CENG218 - Assignment 3

Q1(55 pts)

Suppose that there are many tourist groups for a trip and only one bus that can transport up to a certain number of people at a time. In this problem, we want to select some tourist groups for transportation that allow us to obtain the greatest reward. The tourists in the groups cannot be separated, in other words, they have to travel together. **SELECT_TOURISTS(g,p,r_array,n_array)** function given below is defined to find the optimal solution for this problem, where **g** is the number of tourist groups, **p** is the maximum number of people the bus can carry, **r_array** is the array of reward belonging to groups, and **n_array** is the array of number of people in each group.

```
SELECT_TOURISTS(g, p, r_array, n_array)

    …
    …


return reward,groups
```

Assume that **g** and **p** are integer numbers that could not be less than 1 and greater than 1000. **SELECT_TOURISTS(g,p,r_array,n_array)** function returns two local variables named as **reward** and **groups**: the optimal reward value and an array of the selected group indices (e.g. [2,3] or [3,2]).

Let we have 5 tourist groups: Group 1, Group 2, Group 3, Group 4, Group 5 and a bus that can transport up to 40 people at a time. The number of people and reward in $ for each group are 24, 16, 32, 8, 26 and 2000, 400, 1200, 800, 2200, respectively. Then, the optimal selection and reward will be Group4, Group5 and $3000 (i.e. output of the function is either 3000, [4,5] or 3000, [5,4]).

a)(30 pts) Design an efficient algorithm that is the optimal solution of the problem, write its pseudocode in **SELECT_TOURISTS** function. Explain what your algorithm design technique is and why you suggest this technique.

**Hint:** You can solve this problem with just 20-25 lines of code.

b)(15 pts) Analyze the worst-time time and space complexity of your proposed algorithm and explain your code in detail line by line.

c)(10 pts) What are the optimal tourist groups for transportation (e.g. Group 1, Group 3) and calculated reward according to the algorithm for the function call given below?

```
SELECT_TOURISTS(7,90,[500,1200,800,100,1100,60,900],[40,8
0,50,30,60,15,25])
```

Q2(45 pts)

In this problem, there are many cities separated by rivers, and some villages in the cities which are represented as vertices of the undirected graph as shown below. You will build some bridges to connect the cities, however a minimum number of bridges is required to solve this problem.
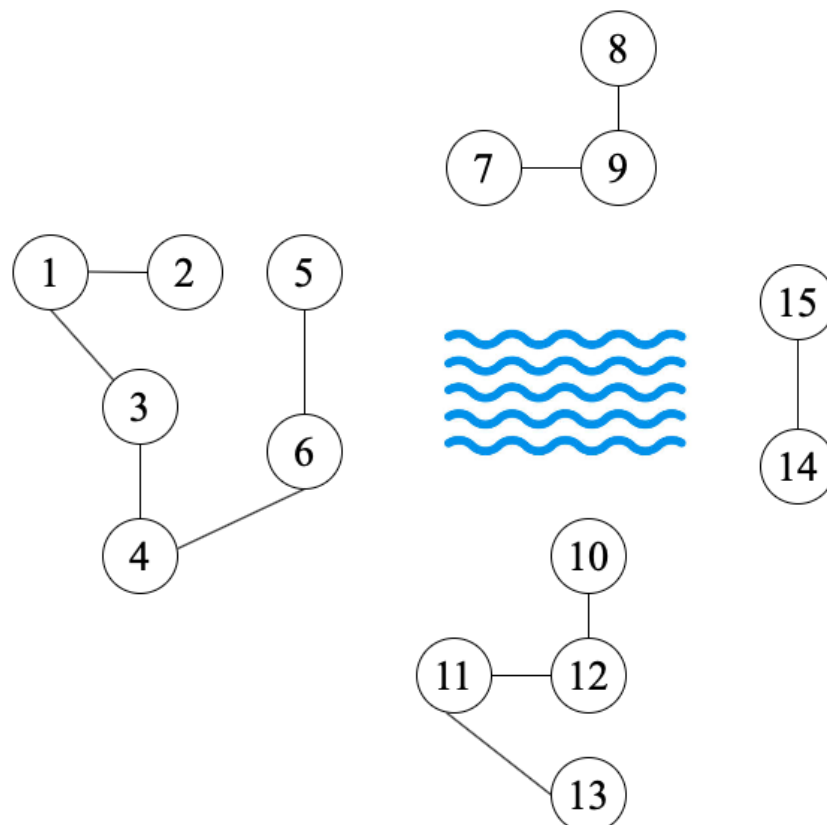
In the figure, there are 15 villages and 4 cities. All villages are numbered from 1 to 15, as well as some of them are connected by edges.

a)(10 pts) How many bridges do we need to build to visit any village starting from the 1st village? Explain why.

b)(10 pts) Explain how we can programmatically find out how many cities we have in the graph above. You can suggest a familiar graph algorithm.

c)(20 pts) Design an algorithm to find the minimum number of bridges in accordance with your explanation in (a), write its pseudo code in MIN_BRIDGES function. Use the algorithm you suggested in (b) to find the number of cities.

```
MIN_BRIDGES(graph,n)

    ...
    ...


return num_of_bridges
```

In the function, **graph** is the adjacency list (e.g. 1:[2,4], 2:[1], 4:[1]) of the graph. This graph consists of 15 villages as seen in the image above. Second parameter **n** is the number of villages, and the returned value **num_of_bridges** is an integer specifying the number of bridges.

Hint: You can solve this problem with just 10-15 lines of code.

d)(5 pts) What is the worst-time time complexity for your proposed solution?

Submission Rules

Important Note: Violation of any rules given below will end up with point reduction.

- Submit your homework as a single PDF file through CMS until due date.
- Late submissions will not be allowed.

- The file should be named as CENG218_HW3_<student_number>.pdf (Omit the angle brackets).
- This document should consist of at most 4 pages each of which is A4 size.
- State your name and student number at the top of every page.
- You can use any word processor (such as LibreOffice Writer) or preferably LaTeX. If you prefer to do the homework on a physical paper, please use A4 papers and scan the pages using a scanner device or a scanner app rather than simply taking a photo. Make sure that it is effortless to read all the content.
- Cheating or collaborative work will not be tolerated and will be considered as zero grade.