

## MATLAB Marina: Plotting 2D

### Student Learning Objectives

After completing this module, one should:

1. Be able to generate and appropriately annotate 2D plots using MATLAB.

### Terms

figure window, 2D plot, annotate

### MATLAB Functions, Keywords, and Operators

figure, plot, xlabel, ylabel, title, legend, text, gtext, grid, axis, clf, close, subplot, stem, semilogx, semilogy, loglog

### Plotting

MATLAB has an extensive set of functions for creating and annotating plots. Two-dimensional plots can be created using the `plot` function. The statement `plot(x,y)` creates a two-dimensional plot using the array `x` as the x-axis values and the array `y` as the y-axis values. The `x` and `y` arrays must have the same dimensions. Invoking the plot function for a single argument, `plot(y)`, plots the values of `y` versus their array index.

Multiple plots can be placed on the same axes by invoking plot with multiple pairs of `x` axis and `y` axis arrays. The statement `plot(t,y1,t,y2)` plots `y1` versus `t` and `y2` versus `t` on the same axes. The scale of each axis and the axes ticks are added automatically. Plots are placed in the active figure window. If there is not an active figure window, the plot function will create and open a figure window (starting with figure 1).

Plots can be annotated using the `xlabel`, `ylabel`, `title`, and `text` functions. The `xlabel` and `ylabel` functions take a string (or array of characters) as their argument and place the text in the string on the `x` and `y` axis respectively. The `title` function places text centered on the top of the figure. The `text` and `gtext` functions allow one to place text from a string anywhere in the figure (`gtext` activates a set of cursors that are used to select where to place the text). MATLAB also has functions: `grid` to place a grid on the plot, `axis` to specify the `x` and `y` axis limits and other axis properties, and `legend` to create a legend.

### Figure Windows

MATLAB plots are displayed in figure windows (figure containers). The MATLAB function `figure` creates a new figure window which can be referenced by its figure number and `figure(#)` creates a figure with the specified figure number or makes the specified figure the current active figure.

The MATLAB function `clf` clears the current figure window and `clf(#)` clears the specified figure window. The MATLAB function `close` closes the current figure window, `close(#)` closes the specified figure window, and `close all` closes all open figure windows.

The MATLAB program of Figure 1a generates the plot of Figure 1b,  $f(t) = 1 - e^{-t}$  for  $0 \leq t \leq 1$  s.

