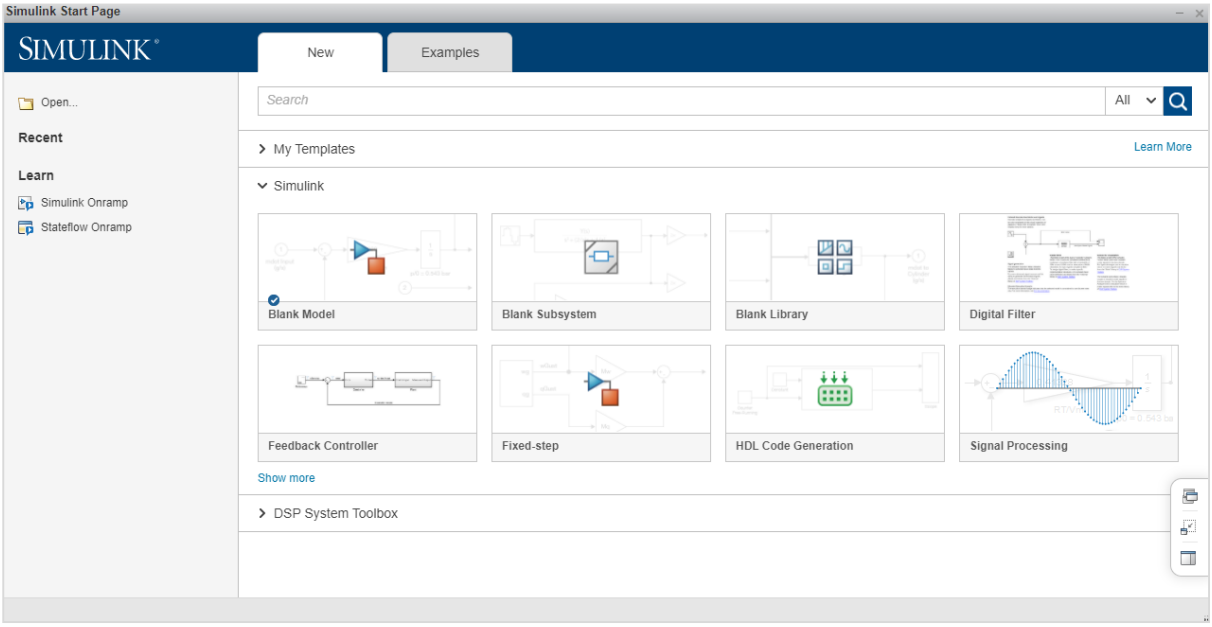
It will open the Simulink page as shown below:



You can also make use of Simulink icon present in MATLAB to get started with Simulink:



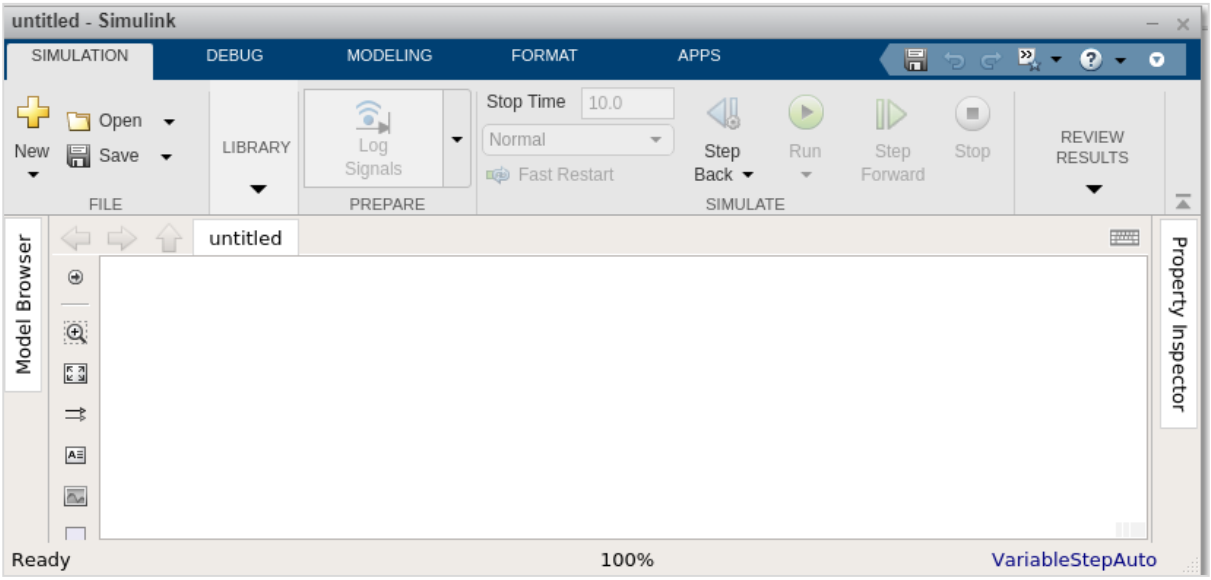
When you start Simulink, you are navigated to the start page as shown below:



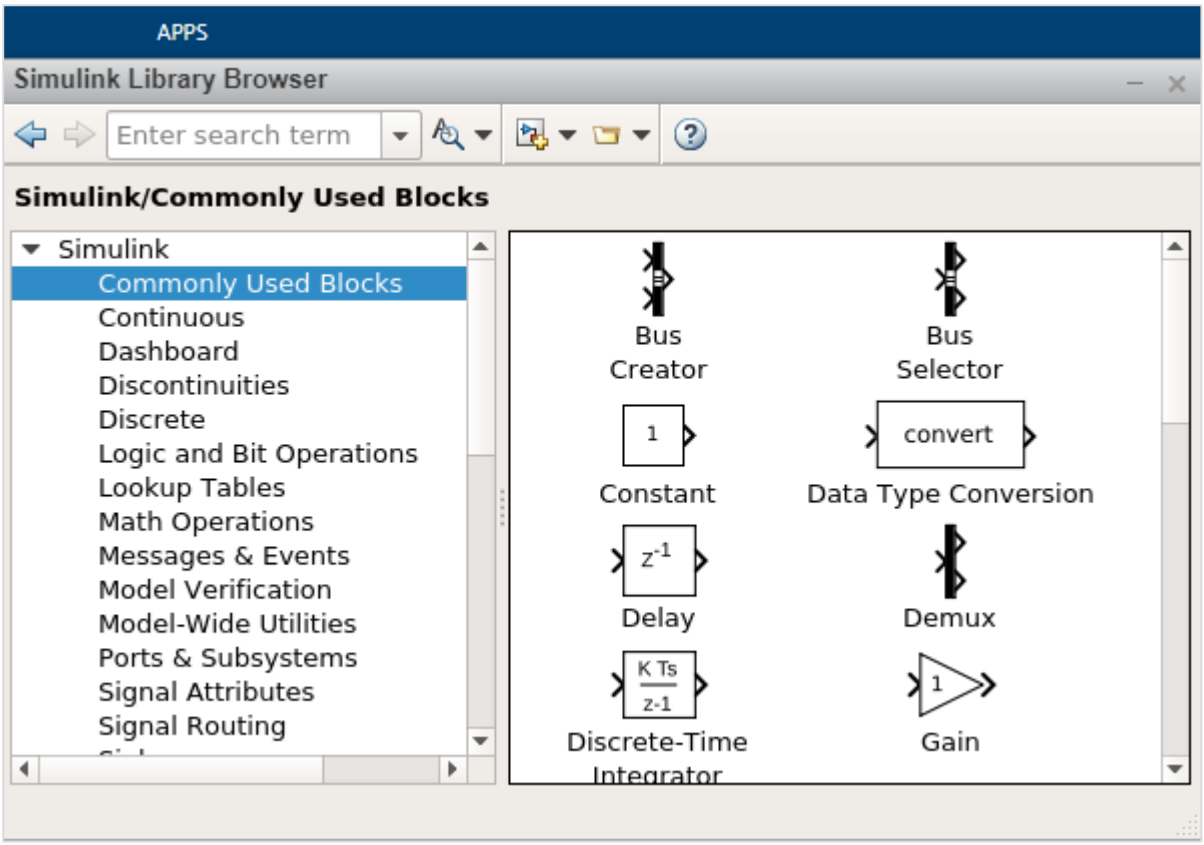
Here you can create your own model, and also make use of the existing templates.

Click on the Blank Model and you will get a Simulink library browser that can be used to create your own model.

The screen for Blank model is as follows:

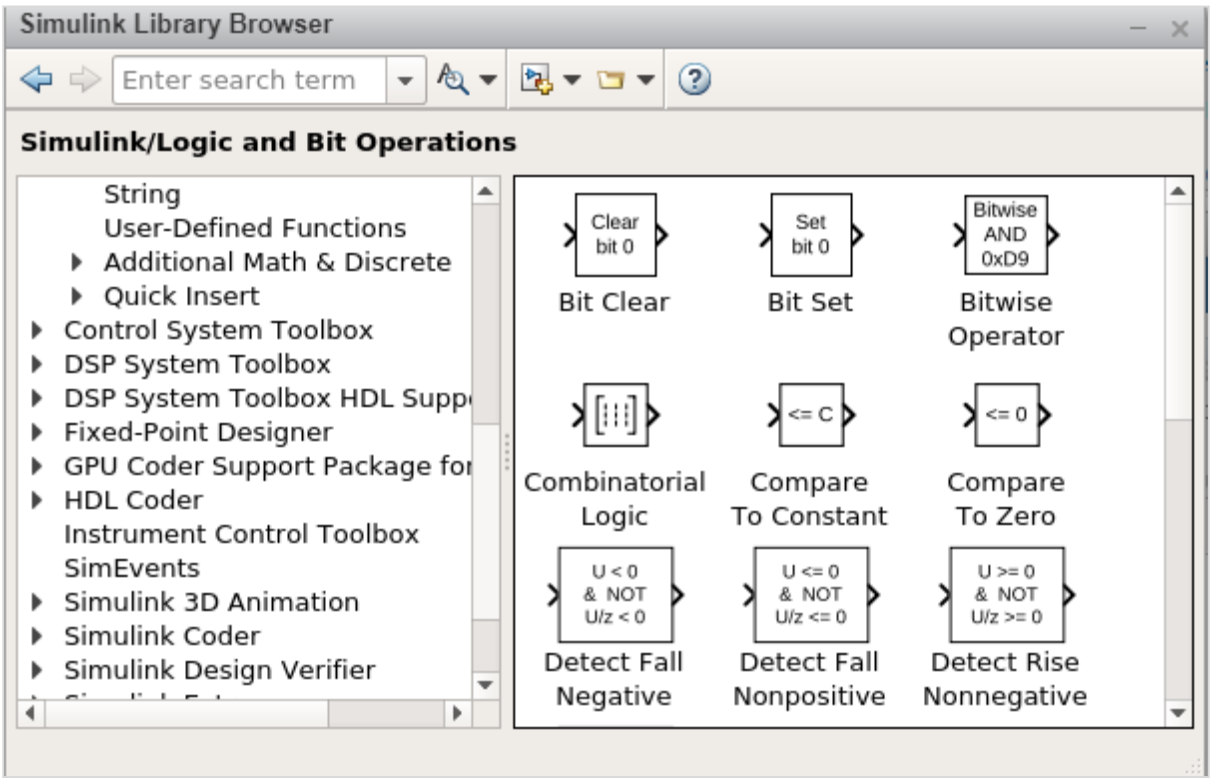


Click on Library and it will display you the Simulink library as shown below:

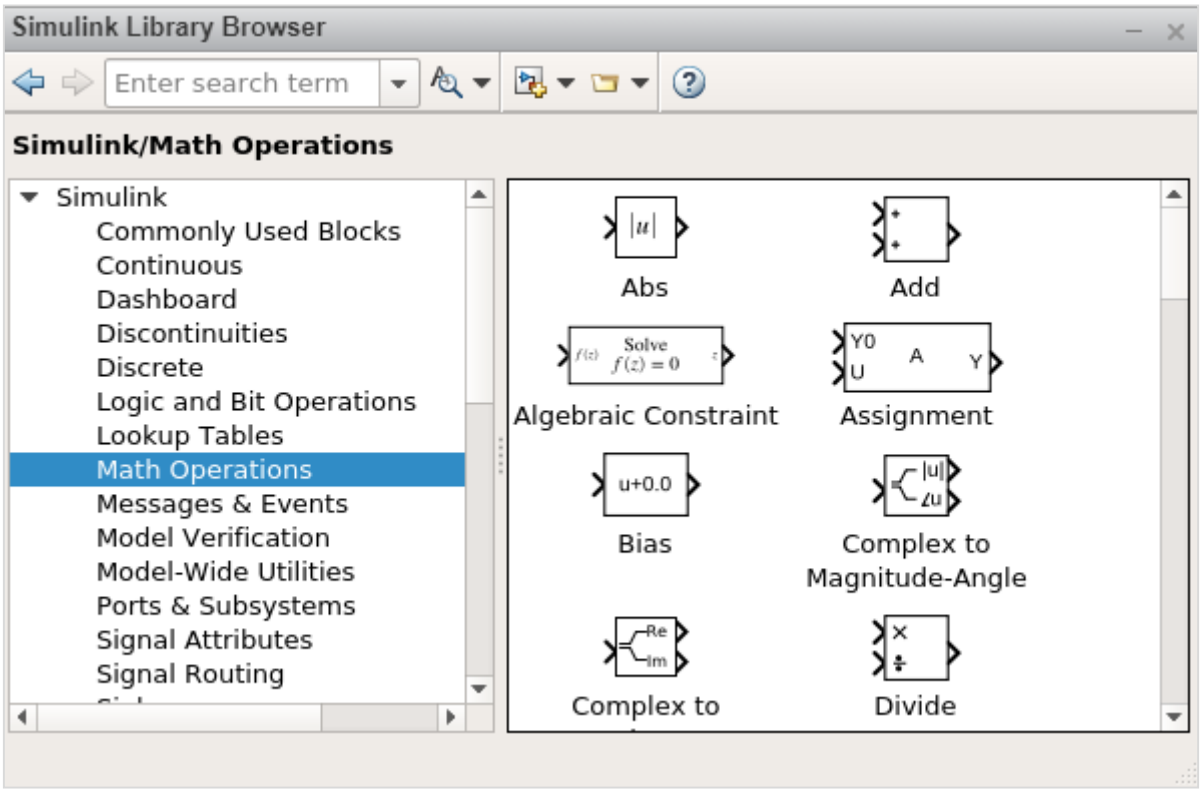


The Simulink library browsers is a collection of many libraries. It offers Commonly Used Blocks, Continuous, Dashboard, Logic and Bit Operation, Math Operations etc.

Besides that, you will get other library list like Control system toolbox, DSP system toolbox etc.

