Return as an email attachment to taneli.kalvas@jyu.fi no later than 31 January at 12:15 (before lecture). The email title should include FYSY115/Harjoitus 1. If the exercises are made with a partner include the names of the team.

Make each exercise to its own script file.

1. Calculate using Matlab:

(a) $\frac{5}{4\times 3.14}$
(b) $1-\frac{3}{5}+7^{10}$
(c) $\cos(-\frac{5\pi}{2})$
(d) $\frac{10}{2}-3+2\times\sqrt{3}$
(e) $3^2/4$
(f) $(3^2)^4$
(g) $2+\frac{1}{2}\,\mathrm{round}(\frac{6}{9}+3\times 2)-3$

2. Solve roots of x^2-2x+3 using the quadratic formula

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}.$$

Store results to variables `x1` and `x2`. Matlabissa also has an internal function for solving polynomial roots. Find out the name of the function and use it to solve the polynomial.

3. Produce the following vectors. Start from :-operator.

(a) $4,5,6,7,\ldots,19,20$
(b) $5\frac{1}{2},6\frac{1}{2},7\frac{1}{2},\ldots,10\frac{1}{2}$
(c) $1,1/2,1/4,1/8,1/16,\ldots,1/512,1/1024$

4. Produce a vector x with elements

$$x_n=\frac{(-1)^n}{(2n)!},$$

where $n=0,...,19$. The factorial can be calculated with `factorial()`. Calculate the sum of the elements.

5. Vector `x=1:0.2:2`. Calculate the following operations:

(a) $\cos^2(x) + \sin^2(x)$

(b) $e^x(1 + \cos(3x))$

(c) $\tan^{-1}(x)$

(d) $\ln(2 + x + x^2)$

(e) $x \cdot x$, This is the dot product

6. You wish to calculate the wavelengths for the photons emitted from Hydrogen using energy levels from the Bohr atomic model Define an anonymous function

$$E(n) = \frac{-m_e e^4}{8n^2\epsilon_0^2 h^2},$$

which gives the energy of for state n in Joules. Notice that you must define the physical constants. Test that you get the known -13.6 eV energy for the $n = 1$ state (make a change of units in the code). Define another anonymous function, which uses the first and calculates the wavelength of the photon emitted from transition from m to n:

$$\lambda(n, m) = \frac{hc}{E(n) - E(m)}.$$

Use this function to calculate the wavelengths for transitions $3 \to 2$, $10 \to 1$ and $5 \to 4$ in nanometers (make change of units in the code).

7. Plot function

$$f(x) = \frac{4}{\pi}\left(\sin(2\pi x) + \frac{1}{3}\sin(6\pi x) + \frac{1}{5}\sin(10\pi x)\right)$$

between $x = [-2, 2]$. Use a dense enough grid of points and adjust the plotting ranges to be suitable.