IE5600 – Applied Programming for Industrial Systems

AY 2023/24 Semester 1

Practical Lab 01 – Introduction to Computational Problem Solving | Introduction to Python | Variables and Operators

Section A – Tutorial Discussion

Question A1 – An Algorithm to Check Palindrome

A palindrome is a word that can be read/spelt the same way in either direction (such as "Madam" and "Level") without regard to the capitalisation of the alphabets.

a) Apply the six-step algorithmic thinking process to design an algorithm that can check whether a word that contains at most five characters is a palindrome.

   At a high-level, the three basic computation tasks would entail the following:

   - Input – Asks the user to input a word of at most 5 alphabets.
   - Process – Check whether the word is a palindrome.
   - Output – Print out a message to inform the user whether the word is a palindrome.

   Your algorithm should not use any library function.

b) What happen if we want to refine the problem into a more generic one that involves words of any number of characters? Design an algorithm that can check whether a word that contains any number of characters is a palindrome.

c) Which algorithm, (a) or (b), seems easier?

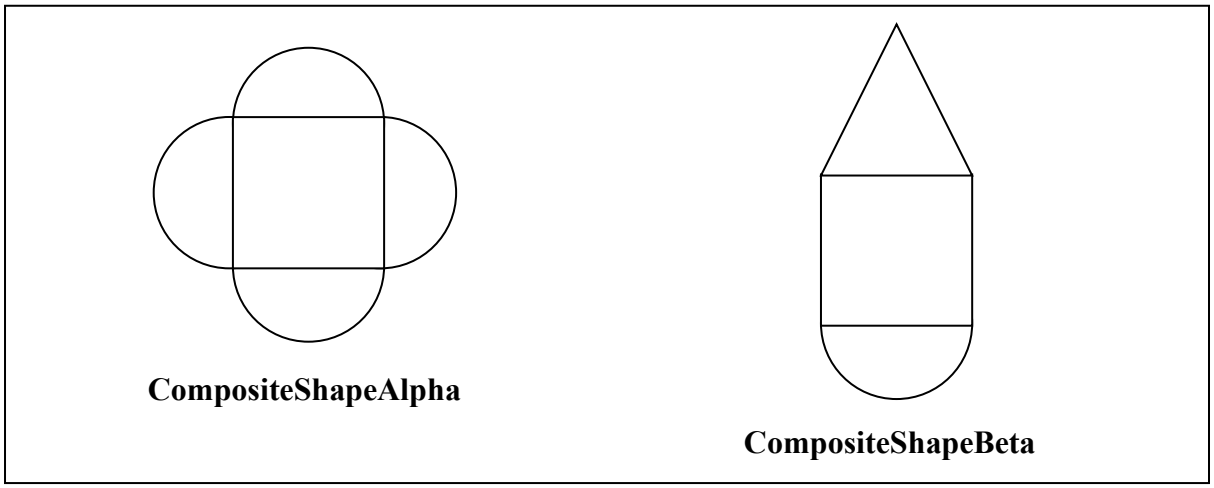
Question A2 – Area of Composite Shapes

Recall that in Lecture 01, we had applied the computational problem solving process to compute the area of a rectangle and a more complex composite shape. As part of our discussion, we had applied the divide and conquer strategy as well as various programming paradigms such as structured programming, procedural programming and object-oriented programming.

Suppose we would like to extend the problem to compute the area of the following two new composite shapes:

- CompositeShapeAlpha is made up of a square and four semi-circles (whose diameter is equal to the length of the square).

- CompositeShapeBeta is made up of a square, one semi-circle (diameter is equal to the length of the square), and an equilateral triangle (base is equal to the length of the square)



CompositeShapeAlpha

CompositeShapeBeta

a) Briefly explain how you would go about computing the area of these two composite shapes using the structured and procedural programming paradigms. You do not need to write the actual code.

b) Briefly explain how you would go about computing the area of these two composite shapes using the object-oriented programming paradigm. You do not need to write the actual code.

Question A3 – Applying Computational Problem Solving to Your Workplace

Recall that our Canvas module description had cited logistic warehouse automation as a typical example of an industrial system engineering problem that would benefit from computation problem solving. For example, we would likely need to develop a software application to track inventory at various storage locations within the warehouse. The application would also need to enable fast searching of inventory, and to plan efficient routes to put away and pick items.

