MATLAB tips

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Here are some suggested style tips that might help clean up your future MATLAB code and plots (and make it a bit easier for us TAs to grade your work).

Note: Most of these are only recommendations, and style will **not** be factored into assignment grades. That being said, if your plot is *particularly* confusing (multiple lines without labels, multiple plots with axes unlabeled, etc.), it is the grader's discretion to take off points.

1 Plots

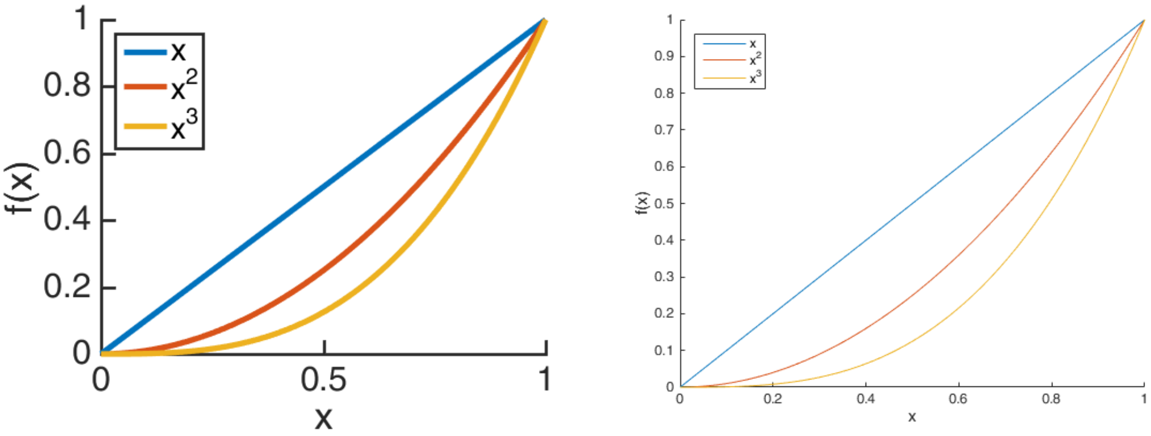
- **Multiple lines:** Use the `hold on` command, which will not only allow multiple plots to be displayed on the same figure, but it will automatically cycle through a pre-defined set of colors (blue, orange, yellow, etc.) for each plot in order (even if you plot different lines all in one `plot()` command, such as with a matrix).
- **Line thickness:** Inside each `plot()` function, add the arguments `'linewidth', 4` to increase the thickness of your lines and improve visibility. Even thicker is fine, but 4 is probably the minimum you'd want.
- **Plot labels:** The commands `xlabel()` and `ylabel()` will give context to what you've plotted. If units are appropriate, include them in parentheses ().
- **Axes readability:** After you've finished decorating your plot with labels and titles, add one more line with

  ```
  set(gca, 'fontsize', 20, 'linewidth', 2, 'ticklength', [0.03 0.03]);
  ```

  This will increase the font of the labels to 20, increase the thickness of the axes to 2 (in general I make the axes line width half of the plot line width), and increase the length of the axes tick marks. This greatly improves readability, particularly when the figure is made smaller.

For comparison, I've included the code for figures with styling, and inserted figures with and without the extra styling:

```
close all; % handy to put this in front of first figure call
figure; hold on;
x = 0:0.01:1;
plot(x, x, 'linewidth', 4);
plot(x, x.^2, 'linewidth', 4);
plot(x, x.^3, 'linewidth', 4);
% Simpler: same figure would show with plot(x, [x; x.^2; x.^3], 'linewidth', 4);
xlabel('x');
ylabel('f(x)');
legend('x', 'x^2', 'x^3', 'location', 'northwest');
set(gca, 'fontsize', 20, 'linewidth', 2, 'ticklength', [0.03 0.03]);
```



(a)

(b)

Figure 1: MATLAB figures (a) with style formatting and (b) without.

2 Code

- The first line of your MATLAB script can contain `clear variables; clc;` to clear the workspace and clear the command window respectively at the start of each run.
- Sections are created with two percent symbols, `%%`. Since MATLAB saves all workspace variables, you can just run a specific section without having to run the whole script.

  Example: You painstakingly solve a PDE and want to plot the solution, but your code errors out with bugs in the plotting section. You can section off the plot part and just change the plotting code until everything works without having to solve the PDE each time.
- It can be helpful to put `close all` before your first `plot` command. This way each time your code runs all of your plots will close automatically and be regenerated anew.
- Learn to love whitespace...
- Matrix / vector tips:
  - Pay attention to whether your vectors are rows or columns. MATLAB will attempt to *broadcast* data structures (automatically expand their dimensions) when there's a dimension mismatch, but more often than not this turns out very poorly. Some operations will simply fail.
  - Putting a period in front of an operator usually turns it into elementwise. Therefore, `A^2` is equivalent to the product AA (where A is square), but `A.^2` is take every element of A and square it.
  - Take advantage of built-in functions like `linspace()`, `zeros()`, `ones()`, `eye()`, `diag()`, etc.
  - In MATLAB, basically every variable within a script is a global variable. While this (and the fact that it's 1-indexed) makes CS majors cry, you can use it to your advantage. In the place where variables are stored, click on the data structure you just created to see its contents and see if they match intuition.

- More to come...?