CS1002 – Programming Fundamentals

Assignment # 3

Max Points: 100   **Due Date:** 07-11-2021

Carefully read the following instructions!

- It should be clear that your assignment would not get any credit if the assignment were submitted after the due date.
- Strict actions will be taken if submitted solution is copied from any other student.
- For any query, feel free to email at: **murk.marvi@nu.edu.pk**

- If you find any confusion in assignment (Question statement), please consult at least two days before the deadline. After the deadline no queries will be entertained in this regard.
- **Submission:** Submission will only be accepted through GOOGLE CLASSROOM. Place the solutions to all your programming questions (as separate files) inside a folder named by your roll number, e.g. k212150. Zip/compress the folder and submit it. You should submit only a single zip file containing a folder with all your solutions, as well as the document with screenshots and pictures, e.g. k212150.zip.

Problem: 1

Octal number system has been popularly used as a potential number system in computing texts, graphics, and especially file protection systems in UNIX operating system. Develop a C- script that takes a decimal number as an input and produces its equivalent octal number.

$$[DoB]_{10} = (----)_8$$

DoB. Date of birth

Problem: 2

A certain series has been widely used in many fields such as cyber security, information coding, and music. Develop a C-script that generates the following sequence for n number of terms.

0, +1, +1, +2, +3, +5, +8, +13, +21, +34……….

Length of the sequence:

$$\left[\textbf{ MSD of your birth year + LSD of your Student ID + 2}^{\text{(third smallest prime number)}} \right]$$

MSD = Most significant digit
LSD = Least significant digit

Problem: 3

Taylor series expands function into a finite sequence of a variable *x* or a finite series plus a remainder. A complex electromagnetic signal transmitted from a radio transmitter can be decomposed into its components by using Taylor approximation, which is equivalent to estimating the parameters of complex exponential functions. Let *x(t)* be a signal transmitted. Develop a C-script that calculates the following Taylor series approximation of function *f(x)* for *N* number of terms. Where *N* is the largest whole number which is a factor of both 42 and 98. You can select any positive real value of *x*.

$$\textbf{f}(\textbf{x}) = \sum_{n=0}^{N} \frac{x^n}{n!} = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} \cdots$$

Problem: 4

As shown in Fig.1, two self-driving or autonomous cars **SA_a** and **SA_b**, run on a circular track. They begin moving at the same time. **SA_a** takes 12 minutes to complete one round, whereas **SA_b** goes around in 10 minutes.

Develop a C-script that calculates when both cars will run together or meet each other?

Input: Time taken by both SA cars in minutes.
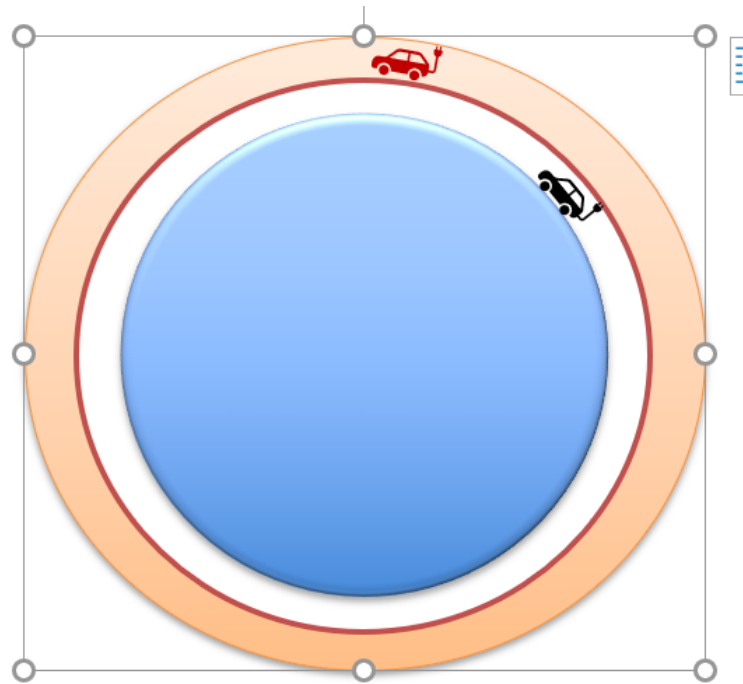Output: Time (in minutes) at which SA_a and SA_b will meet each other.

Fig.1 Self-driving cars moving in a circular track.

