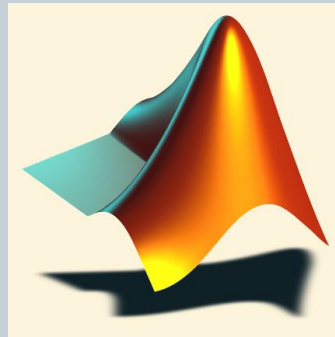# Introduction to SIMULINK

1

Shameer Koya

Simulink

- Used to model, analyze and simulate dynamic systems using block diagrams.

- Simulink is a graphical, "drag and drop" environment for building simple and complex signal and system dynamic simulations – therefore is easy to use.

- It allows users to concentrate on the structure of the problem, rather than having to worry about a programming language.

- We simulate a model to study the behavior of a system – need to verify that our model is correct
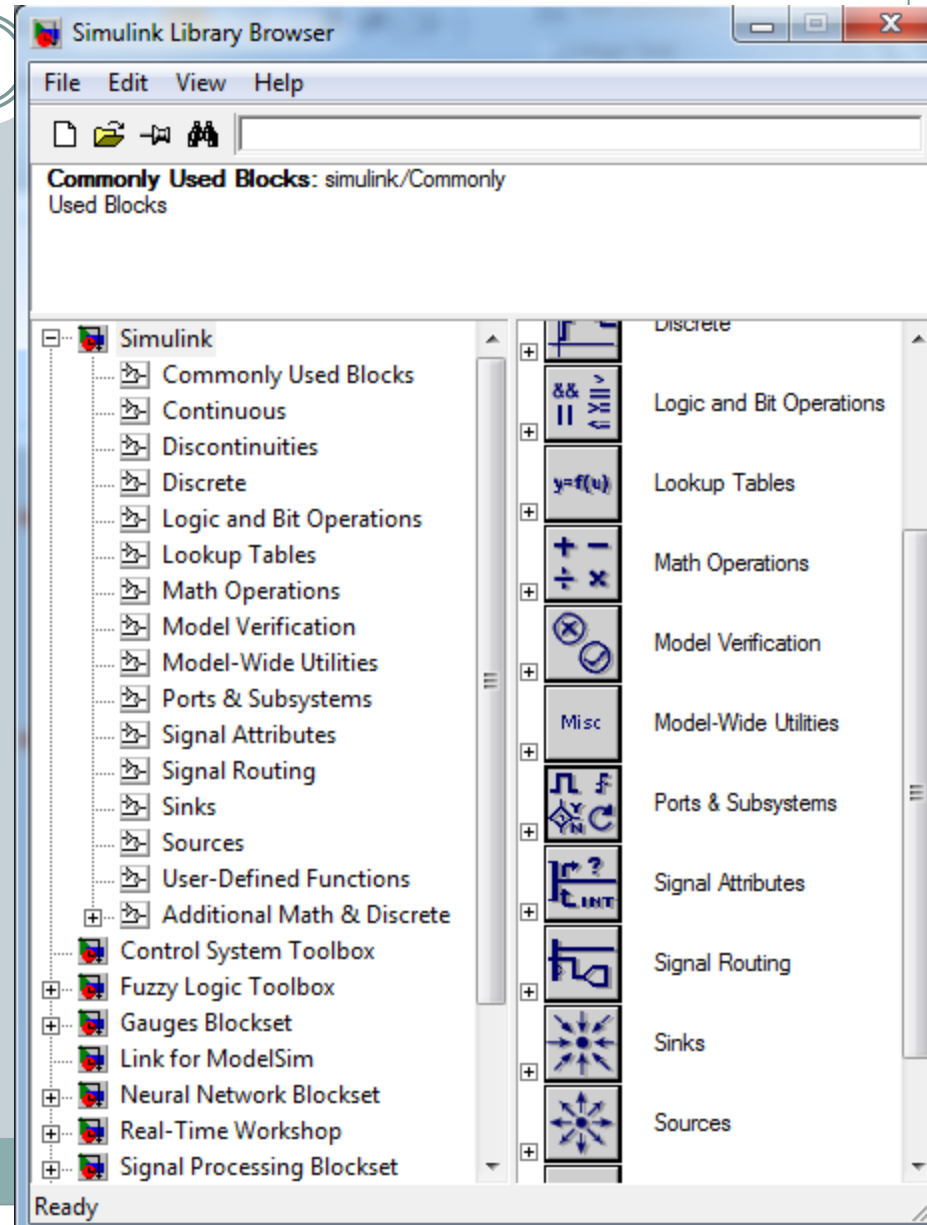
Launch Simulink

Create a new model

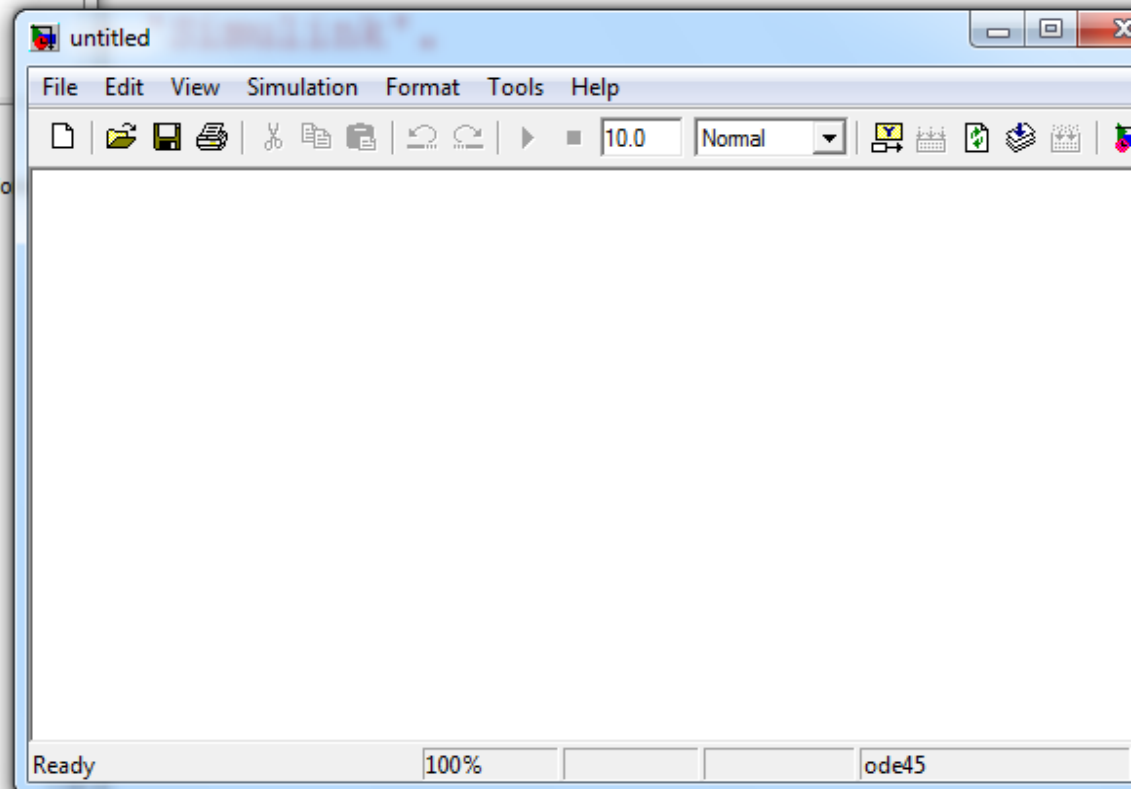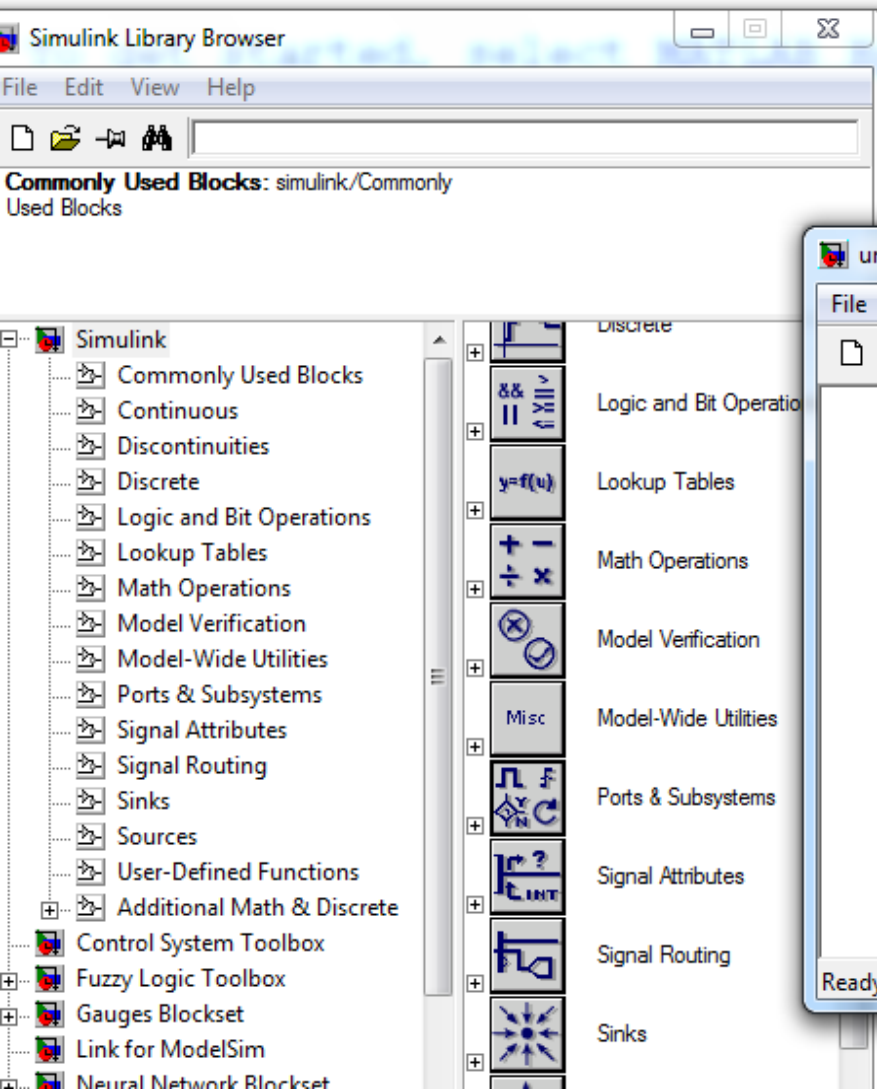Click the new-model icon in the upper left corner to start a new Simulink file

Create new model under *file/new/model.*

Your workspace

...elp or Demos from the Help menu.

Simulink- libraries

- *Sources*: blocks that have only output, generators, constant,...

- *Sinks*: blocks that have only input, scope, to worspace..

- *Continuous*; integrator, transfer function..

- *Discrete*: discrete transfer function, unite delay, memory..

- *Math operations*: gain, product, sum, trigonometric functions..

- *User defined functions*: S-function, S-function builder,..

- *SimPowersystem:* Electrical blocks – electrical sources, machines, measurements, ...

Simulink Library Browser (1)

Band-Limited White Noise: White noise for continuous (s-domain) systems. Band-limited using zero-order-hold.

