Question: Why do engineers use plots?
Answer: To analyze, visualize, and present data.

- Matlab has many useful plotting options available!
  We'll review some of them today.
- Textbook chapter 5, pages 107-135 (skip 5.2)

Recall the Week 1 problem:

\[
\begin{align*}
    xv &= -3:0.1:3; \\
    yv &= xv.^3 - 5*xv.^2 + 4; \\
    plot(xv,yv) \\
    xlabel('value of x') \\
    ylabel('value of y') \\
    title('Problem 10') \\
    text(0,1, 'egr106 week 1')
\end{align*}
\]

Matlab has interactive tools for modifying plots:

default is Figure 1, blue lines, and small text
scales are automatic

Click on the arrow to start interaction
Double click on some part of the figure to initiate choices

Modify text:

Or the lines themselves:
• So, the property editor is like a spreadsheet’s tools, but…..
  - is limited to a single figure
  - is tedious to repeat for other plots

• Command line manipulation is available through optional additional arguments:
  plot(x,y, 'linespec', 'Propname', PropValue)
  - line specifiers: color, line type, markers for data
  - property name and value: thickness, size, etc

Line Specifiers
plot(x,y, ' r : d ' )
- red
dotted line
diamonds

The order is not important!

General form: plot(x,y, "r:kd")
- Color:
  k black
  r red
  b blue
  g green
  y yellow
  c cyan
  w white
  m magenta
- Line type:
  - solid
  : dotted
  -- dashed
  - dotted
- Symbol:
  . point
  o circle
  x x-mark
  s square
  d diamond
  etc.

General form: plot(x,y, Property, value)
- Properties:
  linewidth
  markersize
  markeredgecolor
  markerfacecolor
- Value:
  varies with each property
  sizes in points
  colors as strings

Can have multiple pairs!

Line Properties and Values
plot(x,y, 'linewidth',5)
- line width is 5 "points"

Example:
plot(x,y, '- k o', 'LineWidth', 3, 'MarkerSize', 6,...
'MarkerEdgeColor','red','MarkerFaceColor','green')
Multiple Plots on the Same Axes

- Plot allows multiple sets of arrays and line specifiers:

```matlab
x = linspace(0,pi,10);
y1 = cos(x);
y2 = sin(x);
plot(x,y1,x,y2);
```

- Can also use `hold` to freeze the plot

```matlab
x = linspace(0,pi,10);
y1 = cos(x);
y2 = sin(x);
plots(x,y1,'linewidth',2)
hold on
plot(x,y2,'linewidth',2)
hold off
```

Two Useful Commands

- `figure`:
  - alone it opens a new window
  - `figure(n)` takes you to window n

- `ginput(1)`:
  - creates crosshairs on the screen
  - returns (x,y) location of cursor at mouse click
  - `ginput(n)` returns n pairs of locations

Formatting Plots – Adding Text

- Week 1:
  - `xlabel('string')`
  - `ylabel('string')`
  - `title('string')`
  - `text(x,y,'string')`

- New:
  - `gtext('string')` – cursor controlled
  - `legend('string1', 'string2', 'string3')`
Can add greek letters, sub and superscripts
e.g. \texttt{gtext( '\beta_1 x^2' )}

Text properties allow manipulation of the look
E.g. \texttt{gtext( 'cosine', 'fontsize', 20, 'rotation', 45, 'color', 'red', )}

Formatting Plots – The Axes

- Adding a grid
  \texttt{grid}
- Setting the axis limits:
  \texttt{axis([ xmin xmax ymin ymax ] )}

Can plot on logarithmic axes using:
\texttt{semilogx(x,y)}
\texttt{semilogy(x,y)}
\texttt{loglog(x,y)}

Note – negative data is ignored

Figure Files (not in the text)

- Save to create a .fig file
Figures outside Matlab (not in the text)

- Print them:
- Copy for pasting

Multiple Axes in One Figure - Subplot

```
subplot(2,2,1)
plot(x1,y1)
subplot(2,2,2)
etc.
```

Argument is rows, columns, choice

Other Types of 2-D Plots - Polar

```
x = 1:100;
log10(x);
t = x/10;
polar(t, r)
```

magnitude
angle in radians

Other Notes

- Vertical and horizontal bar plots, stem and stair plots, pie and compass plots:

- Line specifiers, properties, axis, grid, … work on many of the plot types
- Most of these tools have additional features – use the help function
- 3-dimensional plots are available (chapter 9) with viewpoint options
For array arguments:
```
plot(x_array, y_array)
```
- plots column by column
- cycles through colors

For a single argument, `plot(x)`:
- plots imaginary versus real if `x` is complex
- plots `x` versus index if `x` is real

Fun stuff (not in the text):
- Handle graphics – low-level control

```
>> x = -5:5;
>> y = x.^2;
>> h = plot(x,y)
```

- GUIs – high level interfaces