Problem: 5

Consider an interactive and cognitive environment (ICE) in which a smart camera is monitoring robot movement from one location to another. Let a robot be at location A for some time instant and then moves to point B and eventually reaches at point C and so on and so forth shown in the Fig.2.

Develop a C-script that calculates a distance between reference point R (1,3) of a camera and A, B, and C and N number of locations.

N is the (non- zero) MSD of your mobile number.

For 0 < MSD <=9 then take [N = (2^{MSD}) *0.0625], and if MSD = 0, take [N = (2^{MSD}) *4+3]
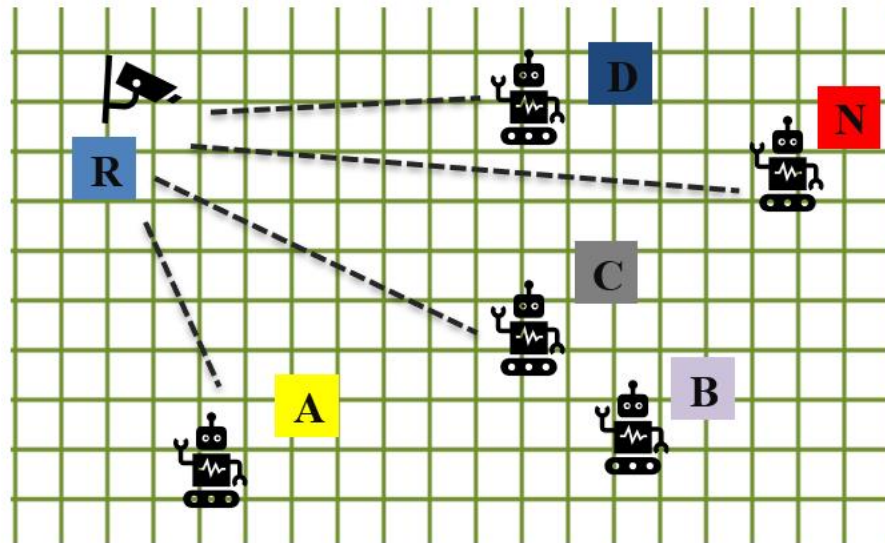**Note: (Use only For loop to accomplish this task).**

Fig.2 An ICE environment in which robot is being monitored by a smart camera.

Problem: 6

Covid'19 vaccination has become a mandatory requirement for many things such as traveling, bank account opening, admissions in higher educational universities, and many more. Develop a C-script that facilitates the hospital in determining which person needs to be vaccinated based on age and underlying disease. The program should run for 10 persons, and do the following:

if age is greater than or equal to 18 and person belongs to the Urban area of a city then program should display the following message

<p align="center">YOU ARE ELIGIBLE FOR A VACCINATION</p>

if age is less than 18 and person belongs to the Rural area of a city then program should display the following message

<p align="center">YOU ARE NOT ELIGIBLE FOR A VACCINATION</p>

Problem: 7

Develop a program that asks user to enter a real number. After entering the numbers, the program should display how many positive, negatives, and zeros were entered by the user. In addition to that, it should provide information about the majority count either of the entered numbers.

Problem: 8

An **Unarmed Vehicle (UAV)** is operating in a Cognitive Radio Internet of Things (CR-IoT) network where it is communicating with the mobile devices to perform specific tasks. An illegitimate device is also present in a network that tries to seize or block the transmission between UAV and smart devices as shown in Fig.3 UAV is equipped with an AI facility and it displays the pattern A to the devices under normal situations. If a situation is abnormal, it shows pattern B. Develop a C- script that is needed to be integrated into UAV which generates pattern A for normal situation and pattern B for abnormal situation.