Simulink tree:
- Simulink
  - Continuous
  - Discontinuities
  - Discrete
  - Look-Up Tables
  - Math Operations
  - Model Verification
  - Model-Wide Utilities
  - Ports & Subsystems
  - Signal Attributes
  - Signal Routing
  - Sinks
  - Sources
  - User-Defined Functions
- Fixed-Point Blockset
- Fuzzy Logic Toolbox
- S-function demos
- Simulink Extras

Sources blocks:
- Band-Limited White Noise
- Chirp Signal
- Clock
- Constant
- Digital Clock
- From Workspace (simin)
- From File (untitled.mat)
- Ground
- In1
- Pulse Generator
- Ramp
- Random Number
- Repeating Sequence
- Signal Generator
- Signal Builder (Signal 1)
- Sine Wave
- Step
- Uniform Random Num

Ready

Simulink Library Browser (2)

Discrete Transfer Fcn: Matrix expression for numerator, vector expression for denominator. Output width equals the number of rows in the numerator. Coefficients are for descending powers of z.

Simulink tree:
- Simulink
  - Continuous
  - Discontinuities
  - **Discrete**
  - Look-Up Tables
  - Math Operations
  - Model Verification
  - Model-Wide Utilities
  - Ports & Subsystems
  - Signal Attributes
  - Signal Routing
  - Sinks
  - Sources
  - User-Defined Functions
- Fixed-Point Blockset
- Fuzzy Logic Toolbox
- S-function demos
- Simulink Extras

Discrete blocks:
- $\frac{1}{z+0.5}$ Discrete Transfer Fcn
- $\frac{(z-1)}{z(z-0.5)}$ Discrete Zero-Pole
- $\frac{1}{1+0.5z^{-1}}$ Discrete Filter
- Discrete State-Space
- $\frac{T}{z-1}$ Discrete-Time Integrator
- First-Order [Drag this icon into]
- Memory
- $\frac{1}{z}$ Unit Delay
- Zero-Order Hold

Ready

Simulink Library Browser (3)

Display: Numeric display of input values.

Simulink tree:
- Simulink
  - Continuous
  - Discontinuities
  - Discrete
  - Look-Up Tables
  - Math Operations
  - Model Verification
  - Model-Wide Utilities
  - Ports & Subsystems
  - Signal Attributes
  - Signal Routing
  - **Sinks**
  - Sources
  - User-Defined Functions
- Fixed-Point Blockset
- Fuzzy Logic Toolbox
- S-function demos
- Simulink Extras

Sinks blocks:
- Display
- Floating Scope
- Out1
- Scope
- STOP Stop Simulation
- Terminator
- To File (untitled.mat)
- To Workspace (simout)
- XY Graph

Ready

Simulink Library Browser (4)

Simulink tree:
- Simulink
  - **Continuous**
  - Discontinuities
  - Discrete
  - Look-Up Tables
  - Math Operations
  - Model Verification
  - Model-Wide Utilities
  - Ports & Subsystems
  - Signal Attributes
  - Signal Routing
  - Sinks
  - Sources
  - User-Defined Functions
- Fixed-Point Blockset
- Fuzzy Logic Toolbox
- S-function demos
- Simulink Extras

Continuous blocks:
- $\frac{du}{dt}$ Derivative
- $\frac{1}{s}$ Integrator
- $\begin{array}{l} x = Ax+Bu \\ y = Cx+Du \end{array}$ State-Space
- $\frac{1}{s+1}$ Transfer Fcn
- Transport Delay
- Variable Trans [Drag this icon in]
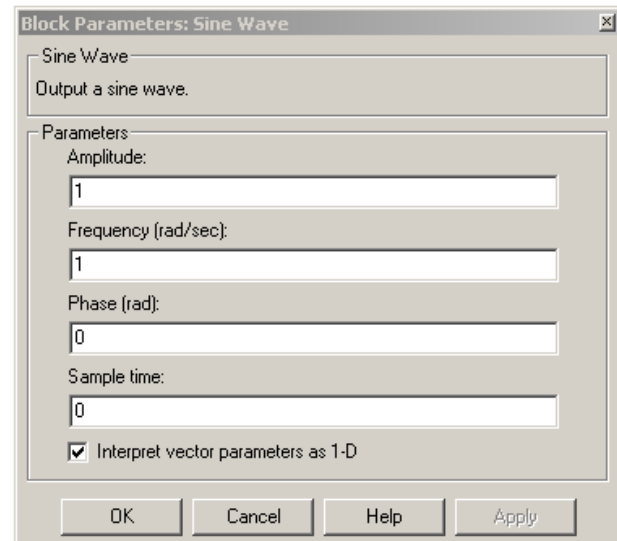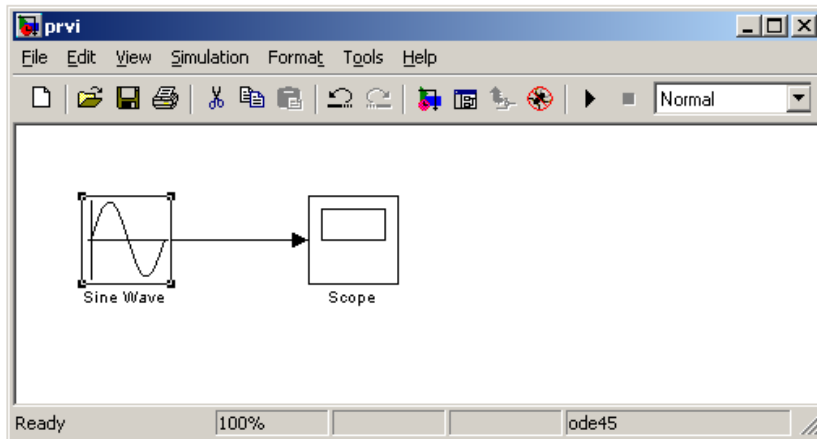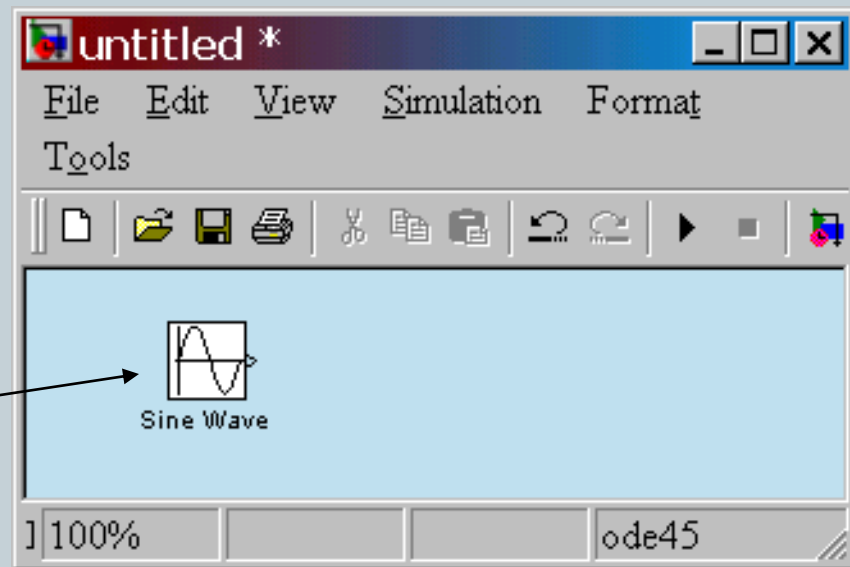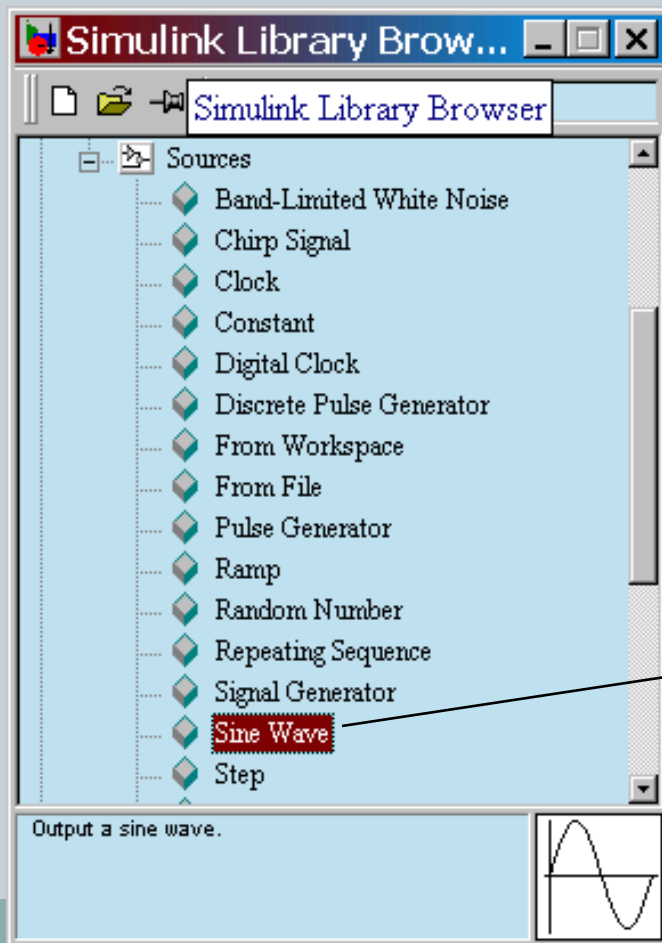- $\frac{(s-1)}{s(s+1)}$ Zero-Pole

Ready

Creating a model

- Model is created by choosing the blocks from different libraries, dragging them to model window and linking them.

- The parameters of block (shown on picture, sine wave parameters), can be reached with double click on the block.
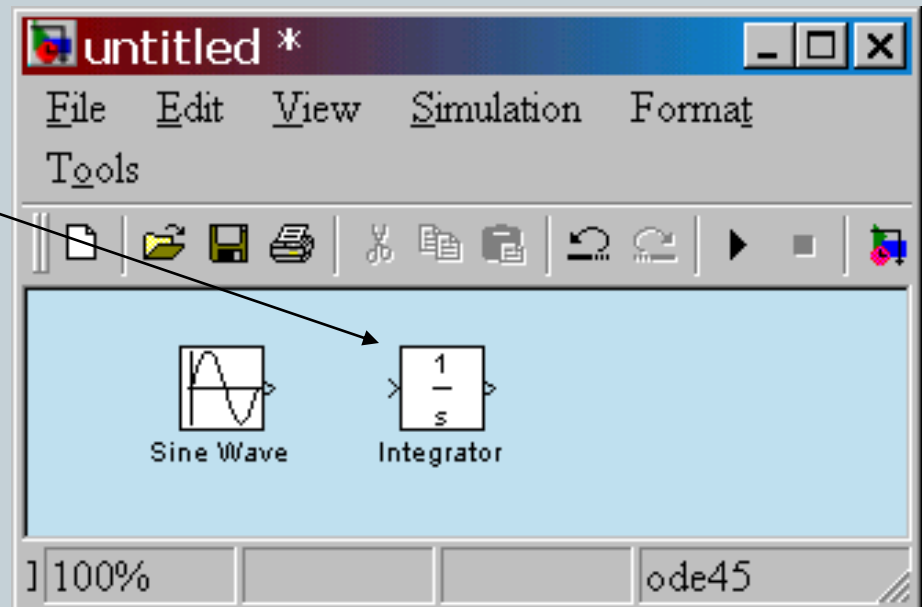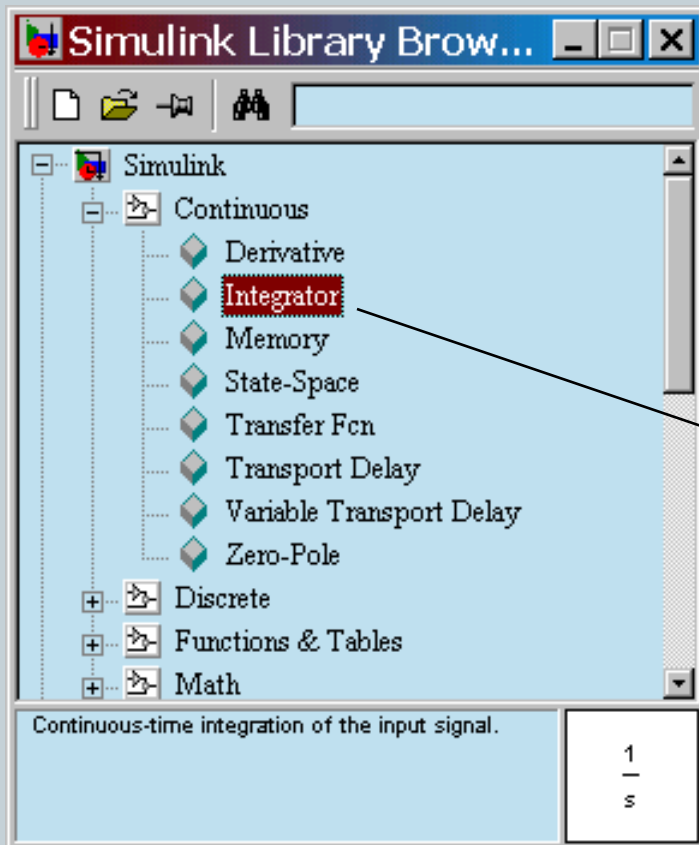
Select an input block