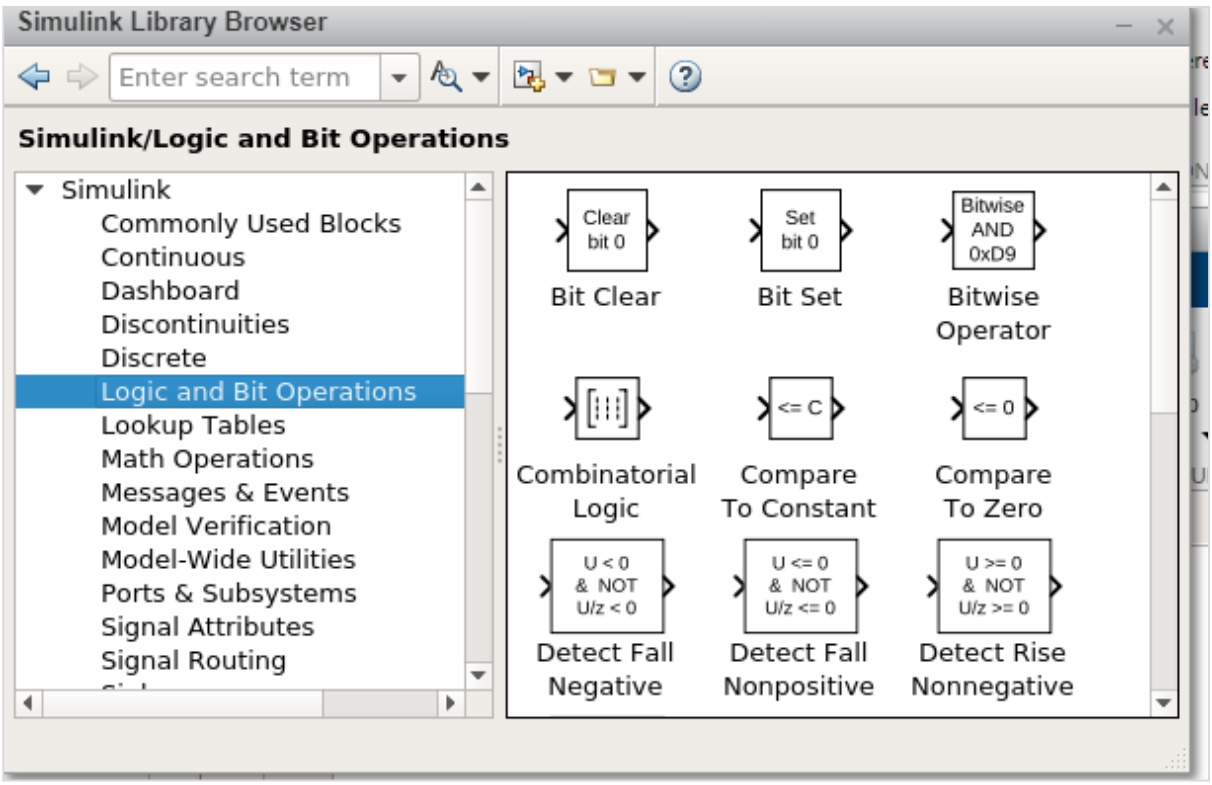


Here is an example of Math operations library list:



It has Abs, Add, Algebraic Constraint, Assignment etc. that you can make use in your model.

Given below is an example of Logic and Bit Operations:

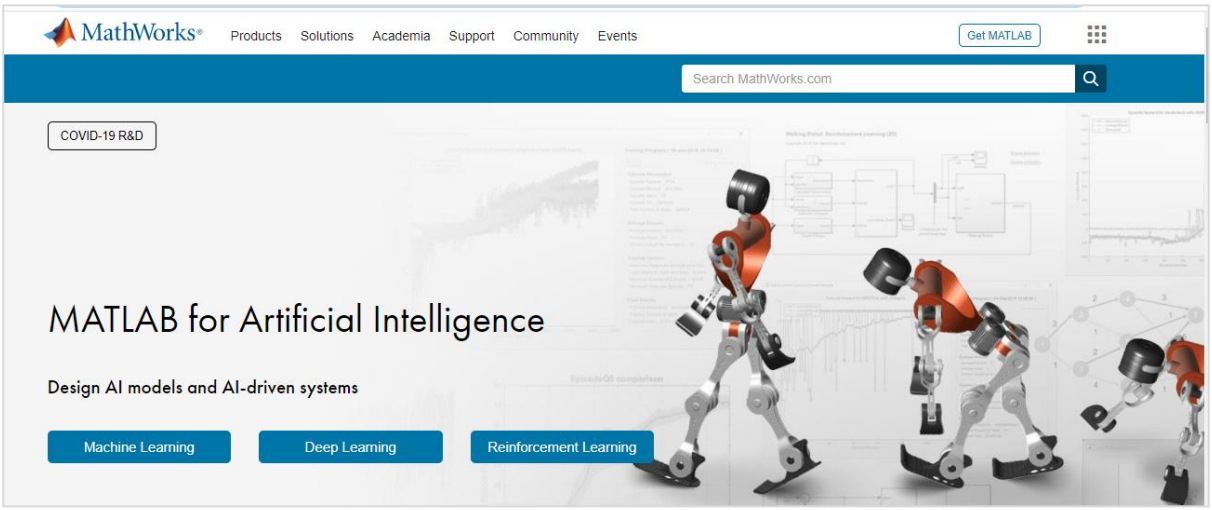


2. MATLAB Simulink — Environment Setup

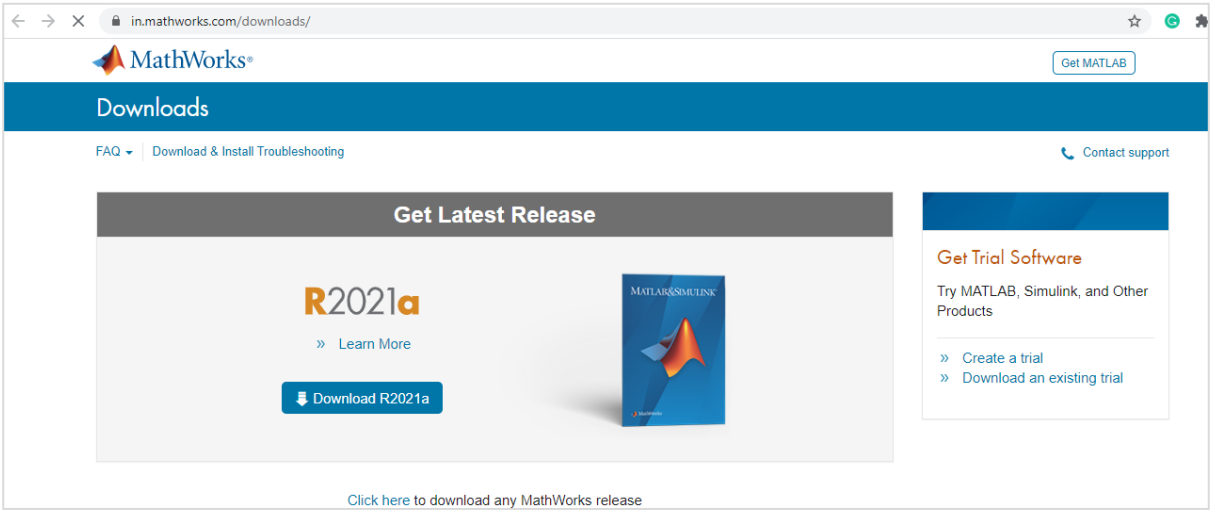
MATLAB simulink is a MATLAB product and to work with it, we need to download MATLAB.

The official website of matlab is https://www.mathworks.com/

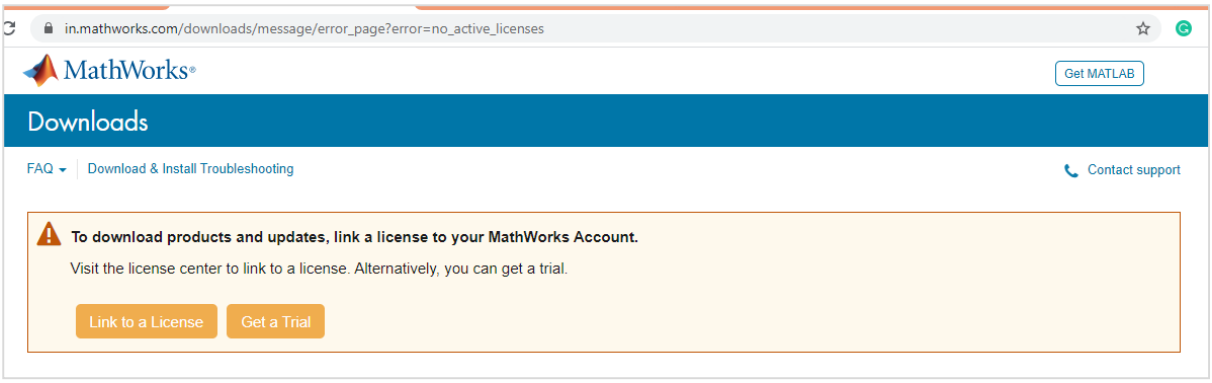
The following page will appear on your screen:



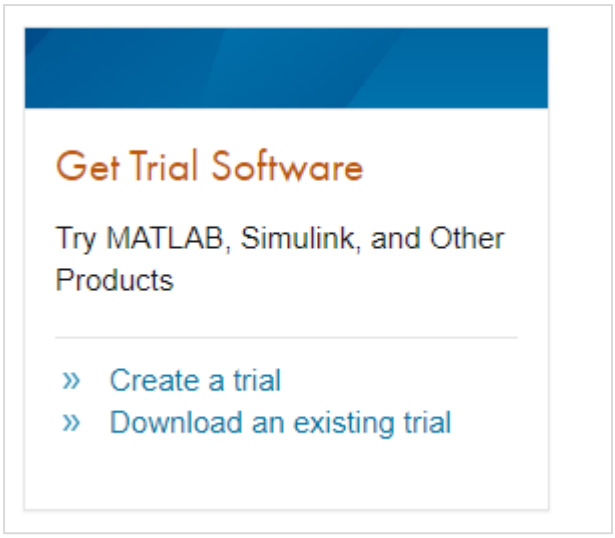
To download MATLAB go to https://in.mathworks.com/downloads/ as shown below:



MATLAB is not free to download and you need to pay for the licensed copy. Later on you can download it.

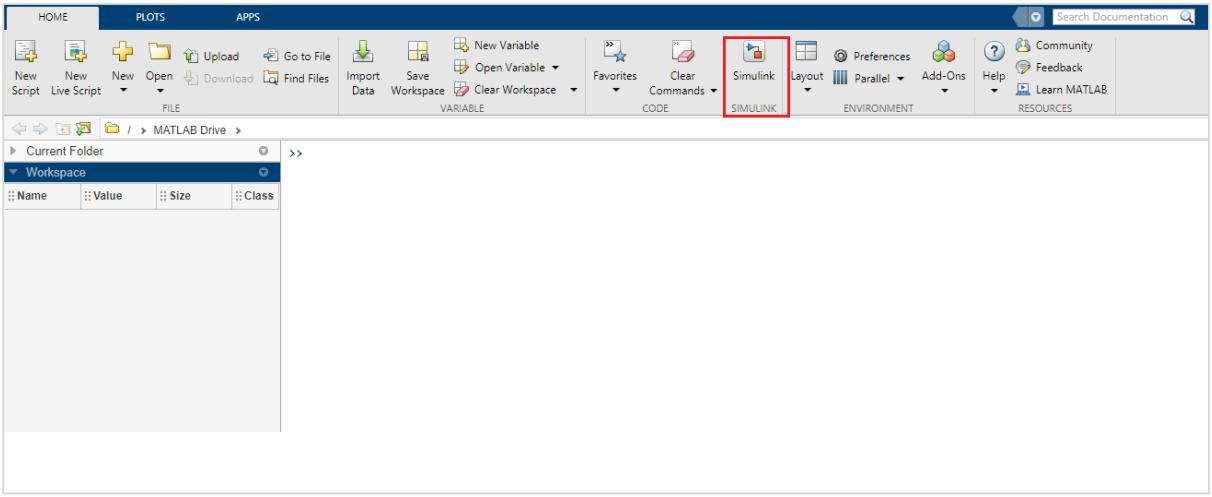


A free trial version is available for which you have to create a login for your respective account. Once an account is created, they allow you to download MATLAB and also an online version for a trial of 30 days' license.



Once you are done with the creating a login from their website, download MATLAB and install on your system. Then, start MATLAB or you can also make use of their online version.

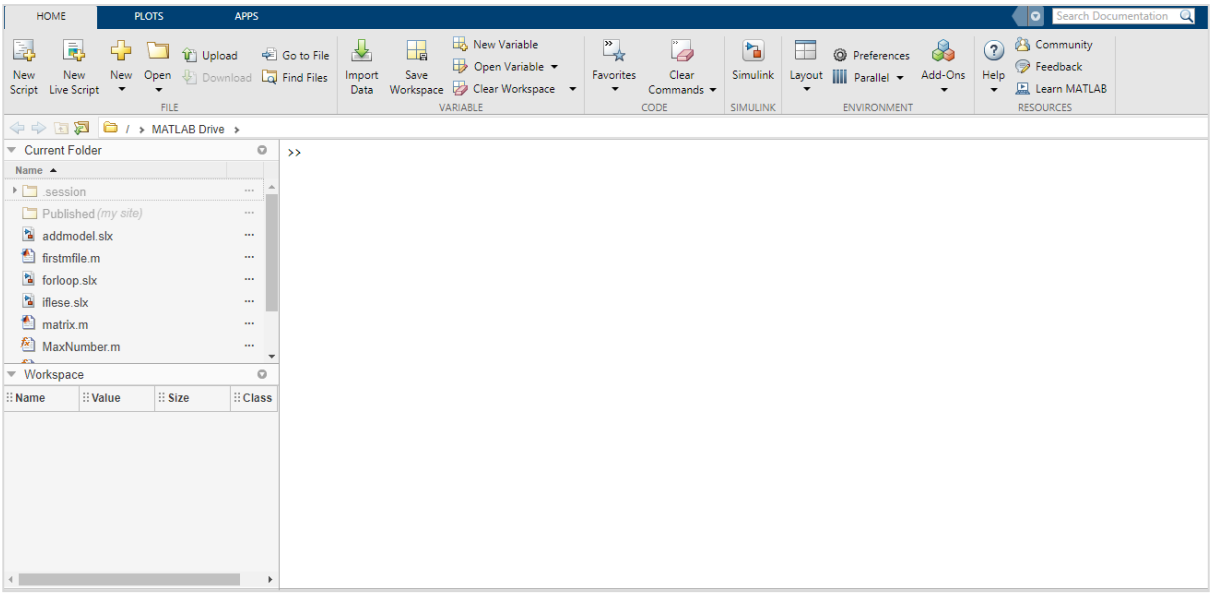
Simulink comes in-built with MATLAB. Once you install MATLAB, you will get Simulink as shown below:



3. MATLAB Simulink — Starting Simulink

In this chapter, we will understand about using Simulink to build models.

