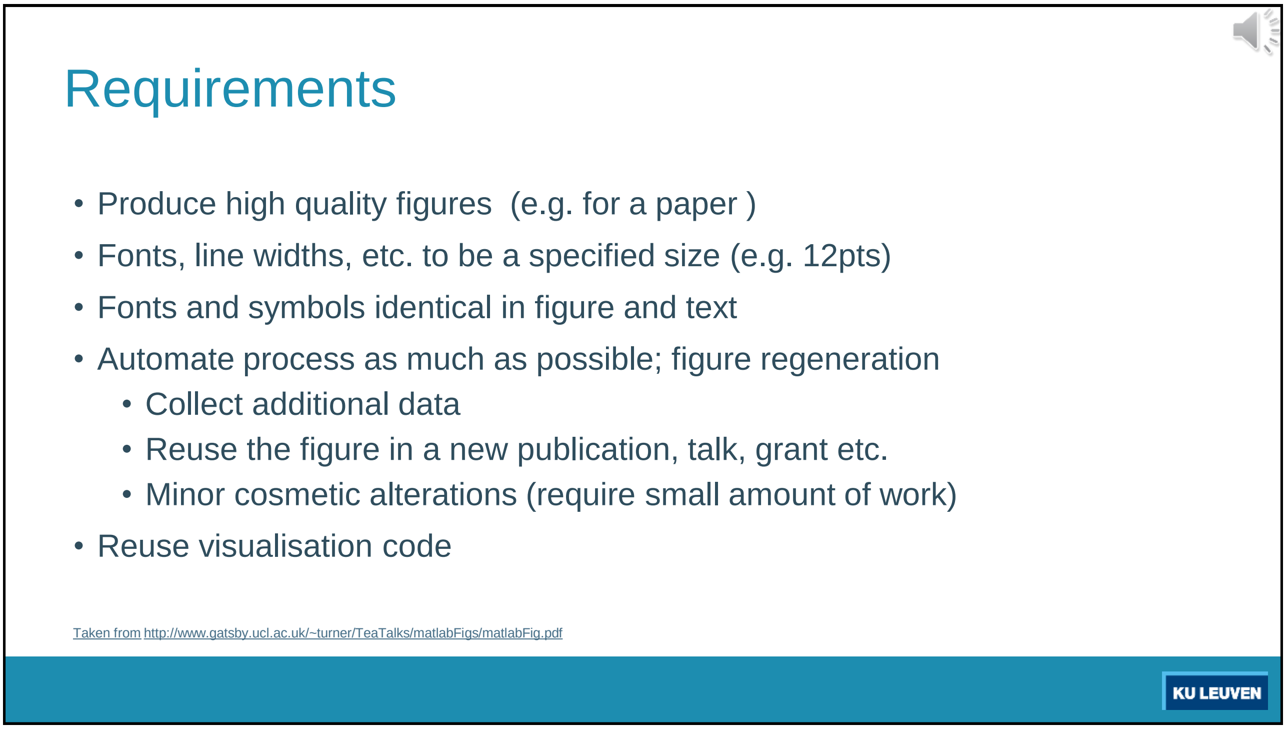
# MATLAB

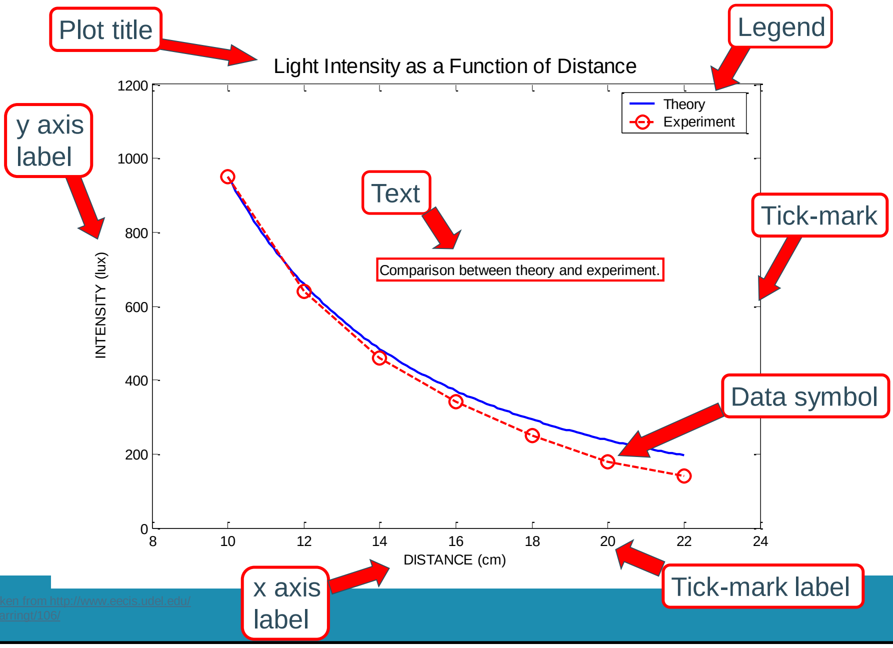
Quality plots



## Requirements

- Produce high quality figures  (e.g. for a paper )
- Fonts, line widths, etc. to be a specified size (e.g. 12pts)
- Fonts and symbols identical in figure and text
- Automate process as much as possible; figure regeneration
  - Collect additional data
  - Reuse the figure in a new publication, talk, grant etc.
  - Minor cosmetic alterations (require small amount of work)
- Reuse visualisation code

Taken from http://www.gatsby.ucl.ac.uk/~turner/TeaTalks/matlabFigs/matlabFig.pdf



Plot title

Legend

y axis label

Text

Tick-mark

Data symbol

x axis label

Tick-mark label

Taken from http://www.eecis.udel.edu/~yarringt/106/

# Approach

As proposed by Turner / Rajashekar (http://www.gatsby.ucl.ac.uk/~turner/TeaTalks/matlabFigs/matlabFig.pdf)

