Plotting in Matlab

CHEN 1703

see the wiki page for more information on plotting
Creating 2-D (x,y) Plots

plot(x) - plot vector x.

plot(x,y,'abc') - plots vector x versus vector y.
  • if y is a matrix, then this generates several lines - one for each column in y.
  • a - color of the line & symbol
  • b - style of the symbols (markers)
  • c - style of the line
  • See Table 5.2-1 in your text.

<table>
<thead>
<tr>
<th>Color</th>
<th>Symbol</th>
<th>Line Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>blue</td>
<td>point</td>
</tr>
<tr>
<td>g</td>
<td>green</td>
<td>o</td>
</tr>
<tr>
<td>r</td>
<td>red</td>
<td>x</td>
</tr>
<tr>
<td>c</td>
<td>cyan</td>
<td>+</td>
</tr>
<tr>
<td>m</td>
<td>magenta</td>
<td>*</td>
</tr>
<tr>
<td>y</td>
<td>yellow</td>
<td>s</td>
</tr>
<tr>
<td>k</td>
<td>black</td>
<td>^</td>
</tr>
<tr>
<td>w</td>
<td>white</td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>&lt;</td>
</tr>
<tr>
<td></td>
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<td>&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>h</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Examples:
plot(x,y1,'r-')
plot(x,y2,'b.:')
plot(x,y3,'ks--')
Multiple Lines on a Plot

**hold on** - allows you to “stack” lines on a plot.

```matlab
figure;  % create a new plotting window.
hold on;  % add multiple plot commands to this figure
plot(x1,y1);
plot(x2,y2,'gs--');
fmt = 'bo:';
plot(x3,y3,fmt);
hold off;  % next plot command overwrites the figure
```

Plot several lines with different styles, all in the same command and on the same plot.

```matlab
plot(x1,y1,s1, x2,y2,s2, x3,y3,s3);
```

**NOTE:** you may eliminate formatting strings here as well...
Labeling is a MUST for ALL plots!

• Include units where applicable.

\texttt{xlabel(‘label text’);}  
• Adds a label to the x axis

\texttt{ylabel(‘label text’);}  
• Adds a label to the y axis

\texttt{legend(‘1’,’2’,’3’);}  
• Add any text to legends, including greek symbols.

Annotating plots:

• \texttt{text( xpos, ypos, label );}  
  • adds text label to position (xpos, ypos).

Use the figure editor to control many aspects of a plot after it is created (like in Excel)

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Text} & \textbf{Symbol} \\
\hline
\texttt{\Lambda} & \texttt{\Lambda} \\
\texttt{\Xi} & \texttt{\Xi} \\
\texttt{\Pi} & \texttt{\Pi} \\
\texttt{\Sigma} & \texttt{\Sigma} \\
\texttt{\Psi} & \texttt{\Psi} \\
\texttt{\Omega} & \texttt{\Omega} \\
\texttt{\alpha} & \texttt{\alpha} \\
\texttt{\beta} & \texttt{\beta} \\
\texttt{\gamma} & \texttt{\gamma} \\
\texttt{\delta} & \texttt{\delta} \\
\texttt{\epsilon} & \texttt{\epsilon} \\
\texttt{\eta} & \texttt{\eta} \\
\texttt{\theta} & \texttt{\theta} \\
\hline
\end{tabular}
\end{table}
Example - Ideal Gas Law

\[ pV = nRT \]

\( V \) is the volume occupied by \( n \) moles of an ideal gas at temperature \( T \) and pressure \( p \).

\[ p\bar{V} = RT \]

\( \bar{V} \) is the volume occupied by a single mole of an ideal gas at temperature \( T \) and pressure \( p \). (molar volume)

Plot \( \bar{V} \) as a function of \( T \) at various pressures.

• What do we expect?

Plot \( \bar{V} \) as a function of \( p \) at various temperatures.

• What do we expect?

\[ R = 8.20574587 \times 10^{-5} \text{ m}^3 \text{ atm} \text{ mol}^{-1} \text{ K}^{-1} \]

• \( T \) in Kelvin,
• \( p \) in atmospheres,
• molar volume in \( \text{ m}^3 \).
Log-scale Plots

- **plot(x,y)**
  - linear in x and y
- **semilogx(x,y)**
  - log scale in x, linear in y
- **semilogy(x,y)**
  - log scale in y, linear in x
- **loglog(x,y)**
  - log scale on x and y.

**Some Plotting Tips:**
- Always label your plots!
- Include axis labels and units.
- Include legends
- Use symbols when you have data to plot (unless their use would make the plot unreadable)
- Do NOT use symbols when plotting an analytic function.

**Example:**
- How many times can you fold a piece of paper in half?
- Plot number of sheets as a function of number of folds...
  \[ n_s = 2^{n_f} \]
Other useful Plotting commands

- **grid** command - put x-y grid lines on the plot
  - grid on - turn grid on.
  - grid off - turn grid off.

- **axis** - control range on axes.
  - axis( [xmin,xmax,ymin,ymax] );
    - sets x and y limits on the axes.
  - axis auto, axis tight, axis square, axis equal
  - axis manual
    - use with “hold on” to keep the axis limits from the first plot.

- **plotyy**(x1,y1,x2,y2) - plot with a secondary y-axis.
  - y1 on primary (left) axis, y2 on secondary (right) axis.
  - See MATLAB help for more details.

Figures may be edited graphically after they are created.
- Do as much in the script as you can easily do to save time tweaking plots manually.
Subdividing a Figure

```matlab
 subplot(m, n, p);
 • creates a plotting window with m rows and n columns. The current plot is placed at position p. p is counted along rows...
 • plot(x,y,style);
 • You can also add labels, legends, etc. to each subplot.
```

```matlab
clear; close all; clc;

x=linspace(-2,2,40);
subplot(2,3,1); plot(x,sin(pi*x),'k-.');
subplot(2,3,2); plot(x,sin(pi*x),'k:','x',cos(pi*x),'r.-');
subplot(2,3,3); semilogy(x,exp(x));
subplot(2,3,4); plot(x,2*x,'go');
subplot(2,3,5); plot(x,x.^4-3*x.^3,'m+');
subplot(2,3,6); plot(x,exp(x),'b--');
```
Other MATLAB Plots

- bar graphs, pie charts, histograms
- surface plots
- contour plots

For more information:

```
help graph2d
help graph3d
```