- Drag a *Sine Wave* block from the *Sources* library to the model window
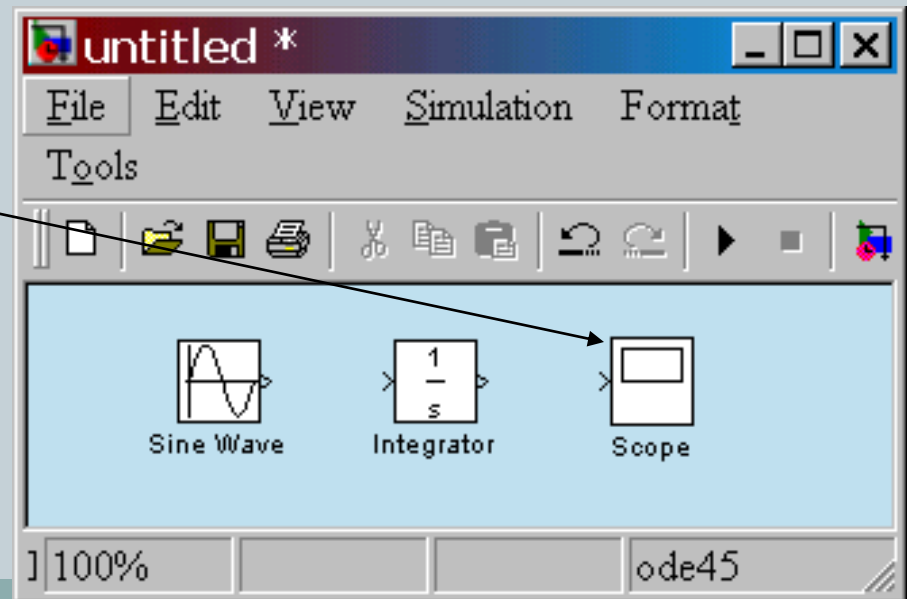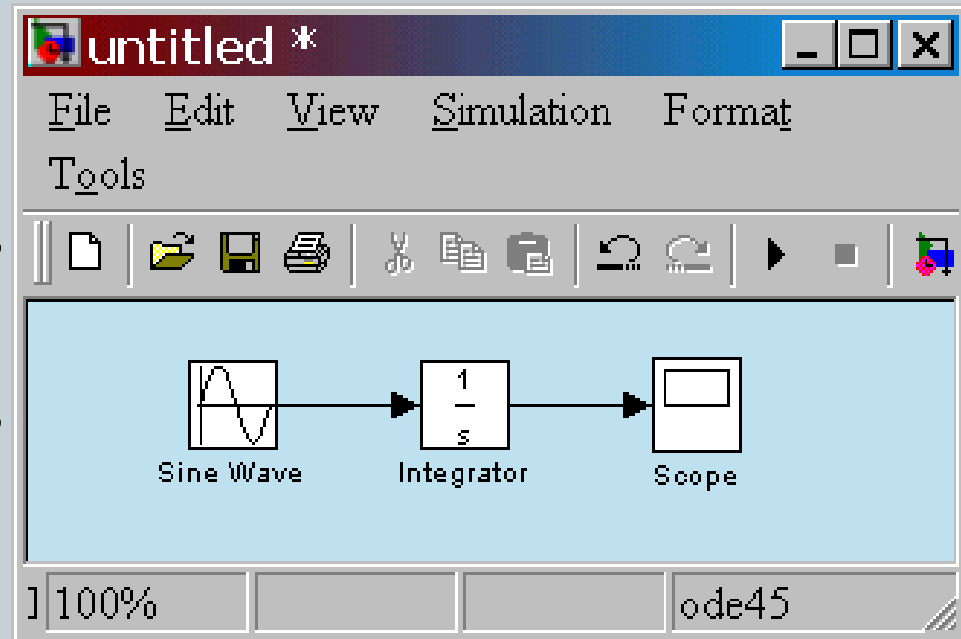
Select an operator block

Select an output block

- Drag a *Scope* block from the *Sinks* library to the model window
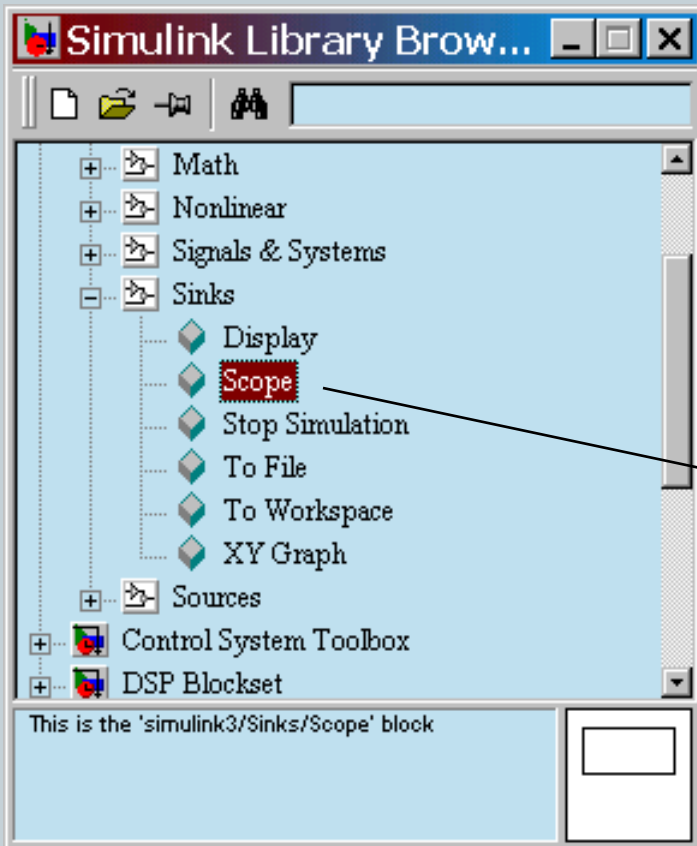
Connect blocks with signals

- Place your cursor on the output port (>) of the *Sine Wave* block

- Drag from the *Sine Wave* **output** to the *Integrator* **input**

- Drag from the *Integrator* **output** to the *Scope* **input**

- Arrows indicate the direction of the signal flow

Set block parameters

- The parameters of block (shown on picture, sine wave and integrator parameters), can be reached with double click on the block
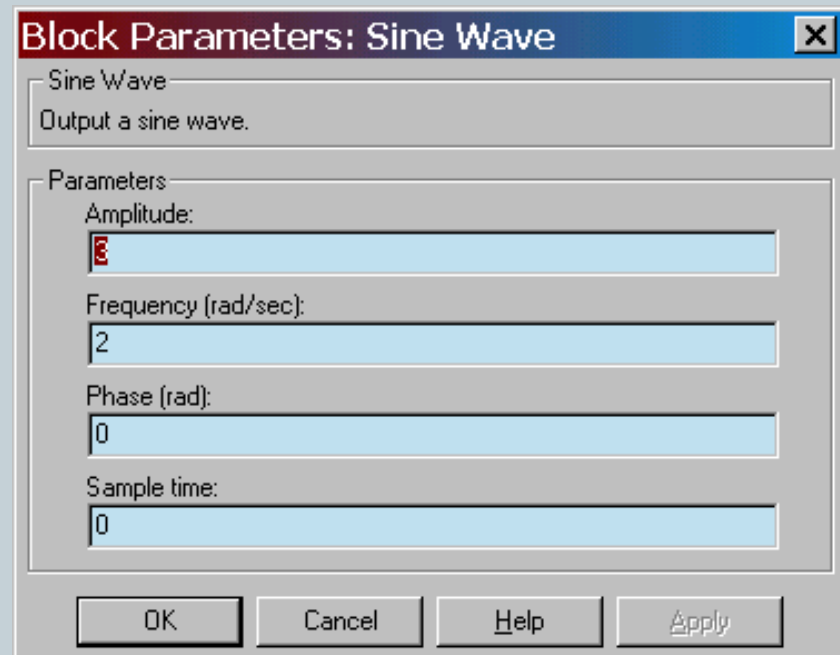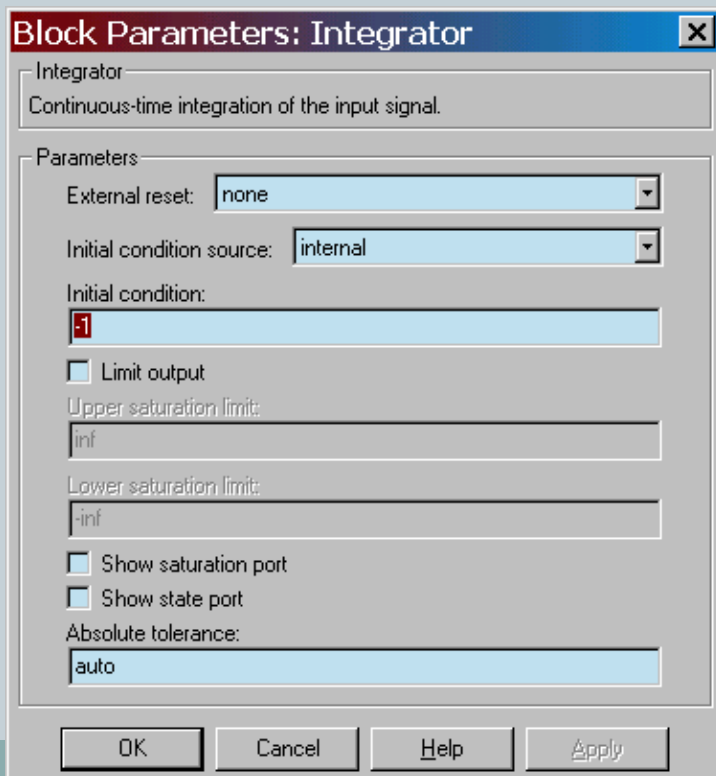
Configuration parameters

