



IE5600 – Applied Programming for Industrial Systems

AY 2023/24 Semester 1

Practical Lab 02 – Basic Input/Output | Conditional Control Flow

Section A – Tutorial Discussion

Question A1 – Elegant and Efficient Usage of If-Else Statement

During the lecture, we have discussed about the use of the `if` statement to implement conditional control flow in Python. Think about various techniques that could be applied to enhance the readability and efficiency of writing `if` statements in Python. Briefly explain each technique and illustrate with a simple example.

You might find it useful to research on the Internet or ask ChatGPT :)

Section B – Programming Exercises

For this series of programming exercises, you should not use any iterative control flow.

Question B1 – Compound Interest and Future Value Calculator (Basic)

Write a program to calculate the compound interest and future value of an investment using the following formula without the use of any iterative control flow:

$$P(t) = P_0 \left(1 + \frac{r}{n}\right)^{nt}$$

$P(t)$ is the current principal amount at time t and P_0 is the initial principal amount.
 r is the annual interest expressed as a decimal, n is the number of compounding period per annum
and t is the total amount of time in years.

You should prompt the user to input only the following data and print out the compound interest as well as the future value.

- Principal amount (initial investment)
- Annual interest rate (%)
- Length of time in years
- Number of time interest is compounded annually (compound frequency)

You may use this online calculator to validate your result assuming that monthly contribution is \$0 – <https://www.investor.gov/financial-tools-calculators/calculators/compound-interest-calculator>

Initial Investment *
Amount of money that you have available to invest initially.

Step 2: Contribute

Monthly Contribution
Amount that you plan to add to the principal every month, or a negative number for the amount that you plan to withdraw every month.

Length of Time in Years *
Length of time, in years, that you plan to save.

Step 3: Interest Rate

Estimated Interest Rate *
Your estimated annual interest rate.

Interest rate variance range
Range of interest rates (above and below the rate set above) that you desire to see results for.

Step 4: Compound It

Compound Frequency
Times per year that interest will be compounded.

CALCULATE **RESET**

The Results Are In
In **30** years, you will have **\$10,535.91**

Enter Principal = 5000

Enter Annual Interest Rate (%) = 2.5

Enter Time in Years = 30

Enter No. of Times Interest Compounded Annually = 2

Compound interest is \$5535.91

Future value is \$10535.91

Question B2 – Enhanced Temperature Conversion (Basic)

Let's try to enhance the programs that you have written in Practical Lab 01 Question B2. Write a single program that asks user for the type of temperature conversion that is required, either Celsius to Fahrenheit or Fahrenheit to Celsius, using a suitable input scheme. For example, you could ask user to input a string ('C' or 'F') or integer (1 or 2).

If the temperature conversion type input by user is valid, the program should ask user to input the temperature in the original scale. Finally, the program should convert the input temperature to the required scale before printing out the converted temperature.

Depending on the type of temperature conversion selected by the user, check that the original temperature input by the user is within the boiling point of water and the freezing point of water for the original temperature scale. If the input temperature is valid, continue to perform the temperature conversion and print out the converted temperature. Otherwise, print out an error message.

Sample Input	Sample Output
Celsius to Fahrenheit, 0	32
Celsius to Fahrenheit, 33.3	91.9
Fahrenheit to Celsius, 212	100
Fahrenheit to Celsius, 180.5	82.5

Question B3 – Palindrome Checking the Hard Way (Basic)

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.

Write a program that asks the user to input a word of at most 5 alphabets. Remove any leading and trailing whitespaces from the inputted word with the `strip()` function and convert the word to lowercase using the built-in function `lower()`. Then use the built-in function `len()` to determine the length of the word. Finally, the program should check whether the inputted word is a palindrome and print out a message accordingly to inform the user. Other than these three built-in functions, you should not use any other library function in your program.

