MATH 131: Numerical Methods for scientists and engineers – Discussion 1: Coding

The goals of this first discussion section are:

- Get familiar with the Matlab framework. This includes writing functions, using the help, Live scripts and documentation.
- Get familiar with Cody Coursework.
- Understand round-off errors, pseudo-code.

1. **Get familiar with Matlab.**
   (a) Write a `Matlab` function, called `myalternatesum` that inputs the integer n and outputs the sum: $\sum_{k=1}^{n}(-1)^k k$. Use a for loop to compute the sum. Show your results for $n = 20$ and $n = 100$. Document your code, precise the inputs and outputs.
   (b) Write the pseudo-code associated to the function `myalternatesum`.
   (c) Define on Matlab the function $f(x) = (x-1)^2$ using the function handle `@`. Look up the help if needed. Plot on the same graph the function for `x = [0:0.25:1]` and for `x = [0:0.01:1]`, using different color and aspect for each graph. Compare.
   (d) Type on the Matlab console `format long`, then evaluate $f(\sqrt{3})$. Repeat the operation by typing `format short`. Comment on the result (quantify the difference).
2. **Get familiar with Cody Coursework.** Go online using the invitation you received and try the exercises from assignment 00. Understand the assessments and how to correct your code if needed.
3. **Round-off errors and get familiar with Matlab Live Script**
   Open Matlab 2017, and create a Live Script called `coding-1.mlx`. Read the documentation on Matlab about Live script. Type your answers to the exercises below in `coding-1.mlx`:
   (a) Create a text cell (click on `Text`) and type `Exercises` followed by the associated exercise number.
   (b) Create a code cell (click on `Code`) to program your answer.
   (c) Create a text cell (click on `Text`) to comment your results directly in your Live script.
   (d) To test your code click on `Run all`.
   (e) i. Write a `Matlab` function called `myderivative` that inputs a number x and outputs the derivative of the function $f(x) = \frac{1}{2}(x-1)^2$.
   ii. Compute the absolute error for $x = 1.1$, obtained by comparing the output of your function to $\dfrac{f(x+h)-f(x)}{h}$, with $h = 0.01$.
   iii. Compute the absolute error for $x = 1.1$, obtained by comparing the output of your function to $\dfrac{f(x+h)-f(x)}{h}$, with $h = 0.001$. Comment on the two previous results.
   iv. Plot for $x =$`0:0.1:5` the function $(x-1)^2$ and its tangent line at $x = 1.1$. Write in your report the expression of the tangent line. Put the legend on your graph.
   v. Add to the same plot the *approximate* tangent line at $x = 1.1$, by simply replacing the slope of the tangent line by the one computed in (b). Comment on the result.
   vi. Find the value of c such that $f'(c) = \dfrac{f(5)-f(0)}{5}$. You can add a picture of your notes in your `coding-1.mlx`. Which theorem gives such properties ?