COMPUTER PROGRAMMING LABORATORY
Experiment # 4:
Loops

OBJECTIVES

The main purpose of this experiment is to introduce you to repetition statements, in other word, loops. In this experiment, firstly, while and for repetition statements are examined. Then, some examples are studied.

QUESTIONS

1) Write a Python program to calculate following equation. Sum only positive items. Test your program with x=2.

$$\sum_{n=1}^{7}(-1)^{n+1}\frac{x^n}{n!}$$

2) Write a Python program to convert a binary number to a decimal number. Test your program with

i) x=110.
ii) x= 1010
iii) x= 11101

3) In mathematics, the greatest common divisor (gcd) of two or more integers is the largest positive integer that divides each of the integers.

Example: What is the greatest common divisor of 54 and 24?

The divisors of 54 are: 1,2,3,6,9,18,27,54.

Similarly, the divisors of 24 are: 1,2,3,4,6,8,12,24.

The numbers that these two lists share in common are the common divisors of 54 and 24: 1,2,3,6. The greatest of these is 6. That is, the greatest common divisor of 54 and 24.

Write a Python program to determine the greatest common divisor (gcd) of two integers. Test your program with

i) num1=27, num2=63.
ii) num1=24, num2=54
iii) num1=11, num2=42
iv) num1=25, num2=25

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4) Write a Python program to calculate cosine function by using Taylor series as follows:

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} + \cdots$$

Calculate the last added term (i.e $\frac{x^2}{2!}$) . If its absolute value is greater than threshold, calculate (i.e $\frac{x^2}{2!}$). This procedure must continue until the absolute value of the last added term is less than the threshold.

Test your program with

i) x=1.5708, th=0.01.
ii) x=1.0472, th=0.001

5) A number is called **Automorphic** if the remaining numbers on the right half of the number after it is squared, it is equal to the number itself.

Example: Assume that the numbers are 5 and 76.

$5 \rightarrow 5 * 5 = 25$
$76 \rightarrow 76 * 76 = 5776$

Therefore, 5 and 76 is an Automorphic number.

Write a Python program to determine whether a number is Automorphic or not.

6) The following **checksum** formula is widely used by banks and credit card companies to validate legal account numbers:

d0 + f(d1) + d2 + f(d3) + d4 + f(d5) + d6 + ... = 0 (mod 10)

The **di** are the decimal digits of the account number and f(d) = 2*d (for example, f(7) = 2 × 7 = 14).

Example: 27327 is valid because 2 + 14 + 3 + 4 + 7 = 30, which is a multiple of 10.