- Numerical solver method, start time, stop time (it can be also set directly)…
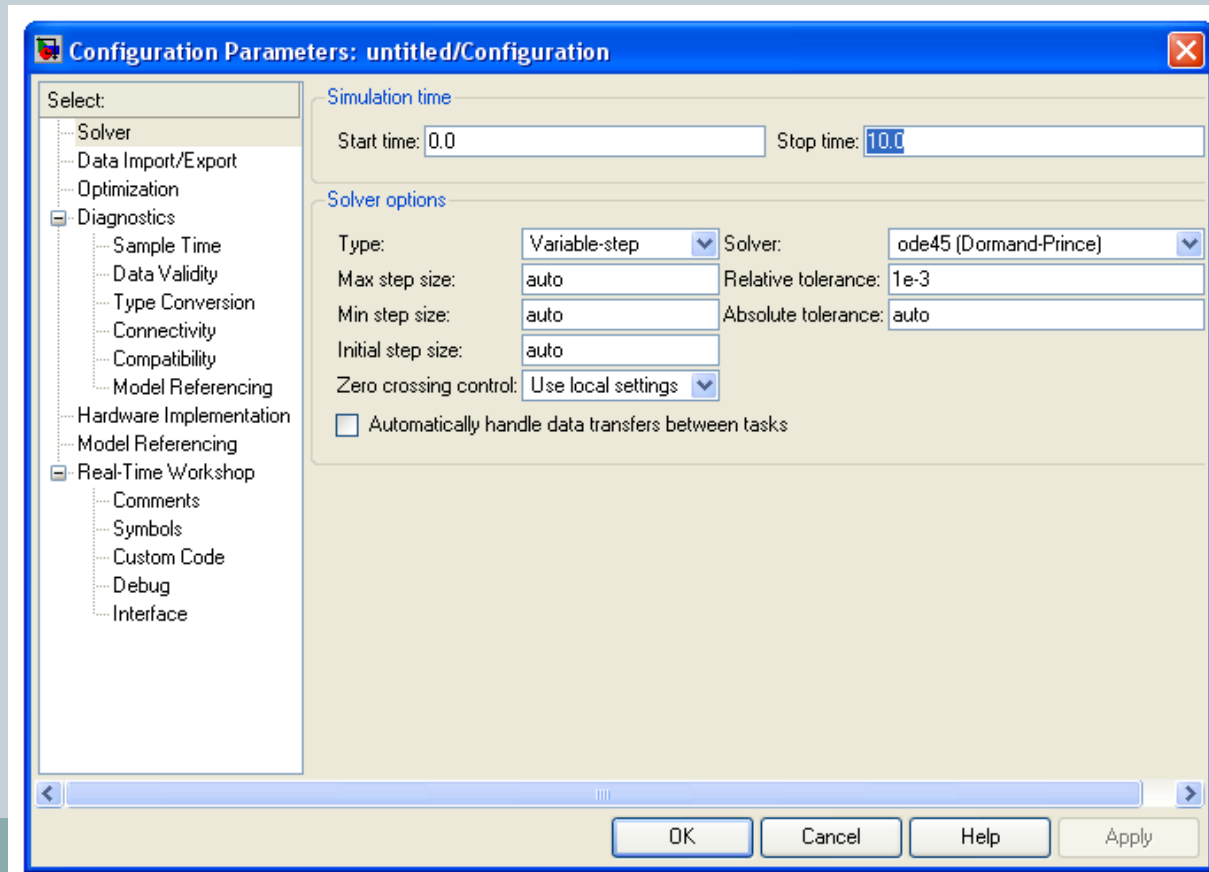
Run the simulation

- In the model window, from the *Simulation* pull-down menu, select *Start*
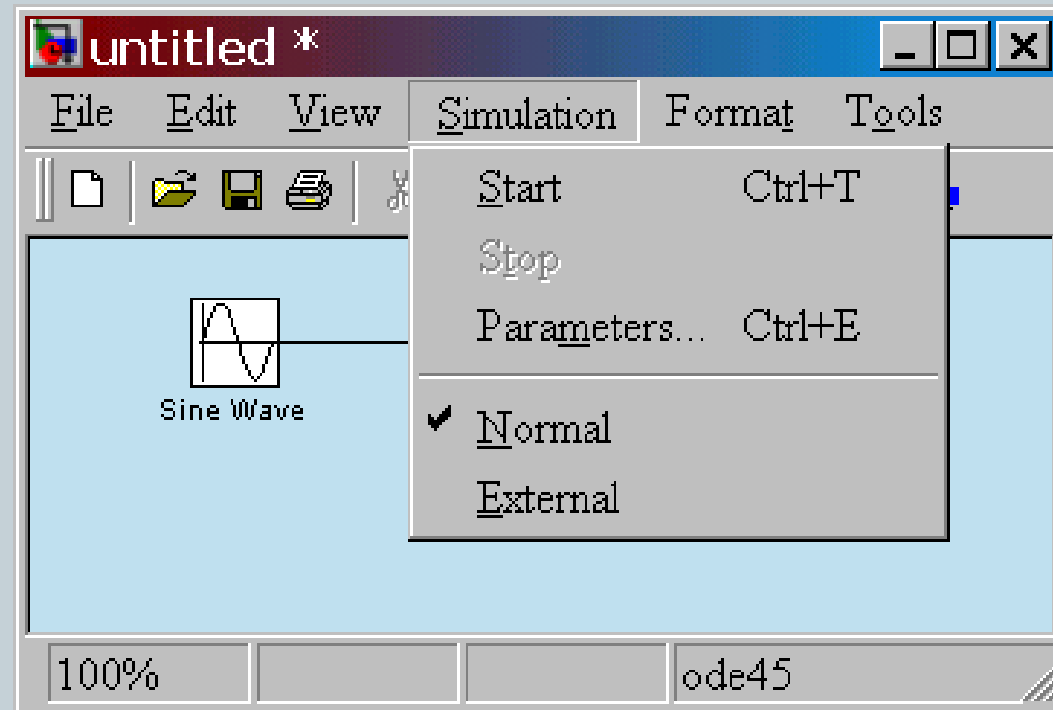
Simulation results

- Double-click on the *Scope* to view the simulation results
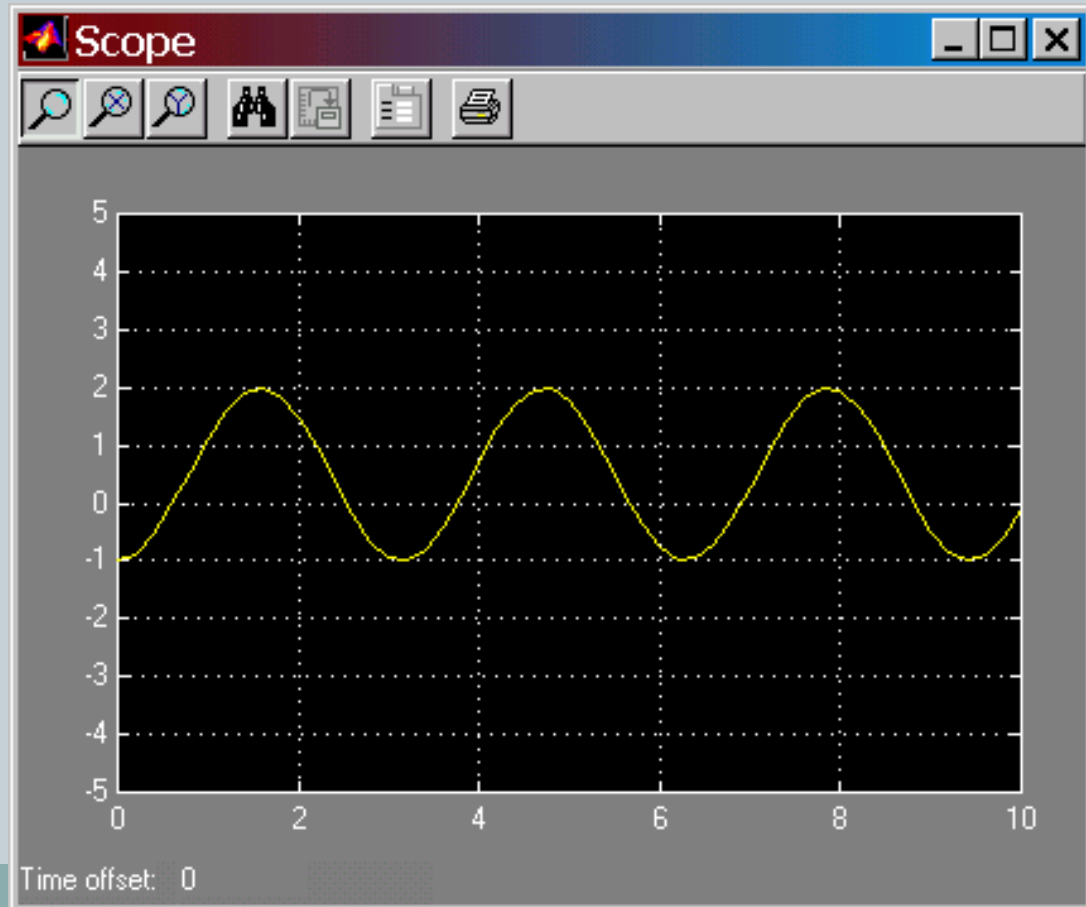
Summary

Type the following at the Matlab command prompt

`>> simulink`

The **Simulink library** should appear

Click File-New to create a new **workspace**, and drag and drop objects from the library onto the workspace.

Selecting **Simulation-Start** from the pull down menu will run the dynamic simulation. Click on the blocks to view the data or alter the run-time parameters
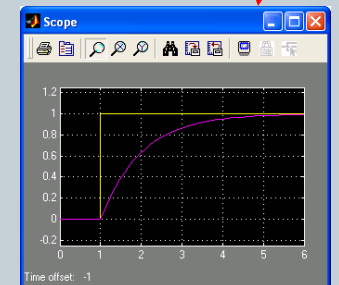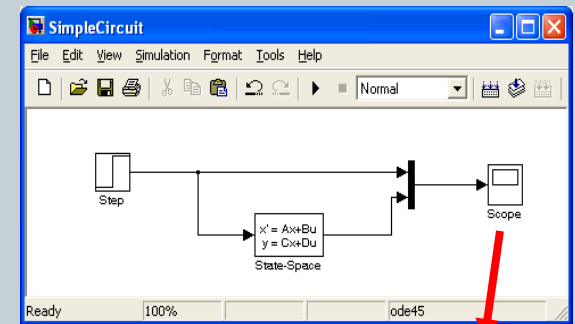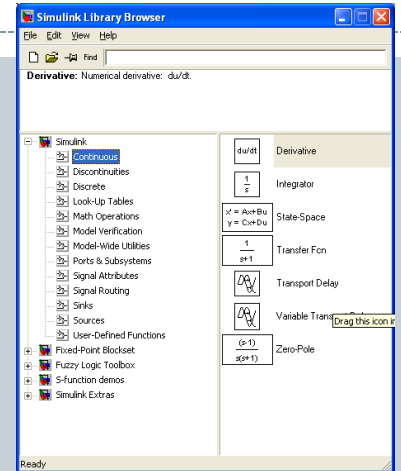
Now, let's build a simple model!

