Outline

• What are good graphics?
• Typefaces & Fonts
• Pictures
• Labels
• Color
• Layouts
• Graphics Software
What are Good Graphics?

BAD FIGURE! ➔ Should not show windows background.
Gray background is ugly and not necessary.

1D Graphics
1D Graphics

STILL BAD FIGURE!  ➔ Lines too thin.
  X axis limits producing white space
  Y axis scaling is poor

1D Graphics

STILL BAD FIGURE!  ➔ Not enough points along x to get a smooth line.
  Axes not labeled
1D Graphics

STILL BAD FIGURE! => Fonts are too small.
Might want a little more space on the y axis
Need labels

1D Graphics

STILL BAD FIGURE! => “f(x)” label on y-axis might look silly rotated
Not enough tick marks along axes
STILL BAD FIGURE! → Inconsistent number of digits on y-axis

STILL BAD FIGURE! → The two lines cannot be distinguished
1D Graphics

STILL BAD Figure! → Two lines should be labeled. Red/blue cannot be distinguished when printed in b/w

1D Graphics

STILL BAD Figure! → Legend is covering the data
1D Graphics

\[
f(x) = \cos(\theta) \quad \sin(\theta)
\]

STILL BAD FIGURE! Equations and math symbols do not have correct formatting.

GOOD FIGURE!
1D Graphics

Be very careful about copy/pasting your diagrams!!

It is easy to lose resolution and produce pixelated images.

Color Figure

$\cos(\theta)$

$\sin(\theta)$

$ f(x) $
Full Page Diagrams are Usually BAD

Diagrams should be made as small as possible so that they are still easily viewed and understandable.

\[ f(x) = \cos(\theta) \quad \sin(\theta) \]

1D Graphics

% CALCULATE DATA
phi = linspace(0,2*pi,1000);
f1 = cos(phi);
f2 = sin(phi);

% OPEN FIGURE WINDOW
figure('Color','w');

% PLOT DATA
h = plot(phi,f1,'-b','LineWidth',3);
hold on;
plot(phi,f2,'--r','LineWidth',3);
hold off;

% SET AXIS LIMITS
xlim([0 2*pi]);
ylim([-1.1 1.1]);

% MAKE LINES THICK AND POINTS BIGGER
h2 = get(h,'Parent');
set(h2,'LineWidth',3);

% SET TICK MARKS
L = {'-1.0' '-0.5' '0' '0.5' '1.0'};
set(h2,'XTick','[0:6]',
'YTick',[-1:0.5:1],
'YTickLabel',L);

% LABEL AXES
xlabel('$\theta$ (rad)','Interpreter','latex');
ylabel('$f(x)$','Interpreter','latex');

% ADD LEGEND
h = legend('cos(\theta)','sin(\theta)',
'Location','NorthOutside');
set(h,'LineWidth',2);
2D Graphics

BAD FIGURE! → Color scale cannot be interpreted.

Solution #1: Print in color
Solution #2: Use grayscale coloring
Solution #3: Use special colormaps

STILL BAD FIGURE! → Colorbar not provided.
Line still not visible.
Still no axis labeling.
STILL BAD FIGURE! ➔ Font size is too small.
Line probably too thin.
No axis labeling.

STILL BAD FIGURE! ➔ Line difficult to see against dark background.
Inconsistent number of digits on colorbar.
$x$ and $y$ axis labels should be done as math symbols.
Unless you have a special reason to do otherwise, horizontal graphics are preferred.
General Advice for Diagrams

• Diagrams should always be as small as possible so that they are still easily read and interpreted. Bigger is not better!
• Ensure diagram is clear, easily read, and easily interpreted.
• Label everything.
• Fonts and lines should be thick enough to be easily seen yet not awkwardly large.
• There should be a comfortable amount of white space separating entities in your diagram without being awkwardly large.
• Good diagrams take a lot of work to produce.
• Diagrams should stay within the same margins as the text.
• Diagrams should not be pixelated.
• Your diagrams should be of professional quality and “publication ready.”

Typefaces & Fonts
Typeface Vs. Fonts

**Fonts** – A complete set of characters that share a common weight, width, and style.

**Typeface** – A collection of fonts sharing an overall appearance that are designed to be used together.

- **Typeface 1**
  - Font 1a
  - Font 1b
  - Font 1c
  - Font 1d
  - Font 1e
  - Font 1f

- **Typeface 2**
  - Font 2a
  - Font 2b
  - Font 2c
  - Font 2d
  - Font 2e
  - Font 2f

Typefaces

- **Serif** – Strokes help guide eyes along sentences.
- **Sans Serif** – No strokes. More pleasing to eye.
- **DISPLAY** – Large titles. Decorative.
- **Script** – Implies handwritten and personal.
- **Dingbat** – Special symbols.
Serifs

Serifs are tails or decorative structures at the ends of the strokes of letters.

