# Assignment Proposal

Instructions:
1. **Read the assignment proposal carefully.**
2. **If any of the requirements are missed in the final code submission, the respective marks will be deducted.**
3. **It is mandatory to submit the assignment in the PDF format only consisting of all the outcomes with each and every iteration. Any other format will not be accepted.**
4. **Add comments and description to every function you are creating or operation you are performing. If not found, then 1 mark will be deducted. There are many assignments that need to be evaluated. By providing the comments and description it will help the evaluator to understand your code quickly and clearly.**
5. **Late submissions will have the penalty of -2 marks.**

Title: Applying Markov Decision Process for obtaining the optimized route for transportation.

Problem Statement: Suppose there is a driver who wants to transport some purchased item to a customer from source location A (shop) to destination location B (customer house). There are a number of routes available for transporting an item from location A to location B. While delivering the item, there are certain challenges the driver has to look after such as transportation time, cost and traffic. The objective of the problem is to find the optimal route for the driver by overcoming all the three parameters mentioned above.
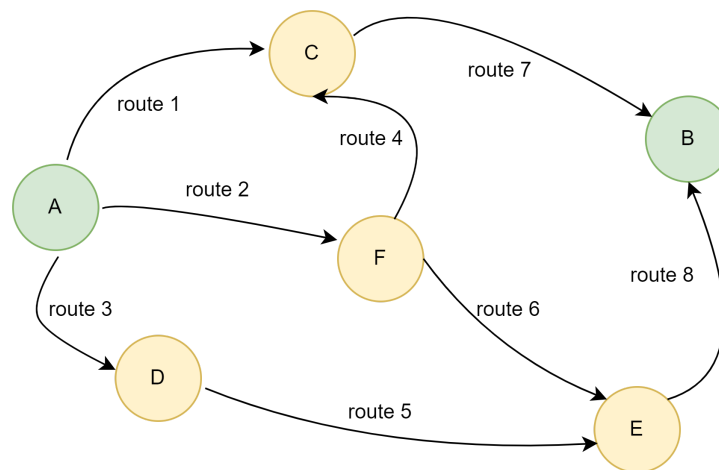
Scenario: Let's say the driver has his own navigation system and he can optimize his route using the following different scenarios:
1. <u>Optimize the route with respect to time:</u> The driver has to find a route in such a way that the total time taken to transport from A to B should be minimum irrespective of cost and traffic.
2. <u>Optimize the route with respect to cost:</u> In this scenario, the driver can find the optimal route by minimizing the cost of transportation irrespective of time and traffic.
3. <u>Optimize the route with respect to traffic:</u> The third way of finding the optimal route is with respect to minimum traffic irrespective of time and cost.
4. <u>Optimize the route with respect to all challenges:</u> In this scenario, the driver can find the best optimal route by minimizing all the three challenges such as time, cost and with low traffic.

Requirements / Expected Outcomes:

1. Discuss in detail how Markov Decision Process (MDP) can help in route planning application. Justify your answer in 350-400 words. Explain in detail your environment, state space, action space and equations aligned with the given problem. Write the answer in the Colab Cell itself. **(2 Marks)**

   Note: *The answers from chatGPT, Bing or any other Generative AI tool will not be considered. If any plagiarism is found in the answer, the student will be strictly awarded 0 Marks.*

2. Calculate the transition probability for each route selection based on the values given in the below table. (Sample Link for calculating the probability is here) **(2 Marks)**

   Note: *It is mandatory to show the above given diagram after calculating the probability for each route selection.*

Route	Time	Cost	Traffic Intensity	Selection
Route 1	Best	Minimum	Medium	Yes
Route 2	Average	Minimum	Medium	Yes
Route 3	Best	Maximum	Low	No
Route 6	Worst	Maximum	High	Yes
Route 4	Average	Minimum	High	No
Route 1	Average	Minimum	Low	Yes
Route 5	Average	Maximum	High	Yes
Route 7	Worst	Minimum	High	Yes
Route 8	Best	Minimum	Medium	No
Route 2	Best	Maximum	Medium	Yes
Route 3	Worst	Maximum	Medium	No
Route 8	Best	Minimum	Low	Yes
Route 5	Worst	Maximum	High	No
Route 4	Worst	Minimum	Medium	No
Route 3	Best	Maximum	Low	Yes
Route 7	Average	Minimum	Low	Yes
Route 6	Average	Minimum	Low	Yes
Route 1	Average	Maximum	Low	No

3. Find the best optimal route for the driver for the above mentioned all the scenarios using Bellman equation and value iteration only. **(1+1+1 = 3 Marks)**

   Note: *It is mandatory to show/display the following outcomes:*

   a. *Print all the transition probabilities for each state and action for every scenario.* ***(1 Mark)***

   b. *Print all the iterations for each and every scenario with how the algorithm is finding the best optimal route.* ***(1 Mark)***

   c. *Provide a final optimal route for each scenario separately at the end of the complete code by printing them together.* ***(1 Mark)***

4. Conclude your assignment with your analysis consisting of at least 200 words by summarizing your findings of the assignment. **(1 Mark)**