

Lab Nr. 1, Numerical Calculus

Review of Matlab

1. Matlab files .m

- *script*, *live script* and *function* files

2. Vectors and matrices

- generation
- operations (dot and matrix operations)
- special matrices

3. Polynomials

- evaluation, *polyval*
- rootfinding, *roots*

4. Graphics

- *plot*, *plot3* with options
- *subplot*
- *mesh*

5. Display

- *disp*
- *fprintf* with options

Applications

1. Let $p(x) = x^5 - 5x^4 - 16x^3 + 16x^2 - 17x + 21$.

- Plot the graph of p on the interval $[-4, 7.2]$.
- Compute $p(-2.5)$.
- Find the roots of p .

2. Plot the functions $f, g, h : [0, 2\pi] \rightarrow \mathbb{R}$, $f(x) = \sin x$, $g(x) = \sin 2x$, $h(x) = \sin 3x$, on the same figure, one on top of the other.

3. For $R, r \in \mathbb{R}_+$, consider the *epicycloid* (also called *hypercycloid*), given by the parametric equations

$$\begin{cases} x(t) &= (R + r) \cos t - r \cos \left(\left(\frac{R}{r} + 1 \right) t \right) \\ y(t) &= (R + r) \sin t - r \sin \left(\left(\frac{R}{r} + 1 \right) t \right) \end{cases}, \quad t \in [0, 10\pi].$$

Plot its graph, for $R = 3.8$, $r = 1$ (see details at <https://en.wikipedia.org/wiki/Epicycloid>).

4. Plot the function of two variables $f : [-2, 2] \times [0.5, 4.5] \rightarrow \mathbb{R}$, $f(x, y) = \sin(e^x) \cos(\ln y)$ (using both *mesh* and *plot3*).

Optional

5. Consider the expression

$$f(n) = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{\dots}}}},$$

where $n \in \mathbb{N}^*$ is the number of fractions (e.g. $f(1) = 1 + \frac{1}{1+1} = \frac{3}{2}$). Compute $f(2)$, $f(10)$ and $f(2024)$. What can be noticed?