Do NOT

- Modify figure properties using the mouse
- Export figures using the “export" menu function

Avoid

- Using third party graphics programs where possible

Do

- Use functions and scripts to generate plots: Reuseability
- Specify fonts, line styles, axis positions, figure sizes as variables
- Export using the print command

See also: http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

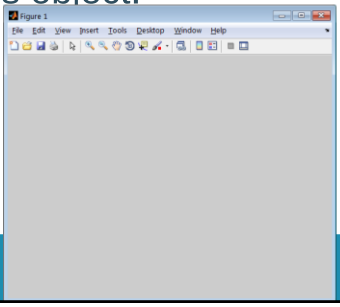
# plotting your data

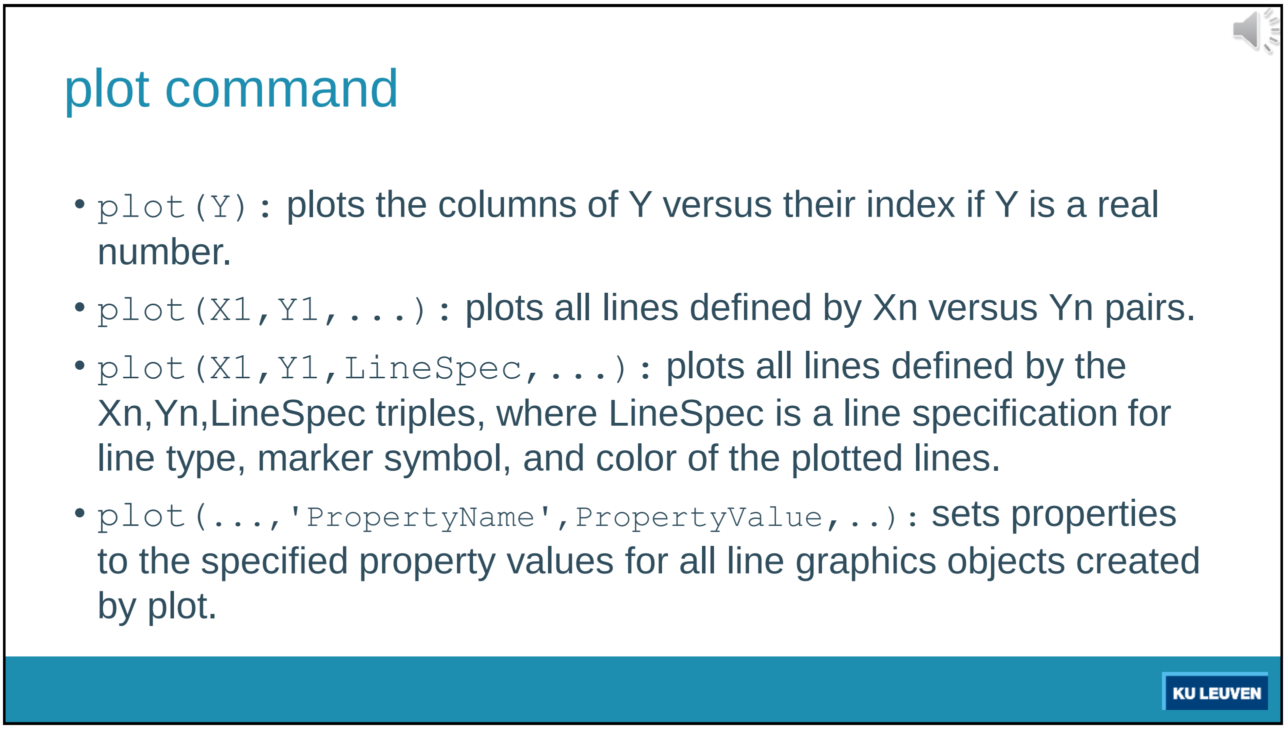
- If only previewing or exploring data, steps 1 and 3 may be all you need.
- If creating presentation graphics, you may want to  finetune your graph  by positioning it on the page, setting line styles and colors, adding annotations,and making other such improvements.
- *File: first_plot*

