Lecture 6: Visualization and Data Management

A8B17CAS

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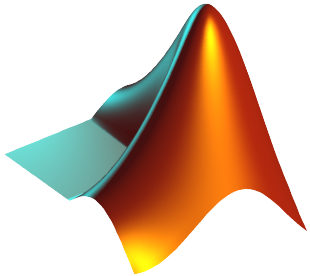
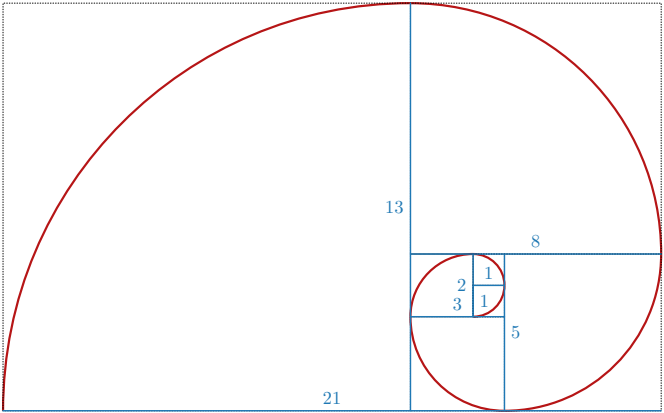
Outline

1. Visualization in MATLAB
2. Visualization – Good Practice
3. Data Management



Warm Up: Fibonacci Sequence

- Fibonacci sequence: $F_1 = 0, \qquad F_2 = 1, \qquad F_n = F_{n-1} + F_{n-2} \quad \text{for} \quad n > 2.$



Exercise

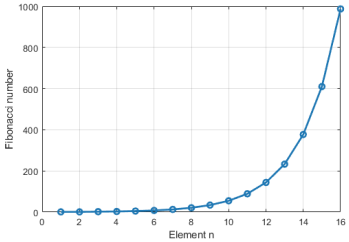
Warm Up: Function Generating Fibonacci Sequence

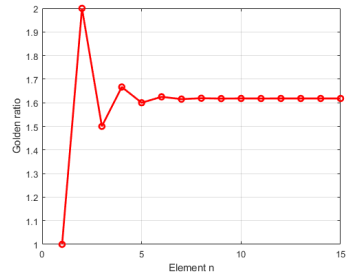
Implement function `fibonnaci` to calculate values of Fibonacci sequence up to a certain value `limit`.

- Plot the resulting series using function: `figure(1); plot(F, '-o');`
- Calculate the length of the Fibonacci spiral.
- Calculate approximations to the golden ratio:

$$\varphi = \lim_{n\to\infty} \frac{F_{n+1}}{F_n} = \frac{1+\sqrt{5}}{2} \approx 1.618033$$

- Plot it: `figure(2); plot(phi, '-or');`





Exercise

Introduction to Visualizing

- We have already got acquainted (marginally) with some of MATLAB graphs.
  - `plot`, `stem`, `surf`, `pcolor`, etc.
- Graphical functions in MATLAB can be used at higher level or lower level.

Introduction to Visualizing

- We have already got acquainted (marginally) with some of MATLAB graphs.
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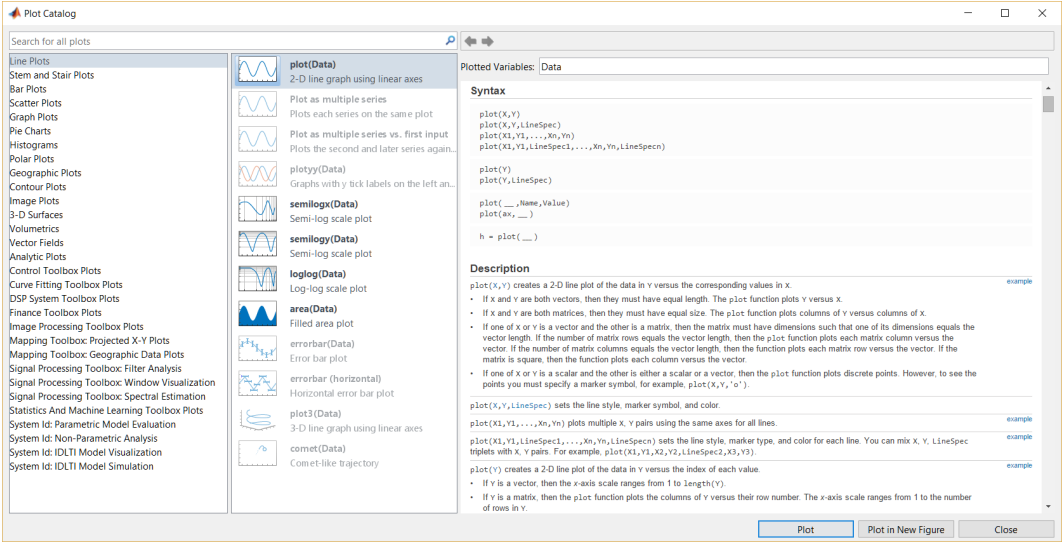
Many ways how to get your data in:

- Upload them with Wizard (`uiimport` function, *Import Data*).
- Drag file and drop it to MATLAB Workspace window.
- You have already `mat` file, use `load('myFile.mat');`
- Use MATLAB to calculate what you need and generate data directly.

