MAT-63506 Scientific Computing

Exercise Set 3 19.–25. 3. 2018

Before doing the exercises read the file "Graphics2D".

Exercise 1. Plot the sequence

$$x_n = \cos((-1)^n n) + \sin(n^2)$$

for $n = 1, \ldots, 50$ with the `plot`-command. Add axis labels and a title. Also make `stem`-, `stairs`-, and `bar`-plots.

HINT: Use elementwise operations in computing x_n.

Exercise 2. Plot in a single figure the graphs of the Bessel functions of the first kind $J_\nu(x)$ for $\nu = 0.5 : 0.5 : 3$ and $x \in [0, 25]$ (command `besselj`). Use sufficiently many points in the x-interval to get smooth curves. Include a title, axis labels, and a legend. You can use TEX-commands in the strings, for example `'J_2'` gives J_2.

Exercise 3. The 4th order elliptic rational function is given by

$$R(x) = \frac{(1+t)(1+\sqrt{t})^2x^4 - 2(1+t)(1+\sqrt{t})x^2 + 1}{(1+t)(1-\sqrt{t})^2x^4 - 2(1+t)(1-\sqrt{t})x^2 + 1},$$

where $t = \sqrt{1 - 1/k^2}$. Plot $|R(x)|$ for $k = 1.4$ and $x \in [0, 5]$ with the comands `plot`, `loglog`, `semilogx`, and `semilogy` in the same window with `subplot`.

Elliptic rational functions are used in electrical engineering in the design of elliptic filters.

Exercise 4. Plot the curve with parametrization

$$x(t) = \sin(t)\left(\mathrm{e}^{\cos(t)} - 2\cos(4t) - \sin^5(t/12)\right)$$
$$y(t) = \cos(t)\left(\mathrm{e}^{\cos(t)} - 2\cos(4t) - \sin^5(t/12)\right)$$

for $t \in [0, 2\pi]$. Add also axis labels and a title. Use sufficiently many points in the t-interval to get a smooth curve.

Exercise 5. Plot the Bow curve given in implicit form $x^4 - x^2y + y^3 = 0$ with the command `fimplicit` for $x \in [-1, 1]$ and $y \in [-1, 0.4]$ and line width 2.

Add a context menu to the plot with menu items red, green, and black. Then right-clicking the plot and selecting a color should set the plot to that color. You can of course add more colors if you want.

You have to first give the command `figure('Visible', 'on')` before plotting anything. This opens a separate window, where the context menu works.

HINT: Write a function that takes as a third argument the color specification. Then you can use this function for all callbacks, just pass the corresponding color as an extra argument.

Exercise 6. Plot $\tan x$ and $\cot x$ into the same figure for `x = 0:0.05:2*pi` and store handles to them in a variable. Then, using the handles, do the following:

1. Replace with `NaN`s the y-values which satisfy $|y| > 8$ (modify `'YData'`). Don't use `find`, use logical indexing, i.e., use the result of the comparison as an index.

2. Set the x-tickmarks (`'XTick'`) and the corresponding labels (`'XTickLabel'`) to 0, $\pi/2$, π, $3\pi/2$ and 2π (put the label strings into a cell array, you get π with the string `'\pi'`). Since these are axis properties, you need `gca`.

3. Set the x-axis label to `'x'` and the y-axis label to the two lines `'tan(x)'` and `'cot(x)'` (use curly braces and set `'Rotation'` to zero), with fontsize 12 and LaTeX-interpreter (the TeX-commands for tan and cot are `\tan` and `\cot`).

4. Set the markers to magenta diamonds of size 6 for tan and cyan right pointing triangles of size 7 for cot.

You can of course experiment with other plot properties or other values for the above.