| | |
|---|---|
| 1. Prepare your data | `x = 0:0.2:12;`<br>`y1 = bessel(1,x);`<br>`y2 = bessel(2,x);` |
| 2. Select a window and position a plot region within the window | `figure(1)`<br>`subplot(2,2,1)` |
| 3. Call elementary plotting function | `h = plot(x, y1, x, y2)` |
| 4. Select line and marker Characteristics | `set(h,'LineWidth',2,{'LineStyle'},…`<br>`{'--';':'})`<br>`set(h,{'Color'},{'r';'b'})` |
| 5. Set axis limits, tick marks, and grid lines marks, and grid lines | `axis([0 12 -0.5 1])`<br>`grid on` |
| 6. Annotate the graph with axis labels, legend  and text | `xlabel ('Time')`<br>`ylabel ('Amplitude')`<br>`legend(h,'First','Second')` |

# figure

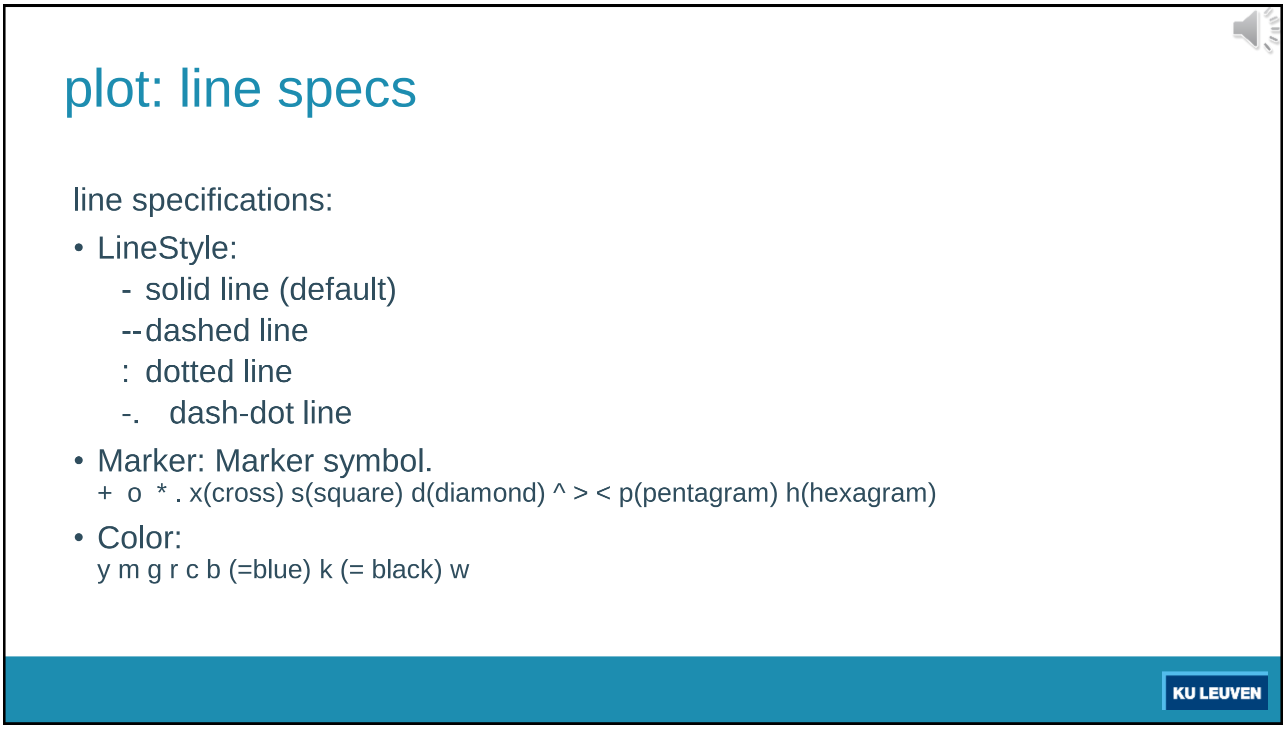
- figure: fundamental container for plotting – a graph is created in a figure window
- separate from the Command Window
- can contain menus, toolbars, user-interface objects, context menus, axes, or any other type of graphics object.
- to create a new figure, use the **figure** function





## plot command

- `plot(Y)`: plots the columns of Y versus their index if Y is a real number.
- `plot(X1,Y1,...)`: plots all lines defined by Xn versus Yn pairs.
- `plot(X1,Y1,LineSpec,...)`: plots all lines defined by the Xn,Yn,LineSpec triples, where LineSpec is a line specification for line type, marker symbol, and color of the plotted lines.
- `plot(...,'PropertyName',PropertyValue,..)`: sets properties to the specified property values for all line graphics objects created by plot.