This model plots the sign of the input signal.
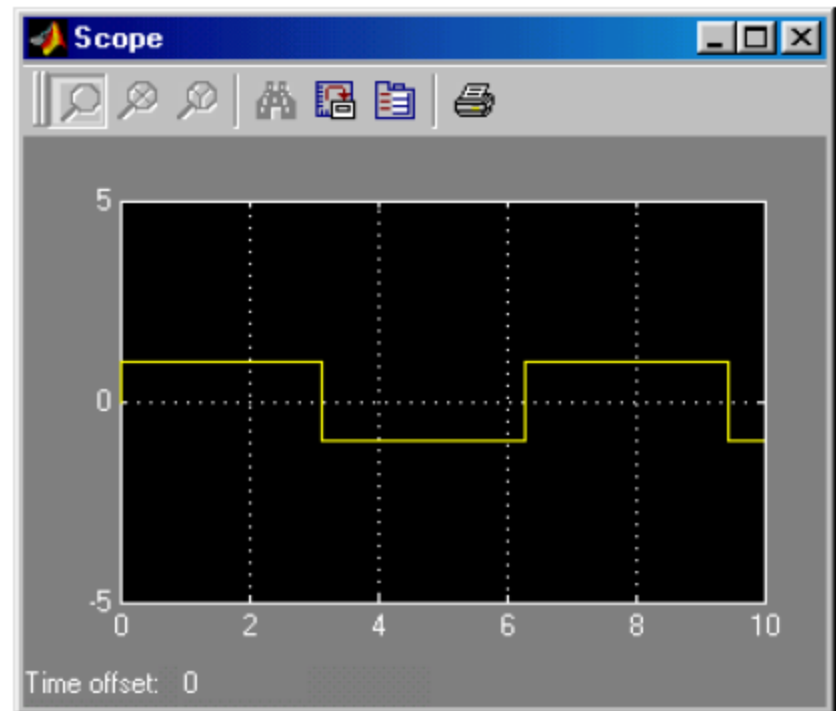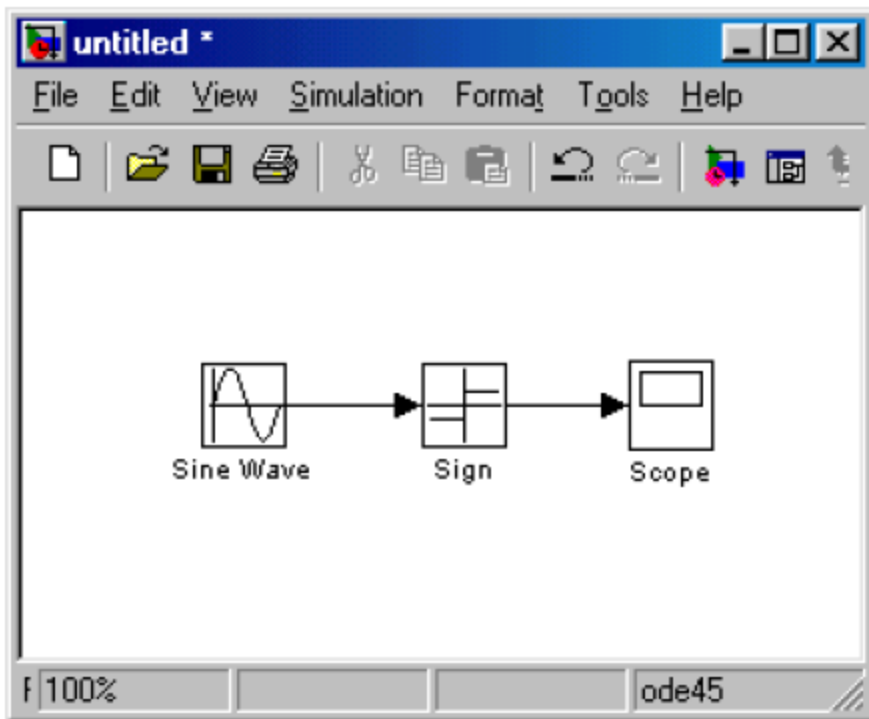
Example -- Step 1

Step1: Start Simulink and choose New then Model from the File menu.
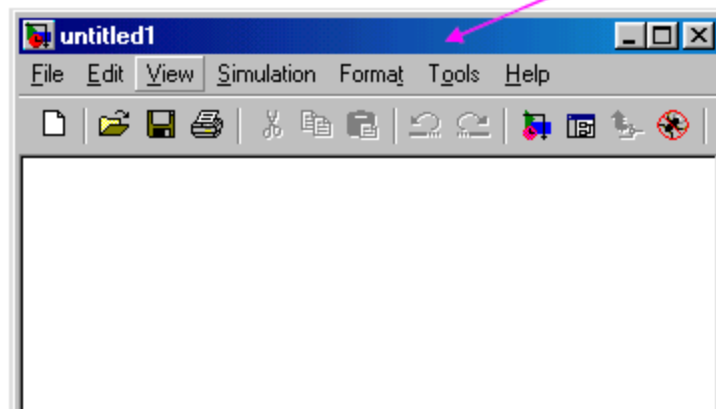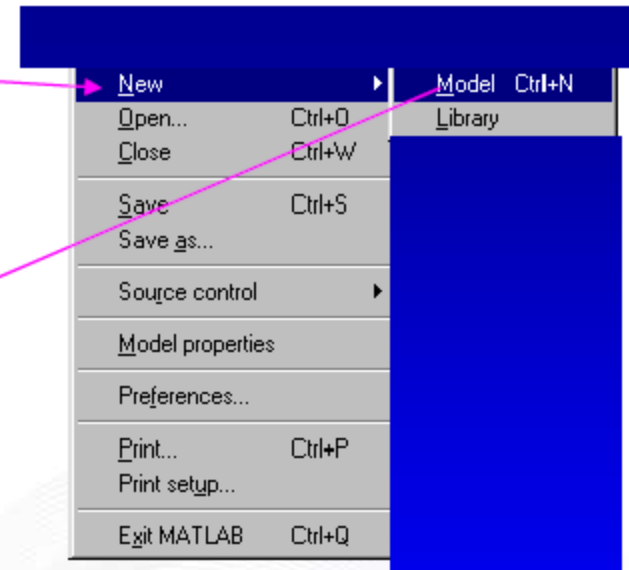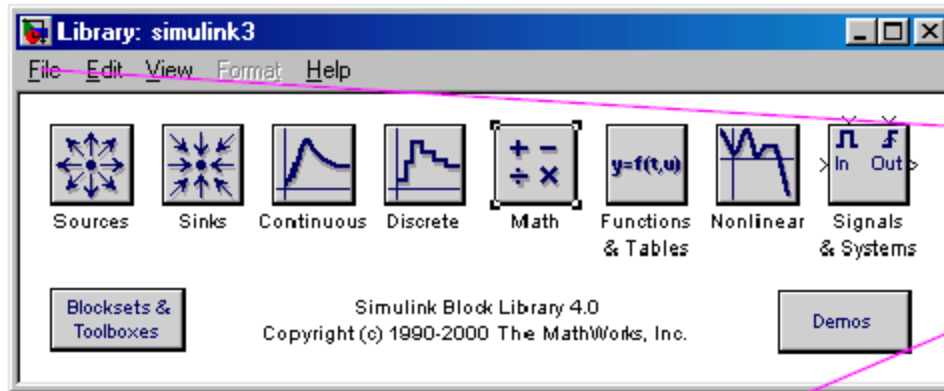
Example -- Step 2

