BLG 556E Digital Solutions for Smart Cities, Spring 2018
Final Take-Home Project

You are expected to work on the project given below and hand in (a printed copy) and upload your Project Report to Ninova before **Jun. 7th, 2018, 10:00 am.**

In a hypothetical city, there are five bicycle docking stations to be used for the bicycles of the municipality. Bicycles are borrowed from these stations and left any one of the docking stations in one hour.

There are total number of 75 bicycles of the municipality and these are evenly distributed among the five docking stations each morning at 5:00 am. Bicycle riders arrive to docking stations according to Poisson distribution of which mean value is $\boldsymbol{\lambda}$ riders per hour. A bicycle rider can travel one of the other docking stations based on the selection probability of the corresponding station. Selection probabilities of the docking stations are given as below:

		DS1	DS2	DS3	DS4	DS5
P(DSi,DSj)	DS1	1/10	2/10	3/10	3/10	1/10
	DS2	1/10	1/10	3/10	3/10	2/10
	DS3	1/4	1/4	0	1/4	1/4
	DS4	2/8	1/8	3/8	0	2/8
	DS5	1/16	5/16	3/16	3/8	1/16

P(DSi,DSj) shows the probability of a rider to travel from docking station *i* to docking station *j*. Make sure that travel duration between the docking stations are fixed, and equal to 1 hour.

Part a) You will study the service quality of each docking station based on the availability of the bicycles at these docking stations by **simulation**. You should construct the following table for each docking station for each one-hour slot considering the period of **5:00 am** – **8:00** pm. The rider arrival rates of $\boldsymbol{\lambda} = \mathbf{3}$ riders per hour and $\boldsymbol{\lambda} = \mathbf{5}$ riders per hour will be studied separately. Note that a rider who cannot find an idle bicycle in the docking station does not wait and finds another alternative solution to travel.

	5.00 am	6.00 am	…….	8:00 pm
Number of idle bicycles at the beginning of the time slot				
Number of riders arriving within that time slot				
Number of unsatisfied riders				

Service Quality of Docking Station *i* ($SQDS_i$), and Overall Service Quality of the Bicycle Sharing Systems (OSQBSS) are defined as below:

$SQDS_i$ = 1- (total_number_of_unsatisfied_riders_at_i)/(total_number_of_arriving_riders_to_i)

OSQBSS = 1 - (total_number_of_unsatisfied_riders)/(total_number_of_arriving_riders)

Part b) You are expected to suggest another approach for the distribution of the bicycles to the docking stations in order to increase the service quality of the docking stations and the overall service quality. You should obtain the results for the approach you suggested and compare them with those obtained in Part (a).

Part c) Assuming that probabilities of moving one docking station to the others are changing throughout the day. You are expected to discuss such a case and introduce solutions in order to increase the quality of the service of the bicycle sharing system.

Moreover, you should mention about the other issues to be considered in order to make this system as realistic as possible.

You may use any programming language for coding. You need to provide a detailed report reflecting your work/results (both electronic and printed copies) and source codes must be also uploaded to Ninova.

Make sure that this is not a group work. Each student must work individually!