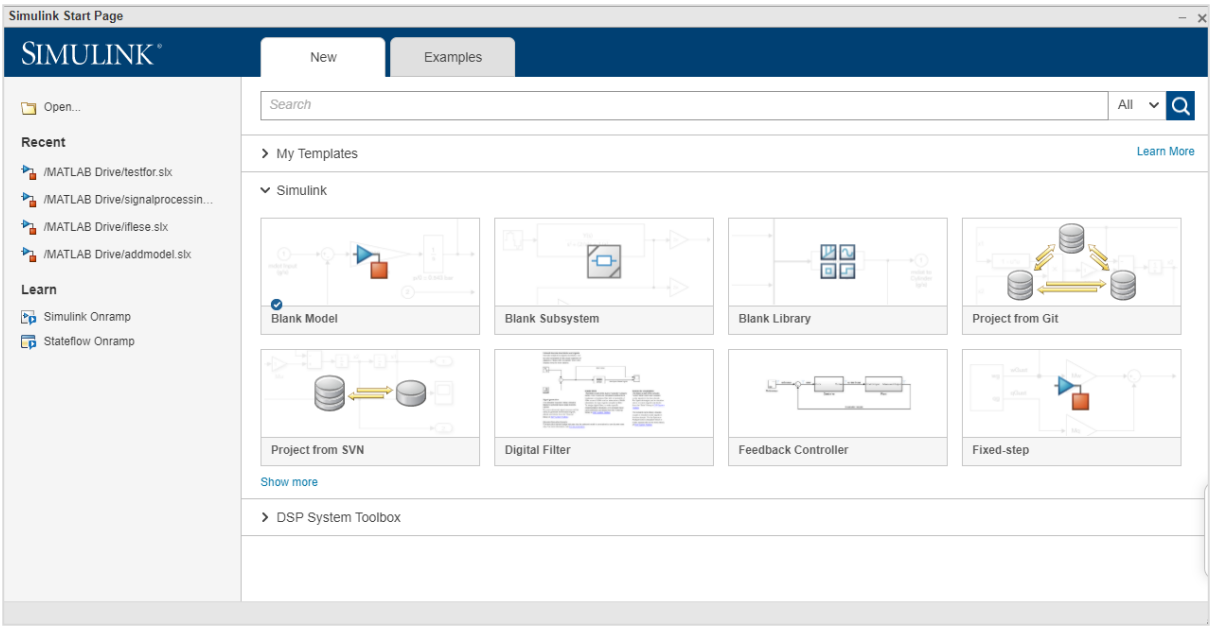
Here is a MATLAB display:



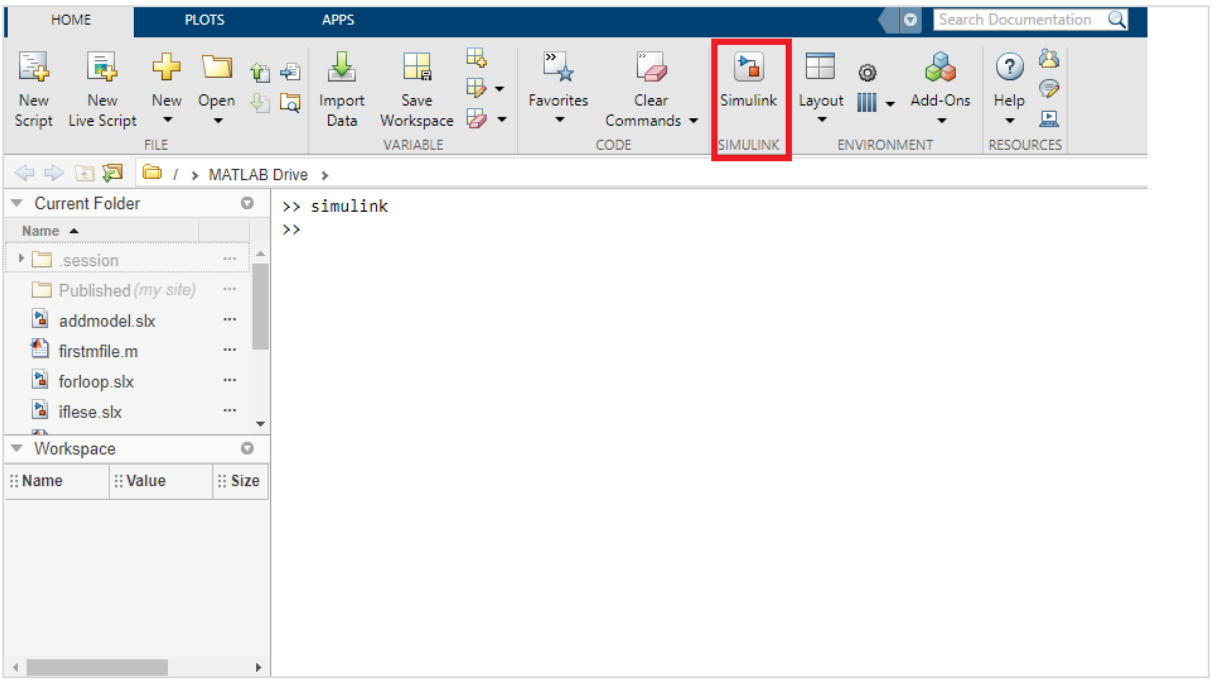
You can start Simulink by using simulink command in the MATLAB command window as shown below:

```
>> simulink
```

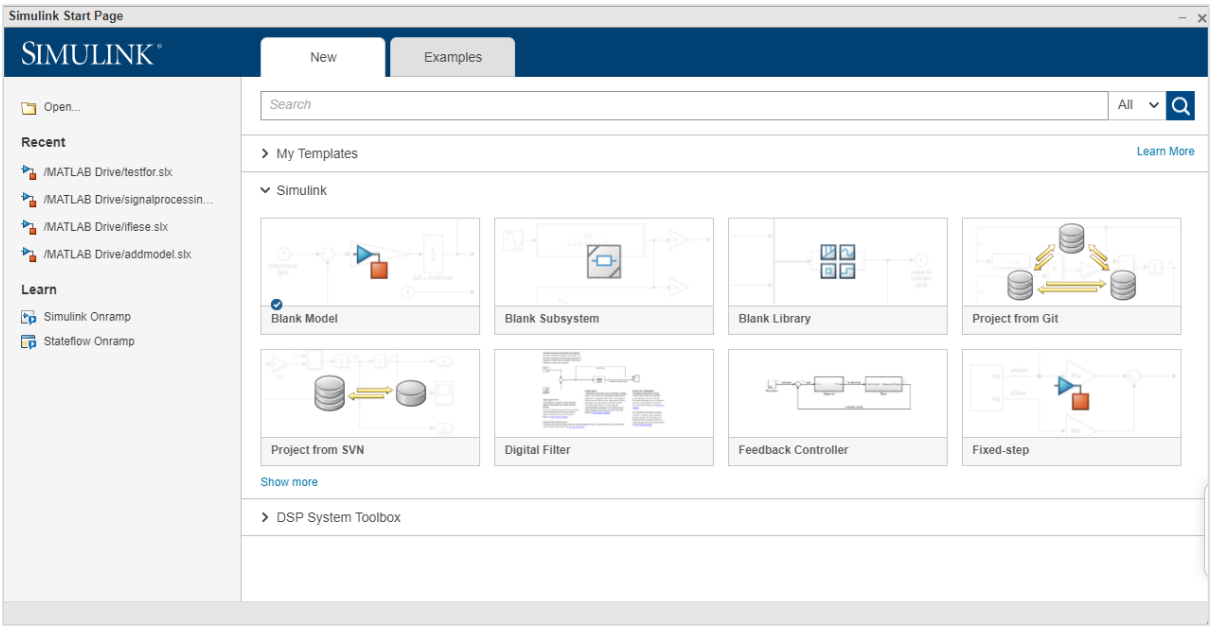
Click on enter to open the Simulink startup page as shown below:



You can also open Simulink from MATLAB interface directly by clicking on Simulink icon as shown below:

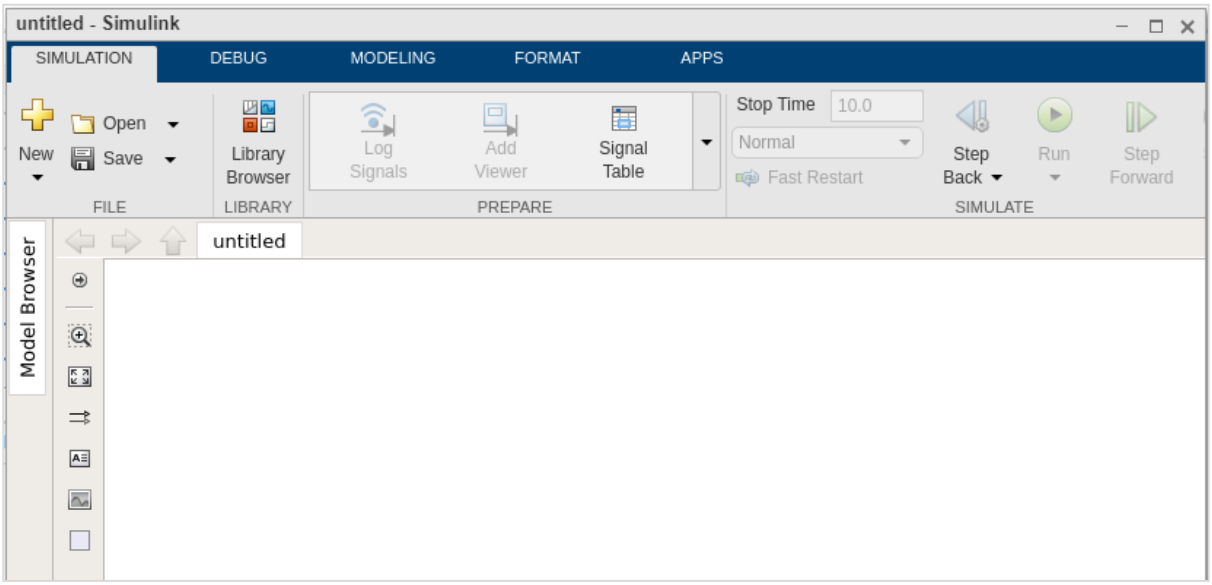


When you click on the Simulink icon, it will take you to a Simulink startup page, as shown below:



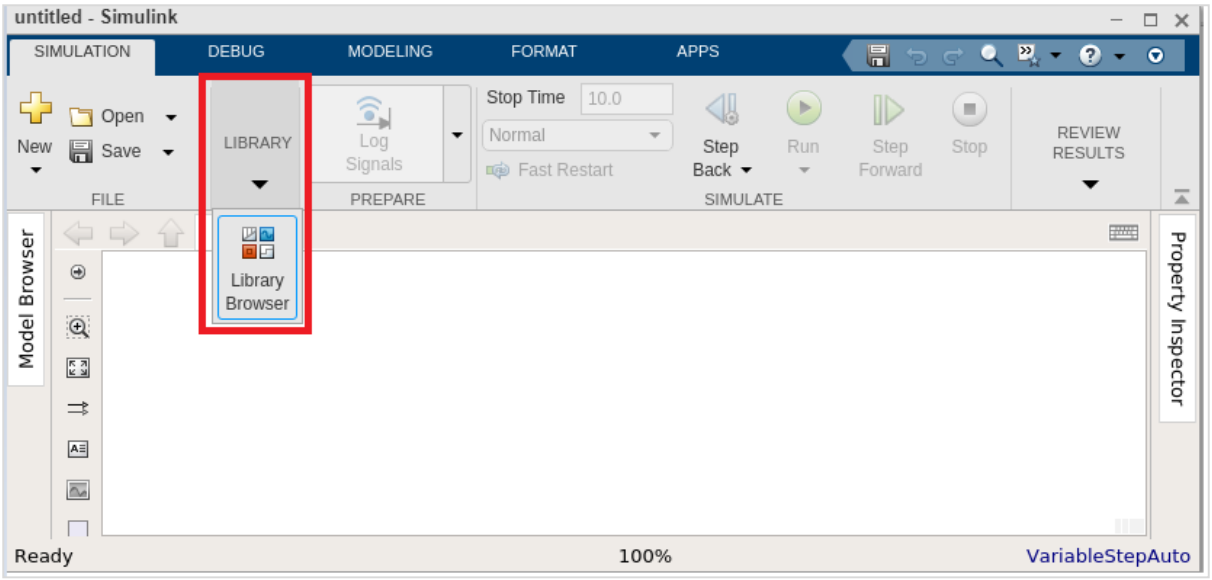
The startup page has a blank model, subsystem, library to start the model from scratch. There are also some built-in templates that can help the users to start with.

To create a model, the user can click on blank model and it will display a page as shown below:

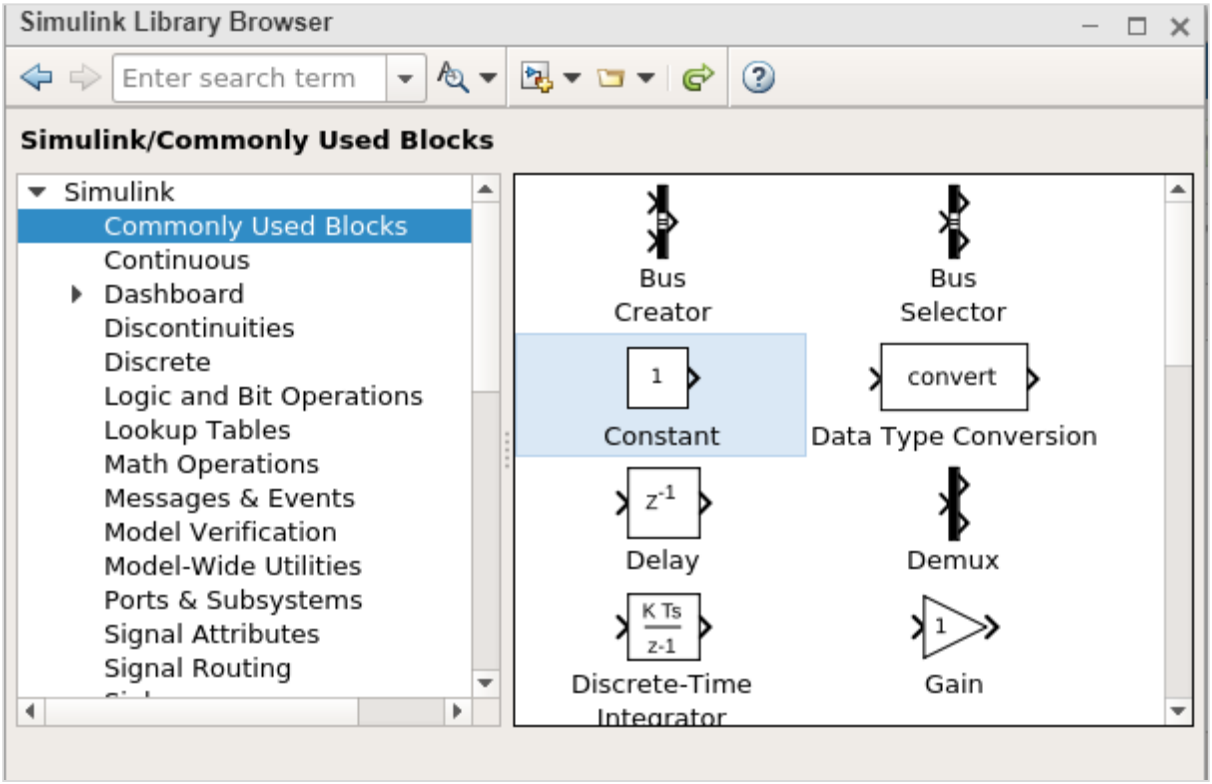


Click on Save to save your model. The blocks to build your model are available inside the Simulink library browser.