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```
% plot of 1-exp(-t), t = 0 to 1 sec
clear; clc; close all;
t = 0.0 : 0.01 : 1.0;
f = 1 - exp(-t);
figure(1)
plot(t, f)
xlabel("t (s)", ylabel("f(t)"));
title("f(t) = 1 - e^{-t}");
grid
```

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Figure 1a. Program to Create a 2D Plot

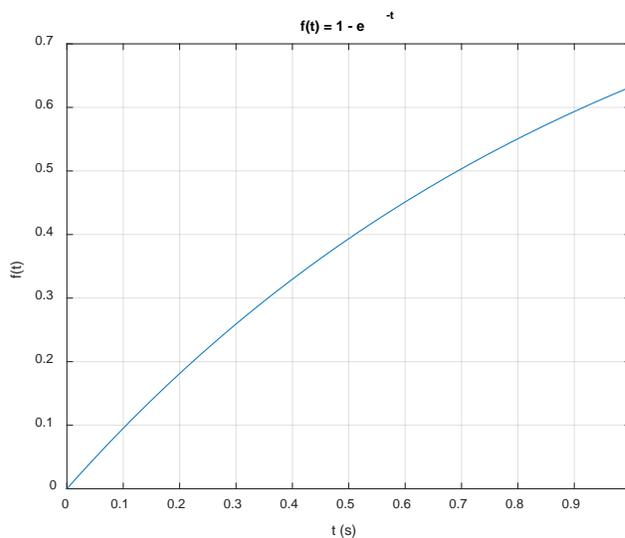


Figure 1b. Plot of  $f(t) = 1 - e^{-t}$

### Other Useful Plotting Functions

Other MATLAB plotting functions are `stem`, `semilogx`, `semilogy`, `loglog`, `bar`, `hist`, `pie`, and `polar`. Other functions that are useful with plots are `subplot`, `hold` and `view`. See MATLAB's help for more info on the different plot types.

### Annotation using Figure Menus

The Figure window toolbar and menus provide many other options for viewing and annotating plots. The Figure Insert menu has options for axis labels, titles, legends, and options for inserting lines, arrows, and textboxes, and shapes. The Edit menu of the figure allows modification of the figure and axis properties. Figures can be copied and pasted into Microsoft Word and other documents via the Edit - Copy Figure selection. The Figure Tools menu has options for zooming, panning, and rotating. The Tools menu also gives access to the Data Cursor which is useful for getting x and y axis values from the plot.

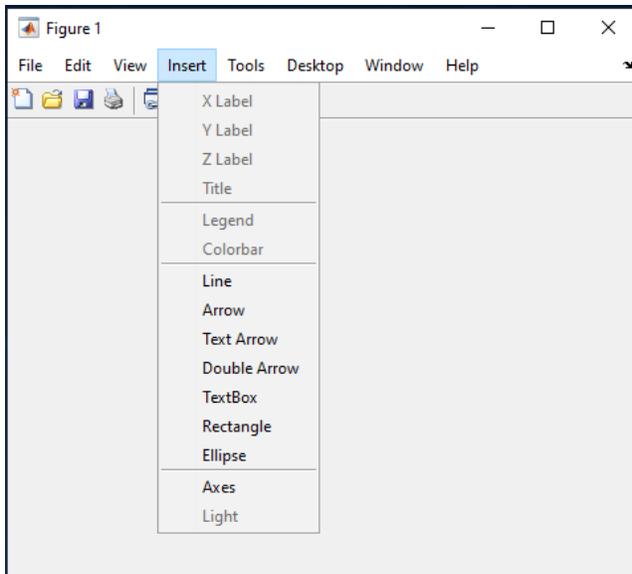


Figure 2. Insert Menu of Figure for Annotation

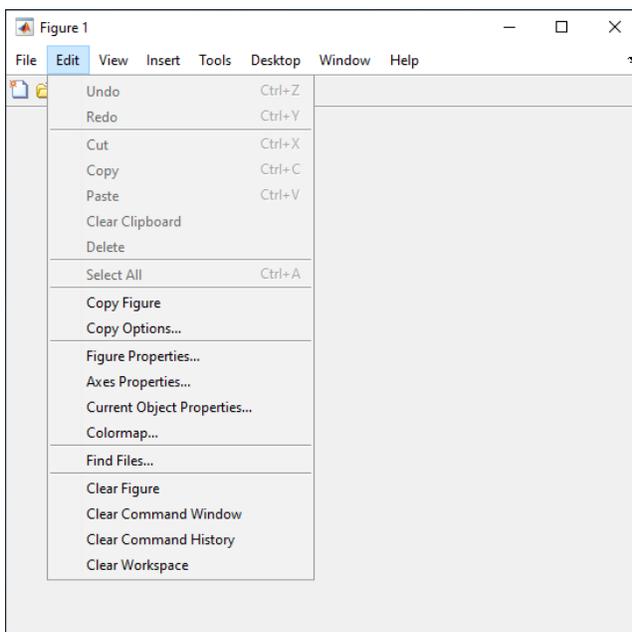


Figure 3. Edit Menu of Figure for Modifying Figure Properties

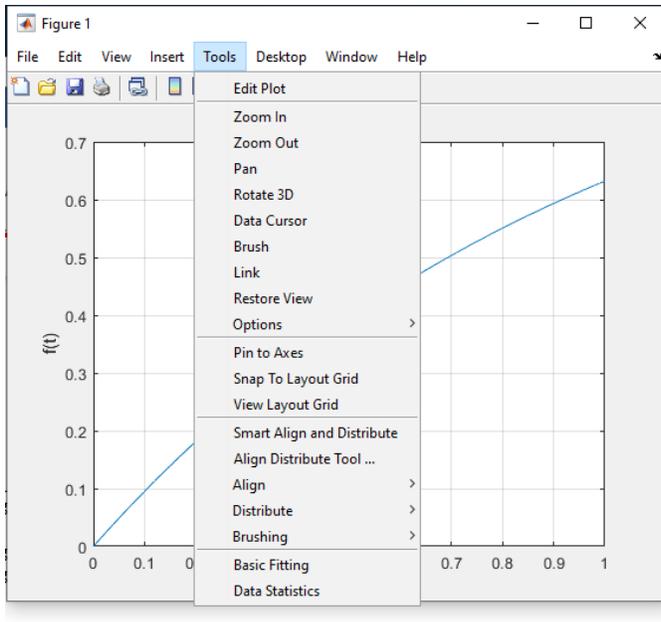


Figure 4. Figure Tools Menu

Keep in mind that any annotation or modifications done via the toolbar or menu is for the current figure window and would need to be redone whenever the plot was generated.

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