## plot: line specs

line specifications:

- LineStyle:

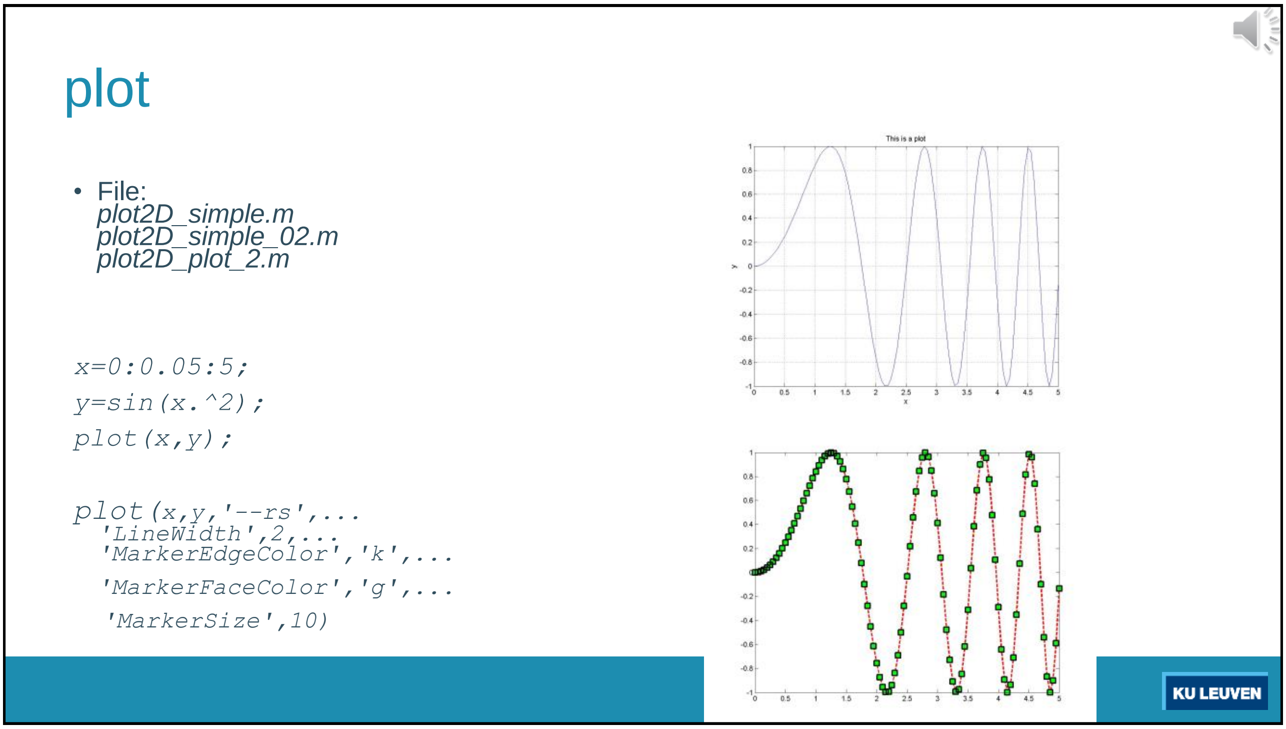
  - solid line (default)

  --dashed line

  : dotted line

  -. dash-dot line

- Marker: Marker symbol.
  + o * . x(cross) s(square) d(diamond) ^ > < p(pentagram) h(hexagram)
- Color:
  y m g r c b (=blue) k (= black) w



# plot

- File:
  *plot2D_simple.m*
  *plot2D_simple_02.m*
  *plot2D_plot_2.m*

```
x=0:0.05:5;
y=sin(x.^2);
plot(x,y);
```

```
plot(x,y,'--rs',...
   'LineWidth',2,...
   'MarkerEdgeColor','k',...
   'MarkerFaceColor','g',...
   'MarkerSize',10)
```