Click on library browser as shown below:



The library browser has a list of all types of libraries with different blocks as shown below:

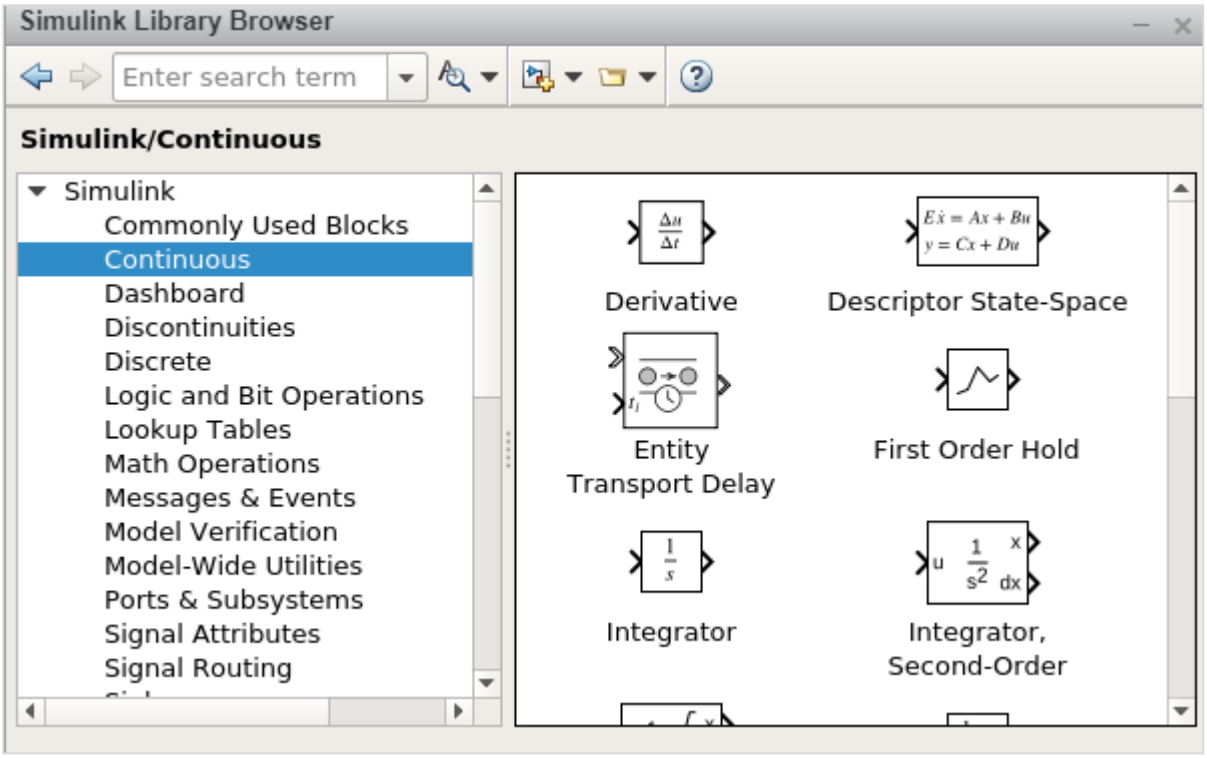


Libraries in Simulink

Let us understand some of the commonly used libraries in Simulink.

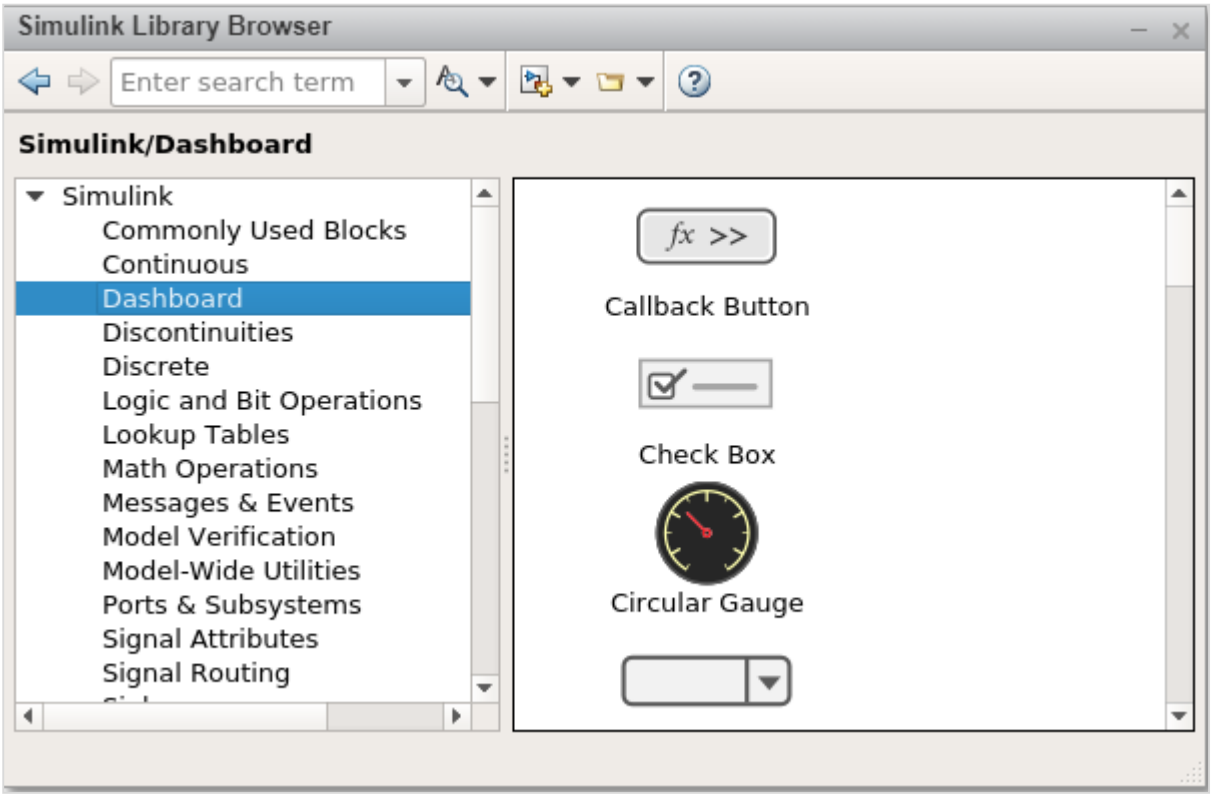
Continuous

A continuous blocks library gives you blocks related to derivatives and integrations. The list of blocks are as follows:



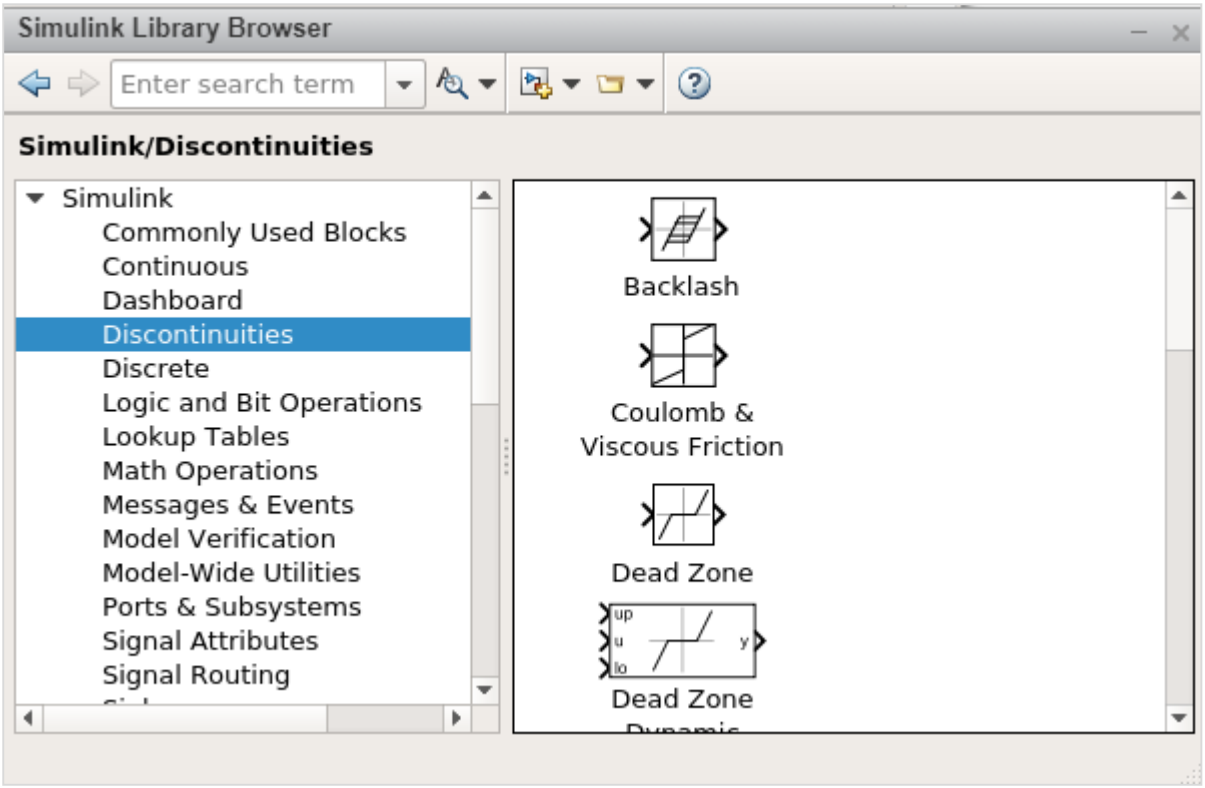
Dashboard

With Dashboard, you will get controls and indicator blocks that help to interact with simulations. The following screen will appear on your computer:



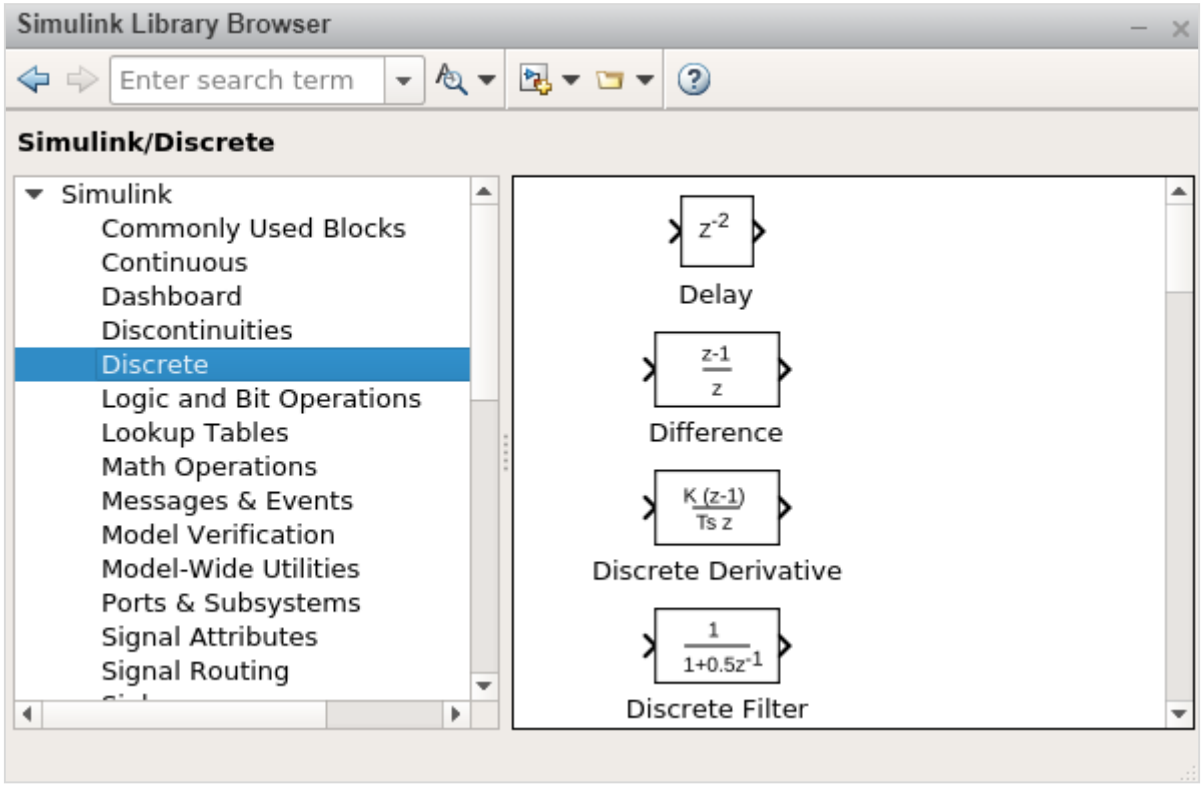
Discontinuities

Here, you will get a list of discontinuous functions blocks as displayed below:



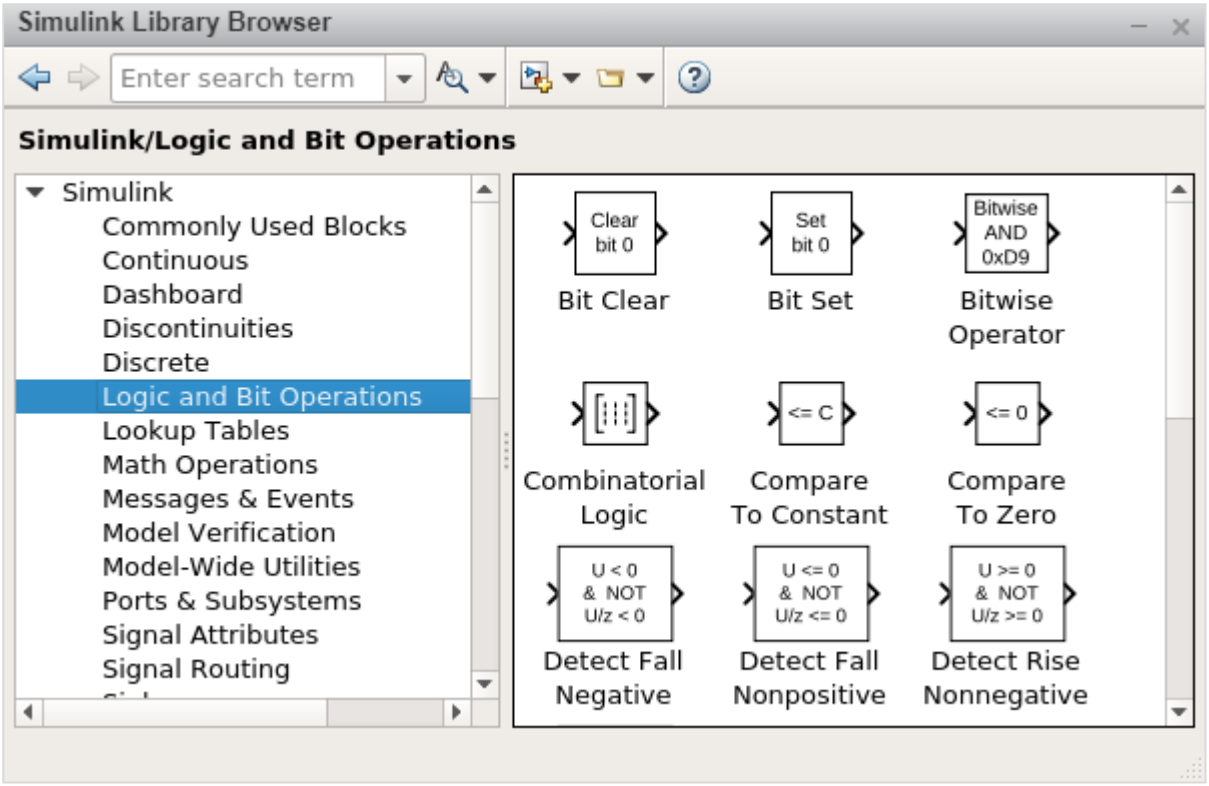
Discrete

Here, you will get time relation function blocks as shown below:



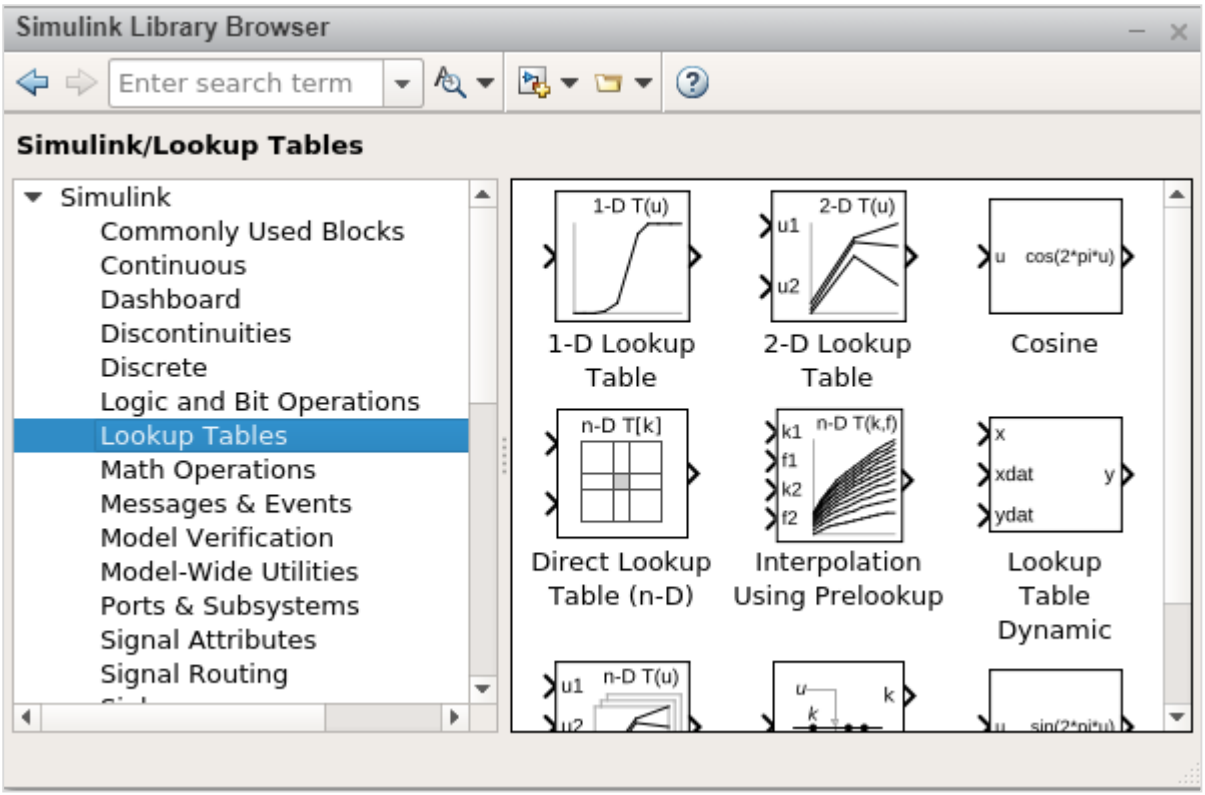
Logic and Bit Operations

In this category, you will get all logical and relational type blocks as displayed below:



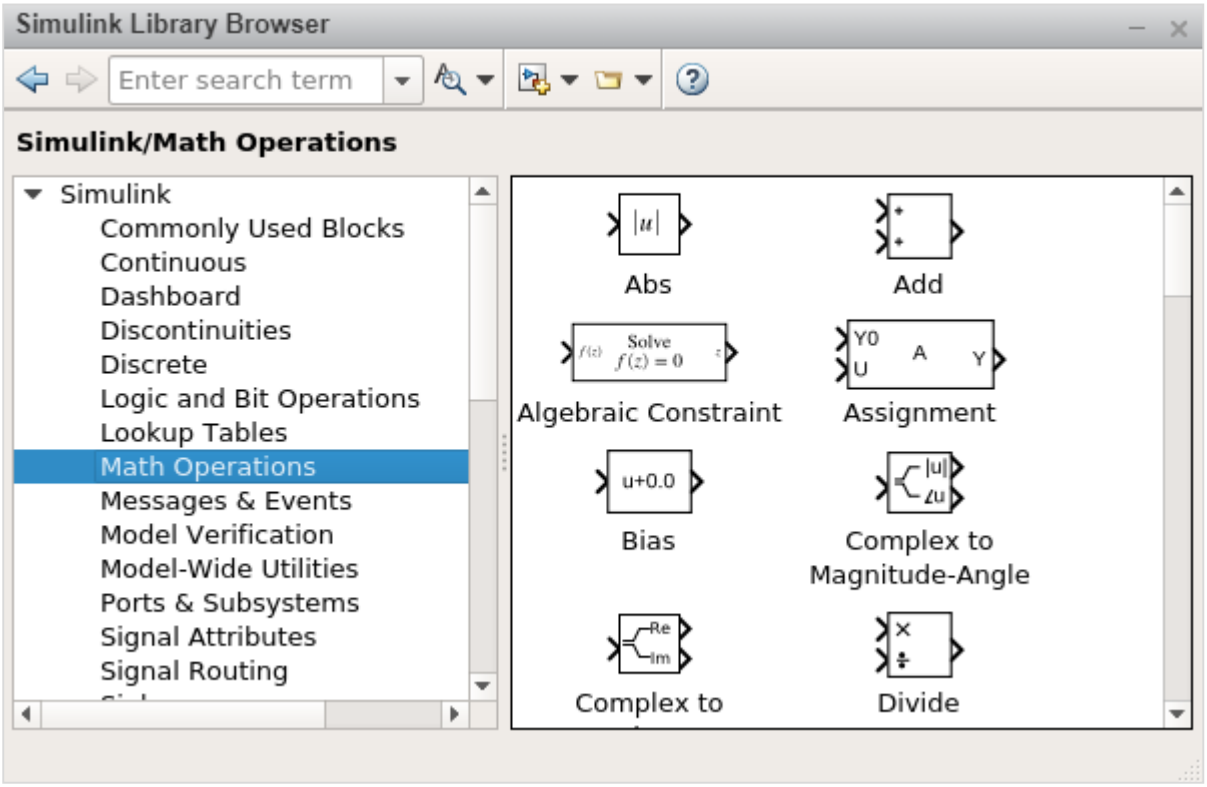
Lookup Tables

You will all the sine, cosine function blocks as shown below:



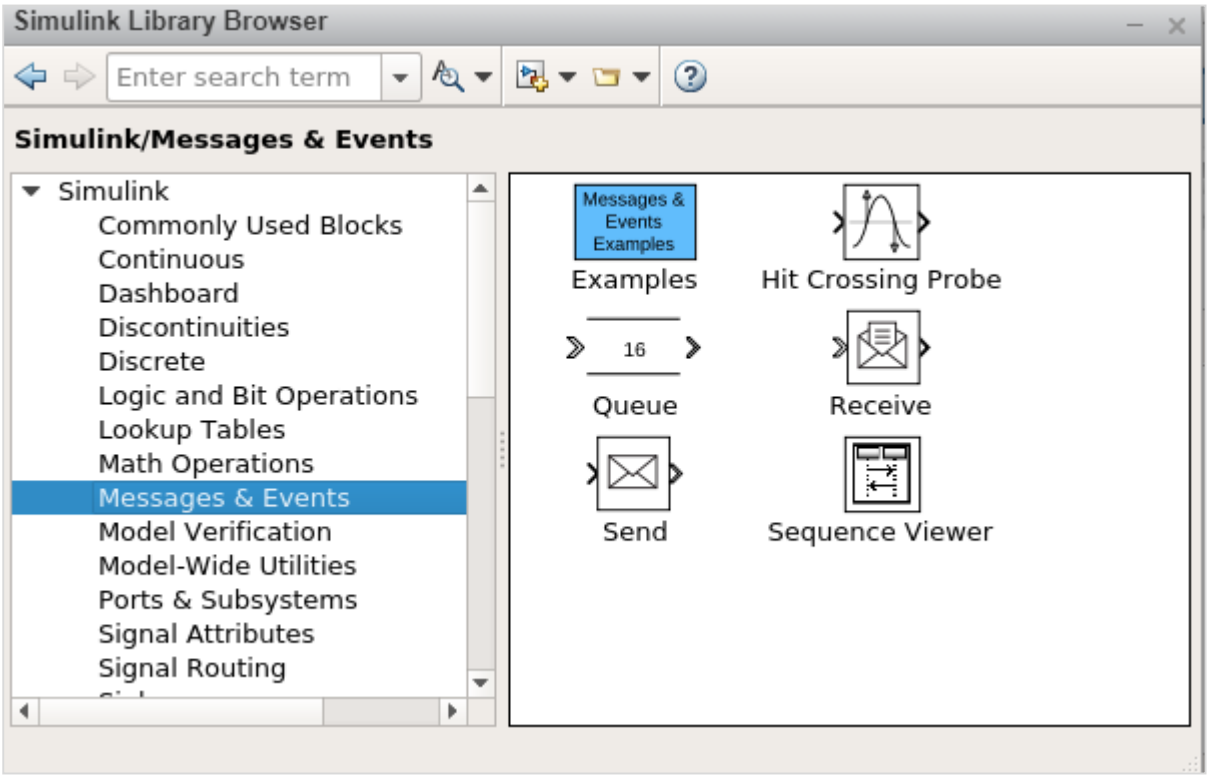
Math Operations

All mathematical operations like Add, Absolute, divide, subtract are available. The list is as follows:



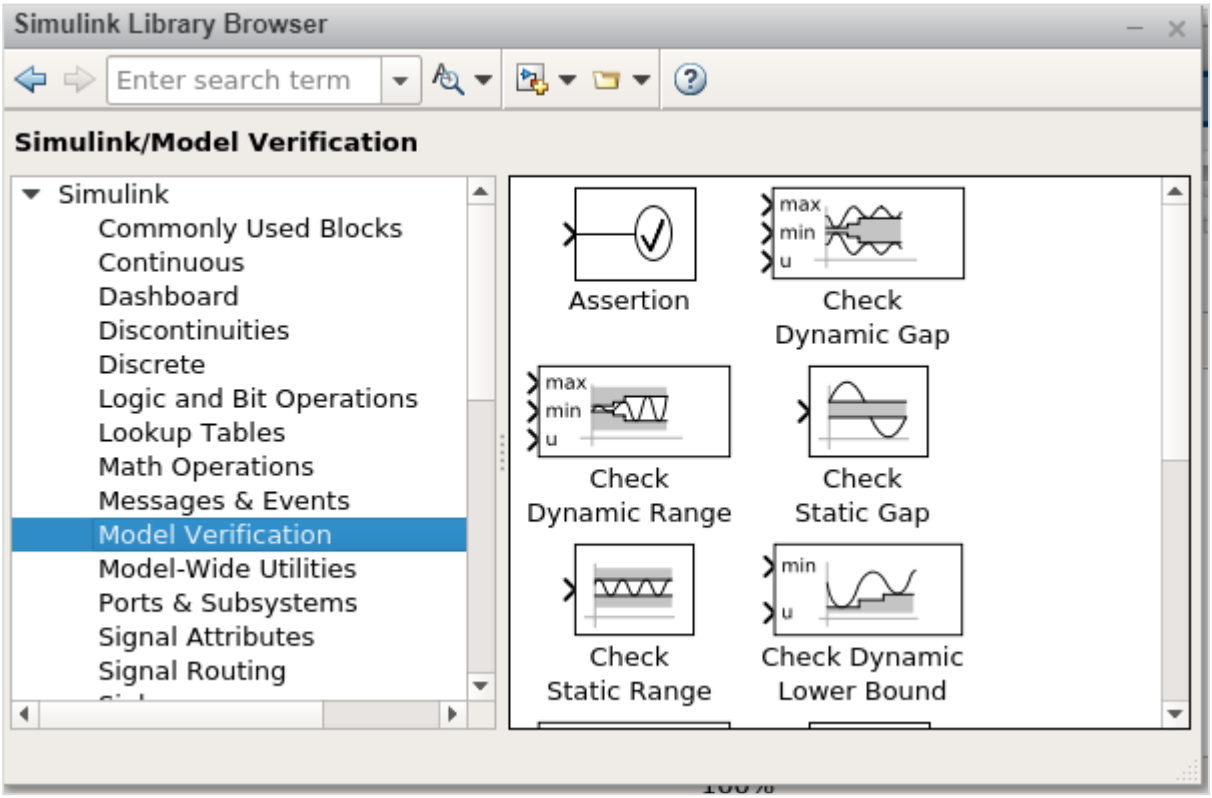
Messages and Events

This block has all the message/communication related functions as shown below:



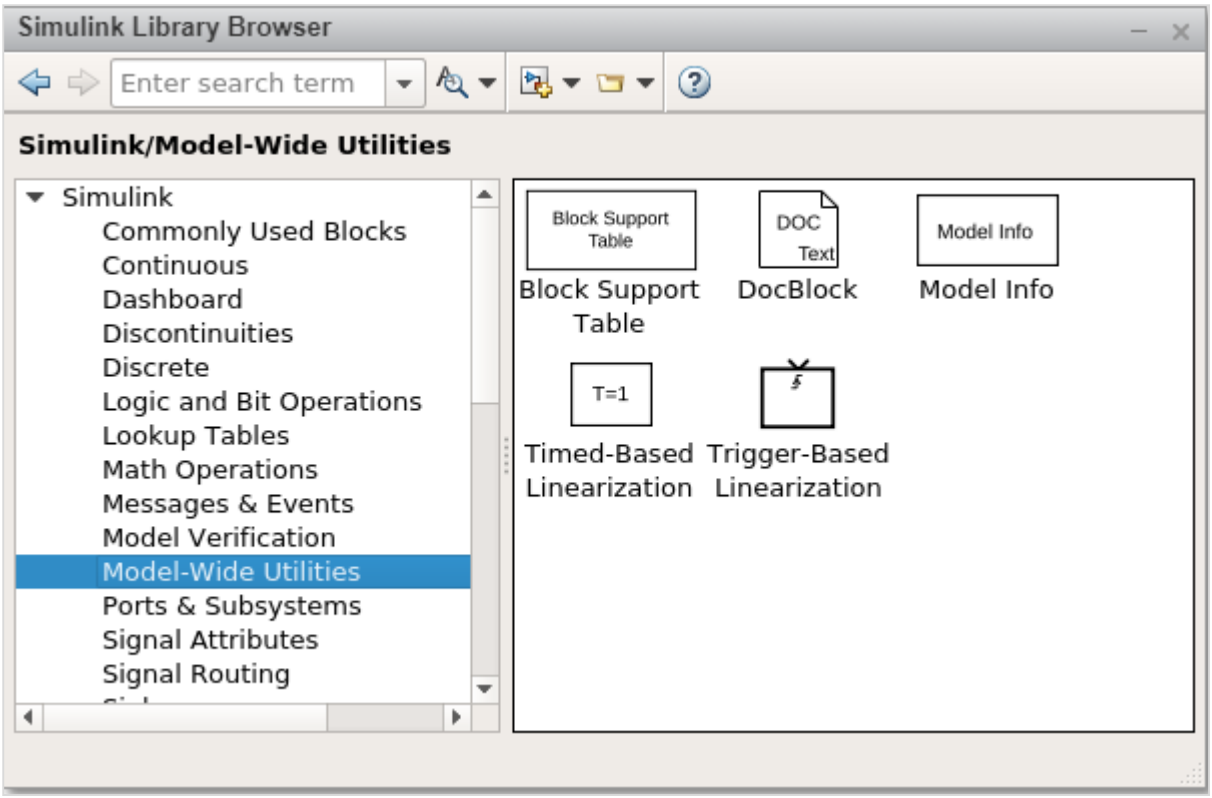
Model Verification

The blocks present here helps to self-verify models, such as Check Input Resolution. The following screen will appear on your computer:



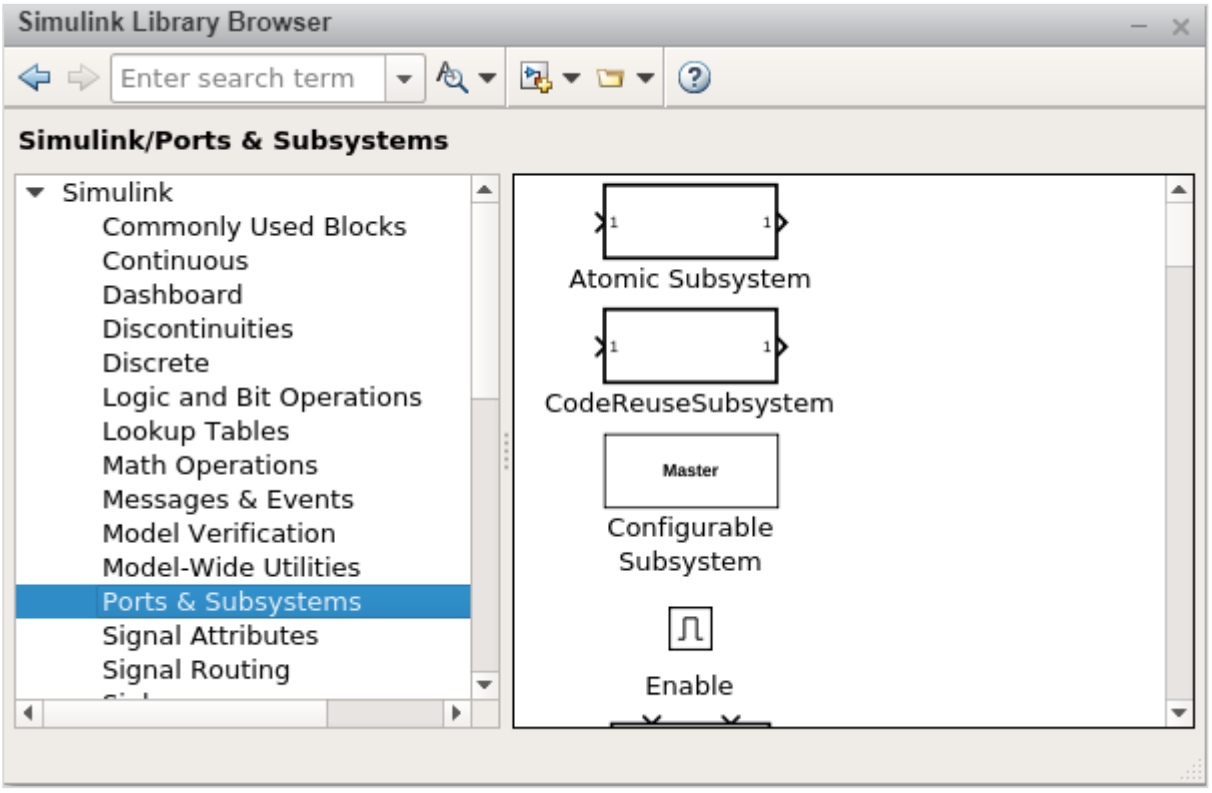
Model-Wide Utilities

This gives you blocks like Model info, Block Support Table etc. The following screen will appear on your computer:



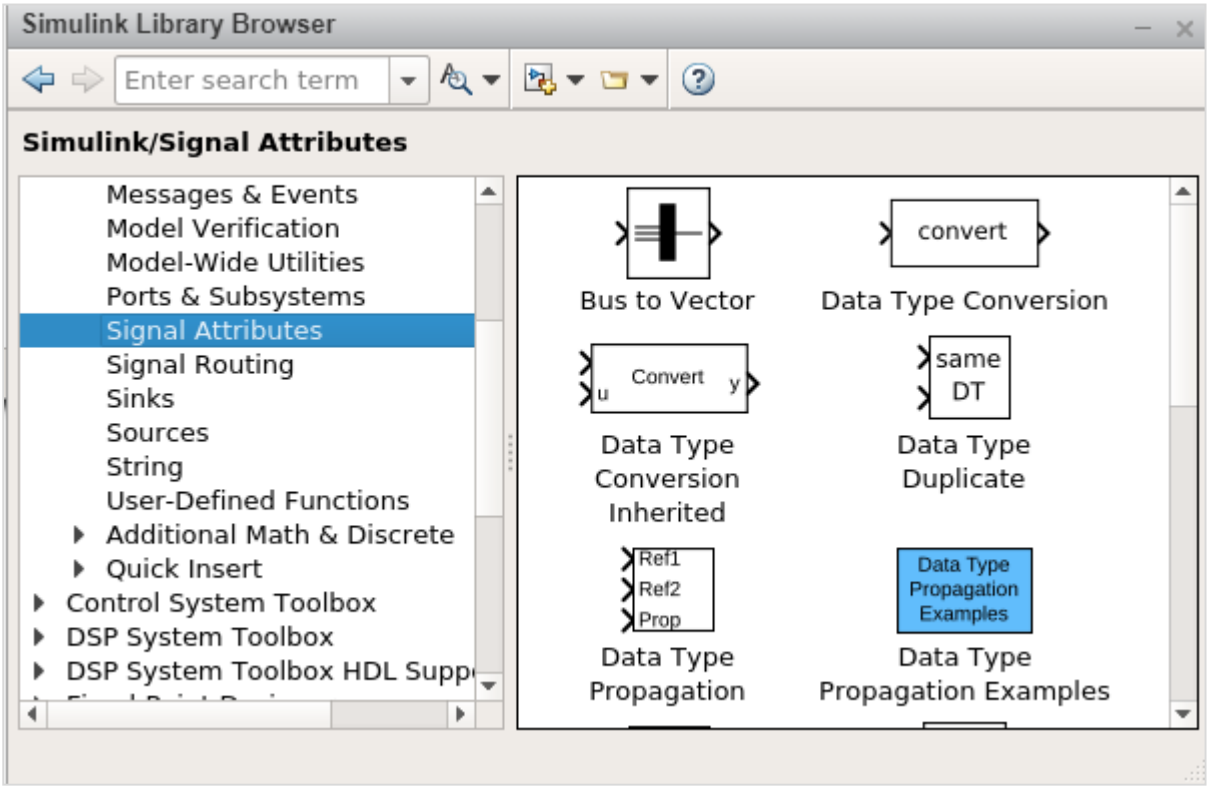
Ports and Subsystems

You will get blocks like a subsystem, switch case, enable etc. The list is displayed below:



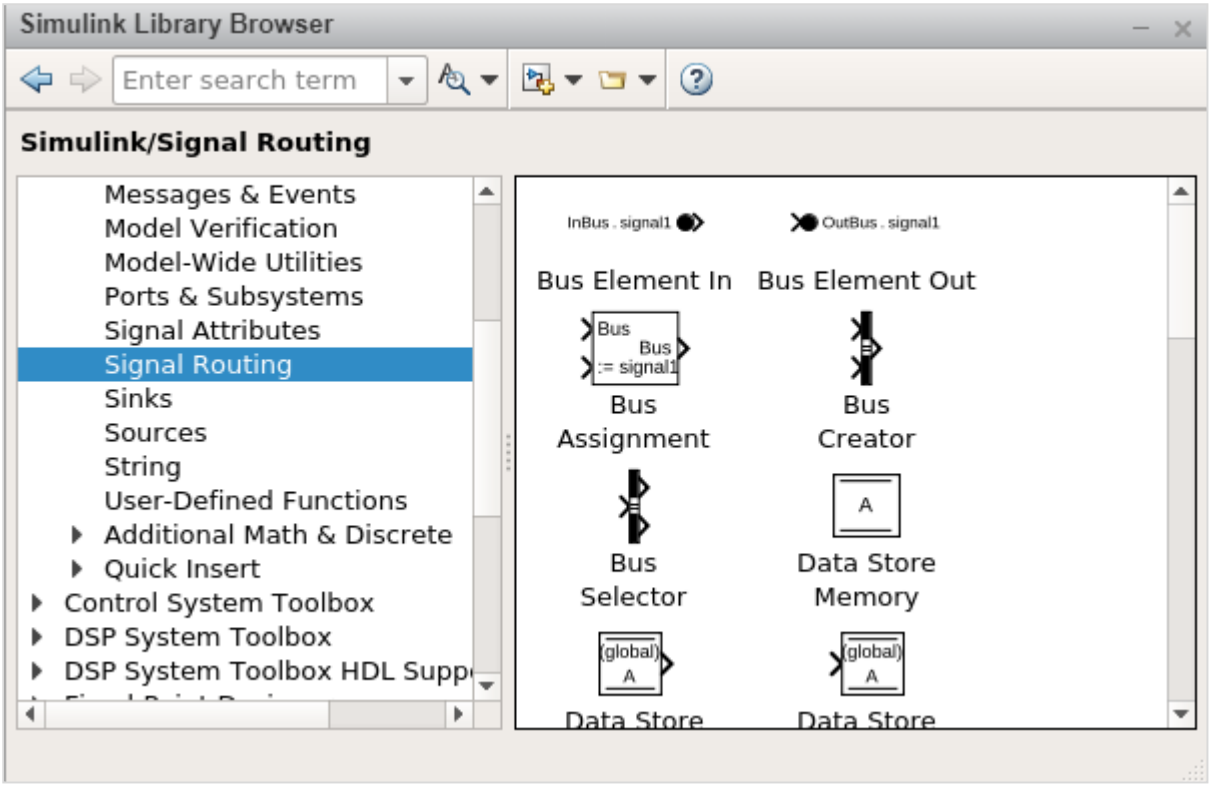
Signal Attributes

Modify the signal attribute blocks such as Data Type Conversion. The following screen will appear on your computer:



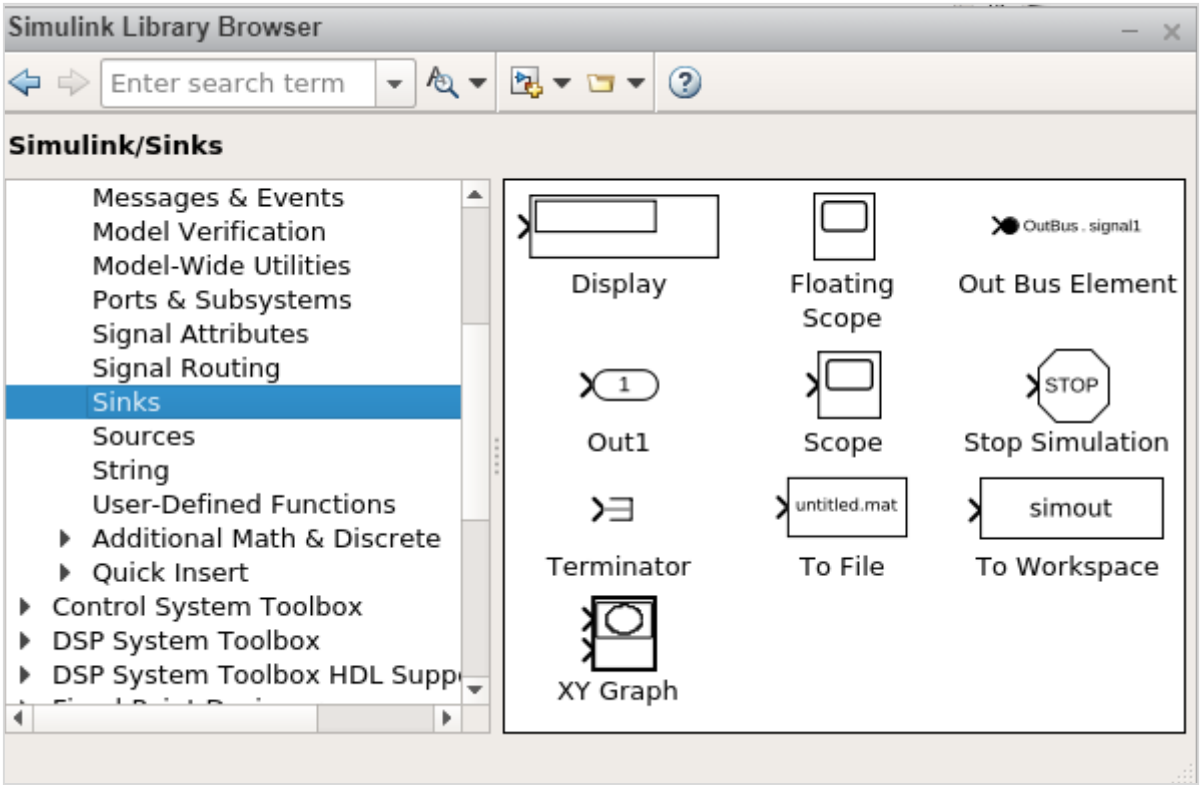
Signal Routing

The blocks in this category is used to route signal blocks such as bus creator, switch etc. The following screen will appear on your computer:



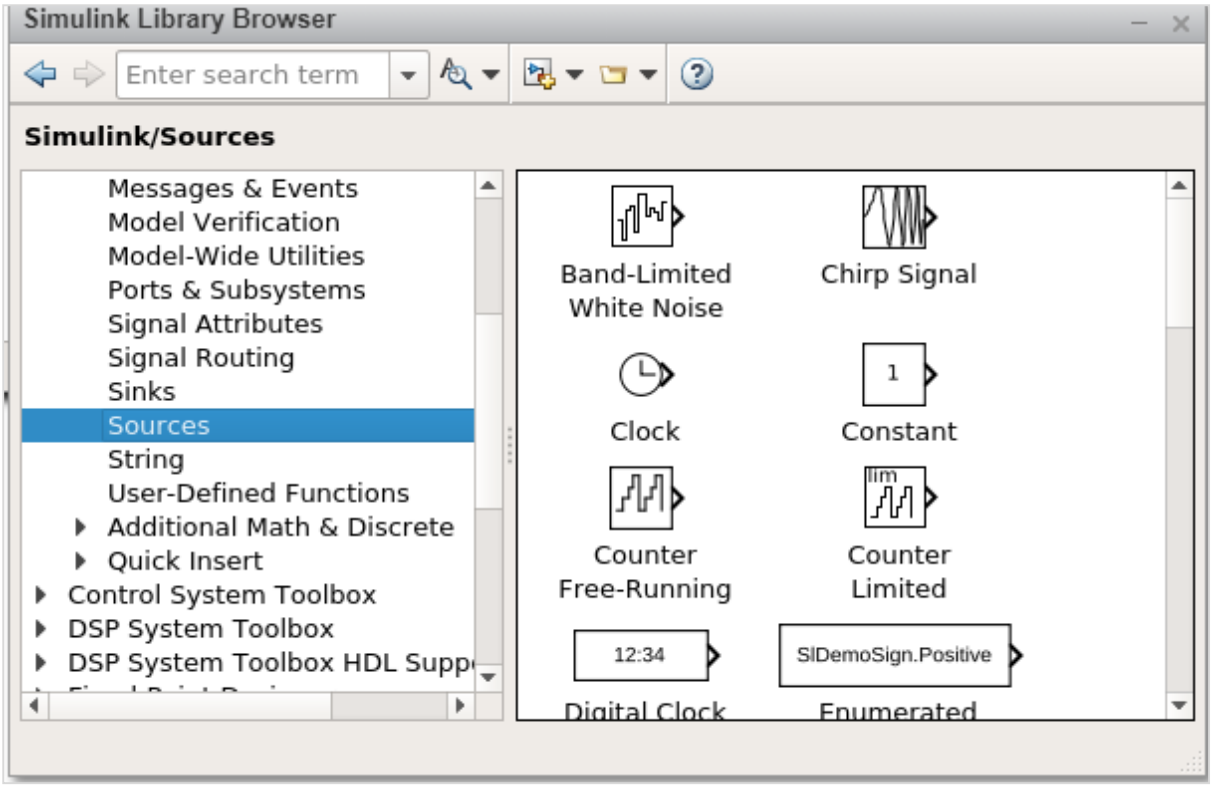
Sinks

The blocks in this category help to display or export signal data blocks such as Scope and To Workspace. The following screen will appear on your computer:



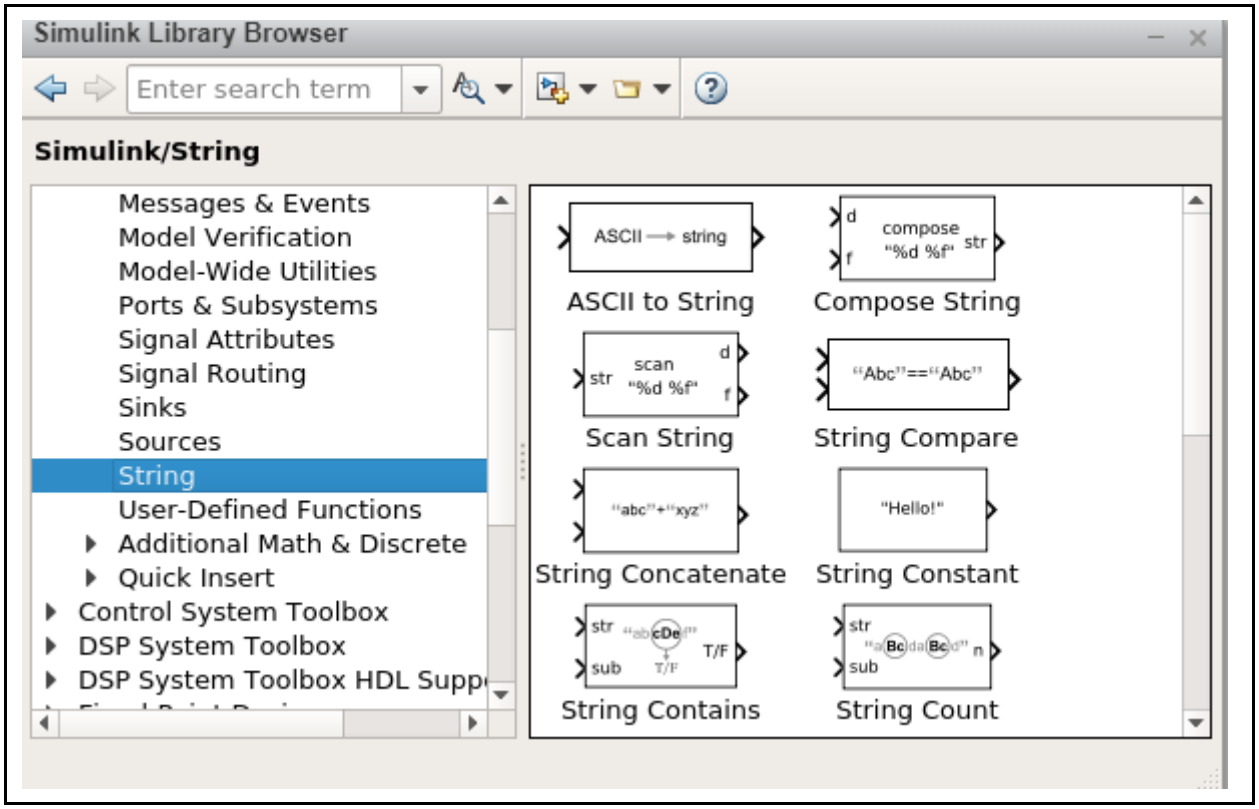
Sources

It helps to generate or import data blocks. For example, sine wave. The following screen will appear on your computer:



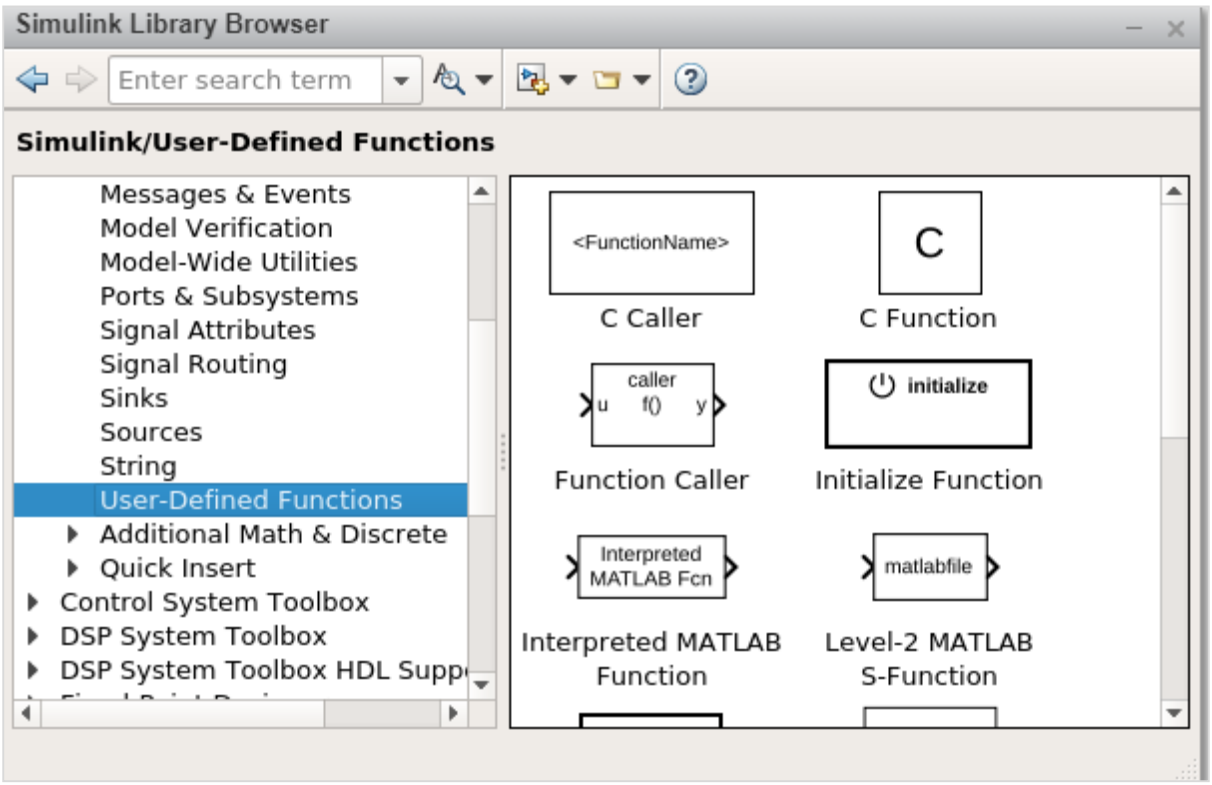
String

This category has string related blocks as shown below:



User Defined functions

Custom function blocks such as MATLAB Function, MATLAB System, Simulink Function, and Initialize Function. The following screen will appear on your computer:

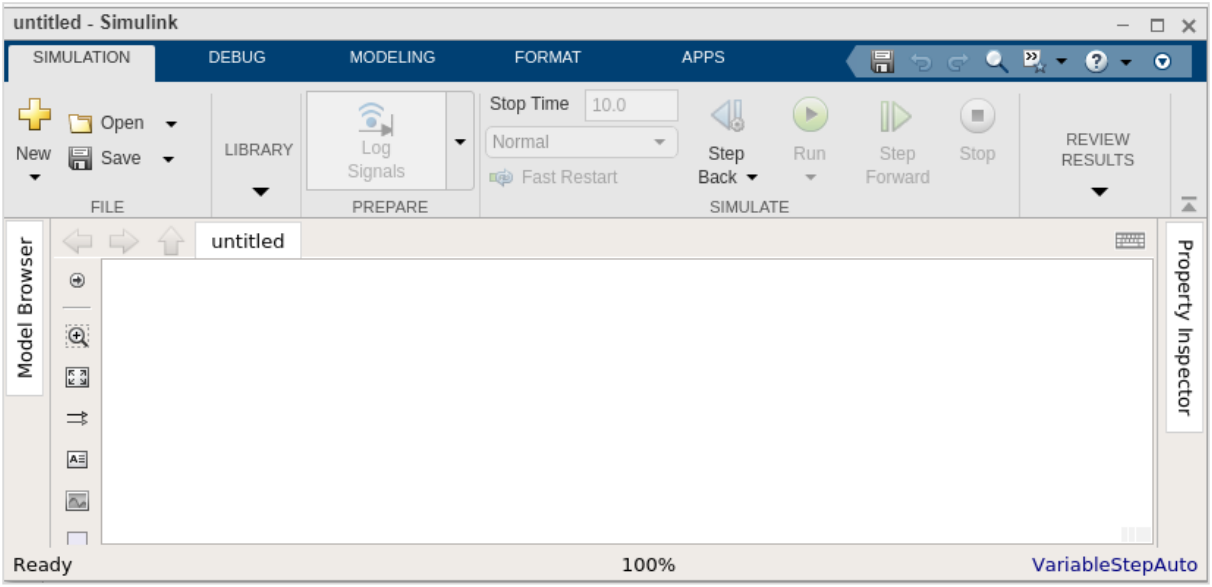


4. MATLAB Simulink — Blocks

In this chapter, we will learn about one of the basic elements in Simulink. These are termed as blocks.

Blocks in Simulink helps to create models. You can make use of a Simulink library browser that has different types of blocks for creating a model.

First, open a blank model. The display will be as shown below:



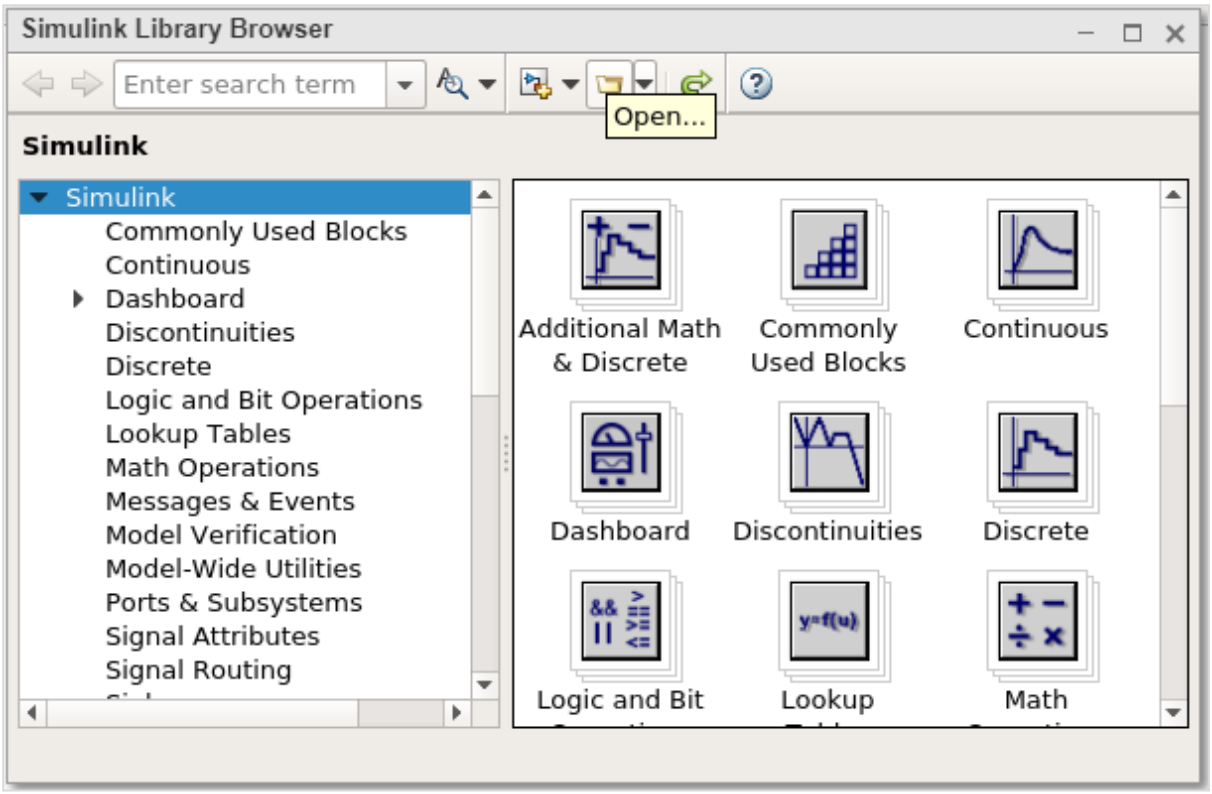
You can save your model by clicking on the Save button. Hence, your changes will be saved successfully. Now, open the library browser to get the blocks into your model canvas.

The two ways to select the blocks are as follows:

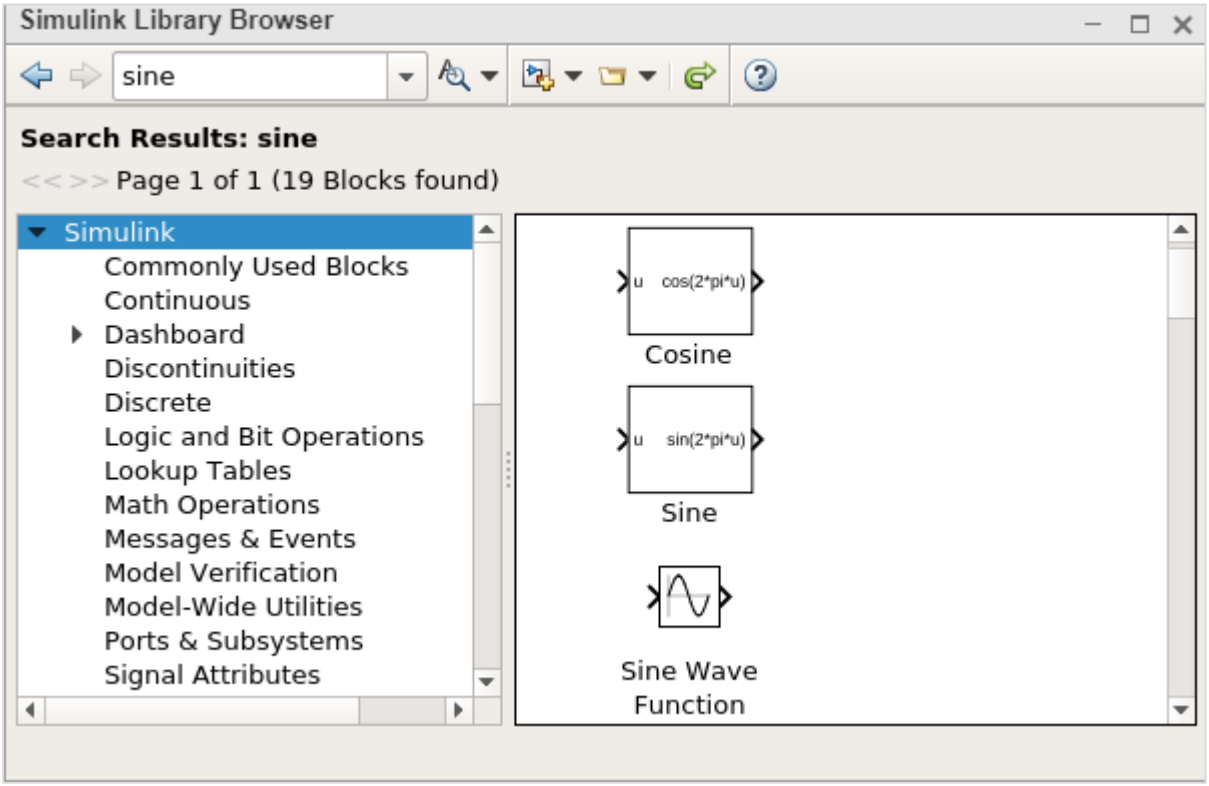
- Using Simulink browser library.
- Searching for block inside model canvas.

