Laboratorio di Calcolo 2: Exercises Matlab

Exercise 1

Let x be a vector of $5n$ numbers for some value of n. Solve the following problems without using a for loop.

- The vector x might contain negative values. Create a vector y, of the same size as x, such that y(i) is 0 if x(i) ≤ 0, otherwise y(i) is log(x(i)).
- Create a vector z where z(1) sums the first 5 elements of x, z(2) sums the next 5 and so on.

Exercise 2

Vectorize the following Matlab functions (without using a for loop).

- The modulus of all complex numbers in the range [1,10] + i [1,10] with step 1:

```
function R = mod_complex()
   for i = 1:10
      for j = 1:10
         R(i,j) = sqrt(i^2+j^2);
      end
   end
```

- The elementwise nearest values of a vector x between two vectors y and z (assuming these three vectors have the same size):

```
function xn = nearest(x, y, z)
   for i = 1:length(x)
      if abs(x(i)-y(i)) < abs(x(i)-z(i))
         xn(i) = y(i);
      else
         xn(i) = z(i);
      end
   end
```

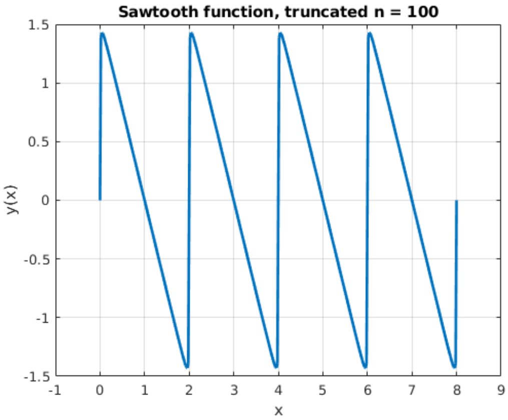
Exercise 3

Given a matrix, extract the maximum of each row and set all the other elements to zero.

For example, the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 5 & 6 & 5 \\ 9 & 7 & 8 & 3 \end{bmatrix}$ should become $\begin{bmatrix} 0 & 0 & 0 & 4 \\ 0 & 0 & 6 & 0 \\ 9 & 0 & 0 & 0 \end{bmatrix}$.

Write a Matlab function that solves this problem. Try to avoid using a for loop.

Exercise 4



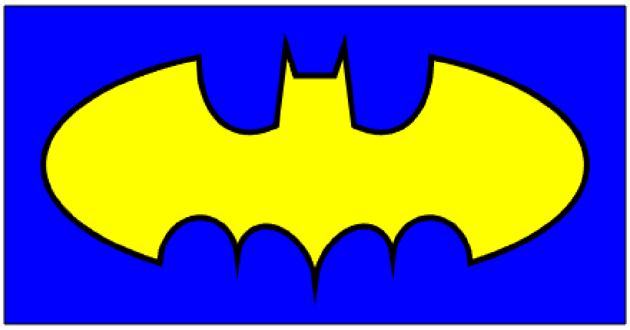
Write a Matlab function to compute and plot the truncated Fourier series given by the sum

$$y(x)=\sum_{k=1}^{n}\frac{\sin(k x \pi)}{k} \quad , \qquad x\in(0,8)$$

for a given value of n. The plot you should see is called the "sawtooth function". Try to avoid using a for loop. Label the axes and give a title to your plot.

Exercise 5

Write a Matlab function that visualizes the batman logo in the following colors:



You can make use of the following equations (with the given color code):

$$x_1(y)=\pm 7\sqrt{1-\left(\frac{y}{3}\right)^2} \quad ,$$

$$y_2(x)=\left|\frac{x}{2}\right|-x^2\left(\frac{3\sqrt{33}-7}{112}\right)-3+\sqrt{1-(||x|-2|-1)^2} \quad ,$$

$$y_3(x)=\left(\frac{6\sqrt{10}}{7}+\frac{3-|x|}{2}\right)-\frac{6\sqrt{10}}{14}\sqrt{4-(|x|-1)^2} \quad ,$$

$$y_4(x)=9-8|x| \quad , \qquad y_5(x)=3|x|+\frac{3}{4} \quad , \qquad y_6(x)=\frac{9}{4}$$