Quiz 1 (part 1) - Computational Physics I

9/10

NAME: Males-Araujo Yorlan **SCORE:**

Date: Friday 15 March 2024 **Duration:** 45 minutes

Credits: 10 points (5 questions) **Type of evaluation:** LAB

This quiz is individual and has two parts: Part 1 is closed-book, in-class, and contains short-answer questions. Part 2 is take-home and contains long application problems.

Provide short and concise answers to the following items:

1. **(2 points) Programming languages**
   Explain the difference between low-level and high-level programming languages.

Low-level p. languages are closer to the machine code, and so their language differs a lot from what high-level p.lan. use, which resembles human language. Also, programs written in the latter can be easily run in other platforms with few or no modification, and this isn't the case for the former.
In performance, low-level p.lan. are better; but harder too.

2. **(2 points) Python basics**
   List 4 types of python data structures, and briefly explain which one you would pick to store a) only numbers and b) numbers and strings.

1) Lists: [, , ,]
2) Tuples: (, ,), paretheses are optional.
3) Dictionaries: { " ": " ", " ": " ", " ": _ , ...}
4) Arrays: [_ _ _ _]

I guess dictionaries are an option as well. To store grades, for ex.
↳ Yes.

a) To store only numbers I'd use arrays as they make easier to handle numbers.

b) To store numbers and strings I'd use lists, and strings should have " " They accept both types, that's why.

3. **(2 points) Python Input/Output**
   Indicate 2 methods that we can use to carry out data input/output in python, and explain one advantage and one disadvantage of each method.

1) Using built-in python functions like open(), .read(), .write(), etc.
-0.5 Advantage: You might be required to do it this way in low-level P.L.
Disadvantage: The process takes longer in comparison to other methods. It's not efficient. ? Not necessarily.

2) Using libraries like pandas.
Advantage: They make everything simpler and faster when carrying out ~~these processes.~~ I/O tasks.
Disadvantage: I don't know. Perhaps that they have to be installed??

4. **(2 points) Regressions**
Indicate the main steps that we need to follow to carry out a meaningful regression using empirical data in python.

1) Inspect the data (quickly plot it and observe)

2) Check if the data is correlated: monotonity and also linearity by calculating the Spearman's and Pearson's coefficients, respectively.

3) Propose a physically-motivated model for the data. Here's where we start using physics. It will give us hint about the behaviour: linear, 2nd grade, $\sqrt{\ }$, etc.

4) Carry out the regressions using a good method, that is, a method that suits best the data.

-0.5

What about free parameters?

→ How?

↳ which ones?

5. **(2 points) Data fitting methods**
Explain the difference between the least-squares (LM) and the χ^2 data fitting methods.

The main difference is that the χ^2 data fitting method does take into account the uncertainties in y that the data may have, while the LM method does not; it just uses one point per point in x.

Their form is quite similar

LM method:

$$\min \sum_j (y_j - y_{model})^2$$

χ^2 method

$$\min \sum_j \frac{(y_j - y_{model})^2}{\sigma_j^2}$$

and it makes clearer to see their difference.