Serif Fonts

Serif

- Serifs guide the eyes making text easier to read.
- Used mostly for body text where many lines must be read.
- Draws attention. More decorative.
- May be overwhelming as a title or label font.

Sans Serif Fonts

Sans Serif

- Simpler and more legible.
- Better looking when scaled large.
- Should be your go-to style, except for body text.

General Rules

- Do not use too many typefaces.
- Use well contrasting colors.
- **LIMIT USE OF DISPLAY FONTS.**
- Make your text easily read and scannable. Use bold headings and focus points to organize.
- Don’t distort typefaces. This includes not using the bold and italics buttons!
Equations

In math equations, only variables are ever to be italicized. Variables that are upper case Greek letters are not capitalized.

<table>
<thead>
<tr>
<th>Incorrect Formatting</th>
<th>Correct Formatting</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \cos(\theta) )</td>
<td>( \cos(\theta) )</td>
<td>Variable ( \theta ) should be italicized.</td>
</tr>
<tr>
<td>( \cos(\theta) )</td>
<td>( \cos(\theta) )</td>
<td>The function should not be italicized.</td>
</tr>
<tr>
<td>( \cos(\theta) )</td>
<td>( \cos(\theta) )</td>
<td>Parentheses are not correct.</td>
</tr>
<tr>
<td>( \nabla \vec{A} )</td>
<td>( \nabla \cdot \vec{A} )</td>
<td>Dot products should have a large dot.</td>
</tr>
<tr>
<td>( P_{\text{avg}} )</td>
<td>( P_{\text{avg}} )</td>
<td>( \text{avg} ) is text and should not be italicized.</td>
</tr>
</tbody>
</table>

Use the correct symbol for the operation!

\[
ab \quad a \cdot b \quad a \ast b \quad \vec{a} \times \vec{b} \quad \vec{a} \cdot \vec{b} \quad a \otimes b
\]
NO PIXELIZATION!!!!!!

Always ensure your graphics have sufficient resolution to avoid pixelization.

Engineer Contrast (1 of 2)

Your eyes are drawn to contrast.
Engineer Contrast (2 of 2)

Design the contrast in your pictures to keep attention on what is important.

There are other techniques for drawing attention to the object(s) of interest. This is just one and probably not the best.
Problem with High Contrast Diagrams

Neither dark or light lines work well as labels in this picture.

A Solution

Dark lines with a light outline are good way to label high-contrast diagrams.
Colors have an extraordinary ability to influence mood, emotions, and perceptions. They can attract attention and even convey cultural and personal meaning.
**Color Wheels**

- **Additive**
  - All about mixing light.
  - Used for graphics on a computer screen.

- **Subtractive**
  - All about mixing pigments.
  - Used for printed graphics.

**Choosing Colors**

- **Monochromatic** -- various shades, tones, or tints of one color. This type of scheme is more subtle and conservative.

- **Analogous** -- hues that are side by side on the color wheel. Easy and versatile to use.

- **Complementary** -- opposites on the color wheel. Complementary colors are high-contrast and high-intensity, but can be difficult to apply in a balanced, harmonious way.

- **Split-Complementary** -- any color on the color wheel plus the two that flank its complement. This scheme still has strong visual contrast, but is less jarring than a complementary color combination.

- **Triadic** -- any three colors that are evenly spaced on the color wheel.

- **Tetradic/Double-Complementary** -- two complementary pairs. This scheme is very eye-catching, but may be even harder to apply than one pair of complementary colors, since more colors are more difficult to balance.
Layout Must Convey Meaning

Even though the text is not readable (bad), the layout immediately conveys there is a step-by-step process being conveyed.
Rule of Thirds

• Divides a layout into three rows and three columns.
• Creates visual interest without overcrowding.
• Either place elements in the boxes or at the locations of the stars.

Graphics Software
Manipulating Photos & Images

Commercial King
Adobe Photoshop

Open Source King
GIMP

Vector Graphics

Commercial King
Adobe Illustrator

Open Source King
Inkscape

Consider using a vector graphics package to create, edit, or annotate diagrams.
3D Modeling & Animation

Commercial King

Engineering CAD -- SolidWorks

Artistic -- Maya

Open Source King

Engineering CAD -- FreeCAD

Artistic -- Blender

Scientific Data Visualization

Commercial King

MATLAB*

Open Source King

Octave**

* MATLAB does not produce the best quality graphics, but is arguably the best for the ease and number of ways to visualize data.

** Octave is not the best open-source scientific visualization package, but it wins here due to being the closest clone of MATLAB.
Posters, Pamphlets, Etc.

Commercial King

- Adobe InDesign
- Microsoft Publisher

Open Source King

- Scribus

DO NOT EVER USE POWERPOINT FOR POSTERS!!!!!!

Text Documents

Commercial King

- Microsoft Word

Open Source King

- LibreOffice