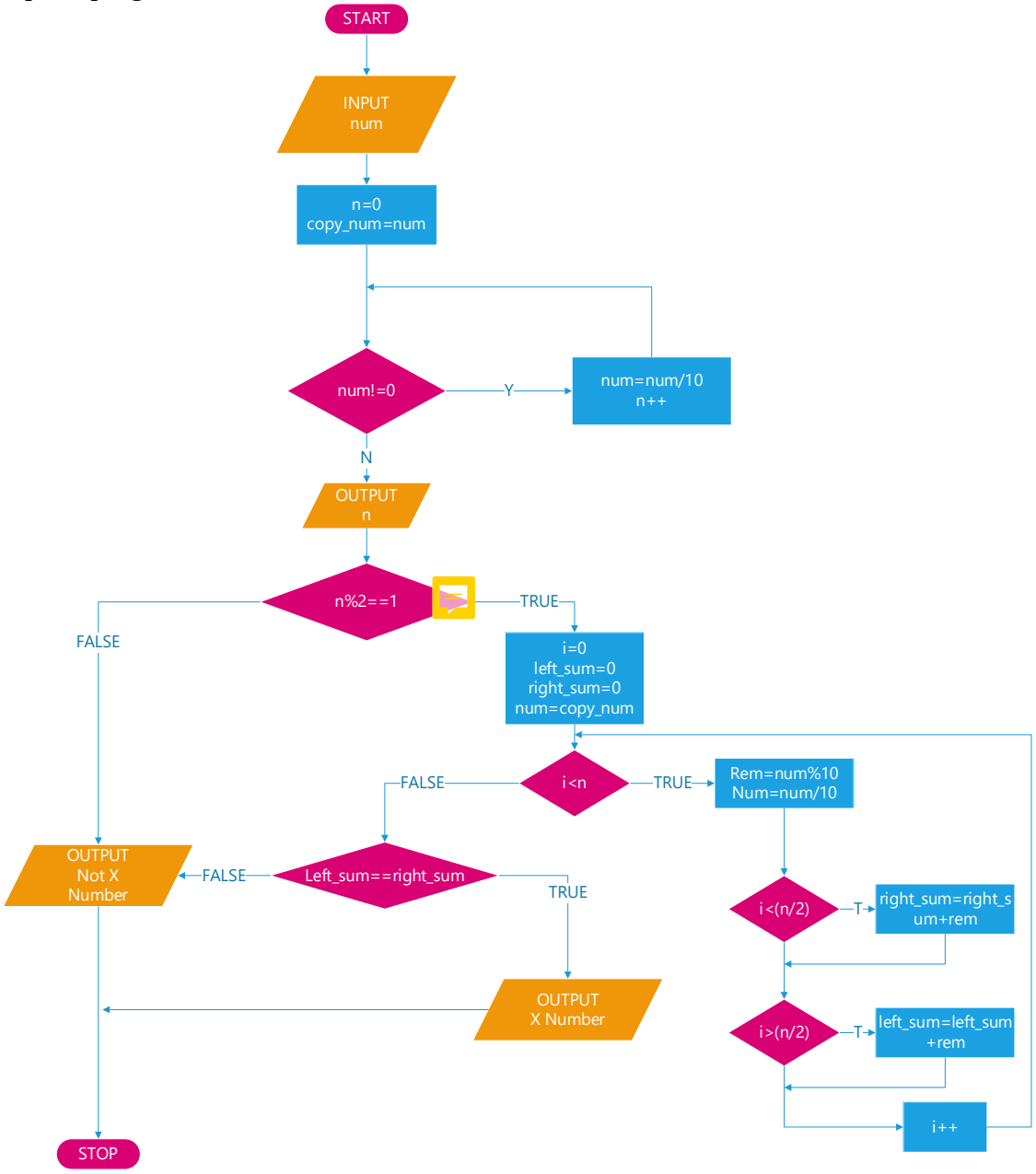
Write a Python program to determine whether an account number is valid or not.

7) In number theory, **Narcissistic Number** is an 4-digit number that is the sum of the 4th powers of its digits is equal to itself. For example:

$$1634 = 1^4 + 6^4 + 3^4 + 4^4$$
$$8208 = 8^4 + 2^4 + 0^4 + 8^4$$
$$9474 = 9^4 + 4^4 + 7^4 + 4^4$$

Write a Python program to determine whether a number readed from user is **Narcissistic Number** or not.

8) Write a Python program to implement the problem. Use the given flowchart given in figure to develop the program.



9) Assume that we have a function f(x) and write a Python program to determine the roots of the function. To implement the program perform the following steps:

i) Prompt the boundaries of the interval (i.e., a and b). Also, prompt the tolerance value (i.e. tol).
ii) Calculate f(a) and f(b). Print these values.
iii) Then, calculate c as follows and also calculate the f(c). Print c and f(c).

$$c = b - f(b)\frac{b-a}{f(b)-f(a)}$$

iv) Update boundaries of the interval. If f(a)f(c)<0, then assign c to b. Otherwise, assign c to a. Print the new interval.
v) Repeat ii), iii) and iv) until the absolute value of f(c) is less than tolerance.
vi) Print the root of the function after repetition.
Test your program with $f(x)=x^3-5x-9$, a=2, b=3, and tol=0.00001