Hertie School, Spring 2024
Data Structures & Algorithms (Professor Dimmery)
Problem Set 1, Due Friday, February 23

In this problem set, we will use some of the tools you've learned in the first few lectures and labs. You should prepare your solutions in a Jupyter notebook, writing and running the appropriate code in the notebook (please no separate script files, as I want to see all of your work in a single document). Provide this document to me on Moodle in a single pdf.

You should prepare all of your writeup and code in this document, formatting it nicely: as if you were going to be sharing the results with your colleagues and boss. What does this mean?

- Clearly label your solutions.
- Solutions which require explanation should use complete sentences.
- If you use code or materials from anywhere else, that should be clearly labeled and cited.
- If you are asked to prepare graphs or tables of output, they should be labeled clearly. A good rule of thumb is that charts should be self-explanatory: they should not require reading the text in order to understand.

To export a Jupyter notebook to a pdf, the easiest solution is to run all of your code and then Print the page to a pdf. Depending on your computer's setup, you may be able to explicitly export using Jupyter's tools through the File - Download as - pdf via LaTeX (.pdf) menu (or one of the other exporters that ends in (.pdf). If you can't make this work (for further details, this blog has some additional instructions that might help), then just print it to pdf. This won't affect your grade, what I care about here is the content.

Note that each question in this problem set has a number of points associated with it. The maximum number of points on this assignment is 15 which, unsurprisingly, corresponds to the number of points on your final grade.

As a reminder, I don't mind if you work together with classmates when you get stuck, but the work you submit should be purely your own.

1. (2 points) Convert the following decimal integers into 8-bit Two's Complement signed integers. If that isn't possible, explain why it isn't.
    - 24
    - 156
    - -37
    - 16
2. (2 points) Now do the following addition / subtraction problems, highlighting where overflow / underflow errors have occurred. The integers are provided in Two's Complement notation.
    - 00010010 + 10011100
    - 00011000 + 00001000

- 01100010 + 00101100
- 11001111 + 10101001

3. (2 points) Convert the following fractions into 8-bit floating point (1 sign bit, 3 exponent bits and 4 mantissa bits). If that isn't possible exactly, explain why, and show how inaccurate the encoding would be:

   - 3 $\frac{1}{4}$
   - -6 $\frac{1}{2}$
   - 4 $\frac{1}{2}$
   - $\frac{9}{256}$

4. (2 points) Convert the following 8-bit floating point numbers into fractions. If that isn't possible, explain why:

   - 01101011
   - 11011001
   - 11001011
   - 01111111

5. (3 points) Write out exactly what will be done (as I did example solution from the lecture slides) by the computer initialized to have nothing in its registers (including the instruction register), A0 in the program counter, and the following data in its main memory:

Address	Contents
A0	14
A1	AA
A2	23
A3	AA
A4	A3
A5	03
A6	82
A7	34
A8	C0
A9	00
AA	B4

6. (2 points) Write a Python function that checks if an input number is a palindrome number (a number that reads the same forward and reverse, e.g. 151) and returns `True` or `False`; this function should raise an error if the input is not an integer.

7. (2 points) Using the flask project that you created in the lab, create an About page with the content listed below. You should show in your code that you know how to pass a variable to the `render_template` function. You need to submit the code of your `about.html` template

and the code of your `flaskapp.py` file, plus a screenshot of the about page in your running app. Include the relevant code in a script listing in a markdown cell of the Jupyter notebook by creating a markdown cell and surrounding it with three backticks (‘‘‘: on a US keyboard, this is above the Tab key, on a German keyboard, this is next to the Backspace key). The screenshot can be inserted using the notebook's UI (in my Jupyter, an image can be embedded using Edit - Insert Image in a Markdown cell).

- a title, e.g. your name
- a subtitle, e.g. a description of you
- a photo of you
- a paragraph about you
- links to at least one social media account

Hint: You will have to research about how to include images and hyperlinks in flask.