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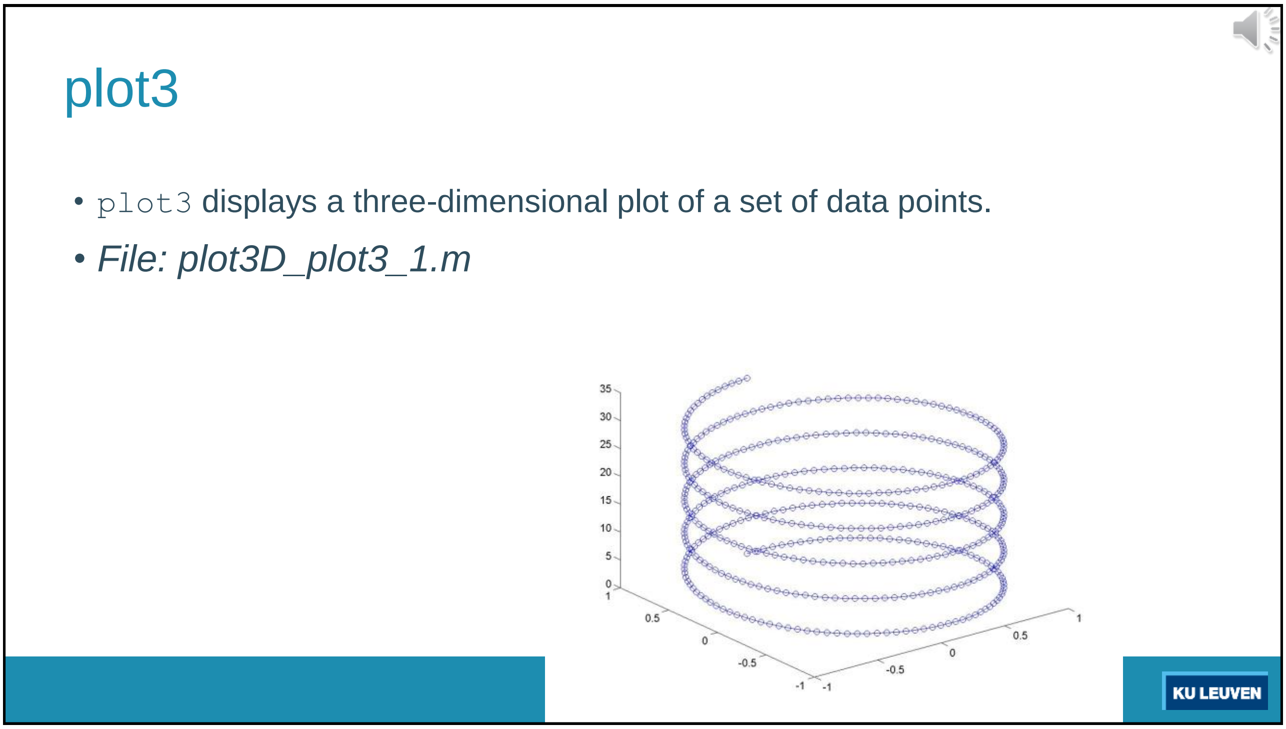

# plot3

- `plot3` displays a three-dimensional plot of a set of data points.
- *File: plot3D_plot3_1.m*

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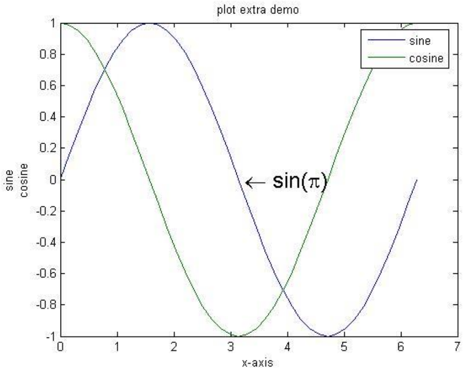
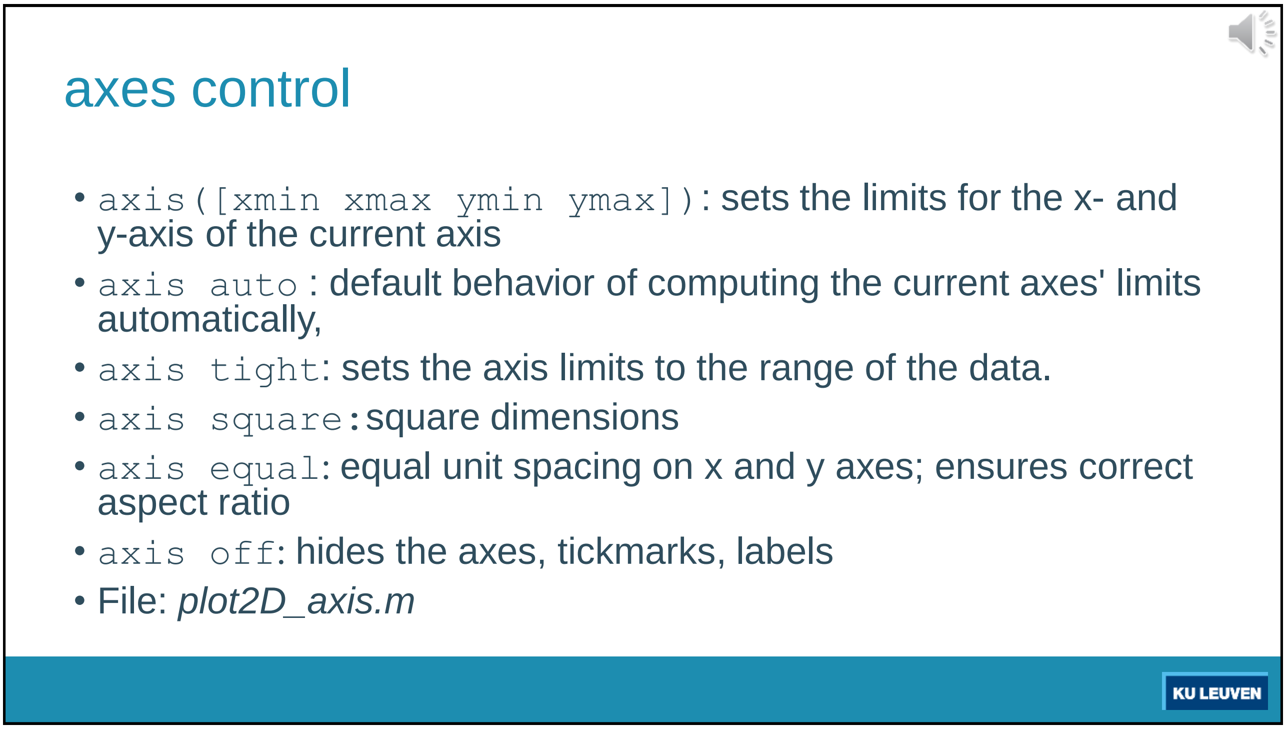
# Extra information