Source: https://pxhere.com/en/photo/663063

Survey your workplace and identify any one opportunity or problem in which you could apply computational problem solving to create a useful software application. At this early stage of the semester, it is perfectly fine to conceptualise a software application that is relatively small, e.g., a simple calculator program.

Section B – Programming Exercises

For this series of programming exercises, you should hardcode the input data as literal values and execute the Python statements on the interactive console such that you do not need to perform input/output.

Question B1 – Currency Exchange

Assume that the prevailing exchange rate from US Dollar (USD) to Singapore Dollar (SGD) is 1.3500. Write a series of Python statements to define the amount of USD to be changed to SGD as a literal value and then compute the equivalent amount in SGD.

Write another series of Python statements to define the amount of SGD to be changed to USD as a literal value and then compute the equivalent amount in USD.

Sample Input	Sample Output
USD to SGD, 100	135.0
USD to SGD, 250	337.5
SGD to USD, 100	74.07407407407408
SGD to USD, 250	185.18518518518516

Question B2 – Temperature Conversion

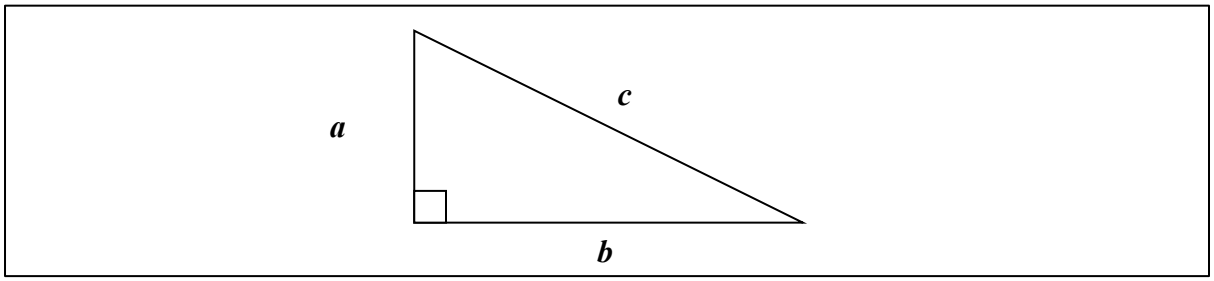
The two most commonly used temperature scales are the Celsius scale (°C) and the Fahrenheit scale (°F). On the Celsius scale, the freezing point of water is defined as 0°C and the boiling point of water is defined as 100°C. On the Fahrenheit scale, the freezing point of water is defined as 32°F and the boiling point of water is defined as 212°F.

Write a series of Python statements to define the temperature in Celsius as a literal value and then compute the equivalent temperature in Fahrenheit.

Write another series of Python statements to define the temperature in Fahrenheit and then compute the equivalent temperature in Celsius.

Sample Input	Sample Output
Celsius to Fahrenheit, 0	32
Celsius to Fahrenheit, 33.3	91.94
Fahrenheit to Celsius, 212	100
Fahrenheit to Celsius, 180.5	82.5

Question B3 – More of the Pythagoras' Theorem



For any right angle triangle with three sides *a*, *b* and *c* as shown in the above figure; side c is known as the hypotenuse (i.e., the side opposite the right angle. The Pythagoras' Theorem may be written as a mathematical equation relating the lengths of the three sides *a*, *b* and *c*:

$$a^2 + b^2 = c^2$$

Using this equation, we can find any unknown side as long as the lengths of the other two sides are known. For instance, we can find the length of side *c* if we know the lengths of sides *a* and *b* using the equation below:

$$c = \sqrt{a^2 + b^2}$$

Recall that we have written a single line of Python statement to calculate the length of side *c* during our lecture as a hands-on exercise.

What happen if we only know the lengths of the hypotenuse and one other side of the right angle triangle? How do we find the length of the third side? For example, if we know the lengths of sides *a* and *c*, how do we find the length of side *b*? How about if we know the lengths of sides *b* and *c*, how do we find the length of side *a*?

Write a series of Python statements to solve the above problem by defining the lengths of the triangle as literal values.

No sample input and output are provided for this question.

Question B4 – Swapping Two Variables Without a Third Temporary Variable

Recall that in Lecture 03, we had discussed the swapping of values across two variables using a third temporary variable. Think about two different ways of performing this swap without the use of a third temporary variable.

Write a series of Python statements to implement the two approaches.

No sample input and output are provided for this question.