Step2: Copy the needed blocks by using Drag and Drop.
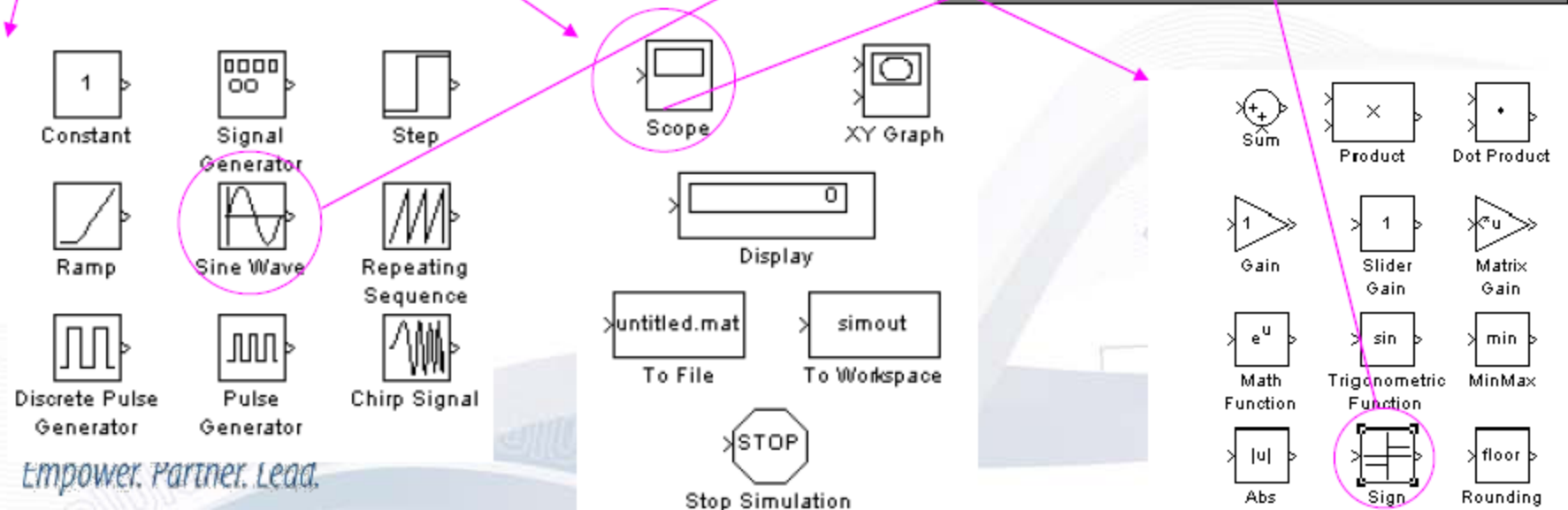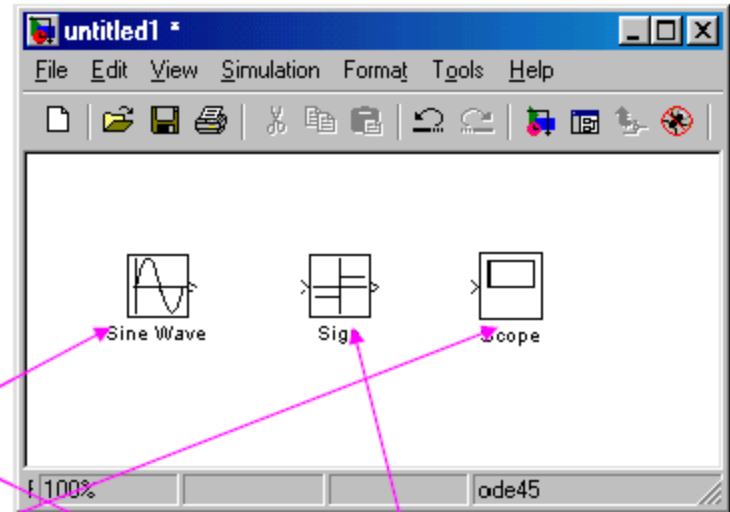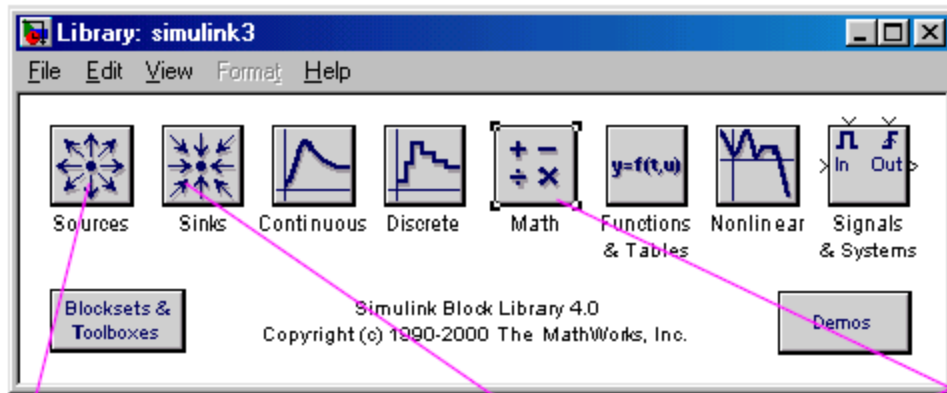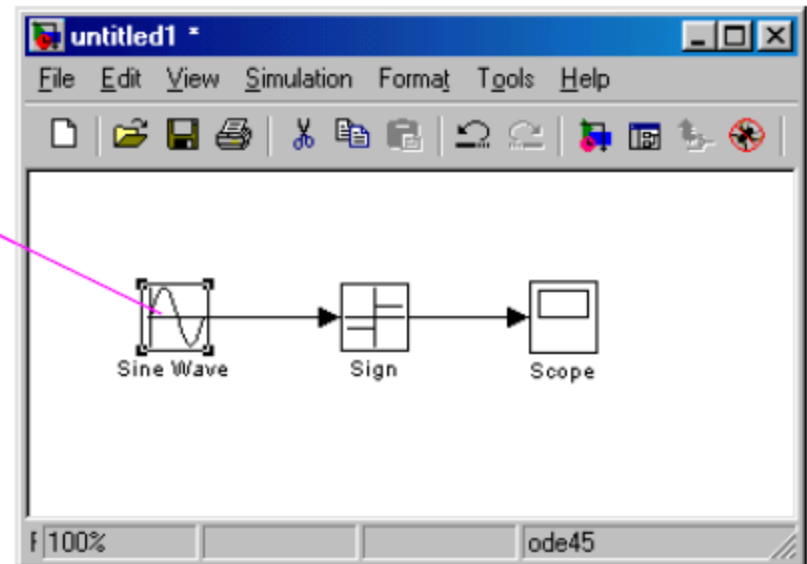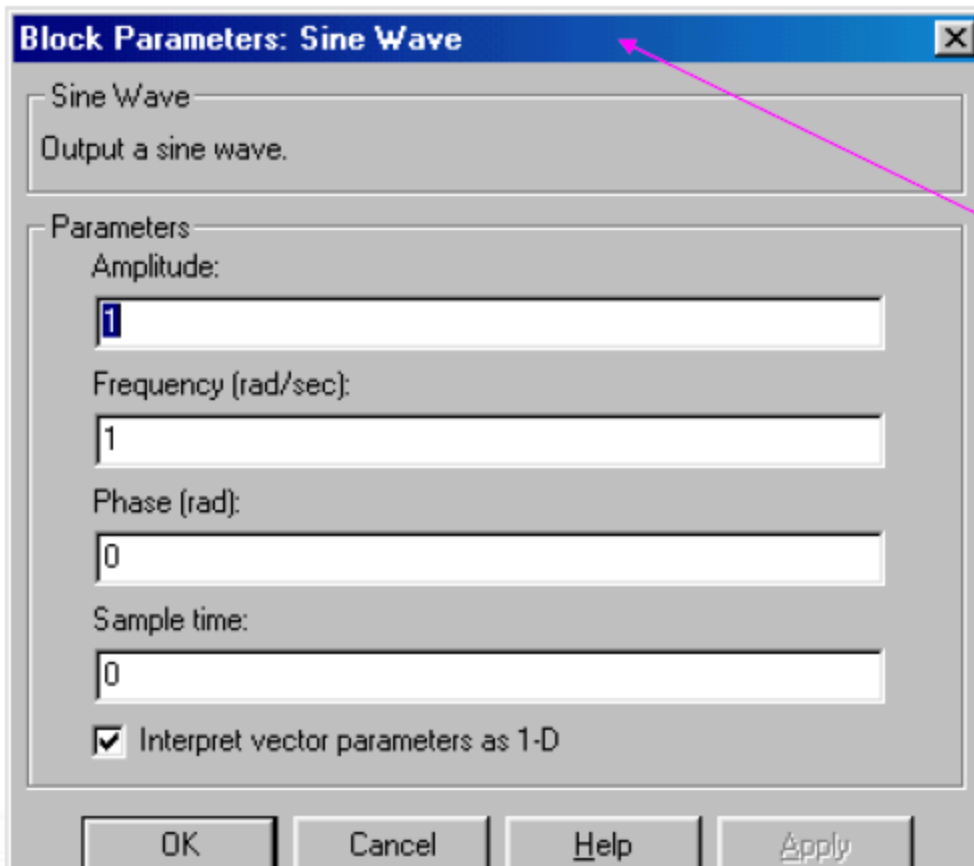
Example -- Step 3

Step3: Complete the connection.
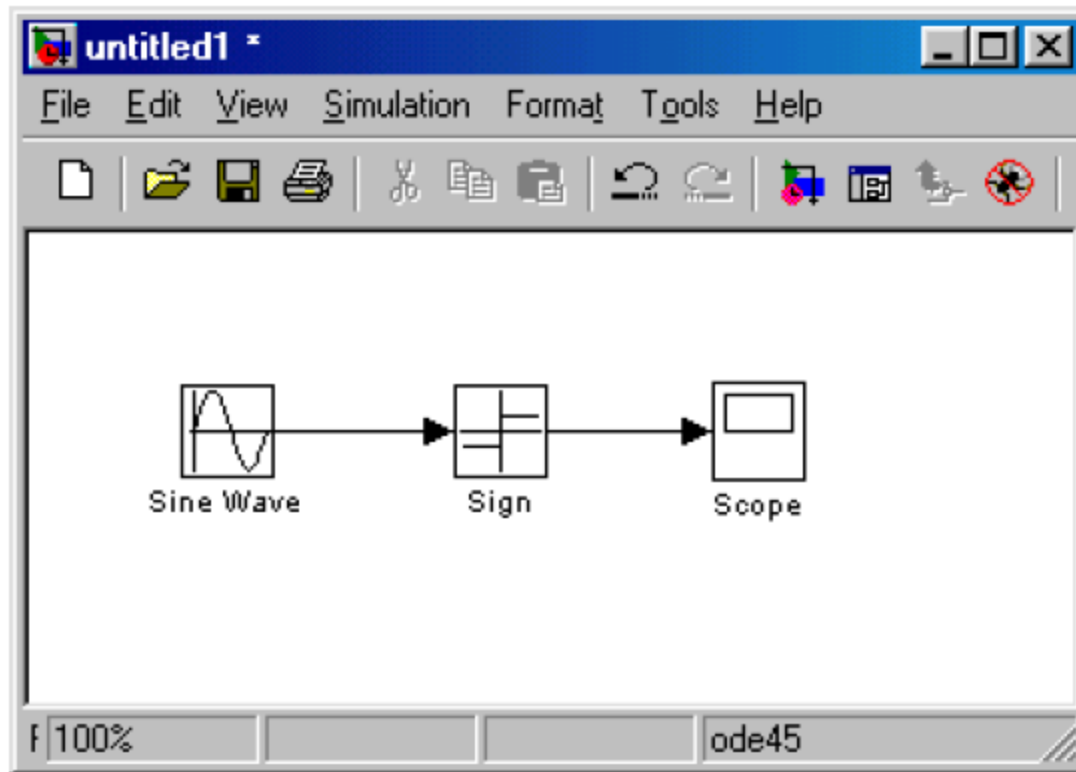
- Move the mouse to the location of output port of the source block.
- Hold down the mouse button and move the cursor to the input port of the destination block.
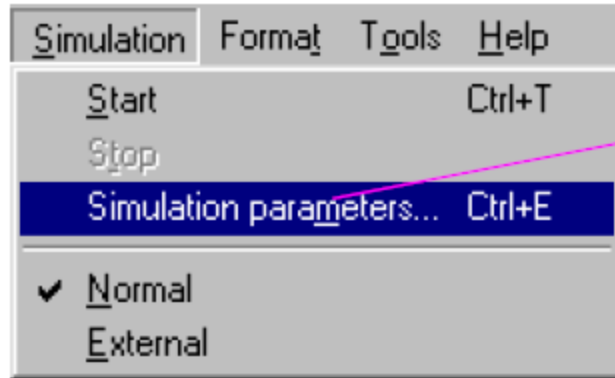- Release the mouse button.

Example -- Step 4

Step4: Set the block parameters.

Double click a block to open its block parameters.