Input: Iterations
         n = normal situation
         ab = abnormal situation
Output: Pattern A for normal situation
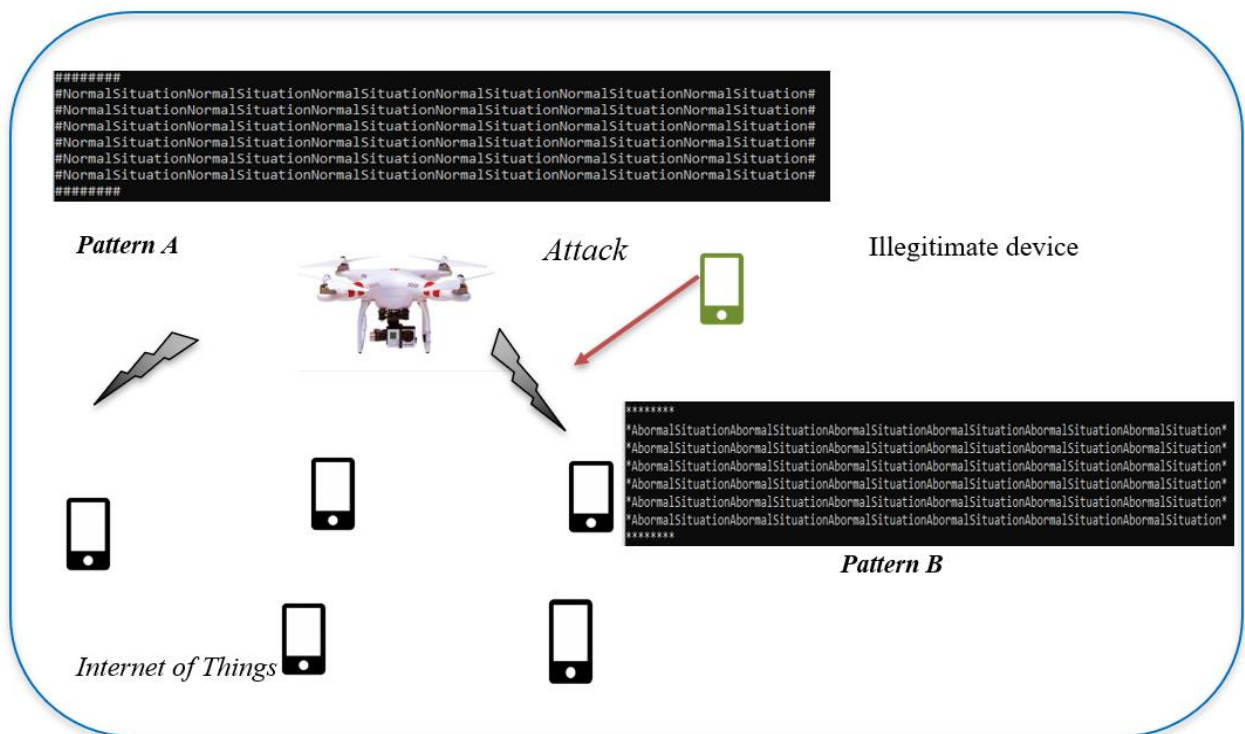   *Pattern B for abnormal situation*

Fig.3 IoT network in which UAV and mobile devices are communicating.

Problem: 9

A toy company manufactures electronic learning boards for kids to learn alphabets. Accordingly, when a kid presses 1 alphabet **a** is shown on the screen, and when 2 is pressed **ab** is shown along with the previous alphabet and so on. The patterns are likely to be as follow:

```
a
ab
abc
abcd
abcde
abcdef
abcdefg
abcdefgh
abcdefghi
abcdefghij
abcdefghijk
abcdefghijkl
abcdefghijklm
abcdefghijklmn
abcdefghijklmno
abcdefghijklmnop
abcdefghijklmnopq
abcdefghijklmnopqr
abcdefghijklmnopqrs
abcdefghijklmnopqrst
abcdefghijklmnopqrstu
abcdefghijklmnopqrstuv
abcdefghijklmnopqrstuvw
abcdefghijklmnopqrstuvwx
abcdefghijklmnopqrstuvwxy
abcdefghijklmnopqrstuvwxyz
```

Develop a C-script which generates the above-mentioned pattern.

Problem: 10

The following series of triangles are displayed on a computer screen with their corresponding side values as shown in Fig.4.
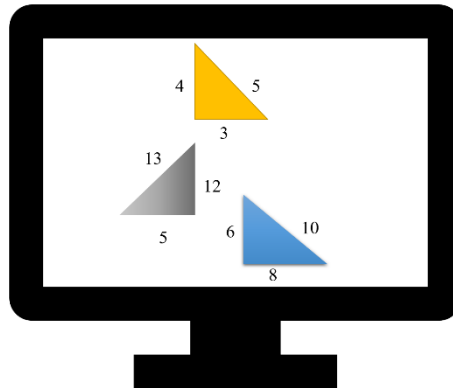

Fig.4 Computer showing triangles.

Develop a C-script that generates the Pythagorean triplets with a side length less than **your age**.

Good Luck