COMP2119 Introduction to data structures and algorithms Programming

Due: April 7, 2021 5:00pm

Part 1 (Graph)

(Only Part 1 is mandatory and graded.)

Q 1. In a scenic area, each bus circulates on only one fixed route. Let's use $routes[i]$ to denote the list of stops for Bus i. For example, if $routes[i] = [1, 3, 5]$, then the path of Bus i will always be $1 \to 3 \to 5 \to 1 \to 3 \to 5$... forever.

Given a list of routes $[routes[0], routes[1], ..., routes[n]]$, consider a commuter who is at station *source* wanting to go to station *target* by bus. We want to write a program to determine the least number of bus trips he/she needs to take to arrive at the *target* station. If there are no bus trips that will take him/her to *target*, the program should return -1.

Some examples:

1 Input: $routes = [[5, 0], [6, 0], [7, 1, 0], [8, 1, 0], [9, 1]]$, $source = 5$, $target = 9$
Output: 3
Explanation: One travelling strategy with the least number of trips is to first take Bus 0 ($routes[0] = [5, 0]$), which takes the commuter from bus stop 5 to bus stop 0, then take Bus 2 (bus stop 0 to 1), and finally take Bus 3 (bus stop 1 to 9). This takes 3 trips.

2 Input: $routes = [[5, 0], [6, 0], [7, 0], [8, 0]]$, $source = 5$, $target = 0$
Output: 1

3 Input: $routes = [[5, 3, 1, 0], [6, 2, 1, 0], [7, 3, 2, 1], [8, 3, 2, 0]]$, $source = 5$, $target = 7$
Output: 2

4 Input: $routes = [[5, 0], [6, 1, 0], [7, 2, 1], [8, 2]]$, $source = 5$, $target = 8$
Output: 4

5 Input: $routes = [[5, 0], [6, 1], [7, 1], [8, 1]]$, $source = 7$, $target = 5$
Output: -1

Note:

1. Students should complete the assignment in Python. Students who wish to write the program in another programming language must email ***gwyuan@cs.hku.hk*** directly and provide convincing reasons. Permissions to using other programming languages other than Python for this assignment are for very exceptional cases only.

2. Part of the test cases are provided but you are encouraged to design your own. The autograding result will be shown on your terminal once you run python **A3.py**. However, your final grade will depend on your accuracy on the total test cases which you do not have access to. Please submit **a photocopy of your result grade** and your **code**. You will also need to hand in a brief description of your solution in **pdf**.

3. In the folder **A3**, You can only modify the code within the **leastNumBus** function in **A3.py**. In the **leastNumBus** function, there will be three parameters, *routes*, *source* and *target*. The structure of the parameter *routes* is List[List[int]]. The data type of both *source* and *target* are int. The output variable of the function is also int.

Part #2

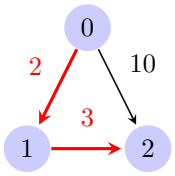
Q 1. Additional exercises

(1) There are n islands connected by m ships. Each ship starts from island u and arrives at v with a price w.

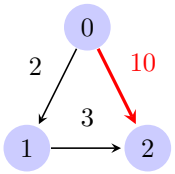
Given n islands and m ships, a rabit wants to travel from *src* islands to *dst* islands. Help the bunny find the least cost to get from *src* island to *dst* island with up to k stops. If the rabit cannot reach *dst* island, please return -1.

Several test cases are shown as follows (you could test your program with other test cases):

1 Input:
$n = 3,\ edges = [[0, 1, 2], [1, 2, 3], [0, 2, 10]]$
$src = 0,\ dst = 2,\ k = 1$
Output:
5
Explanation: One of the strategies with least cost and with up to 1 stop is to take ship from 0 to 1, then take ship from 1 to 2. The least cost with up to 1 stop is $5 = 2 + 3$.



2 Input:
$n = 3,\ edges = [[0, 1, 2], [1, 2, 3], [0, 2, 10]]$
$src = 0,\ dst = 2,\ k = 0$
Output:
10
Explanation: One of the strategies with least cost and with up to 1 stop is to take ship from 0 to 2. The least cost with up to 0 stop is 10.



Note:

(a) In the folder **A3_P2_1**, You can only modify the code within the **theLeastPrice** function in **A3_P2_1.py**. In the **theLeastPrice** function, there will be five parameters, n, *flights*, *src*, *dst* and k. The structure of the parameter *flights* is List[List[int]]. n, *src*, *dst* and k are all int type. The output variable of the function is int.