Cairo University
Faculty of Engineering
Computer Engineering
Fall 2019

Design and Analysis of Algorithms
Homework 5

DEADLINE Saturday, December 7th 2019, 11:59 PM

Your code should be taking into consideration the following requirements:

1. Implement your code in C++.
2. The grade will be granted based on the running time of your code as well as the correct output.
3. Remember! Plagiarism is not tolerated. Any sign of cheating or plagiarism will be graded as ZERO in this assignment and all other assignments.

Deliverables:

- You will submit your code on SPOJ in the contest sent by email.
- Hint:
  - For a problem that has a time limit of 1 second it is expected that your code runs $O(10^8)$ operations on the maximum input size.
  - If your code is $O(N^2)$ while the maximum N is 10^8 your code will cause a time limit exceeded. If the maximum N is 10^4 your code should be fine.
- Think before approaching the problem which graph algorithm suits the solution.

Requirements:

1. Fueling The Ship

You are the captain of a spaceship currently landed on a planet. You have the ability to make a jump using space tunnels to another planet. Each space tunnel requires a certain amount of fuel. There can be multiple tunnels between two planets in the same direction. Your goal is to pass by all planets using minimum amount of fuel. If a planet is not reachable simply do not visit it.

Given **N** planets and **M** space tunnels, find the number of planets visited and the minimum amount of fuel required to make the trip. You are starting on planet with index **S.**

$1<=N<=5000$
$1<=M<=900000$
$0<=S<=N-1$
$1<=Wi<=1000$

Where Wi is the amount of fuel needed for each tunnel.

The input format will be as follows:

- One line containing **N, M, S** separated by spaces
- For the next **M** lines, each line will contain 3 numbers representing the space tunnel
    - Start planet index
    - End planet index
    - Amount of fuel needed for the jump

Output format should be:

- One line containing the number of planets visited, and the minimum amount of fuel

Sample Input:

5 10 0
0 1 10
0 2 5
1 2 2
1 3 1
2 1 3

2 4 2

3 4 4

2 3 9

4 0 7

4 3 6

Sample Output:

5 9

2. Family Tree

You are given **N** persons were each person has two parents. You are required to print all persons such that no person appears before any of his predecessors. Note that for some generations we do not know the parents. When implementing your algorithm iterate on person 0 first.

$1 <= N <= 10^4$

The input format will be as follows:

- The first line contains the integer **N**.
- For the next **N** lines,
  - Each line represents the parent of one person
  - First line will contain parents of person with index 0, and last line will contain parents of person with index **N**-1.
  - Each line will contain two number representing the indices of the parents. If any parent is unknown a -1 is present.

Output format should be as follows:

- One line containing the indices of all people in the order defined by the constraints.

Sample Input:
9
-1 -1
0 -1
1 3
0 6
-1 -1
-1 -1
-1 5
-1 -1
7 6

Sample Output:
7 5 6 8 4 0 3 1 2