CS 213: Object Oriented Programming
Spring (Jan-May) 2024
Assignment 1

Total Points:	20
Assigned:	Friday, 12 January, 2024
Due:	Monday, 22 January, 2024, by 11:59pm
Submission format:	Canvas

Instructions

- Work on this assignment individually. Remember the following policy stated in the course syllabus:

  For programming assignments, you are allowed and encouraged to brainstorm about the problems with your peers. You can talk in English (not Java!) about algorithms and approaches. However, unless you are explicitly asked to work in a team, you must sit down behind the computer and write the program you turn in yourself. If you copy a section of code from any source (e.g., part of an example from class, or from the course textbook) you must include an appropriate citation in a comment above the code segment that you copied. You may not copy code from the internet, an AI tool or from your peers – this is plagiarism, and furthermore, will not help you learn.

  A good way to collaborate with your peers is to discuss the problem together to make sure that you fully understand the problem and how to solve it from a logical point of view, before you start writing code for it.

- Upload your source files (.py and .java) to Canvas. Submit your solution in a zip file named *Surname.Firstname*-Assign1.

Problem 1 [12 points]: Income Tax

Individuals in Ghana pay tax on earned income. You will write a program to help individuals compute the amount of tax that they are required to pay. This program will be helpful in many situations. In particular, when you apply for and are offered a full-time job, you can use the program to estimate what your actual take-home pay is going to be, after you pay your taxes on your gross income.

Background Information

Income taxes in Ghana and many countries are graduated such that high-income earners pay proportionally more than low-income earners. Below is the tax rate table published by the Ghana Revenue Authority (https://gra.gov.gh/domestic-tax/tax-types/paye/)

Year 2023	Chargeable Income GH¢	Rate %	Tax Payable GH¢	Cumulative Income GH¢	Cumulative Tax GH¢
First	402	0	0	402.00	0
Next	110	5	5.5	512.00	5.5
Next	130	10	13.00	642.00	18.5
Next	3,000.00	17.5	525	3,642.00	543.5
Next	16,395.00	25	4,098.75	20,037.00	4,642.25
Next	29,963.00	30	8,988.90	50,000.00	13,631.15
Exceeding	50,000.00	35	17,500		

For example, if my gross income for the month is GH¢ 2,000.00, I can calculate the income tax that I need to pay as follows, by referring to the *Chargeable Income GH¢*, *Rate %* and *Tax Payable GH¢* columns of the table above:

a) For the first GH¢402 of my income, I pay nothing in taxes. This leaves GH¢ (2,000 - 402) = GH¢1,598 on which I must pay tax
b) For GH¢110 out of the remaining GH¢1,598, I pay 5% tax = GH¢ 5.50. I still have income of GH¢ (1,598 - 110) = GH¢1,488 on which I must compute tax.
c) For GH¢130 out of the remaining GH¢1,488, I pay 10% tax = GH¢13. Thus, my tax so far is GH¢5.50+13 = GH¢18.50 and I still have income of GH¢ (1,488-130) = GH¢1,358 on which I must compute tax.
d) On the remaining GH¢1,358 (because it is not more than the next block of chargeable income of 3,000), I pay 17.5% tax = GH¢237.65. Adding to the previously computed tax of GH¢18.50, my total tax obligation is thus **GH¢256.15**
e) This means that after paying my income tax, my net monthly salary will be GH¢ (2,000 – 256.15) = **GH¢1,743.85**

Another (shorter) way to compute my tax obligations would be to refer to the *Cumulative Income GH¢* and *Cumulative Tax GH¢* columns of the tax table:

- The largest value in the *Cumulative Income GH¢* column that is less than my gross salary of GH¢2,000 is GH¢642 and the corresponding cumulative tax is GH¢18.50. Thus, I can skip steps (a)-(c) of the computation above and simply note that the tax to be paid on the first GH¢642 of my income is GH¢18.50. This leaves a balance on my income of GH¢(2,000 - 642) = GH¢1,358 on which I must compute tax.
- On the remaining GH¢1,358, I pay 17.5% tax = GH¢237.65. Adding to the previously computed tax of GH¢18.50, my total tax obligation is thus **GH¢256.15**
- This means that after paying my income tax, my net monthly salary will be GH¢ (2,000 – 256.15) = **GH¢1,743.85**

You can verify the computation above by using a tax calculator provided by the GRA: https://gra.gov.gh/online-tools/tax-calculators/

Tasks:

(a) To make sure that you understand how the tax laws work, compute by hand the income tax and resulting net salary for the following gross monthly salaries: GH₵600, GH₵6,000, GH₵60,000.

(b) Your task is to write a program that can compute the income tax and net salary given some gross monthly salary entered by the user. Based on how you did the manual calculations, come up with an algorithm that works.

(i) Implement your algorithm in Python. It should prompt the user to enter his or her gross monthly salary. It should then compute the income tax that is due as well as the resulting net monthly salary. Test your program for several carefully-chosen test cases and copy your program output to a document. Explain how you chose your test cases.

(ii) Implement the same algorithm in Java and test your program as described above.

Problem 2 [8 points]: Guessing Game

Write a program that picks a number at random, does not disclose the number to the user, but allows the use to try to guess the chosen number, giving feedback such as "too high" or "too low" for each guess the user makes, until they guess the correct number. See a sample interaction below. The values in bold are the user's input.

Welcome to the Guessing Game!
I'm thinking of a number between 1 and 100. Can you guess it?
Guess: **34**

Good try, but that's too low. Try again.
Guess: **63**

Good try, but that's too high. Try again.
Guess: **50**

Good try, but that's too high. Try again.
Guess: **40**

Good try, but that's too low. Try again.
Guess: **46**

Good try, but that's too low. Try again.
Guess: **48**

Yes! You guessed correctly after 6 tries! Congratulations.

Tasks:

(a) Implement this program in Python.
(b) Implement the same program in Java.