CSE101

DUE SEP. 26

23:59 KST

ASSIGNMENT I

PROFESSOR

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ALGEBRAIC OPERATIONS & FUNCTIONS

General instructions

- Please add your name and email in the dedicated location at the top of your code
- Do not use any external library, except when explicitly requested
- Try to follow the naming convention proposed by PEP-8 seen in class
- Use meaningful names for your variables and functions
- If you face a problem submitting your code via GitHub, please contact the professor and the TA by email
- Note that the received code will be tested on a classifier to detect potential usage of Large Language Model. We will also pay particular attention to plagiarism
- Leave comments in your code to explain your code and describe the difficulties you faced

INVITATION LINK

https://classroom.github.com/a/i1TVKXph

Exercise 1: The Grade Calculator (3 points)

You are a teacher who needs to calculate the final grades for your students. The final grade is based on scores in three subjects: Math, Science, and History. Each subject has equal weight in the final grade.

1. **Request input from the user**

Write a Python code that will request the scores (0-100) in Math, Science, and History for a student. If the user enters a value outside of this range, display an error message. You will implement this behavior in a function called `request_score`, which will output the scores for each subject. How can a function return multiple values?

2. **Compute the average**

Then, you will create a function `compute_average` to compute the overall average score of the student:

$$Average = \frac{Math + Science + History}{3}$$

Display this score to the user and return the value as the output of this function.

3. Calculate the corresponding grade

Finally, create another function called `compute_grade` that will input the average score and compute the final grade based on the following scale (this function should be a void function):

Grade	Percentage Range
A	90-100
B	80-89
C	70-79
D	60-69
F	0-59

The grade will be displayed to the user in the terminal.

Recap

1. Create a function `request_scores` 1 point
2. Create a function `compute_average` 1 point
3. Create a function `compute_grade` 1 point

Exercise 2: The Modern Architect (4 points)

You are an architect designing a futuristic building that includes a large atrium shaped like a frustum of a cone. You need to calculate its volume to determine the air conditioning needs. For this exercise, assume that each air conditioning unit can effectively cool 50 cubic meters of space.

1. Compute the volume of a conic frustrum

First, calculate the volume V of the frustum using the formula:

$$V = \frac{\pi h}{3}(R^2 + r^2 + Rr).$$

Write a Python function called `calculate_frustum_volume` that takes in the height h, bottom radius R, and top radius r, and returns the volume of the frustum.

2. Calculate the required number of AC units

Next, calculate the number of air conditioners N_{AC} needed using the formula:

$$N_{AC} = \left\lceil \frac{V}{50} \right\rceil,$$

where $\lceil x \rceil$ is the ceiling function, which rounds x up to the nearest integer.

Write a Python function called `calculate_ac_units` that takes in the volume and returns the number of air conditioning units needed.

3. Call your functions

Now that your functions are ready, it is time to use them. This time, we will not request the input from the user. Instead, you will declare the three input variables R, r, and h in the main and use them to call the two functions. You will display both results for the final user.

4. Make your code more comprehensive and flexible

Now … suddenly, the AC manufacturer tells you that each unit can only cool 30 cubic meters; what can you do to make your code more flexible and adaptive for such kinds of scenarios? Propose some modifications. Finally, add comments on each function to precisely describe their inputs/outputs and usage.

Recap

1.	Create a function `calculate_frustum_volume`	1 point
2.	Create a function `calculate_ac_units`	1 point
3.	Call your functions	1 point
4.	Propose appropriate modifications	1 point

Exercise 3 – The solar panel problem (3 points)

You're an engineer tasked with installing solar panels on a triangular rooftop. After calculating the area, you need to determine how much electricity the panels will generate.

1. Calculate the roof surface

First, we will create a function `calculate_triangle_area` which will compute the area of a triangle given its three side lengths a, b and c based on Heron's formula:

$$A = \sqrt{s(s-a)(s-b)(s-c)},$$

where s is the semi-perimeter, calculated as $s = \frac{a+b+c}{2}$.

2. Calculate the electricity generated by the rooftop

Now that you are able to compute the roof surface, compute the average electricity generated by your solar setup:

$$\begin{aligned} &Electricity\ Generated \\ &\quad = Area(m^2) \times Solar\ Panel\ Efficiency \times Sunlight\ Hours \\ &\quad \times Solar\ Irradiance\ (kW/m^2) \end{aligned}$$

Where the solar Panel Efficiency is 0.18 (or 18%), and let's assume an average of 10 hours of sunlight per day with a solar irradiance of 1kW/m^2. You will implement this calculation in a function called `calculate_energy`, which will take as input the three sides of the triangular rooftop a, b, and c.

3. Test your code

Call your function `calculate_energy` with a=3, b=2.5 and c=4 and display the results to the user.

Recap

1.	Create a function `calculate_triangle_area`	1 point
2.	Create a function `calculate_energy`	1 point
3.	Call your functions	1 point