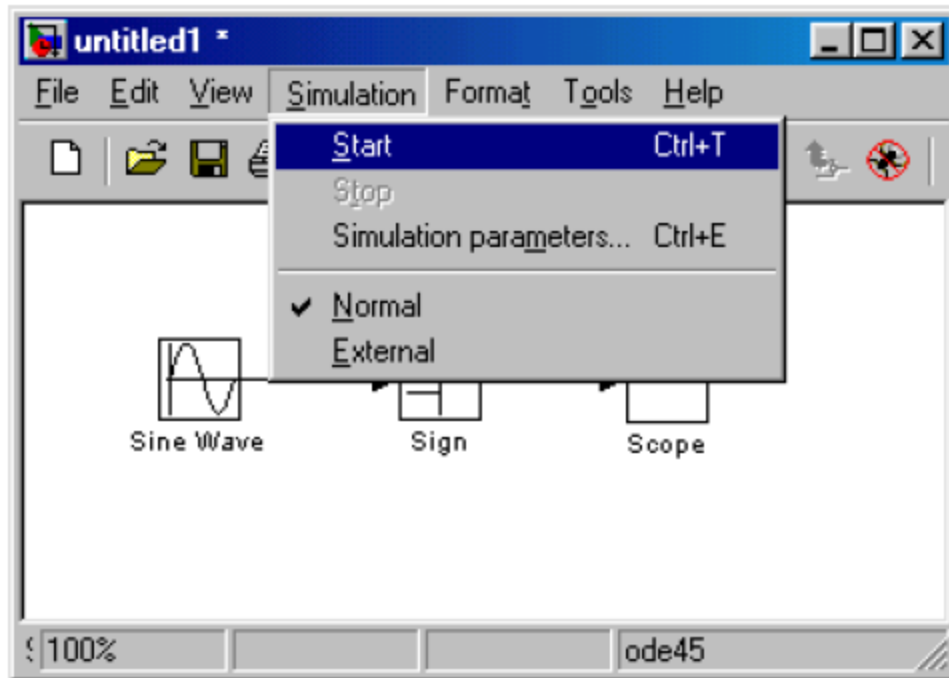# Example -- Step 5
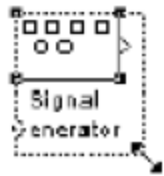
Step5: Setup the simulation parameters.
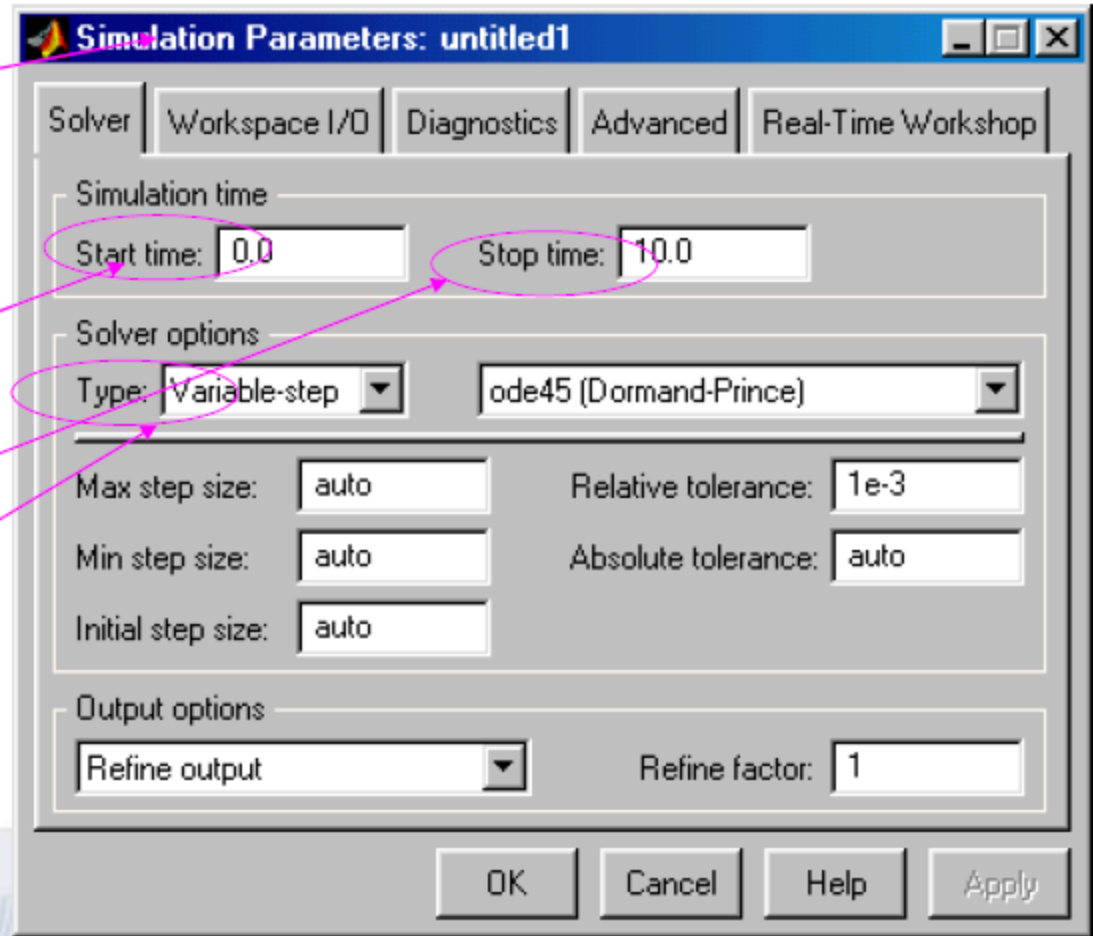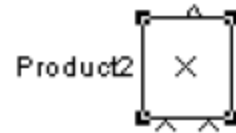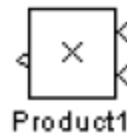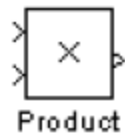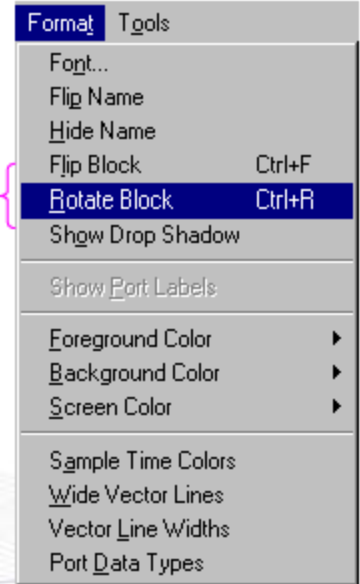
Example -- Step 6

Step6: Start simulation.
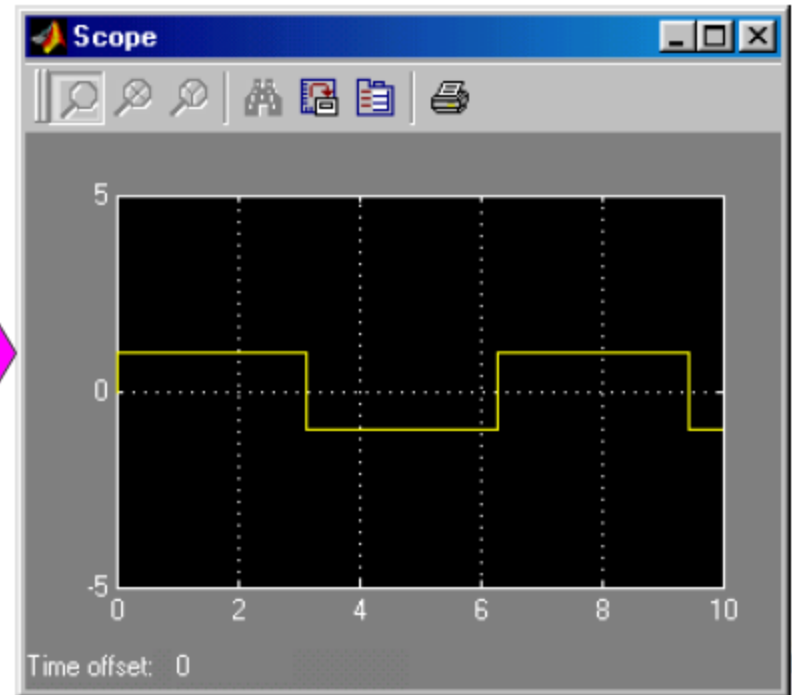
Manipulating blocks

Select a corner and drag to resize a block

Rotating a block

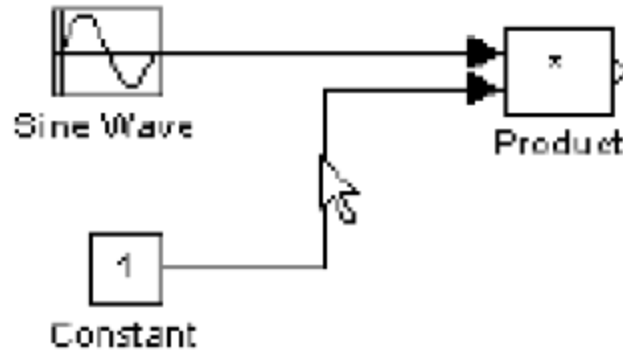Single click on the block label to change block name
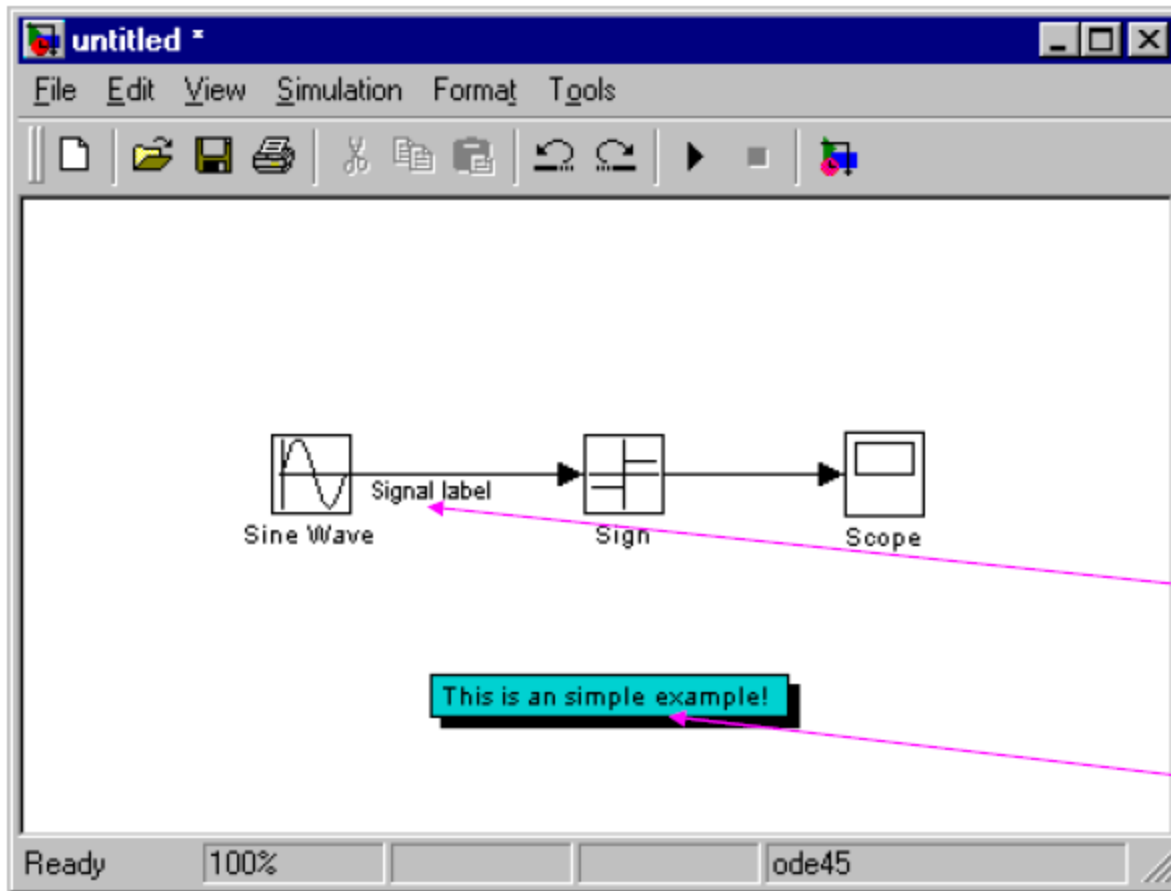
| Format	Tools
Font...	
Flip Name	
Hide Name	
Flip Block	Ctrl+F
Rotate Block	Ctrl+R
Show Drop Shadow	
Show Port Labels	
Foreground Color	▶
Background Color	▶
Screen Color	▶
Sample Time Colors	
Wide Vector Lines	
Vector Line Widths	
Port Data Types	

Labels and Annotations

Moving a line segment

Step1: Position the pointer on the segment you want to move.

Step2: Press and hold down the left mouse button.
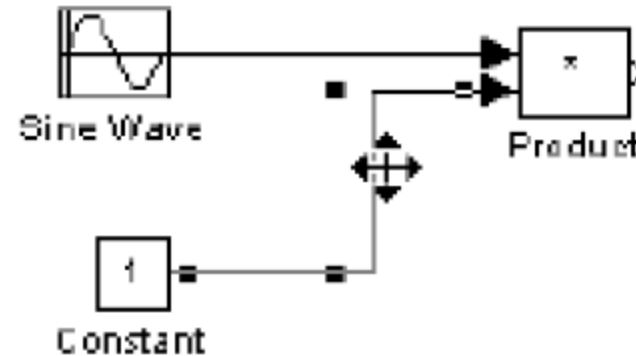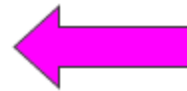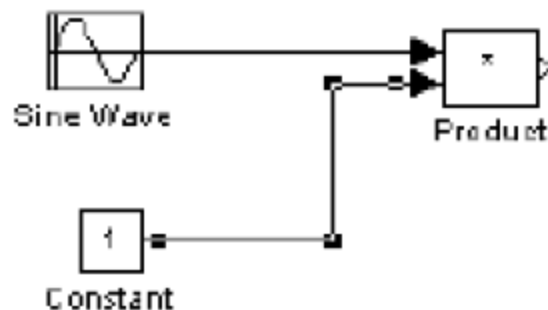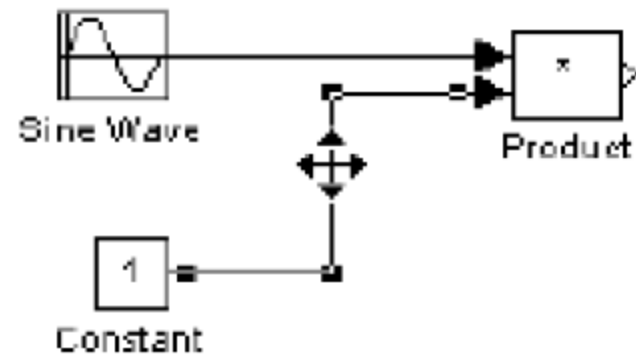
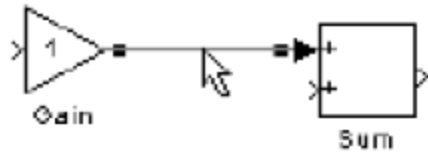**Step3:** Drag the pointer to the desired location.