Process the data to their final form:

- Normalization.
- Averages, etc.

Graph Overview (to get one: MATLAB → Plots → Catalog)



Components of a Graph – Example

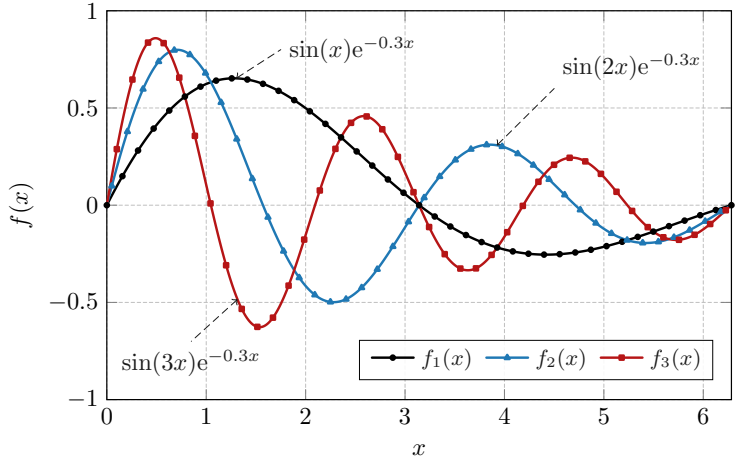


Fig. 1: Functions $\sin(nx)\exp(-0.3x)$.

Components of a Graph – Example

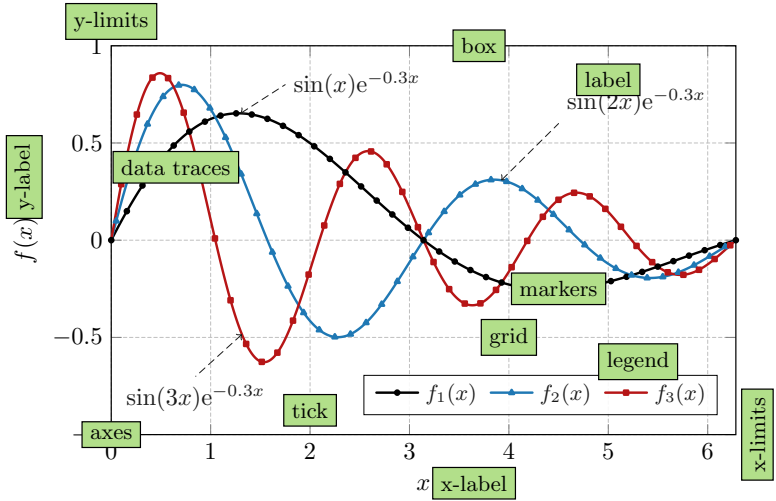


Fig. 1: Functions $\sin(nx)\exp(-0.3x)$. caption

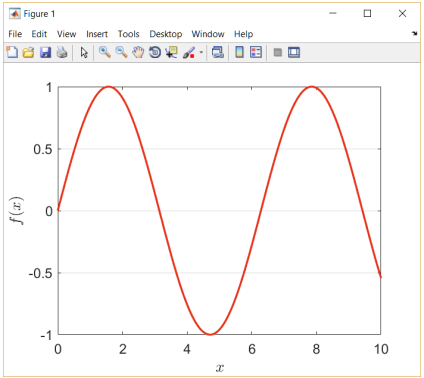
Selected Functions for Graph Modification

- Graphs can be customized in many ways, the basic ones are:

function	description
`title`	title of the graph
`xlabel, ylabel, zlabel`	label axes
`x-, y-, ztickformat`	specify axis tick label format
`grid on`, `grid off`	turns grid on / off
`hold on`	enables to add another graphical elements while keeping the existing ones
`xlim, ylim, zlim`	set axes' range
`legend`	display legend
`tiledlayout, nexttile`	create more axes in one figure
`yyaxis`	create chart with two y-axes
`box on`	display axes outline
`text`	adds text to graph
and others	

