Lab exercises
Degree in mechanical engineering
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Functions declaration and evaluation in Matlab

- In Matlab, to define a function, say `fun.m` we proceed as follows

```
function [o1,...,oM]=fun(i1,..., iN)
%--------------------
%function body
%--------------------
return
```

  where `i1,...,iN` are input parameters and `o1,...,oM` are the output ones.

- Suppose now that `f.m` is a file containing the function $f(x) = x^2 \sin x$, that is

```
function [y]=f(x)
  y=x.^2.*sin(x);
return
```

  Therefore, given the vector `x`, by using the command `y=feval(@f,x)` is equivalent to `y=f(x)`.

  All are equivalent commands

- Finally there are two ‘‘inline’’ ways to define a function. Considering the same function as before, the definition and evaluation of the function at the vector `x` can be done in the following way

```
f=@(x) x.^2.*sin(x);
y=f(x);
```

  or

```
f=inline('x.^2.*sin(x)');
y=f(x);
```

Solve the following problems

1. Build an M-function, `pigreco.m`, that computes the recursive sequence

$$\begin{aligned} z_1 &= 2 \\ z_n &= 2^{n-1/2}\sqrt{1-\sqrt{1-4^{1-n}z_{n-1}^2}}, \quad n \geq 2 \end{aligned}$$

   which should converge to π as $n \to \infty$. The output will be the sequence `z`. Then, on the calling M-script, plot the relative errors. Is the sequence a stable method to compute π?

2. Build another function for the recursive sequence

$$\begin{aligned} z_1 &= 2 \\ z_n &= \sqrt{2}\frac{z_{n-1}}{\sqrt{1+\sqrt{1-4^{1-n}z_{n-1}^2}}}, \quad n \geq 2 \end{aligned}$$

   The output will be as before the sequence `z`. Then, on the calling M-script, plot the relative errors. Is this sequence a stable method to compute π?.

3. Compute the succession

$$I_n = \frac{1}{e}\int_0^1 x^n e^x dx, \quad n \geq 0\,,$$

   firstly with the unstable formula then with the stable one. Use M-functions.