Step4: Release the mouse button.

Dividing a line into segments

Step1: Select the line.

Step2: Position the pointer on the line where you want the vertex.

Step3: While holding down the Shift key, press and hold down the mouse button.
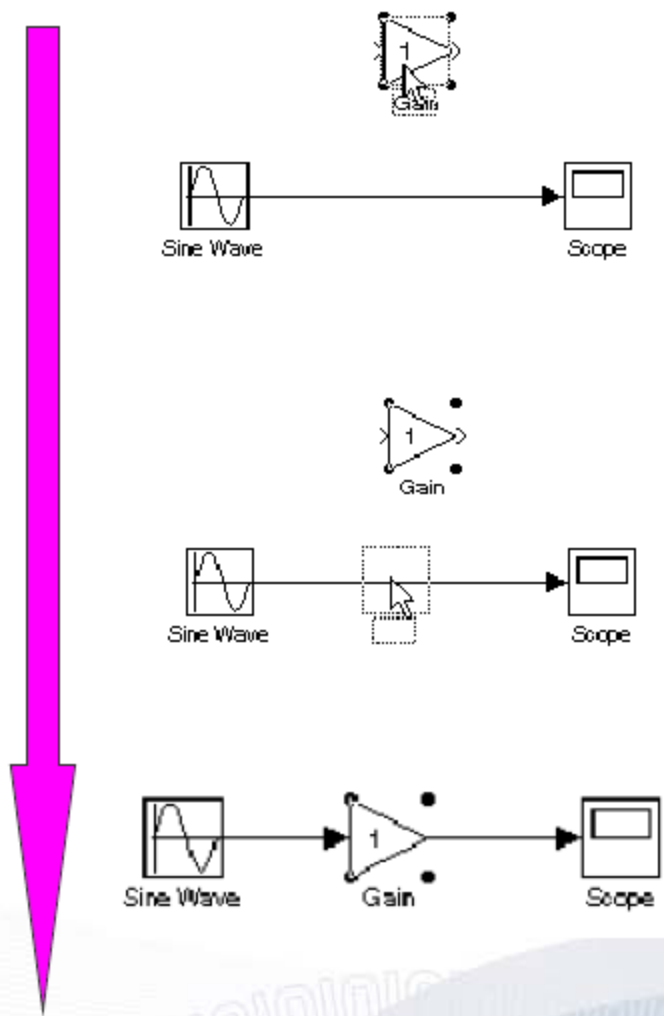
Step4: Drag the pointer to the desired location.

Step5: Release the mouse button and the Shift key.
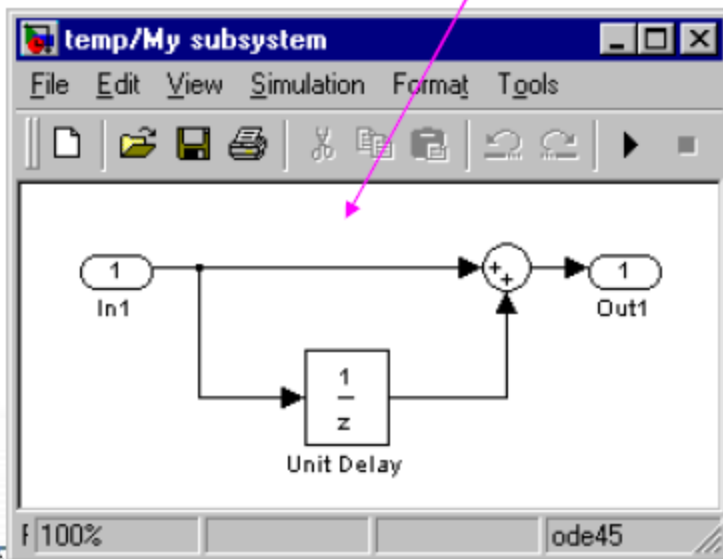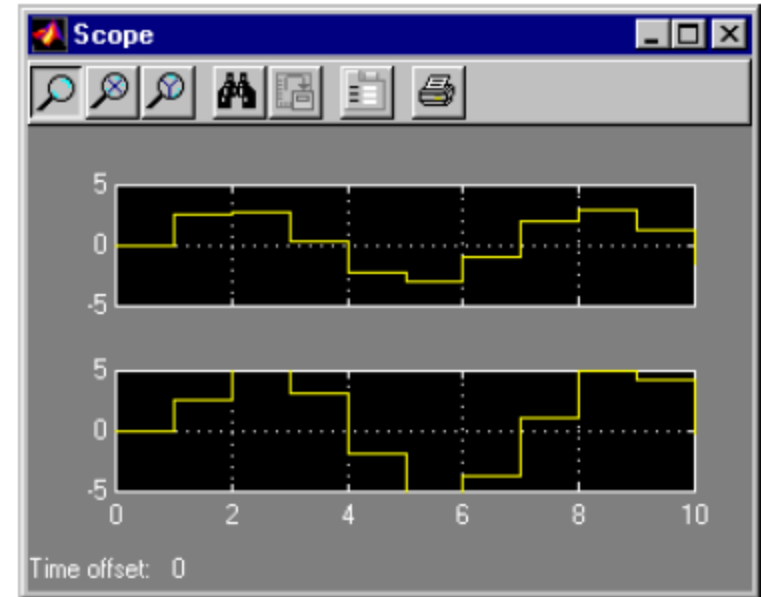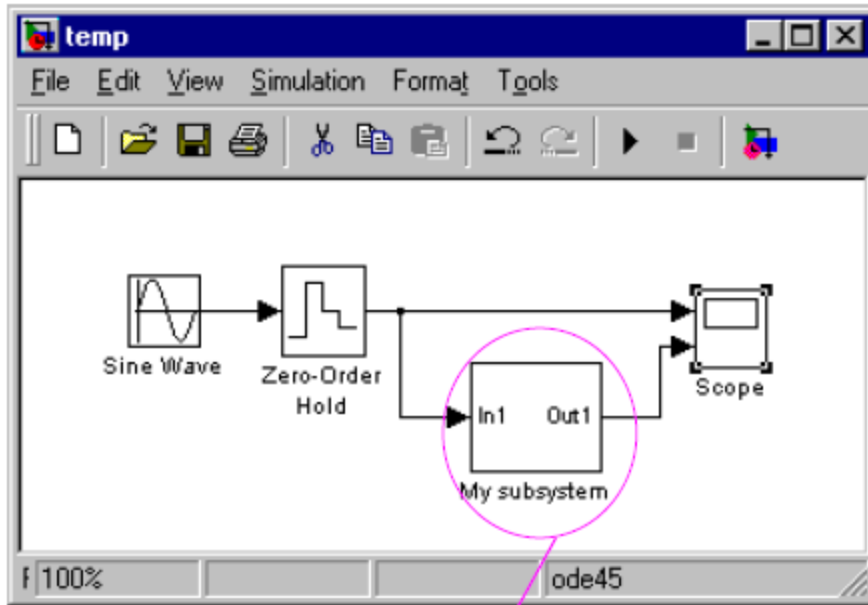
Inserting a block in a line

Step1: Position the pointer over the block and press the left mouse button.

Step2: Drag the block over the line in which you want to insert the block.

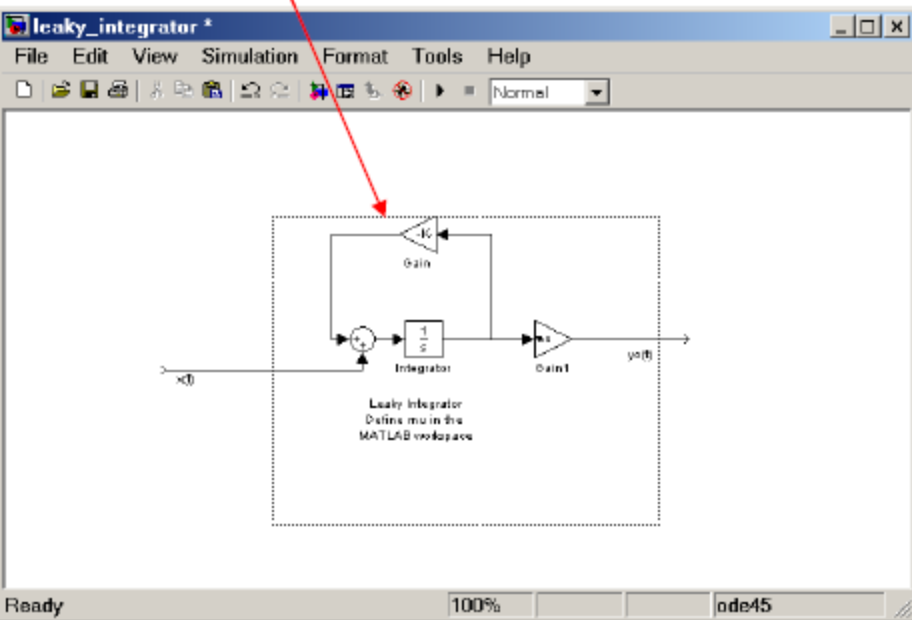**Step3**: Release the mouse button to drop the block on the line.

Subsystems

Subsystems can hide the complexity of the subsystems from the user, which can make your model clearer. There are two ways to create Subsystems.
•You can create a Subsystem by adding the Subsystem block from Signals & Systems. Then you can edit the Subsystem by doubling clicking the Subsystem block.
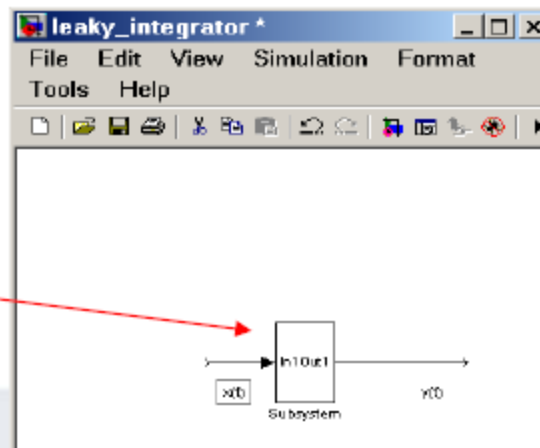•You can create create the subsystem by grouping blocks from an existing system.

1. Use the mouse to select the blocks

2. Choose Create Subsystem from the Edit menu

3. This replaces the selected blocks with a Subsystem block.

Thanks

Questions ??