CMSC 401 – Fall 2023

Programming Assignment 3
(due Thu, 11/9 – 11:59pm)

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CMSC 401- Algorithm Analysis with
Advanced Data Structures

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Second Best Road Trip

- You are planning to drive from Richmond to L.A.

- You want to spend small amount on the gas and motels but also you do not want to go with the cheapest/best option to avoid other problems (e.g., low quality rooms, unexpected traffic congestion)

- Thus, you <u>decided to pick the second best route</u>.

- You have done your research and you know:
  - cost of an overnight stay in the cheapest motel in each of the cities on the possible routes
  - cost of driving between cities without overnight stays

- Now you need to write a program that will take all that data, and find the cheapest route
  - The route with lowest sum of motel and gas costs

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Assignment 3

- Write a program CMSC401_A3.java that reads the database of gas & motel costs, which is in the format below:

  - The number of cities, N, in the first line. N>=3, N<=1000
  - The total number of direct highways between cities, M, in the second line. M>=2, M<=10000
  - Lowest motel price for each of N-2 cities (excluding L.A. and Richmond), each as a single line of two numbers: city number (3...N), motel cost (1...200)
  - Gas prices for traveling direct highways between two cities, each as a single line of three numbers: city number (1...N), city number (1...N), cost of gas for travel between the two cities (1...200)
  - Richmond is city number 1, L.A. is city number 2
  - Cost <u>shouldn't include a motel in Richmond and in L.A.</u>

5
7
3 78
4 87
5 98
1 4 98
5 4 45
1 5 140
4 3 87
2 5 150
3 5 109
3 2 73
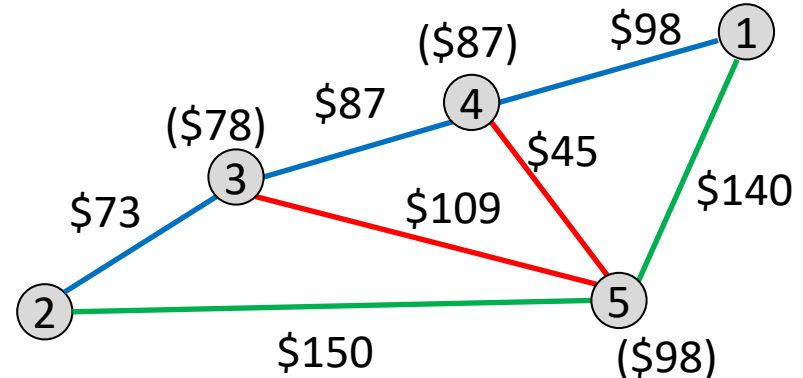
Example

Input in correct format

```
5
7
3  78
4  87
5  98
1  4  98
5  4  45
1  5  140
4  3  87
2  5  150
3  5  109
3  2  73
```

Correct output

```
423
```


Green shows the cheapest route from city 1 (Richmond) to city 2 (L.A) with cost $388: $140+$150 for gas + $98 for motel.
Second cheapest route is shown in blue with cost $423: $98 + $87 + $73 for gas and $87 + $78 for motel.

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Remarks

- There will always be <u>at least two ways</u> of getting from city 1 to city 2

- If a cost for gas from city A to B is in the input, cost for gas from B to A is the same and will not be in the input

- <u>Complexity should be O(V^3).</u>

- Any Java libraries, **<u>classes, functions related to graphs, vertices, edges are</u>** NOT allowed
  - Create your own (adjacency matrix or adjacency list)

- Using <u>Java queue or priority queue</u> (and other simple data structures such as lists, hash maps) is allowed

- No other text, comments, questions on output (you will lose points, if provided)

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Remarks

- <u>Hint:</u> Consider finding the shortest path first, then try to use it to find the second shortest path by running the same algorithm (<u>one of those covered in the class only</u>) multiple times and with some **adaptations** to the graph.

- It is possible that second cheapest road might have the same cost with the best route.

- It is also possible that second cheapest route may have overlaps with the best route.

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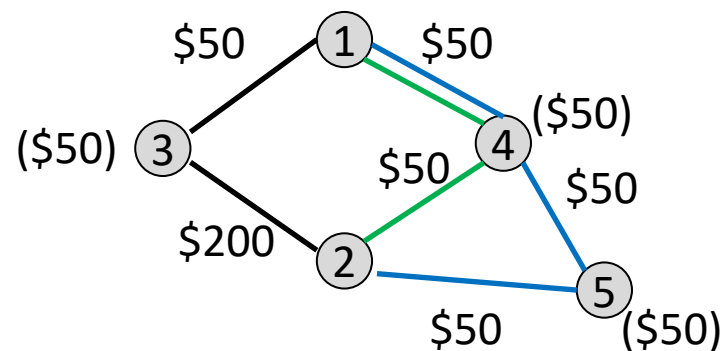
Submission

- Date due: Thu, Nov 9th, 11:59 pm

- Submission through Canvas
  - Just submit the <u>single</u> Java source code file CMSC401_A3.java
    - No need to zip. Don't worry about "-1", "-2" added to your file by Canvas for new versions.
    - <u>The file should have *your name* in a comment in the first line</u>
    - Remember: in Java, <u>class name should match the file name</u>, and is case sensitive

- Please do NOT create your own packages
- Use standard I/O to read input (System.in, System.out) and output
- Make sure the **program compiles and WORKS!**
- Late submissions are accepted up to 2 days only <u>with</u> penalties!

   (If you have a special accommodation, let me know if you will use it at least 24 hours before the deadline)

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