- `xlabel, ylabel, zlabel`:
  - Label the x-, y-, and z-axis
- `title`:
  - places a title on your plot
- `legend`:
  - adds a legend to your plot
- File: *plot2D_extra plot2D_legend*



# Extra information

- `text`:
  - creates a text object in current axes
- `grid on/off`
  - adds/removes grid lines
- `box on/off`
  - adds/removes axes box
- *File: plot2D_extra2.m*



## axes control

- `axis([xmin xmax ymin ymax])`: sets the limits for the x- and y-axis of the current axis
- `axis auto` : default behavior of computing the current axes' limits automatically,
- `axis tight`: sets the axis limits to the range of the data.
- `axis square`:square dimensions
- `axis equal`: equal unit spacing on x and y axes; ensures correct aspect ratio
- `axis off`: hides the axes, tickmarks, labels
- File: *plot2D_axis.m*

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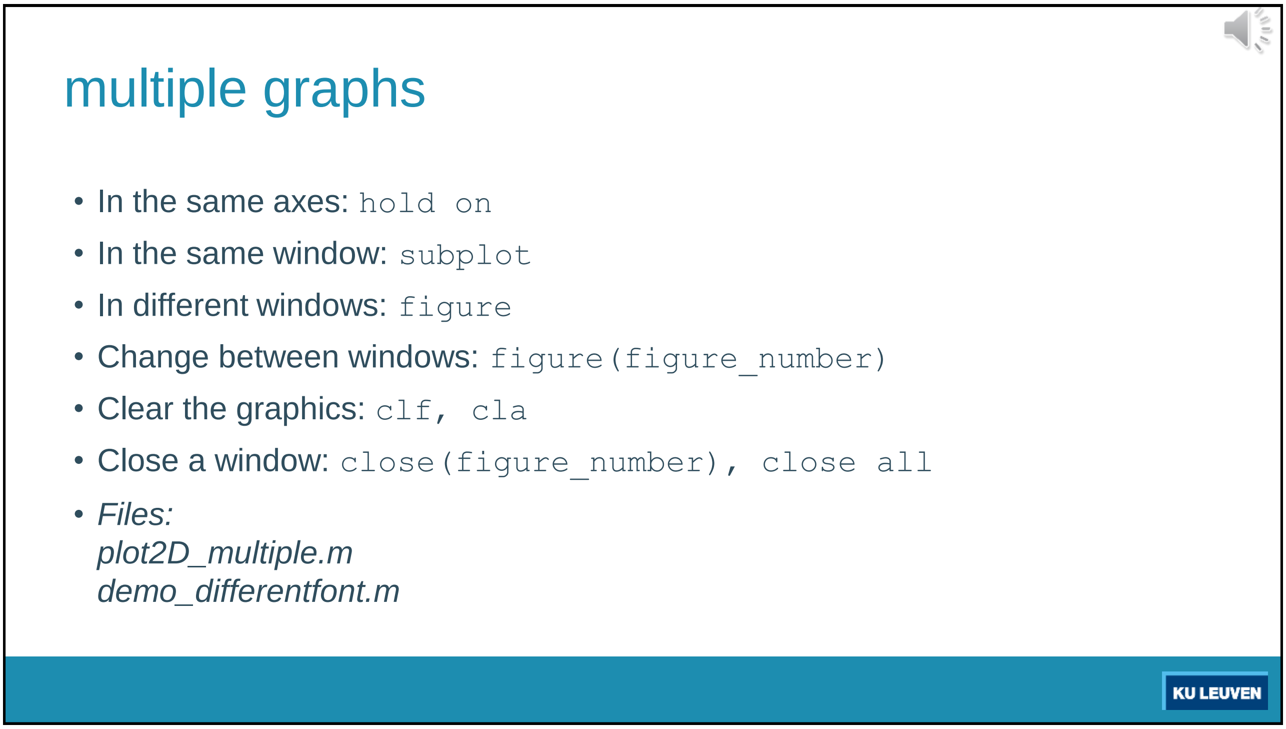

