CAPSTONE PROJECT 1

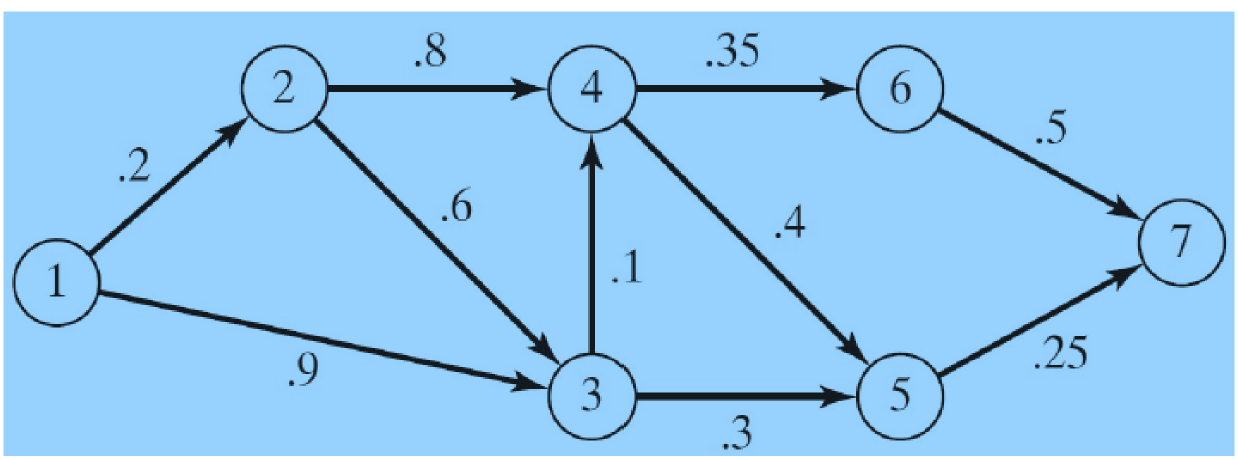
AVOIDING THE POLICE

OPTIMIZATION REPORT

INTRODUCTION

Project Description:

This project is about a new Taxi Driver in Takoradi who is determined to use the shortest route on every trip. Trips to and around Dadzie street, a town in Takoradi has the most financial returns. Unfortunately, the shortest route as mentioned above is heavily patrolled by the police, and with the fines and bribes charged for simply driving through, the shortest route may not be the best choice. Hence, the aim here is to find the route that maximizes the probability of not being stopped by the police. The figure below shows the possible routes from the market circle (1) to Dadzie street (7) and the associated probabilities of not being stopped on each segment.



PROBLEM STATEMENT

Finding the Optimal solution that helps the Driver decide or choose a route that maximizes the probability of not being stopped by the police, thereby avoiding any fines and bribes that comes with that.

GOAL OF PROJECT

Selecting the route that **Maximizes** the Probability of not being fined by the Police.

SOLUTION APPROACH

This problem was solved using the Dijkstra Algorithm. Dijkstra's algorithm is a step-by-step process we can use to find the shortest path between two vertices in a weighted graph. This algorithm enables us to find shortest distances making it a valuable tool.

This algorithm uses distances in calculating the shortest distances, hence given the probabilities of the segments, the probability of not being stopped or fined on a route is the product of the probabilities associated with its segments.

MATHEMATICAL FORMULATION OF PROBLEM

The problem can then be formulated as a shortest-route model by using a logarithmic transformation that converts the product probability into sum of the logarithms of the probabilities that is if $P_{ik} = P_1 \text{ x } P_2 \text{x} \ldots \text{x} P_k$ is the probability of not being stopped, then $\log P_{ik} = \log P_1 + \log P_2 + \ldots + \log P_k$

Hence, mathematically the maximization of P_{ik} is equivalent to the maximization of $\log P_{ik}$. Because $\log P_{ik} \leq 0$, the maximization of $\log P_{ik}$ is equivalent to the minimization of $-\log P_{ik}$.

SOLUTION OF PROBLEM

Using the Dijkstra algorithm and converting all labels from 1 – 7 to A to B i.e. location 1 as A, location 2 as B and so on. I found that the route that maximizes the probability of not being fined as shown below:

```
In [10]: print(" -> ".join(dijkstra.get_path(G)))

         A -> C -> E -> G
```

RECOMMENDATION/CONCLUSION

From the above output, the routes that the taxi driver can which maximizes the probabilities of not being fined by the police are from

Location 1 >> **Location 3** >> **Location 5** >> **Location 7**

This comes with a total probability of:

$$\mathbf{0.9 \times 0.3 \times 0.25 = 0.0675.}$$

REFERENCES

1. https://study.com/academy/lesson/dijkstra-s-algorithm-definition-applications-examples.html
2. https://study.com/academy/lesson/dijkstra-s-algorithm-definition-applications-examples.html
3. http://www.brainkart.com/article/Examples-of-the-Shortest-Route-Applications-or-Problem_11227/