OLLSCOIL NA hÉIREANN, MÁ NUAD

NATIONAL UNIVERSITY OF IRELAND, MAYNOOTH

BSc in Physics with Astrophysics
BSc in Experimental Physics

EP408 Computational Physics Class Test 1

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Answer **both** questions, Time allowed: 2 hours

*Please **save your work regularly** - no credit can be given for work that is lost.*

Q.1 (Interpolation)

The following data were collected during a laboratory experiment:

x	0.0	0.5	1.0	1.5	**2.0**	2.5	3.0	3.5	4.0
y	356.1	397.1	423.8	445.1	**450.7**	509.9	572.6	668.2	806.6

A plot of these suggests that the value of y at $x = 2.0$ was incorrectly recorded. Write a python program that uses global interpolation of the other points (Lagrange formula) to estimate the correct value of $y(2.0)$.

Your code should plot the measured data points as well as the interpolation between $x = 0.0$ and $x = 4.0$ and your estimation of $y(2.0)$. You may base your plot layout on the one below.   (10 marks)
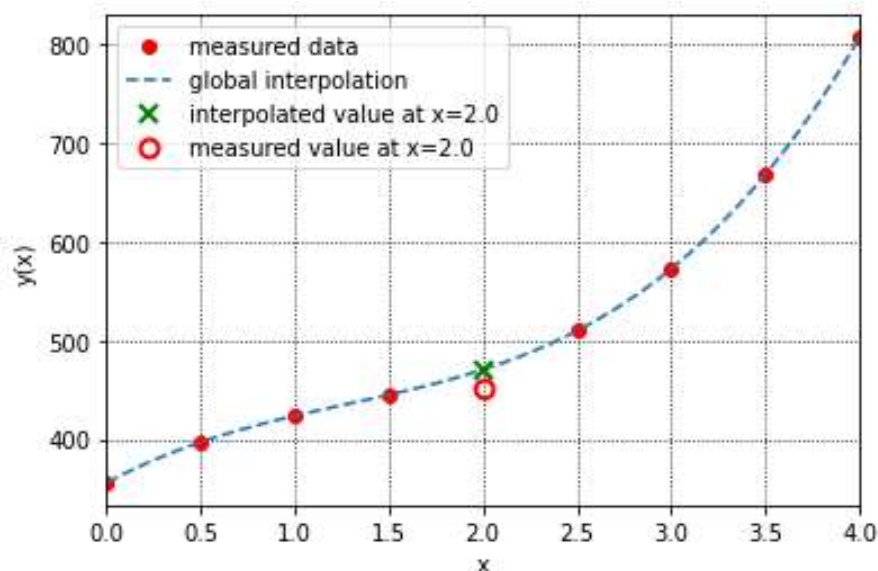
<u>NOTE:</u> *Marks will be given for the style, structure and **commenting** of your code. The plot should be labelled.*

Q.2. (Integration) Write a Python program that uses Simpson's method to carry out the integral:

$$\int_{start}^{end} \cos\left(\frac{\pi x^2}{2}\right) dx$$

where start, end and the number of points to use in the integration can be clearly set in the code. Print out the result for start=0, end = 1 and 500 integration points.

Modify your code to also calculate.

$$\int_{start}^{end} \sin\left(\frac{\pi x^2}{2}\right) dx$$

Print out the result for start=0, end = 0.5 and 500 integration points.

(7 marks)

In your code, define a function

$$C(u) = \int_0^u \cos\left(\frac{\pi x^2}{2}\right) dx$$

and

$$S(u) = \int_0^u \sin\left(\frac{\pi x^2}{2}\right) dx$$

Plot $C(u)$ as a function of $S(u)$ for u in range [-10,10] in 1000 steps. Use 500 steps in the integrations.

(3 marks)

NOTE: *Marks will be given for the structure and **commenting** of your code, labelling of plots etc.*