THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY
Department of Computer Science and Engineering
COMP4641: Social Information Networks Analysis and Engineering
Spring 2019 Assignment 3
Due time and date: 12:00noon, May 13 (Mon), 2019.

IMPORTANT NOTES

- **Your grade will be based on the correctness, efficiency and clarity.**
- **Late submission: 25 marks will be deducted for every 24 hours after the deadline.**
- **ZERO-Tolerance on Plagiarism: All involved parties will get zero mark.**

Q1. Let

- $S(t)$ be the number of susceptible individuals in the population at time t;
- $I(t)$ be the number of infected individuals in the population at time t;
- $R(t)$ be the number of recovered individuals in the population at time t.

Recall that in the SIR model, $dS/dt = -\beta SI$, which can be approximated as

$$S(t+1) - S(t) = -\beta S(t) I(t).$$

The other two equations for dI/dt and dR/dt can also be similarly interpreted.

(a) Assume that $S(0) = 10$, $I(0) = 5$, $R(0) = 0$, $\beta = 0.05$, and $\delta = 0.25$. Obtain the values (to two decimal places) of $S(t)$, $I(t)$ and $R(t)$ for $t = 1, 2, \ldots, 10$.

t	0	1	2	3	4	5	6	7	8	9	10
$S(t)$	10										
$I(t)$	5										
$R(t)$	0										

(b) Now we change β to 0.02, and keep all the other numbers the same. Obtain the values (to two decimal places) of $S(t)$, $I(t)$ and $R(t)$ for $t = 1, 2, \ldots, 10$.

t	0	1	2	3	4	5	6	7	8	9	10
$S(t)$	10										
$I(t)$	5										
$R(t)$	0										

(c) Interpret the results in parts (a) and (b) based on the virus strength.

Q2. This question is on finding the k most influential nodes. You have to implement the greedy algorithm, and then compare its solution with the optimal solution (which can be obtained by exhaustive search). The network has 10 nodes. The optimization objective $f(S)$, which is the expected cascade size for a set S, has been precomputed and can be obtained by calling *utils.py* (can be downloaded from the course webpage). You can import f directly by the following python code:

```
from utils.py import f
```

The output of your program should be:

```
k=1 S={8} f[{8}]=0.9523 opt_ratio=1
k=2 ...
.
.
.
k=10 ...
```

Here, opt_ratio is the approximation ratio between the solution from the greedy algorithm and the optimal solution.

Submission Guidelines

You should submit one single zip file containing pdf file (the answers of Q1, Q2) and the code script of Q2 to **hshiac@hotmail.com** before the deadline. The submitted file should be named like **A3_awangab_12345678.zip** (replace awangab with your ust account and 12345678 your student id).