Simulink browser library

Open the Simulink library browser as shown below:

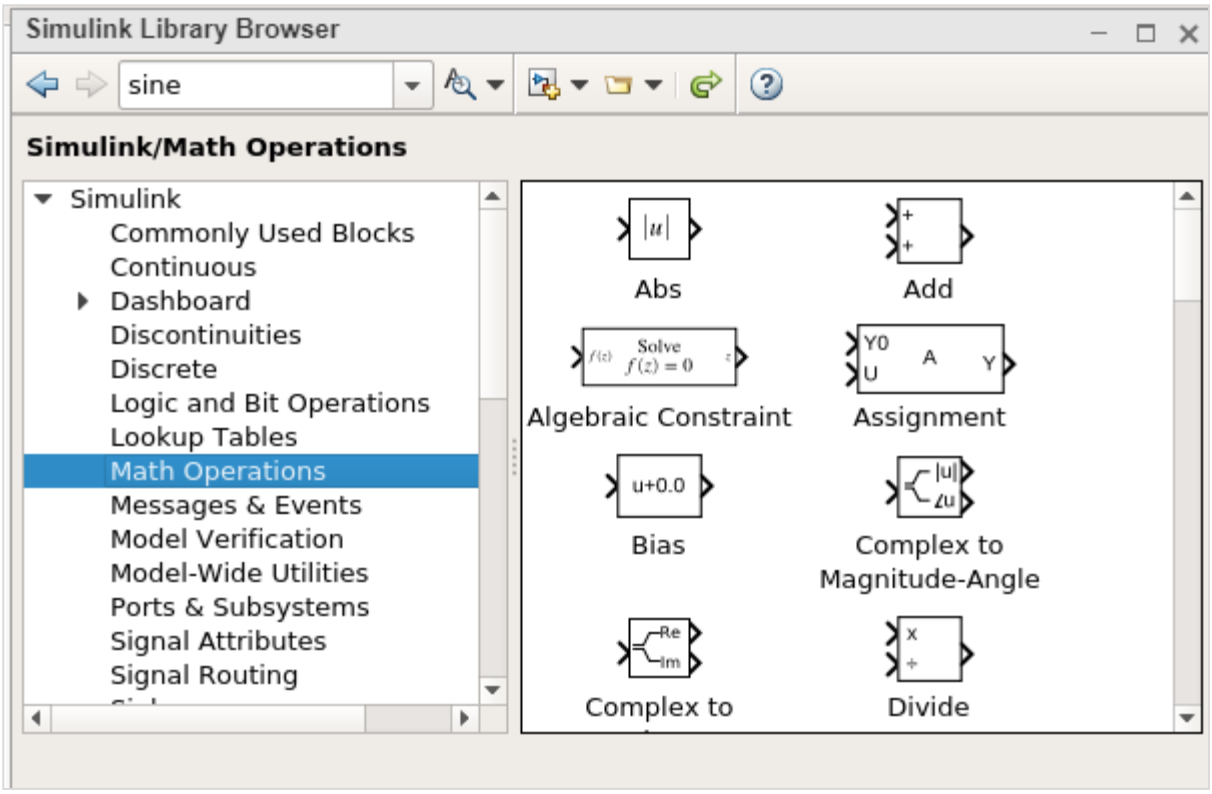


If you looking for a specific block and don't know which library, you can search for it inside the search block which is available as shown below:

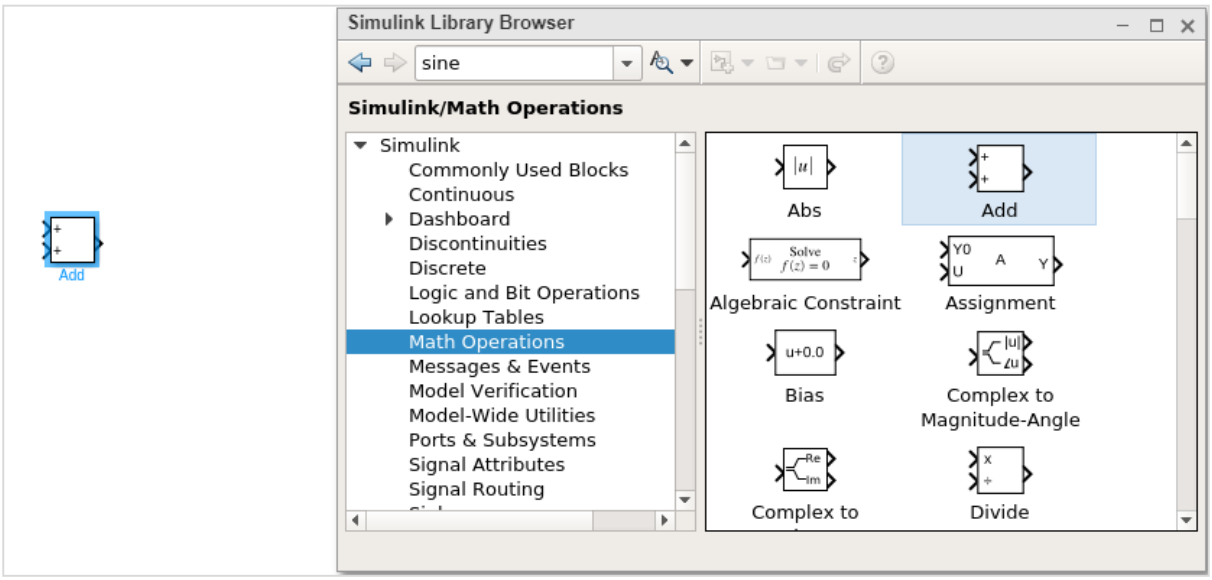


Here, we got all the blocks related to Sine. You can also go inside the library and pick your block.

Add block, Product block etc. The display will be as shown below:

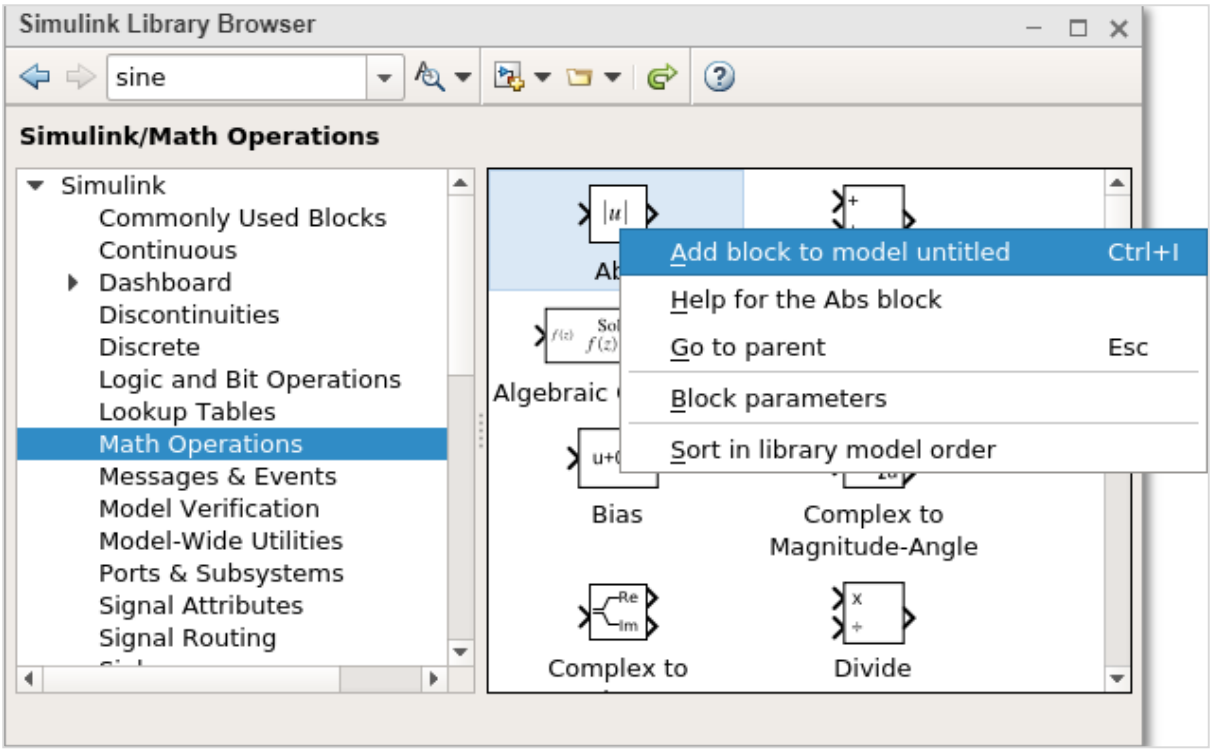


To bring the block inside your model, you can select the block and drag it inside your model, as shown below:



Another way is to right click the block and add to your current model.

An example for the same is given below:

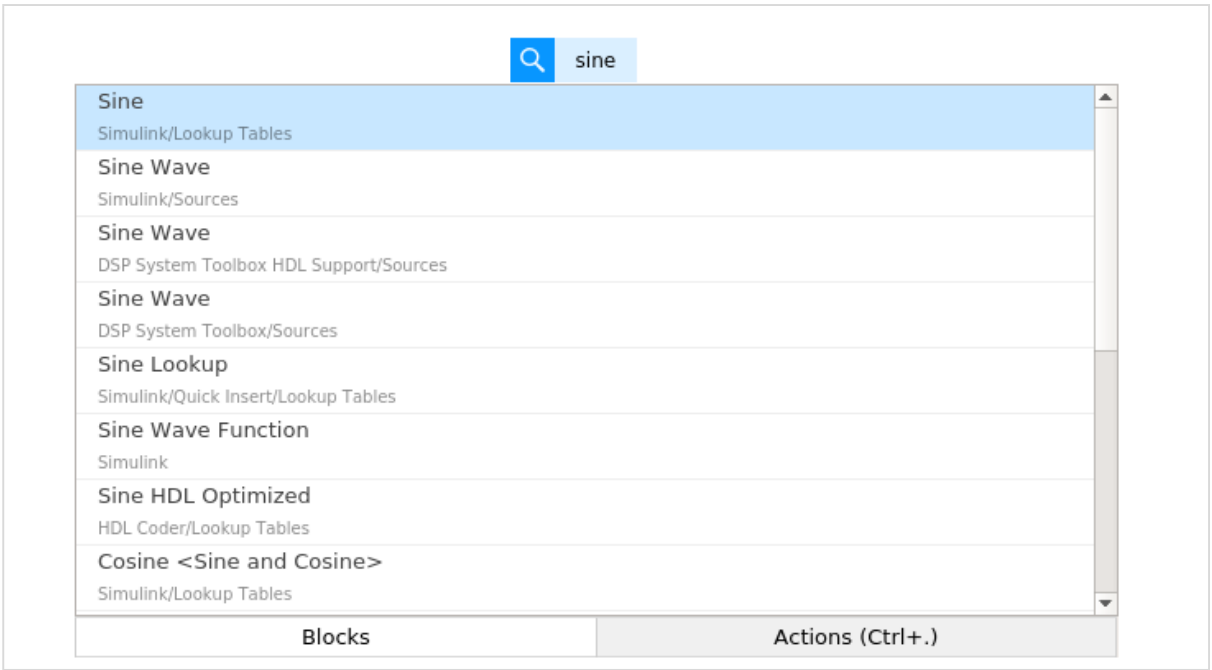


We have not saved our model. Hence, it comes as untitled. Now, you can add to the model untitled. The block will be seen inside your mode.

Searching for block inside model canvas

Another way to add blocks to your model is to click inside the model and type the name of the block. It will search in the library browser and list all the model as per what you have typed.

An example for the same is given below:



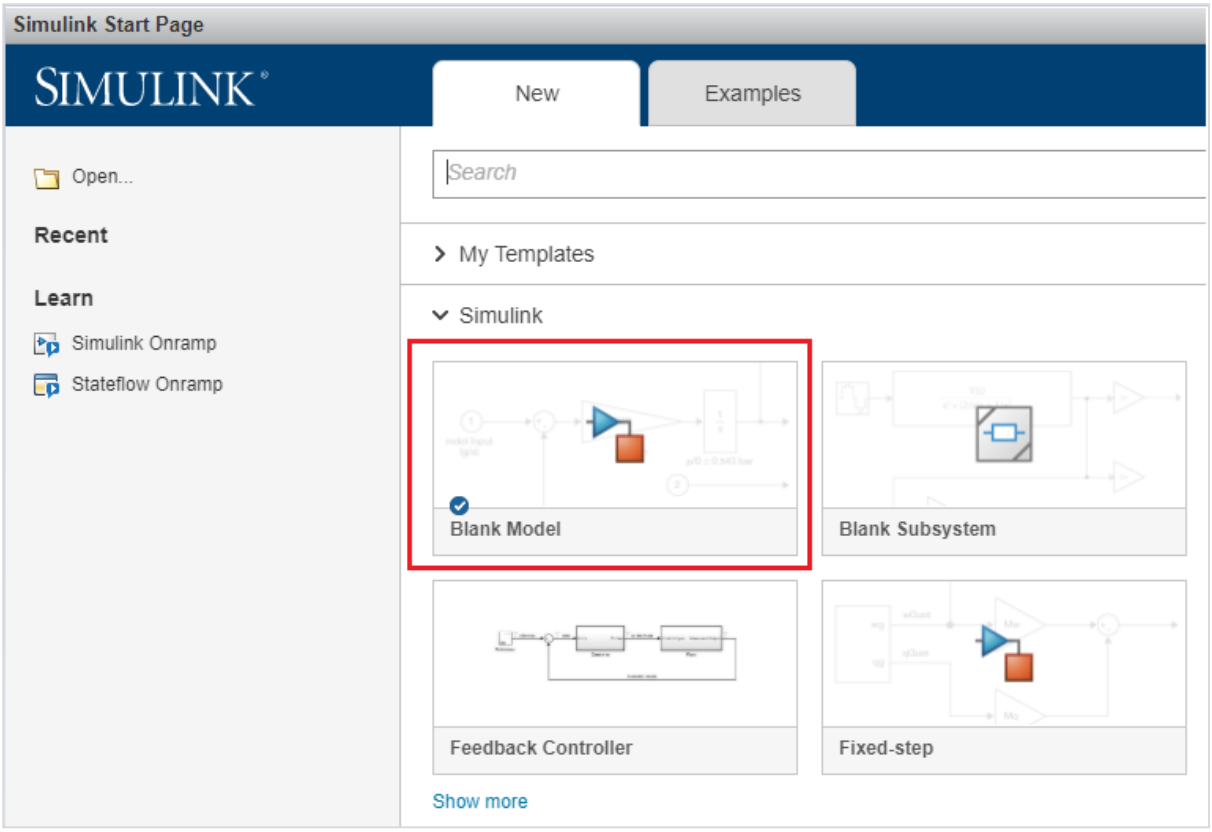
We have typed Sine and it displays all the blocks related to sine.

5. MATLAB Simulink — Lines

In the previous chapter, we learnt about the different types of blocks which are available with Simulink library. In this chapter, we are going to understand about lines.

Lines are used to connect the blocks with an arrow. Each block will have its own input and output connector. The communication between the blocks will take place with the help of lines.

Let us understand the same with an example. Select a blank model from Simulink page as shown below:



It will open a blank model workspace as shown below: