PYU33C01, S. Hutzler, 2019
Assignment 1: Numerical Differentiation

Write a Python program to compute the second derivative of $\cos x$ using the central difference method.

- Plot the analytical and numerical results in the range $[0 : 4\pi]$.

- Compute and plot the variation of the absolute error in that range.

- Start with step size $h = \pi/10$ and keep reducing h until you reach the limits of machine precision, i.e. when a further rediction of h does not not lead to higher accuracy, due to rounding errors. What is the highest accuracy in the relative error that you can achieve? For which value of h?

- Subtractive cancellation refers to the effect that when one subtracts two similarly large numbers, the resulting small number contains only the least significant figures (see discussion in Landau and Paez, Computational Physics, 1997).

  Check whether the following expression for the central difference method reduces the numerical error in your calculation.

  $$f^{(2)}(x)_{CD} = \frac{(f(x + h) - f(x)) - (f(x) - f(x - h))}{h^2} \tag{1}$$

- Submit a report (as pdf) **via Blackboard** which details your findings, include relevant figures. Also submit your Python code as a *.py* file which should also print your name and student number onto the screen when executed.

submission deadline: Monday, September 23, 2019