## multiple graphs

- In the same axes: `hold on`
- In the same window: `subplot`
- In different windows: `figure`
- Change between windows: `figure(figure_number)`
- Clear the graphics: `clf, cla`
- Close a window: `close(figure_number), close all`
- *Files:*
  *plot2D_multiple.m*
  *demo_differentfont.m*

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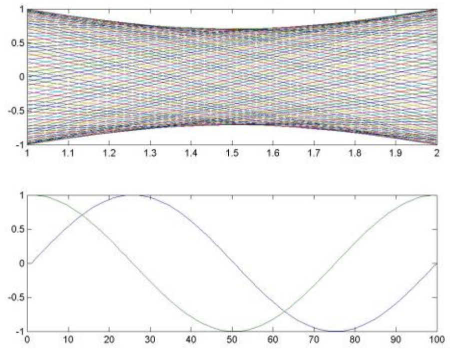
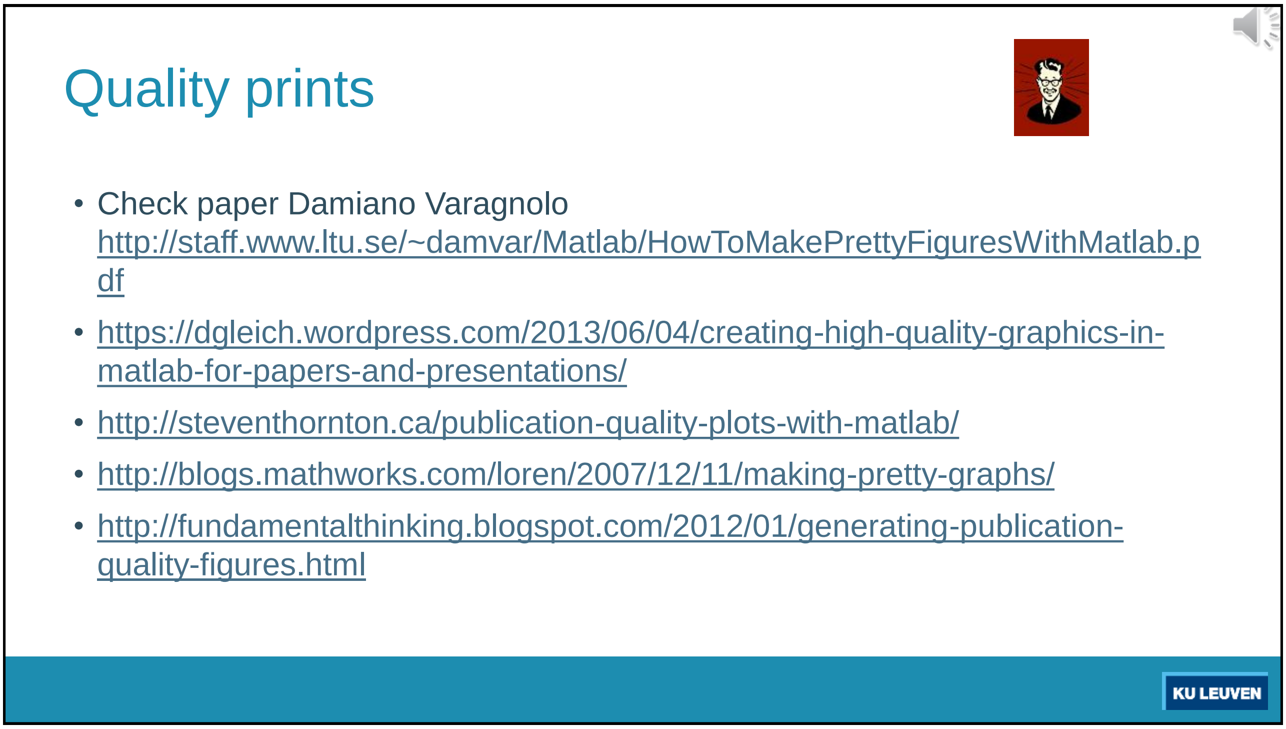
# subplot