Adjusting MATLAB Graph

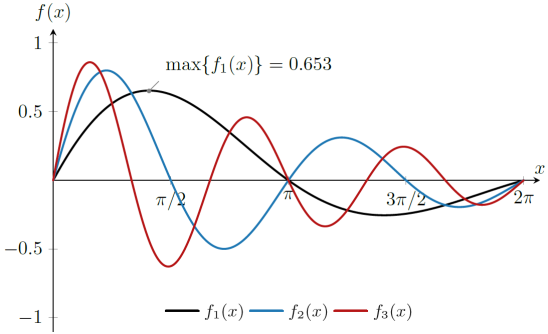
- To realize what are the properties: `properties(obj)` or `get(obj)` (object has to exists).
- `obj.` + TAB to use whispering mode.




```
x  = 0:0.01:10;
fx = sin(x);

fg = figure('color', 'w');
ax = axes('parent', fg);

tr1 = plot(x, fx);
tr1.Color = [0.9 0.2 0.1];

ax.YGrid = true;
ax.YTick = -1:0.5:1;
ax.GridColor = [0 0 0];
ax.XLabel.String = '$x$';
ax.XLabel.Interpreter = 'LaTeX';

ax.YLabel.String = '$f(x)$';
ax.YLabel.Interpreter = 'LaTeX';

ax.FontSize = 14;
```

Decouple SW for Data Preparation and SW for Visualization

Default graph depicted in MATLAB.



Graphics prepared in LaTeX+PGFPlots+TikZ.

MATLAB2Ti*k*z

(Live demo)

MATLAB Templates (PDF, EPS)

(Live demo)

export_fig

(Live demo)

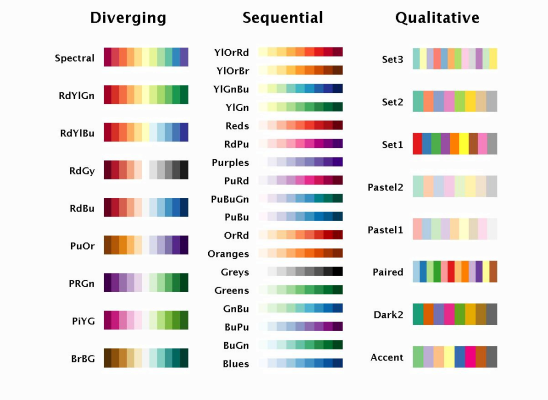
Recommended Practice

▶ Math Nomenclature (Capek, M.)

▶ LaTeX, Overleaf, etc. (Capek, M.)

Colors and Color Maps

- Color perception is a science of its own.
- Purpose of a document: printed/on-line article × presentation (Beamer).
- Do not reduce contrast and readability (keep the number of colors low).
- Black and white printing, colorblindness.

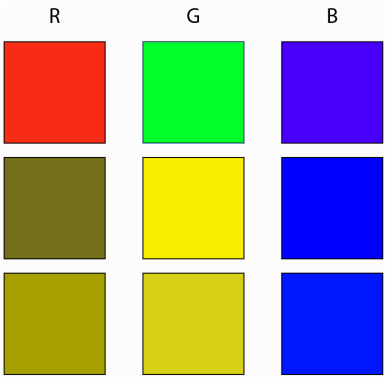


▶ ColorBrewer2 ▶ Selecting Semantically-Resonant Colors ▶ A Colour Alphabet

Stone, M. C.: A Field Guide to Digital Color

Colorblindness

- Approx. 8-9% of people are color blind (do not use red and green)!
- You can/should check your colormap, *e.g.*, in Adobe Illustrator.
  - Second line: *protanopie*, third line: *deuteranopie*.



Data Externalization

- Always externalize data used for the figure.
- Decouple settings of a figure and data.
- Make a not what code and setting have been used to generate data sets.

Overleaf

- On-line tool for collaborative LaTeXwriting.
- Standard account for free (some limitations).
- A plethora of standardized templates.
- Sharing, GIT, Grammarly, spellchecking, versioning and history, review mode.

▶ Overleaf

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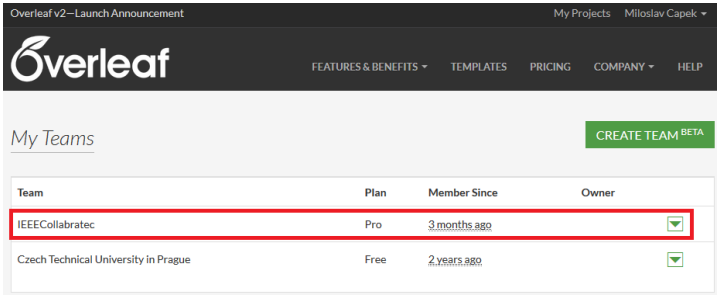

Questions?

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