Marmara University – Faculty of Engineering – Department of Computer Engineering

Spring 2022 – CSE1242 Computer Programming II
Homework #3

Due: 17.05.2022.Tue 23.59

In this homework, you are expected to implement the following programs using recursion.

1) We have bunnies standing in a line, numbered 1, 2, ... The odd bunnies (1, 3, ..) have the normal 2 ears. The even bunnies (2, 4, ..) have 3 ears, because they each have a raised foot. Recursively return the number of "ears" in the bunny line 1, 2, ... n (without loops or multiplication).

Example:

```
Please enter the number of lines (n=): 2
bunnyEars2(0) → 0
bunnyEars2(1) → 2
bunnyEars2(2) → 5
```

2) In this question, you will write a program to find super digit of a number **X** using the following rules:

- If **X** has only 1 digit, then its super digit is **X**.

- If **X** has more than 1 digit, then its super digit is equal to the super digit of the digit-sum of **X**.

    Example:

```
superDigit(1245) = superDigit(1+2+4+5)
                 = superDigit(12)
                 = superDigit(1+2)
                 = superDigit(3)
                 = 3.
```

- The number **X** will be given to your program with two numbers (**n** and **k**) and you will construct the number **X** as the number **n** concatenated **k** times.

    Example:

```
Please enter a number (n=) : 123
Please enter repetition factor (k=) : 3
Super digit of number 123123123 is 9.
```

3) In this question, you will print identical triangles nested each other recursively. You will construct the triangles by using two digits '_'(underscore) and '1'. There will be number of iterations given as an input to your program.

- **If the number of iterations is given as 0**, you will print a simple triangle by using 32 rows and 63 columns in a matrix as the following:

```
_____1_____
_____111_____
_____11111_____
_____1111111_____
_____111111111_____
_____11111111111_____
_____1111111111111_____
_____111111111111111_____
_____11111111111111111_____
_____1111111111111111111_____
_____111111111111111111111_____
_____11111111111111111111111_____
_____1111111111111111111111111_____
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____1111111111111111111111111111111111111111111111111111111____
___111111111111111111111111111111111111111111111111111111111___
__11111111111111111111111111111111111111111111111111111111111__
_1111111111111111111111111111111111111111111111111111111111111_
111111111111111111111111111111111111111111111111111111111111111
```

- **If the number of iterations is given as 1**, you will create 3 triangles by calculating their 3 corner points using the original triangle in the previous iteration. It should be noted that the original triangle at iteration 0 will be decomposed three identical triangles as the following:

```
_____1_____
_____111_____
_____11111_____
_____1111111_____
_____111111111_____
_____11111111111_____
_____1111111111111_____
_____111111111111111_____
_____11111111111111111_____
_____1111111111111111111_____
_____111111111111111111111_____
_____11111111111111111111111_____
_____1111111111111111111111111_____
_____111111111111111111111111111_____
_____11111111111111111111111111111_____
_____1111111111111111111111111111111_____
_____1_____1_____
_____111_____111_____
_____11111_____11111_____
_____1111111_____1111111_____
_____111111111_____111111111_____
_____11111111111_____11111111111_____
_____1111111111111_____1111111111111_____
_____111111111111111_____111111111111111_____
_____11111111111111111_____11111111111111111_____
_____1111111111111111111_____1111111111111111111_____
_____111111111111111111111_____111111111111111111111_____
____11111111111111111111111_____11111111111111111111111____
___1111111111111111111111111_____1111111111111111111111111___
__111111111111111111111111111_____111111111111111111111111111__
_11111111111111111111111111111_____11111111111111111111111111111_
11111111111111111111111111111111_11111111111111111111111111111111
```

- **If the number of iterations is given as 2**, you will again create 3 triangles for each triangle in the previous iteration by calculating their 3 corner points using the triangles in the previous iteration. It should be noted that each triangle at iteration 1 will be decomposed three identical triangles as the following:

```
_____1_____
_____111_____
_____11111_____
_____1111111_____
_____111111111_____
_____11111111111_____
_____1111111111111_____
_____111111111111111_____
_____1_____1_____
_____111_____111_____
_____11111_____11111_____
_____1111111_____1111111_____
_____111111111_____111111111_____
_____11111111111_____11111111111_____
_____1111111111111_____1111111111111_____
_____111111111111111_____111111111111111_____
_____111111111111111_111111111111111_____
_____1_____1_____
_____111_____111_____
_____11111_____11111_____
_____1111111_____1111111_____
_____111111111_____111111111_____
_____11111111111_____11111111111_____
_____1111111111111_____1111111111111_____
_____111111111111111_____111111111111111_____
_____1_____1_____1_____1_____
_____111_____111_____111_____111_____
_____11111_____11111_____11111_____11111_____
____1111111___1111111_____1111111_____1111111_____
___111111111_111111111_____111111111_____111111111_____
__11111111111_11111111111_____11111111111_____11111111111__
_1111111111111___1111111111111___1111111111111___1111111111111_
111111111111111_111111111111111_111111111111111_111111111111111
```