- multiple plots can be set in 1 figure using `subplot`
- `subplot(m,n,p)` creates an axes in the pth pane of a figure divided into an m-by-n matrix of rectangular panes.
- *Files: plot2D_subplot plot2D_subplot_extra*



# print

- Print a figure with `print`, usually providing a better quality than saveas
- Check the documentation
- *File: demo_print_figure.m*



# Quality prints

- Check paper Damiano Varagnolo http://staff.www.ltu.se/~damvar/Matlab/HowToMakePrettyFiguresWithMatlab.pdf
- https://dgleich.wordpress.com/2013/06/04/creating-high-quality-graphics-in-matlab-for-papers-and-presentations/
- http://steventhornton.ca/publication-quality-plots-with-matlab/
- http://blogs.mathworks.com/loren/2007/12/11/making-pretty-graphs/
- http://fundamentalthinking.blogspot.com/2012/01/generating-publication-quality-figures.html

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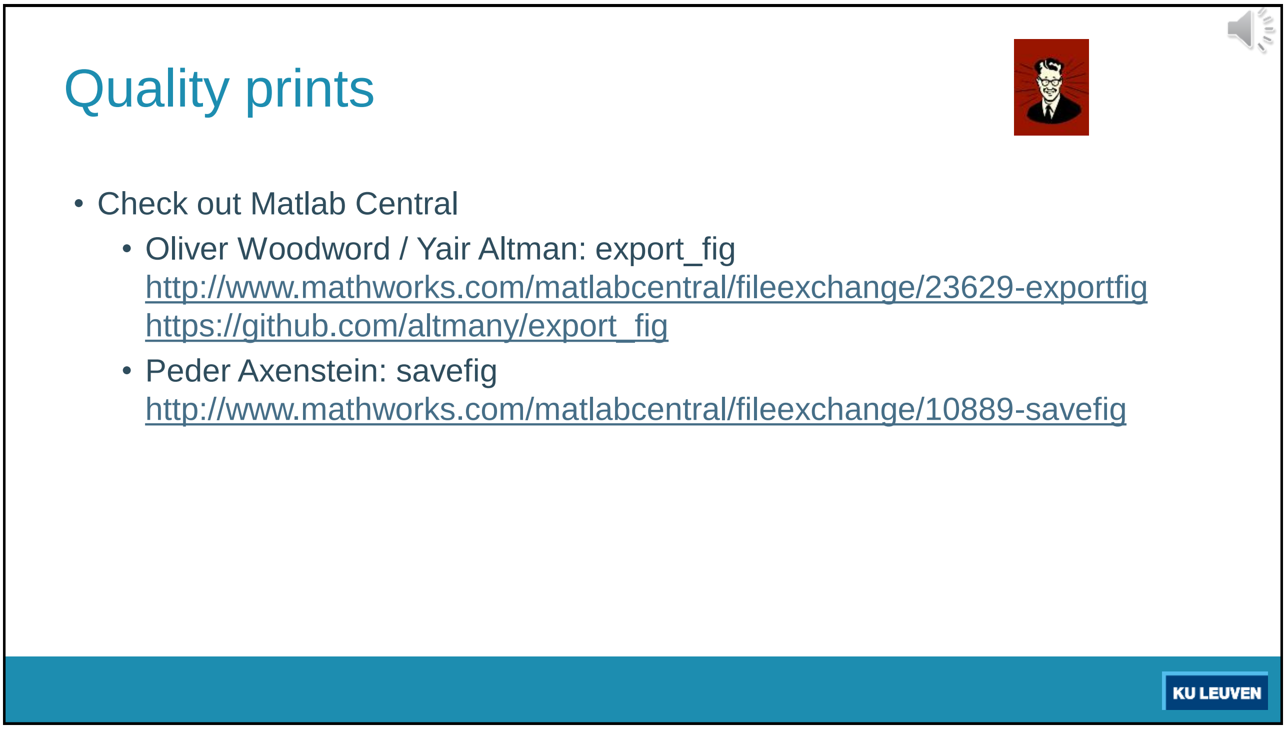

# Quality prints

- Check out Matlab Central
  - Oliver Woodword / Yair Altman: export_fig
    http://www.mathworks.com/matlabcentral/fileexchange/23629-exportfig
    https://github.com/altmany/export_fig
  - Peder Axenstein: savefig
    http://www.mathworks.com/matlabcentral/fileexchange/10889-savefig

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