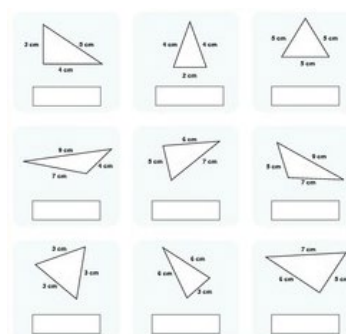
If the length of the word is 0 or more than 5, you should print out an error message.

For this question, please limit your input to a word of at most 5 alphabets. We would revisit the more general case of any number of alphabets in the near future.

Sample Input	Sample Output
Madam	Is a palindrome
Level	Is a palindrome
Apple	Is not a palindrome
Egg	Is not a palindrome

Question B4 – The World of Triangles (Intermediate)

A triangle is a three-sided polygon, which has three vertices. The three sides are connected with each other end to end at a point, which forms the angles of the triangle. Triangles may be classified into different types by side and by angle.



Write a program that asks the user to input the three angles. You may assume that the inputs are valid integer numbers, and no input data validation is required. Based only on the three angles inputted by the user, print out i) whether the three angles constitute a valid triangle; and ii) all applicable type(s) that the triangle may be classified as.

Search on the Internet and find out more about the mathematical properties of triangles, in particular how they may be classified by side and by angle. This would help you to formulate the correct algorithm using appropriate conditional control flow statements.

No sample input and output is provided for this question.

Question B5 – Identity Card Number Validator (Intermediate)

The National Registration Identity Card (NRIC) is the compulsory identity document issued to citizens and permanent residents of Singapore. The unique identifier associated with the document is commonly known as the “identity card number” or simply “NRIC number”.

The identity card number consists of 9 alphanumeric characters in the following format:

- The 1st character identifies the type of residency status, e.g., “S” and “T” are for Singapore citizens and permanent residents, whereas “F” and “G” are for foreigners issued with long-term passes.
- The 2nd to 8th characters “xxxxxxx” is a 7-digit serial number assigned to the document holder.
- The 9th character is a checksum or check alphabet for validating the correctness of the identity card number.

The algorithm to calculate the check alphabet is based on modulo 11. The 7-digit serial number is first summed up using a weighted additive formula. If the identity card number begins with “T” or “G”, 4 is added to the weighted sum. The final weighted sum is then divided by 11 to obtain the remainder, i.e., the modulo 11. The modulo 11 is then mapped to a table of predefined check alphabets to determine the correctness of an identity card number.

The weight mapping is shown in the table below:

Serial Number	Weight
2 nd	2
3 rd	7
4 th	6
5 th	5
6 th	4
7 th	3
8 th	2

The check alphabet mappings are shown in the table below:

Modulo 11	“S” or “T”	“F” or “G”
0	J	X
1	Z	W
2	I	U
3	H	T
4	G	R
5	F	Q
6	E	P
7	D	N
8	C	M
9	B	L
10	A	K

Based on the information given on the algorithm of the identity card number check alphabet, write a program that asks the user to input his/her identity card number and then inform the user whether the inputted identity card number is valid or not valid.

Sample Input	Sample Output
S0000001I	Valid
S0000002G	Valid
S0000003E	Valid
S1234567D	Valid
T0830322Z	Valid

Question B6 – Identity Card Number Generator (Intermediate)

Adapt the algorithm in Question B4 to write a program that generates a valid identity card number. Asks the user to input the required type of residency status. If a valid residency status is inputted, generate a corresponding valid identity card number. Otherwise, print out an error message.

No sample input and output is provided for this question.

Question B7 – Python Membership Operators (Advanced)

Recall that in Lecture 02, we have introduced various Python operators that can be used to manipulate raw input data into useful output results. Python provides support for another set of operators known as the membership operators. Search on the Internet and find out more about the membership operators and then perform the following tasks:

- Briefly explain what are membership operators, and write some simple code fragments or programs to illustrate their usage.
- Inspect the Python codes that you have written for Question B1 to B5 that involve conditional control flow. Are you able to simplify the codes using the membership operators? Identify some of these possibilities and try to re-write the codes with the membership operators.