- **If the number of iterations is given as 3**, you will need to print triangles as the following:

```
_____1_____
_____111_____
_____11111_____
_____1111111_____
_____1_____1_____
_____111_____111_____
_____11111___11111_____
_____1111111_1111111_____
_____1_____1_____
_____111_____111_____
_____11111_____11111_____
_____1111111_____1111111_____
_____1_____1_____1_____1_____
_____111_____111_____111_____111_____
_____11111___11111___11111___11111_____
_____1111111_1111111_1111111_1111111_____
_____1_____1_____
_____111_____111_____
_____11111_____11111_____
_____1111111_____1111111_____
_____1_____1_____1_____1_____
_____111_____111_____111_____111_____
_____11111___11111_____11111___11111_____
_____1111111_1111111_____1111111_1111111_____
_____1_____1_____1_____1_____
___111_____111_____111_____111___
__11111_____11111___11111_____11111__
_1111111_____1111111_1111111_____1111111_
___1_____1_____1_____1_____1_____1_____1_____1___
__111_____111_____111_____111_____111_____111_____111_____111__
_11111___11111___11111___11111___11111___11111___11111___11111_
1111111_1111111_1111111_1111111_1111111_1111111_1111111_1111111
```

- **If the number of iterations is given as 4**, you will need to print triangles as the following:

```
_____1_____
_____111_____
_____1___1_____
_____111_111_____
_____1_____1_____
_____111_____111_____
_____1___1___1___1_____
_____111_111_111_111_____
_____1_____1_____
_____111_____111_____
_____1___1_____1___1_____
_____111_111_____111_111_____
_____1_____1_____1_____1_____
_____111_____111_____111_____111_____
_____1___1___1___1_____1___1___1___1_____
_____111_111_111_111_____111_111_111_111_____
_____1_____1_____
_____111_____111_____
_____1___1_____1___1_____
_____111_111_____111_111_____
_____1_____1_____1_____1_____
_____111_____111_____111_____111_____
_____1___1___1___1_____1___1___1___1____
_____111_111_111_111_____111_111_111_111_
_____1_____1_____1_____1_____
_____111_____111_____111_____111_____
____1___1_____1___1_____1___1_____1___1_____
___111_111_____111_111___111_111___111_111_____
__1_____1_____1_____1_____1_____1_____1_____1_____
_111_____111_____111_____111_____111_____111_____111_____111_____
1___1___1___1___1___1___1___1___1___1___1___1___1___1___1___1_____
111_111_111_111_111_111_111_111_111_111_111_111_111_111_111_111_____
```

- The number of iterations given to your program will be less than 5.
- The output will consist of 32 rows and 63 columns, and will be composed of **ones (1)** and **underscores (_)** as in the triangles above.
- Solutions using iterations will not be graded for ALL questions.
- You have to solve the problems by using RECURSION.
- **It should be noted that <u>selected parts</u> will be graded in your homework.**

SUBMISSION INSTRUCTIONS:

Please zip and submit your files using filename YourNumber_HW3.zip (ex: 150120123_HW3.zip) to http://ues.marmara.edu.tr. Your zip file should contain the following files:

1) C source code for Q1 (Pro3_1_150120123.c)

2) C source code for Q2 (Pro3_2_150120123.c)

3) C source code for Q3 (Pro3_3_150120123.c)

Your program must include necessary comments with your own words to explain your actions!

NOTES:

1) Write a comment at the beginning of each program to explain the purpose of the program.

2) Write your name and student ID as a comment.

3) Include necessary comments to explain your actions.

4) Select meaningful names for your variables and class names.

5) You are allowed to use the materials that you have learned in lectures & labs.

6) Do not use things that you have not learned in the course.

7) **Program submissions** should be done through ues.marmara.edu.tr. Do not send program submissions through e-mail. E-mail attachments will not be accepted as valid submissions.

8) You are responsible for making sure you are turning in the right file, and that it is not corrupted in anyway. We will not allow resubmissions if you turn in the wrong file, even if you can prove that you have not modified the file after the deadline.

9) In case of any form of **copying and cheating** on solutions, you will get **FF** grade from the course! You should submit your own work. In case of any forms of cheating or copying, both giver and receiver are equally culpable and suffer equal penalties. **All types of plagiarism will result in FF grade from the course.**

10) No late submission will be accepted.