AI Project proposal

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1 Problem Description

We choose the problem of **Route planning with uncertain travel times due to time-varying traffic** as our project topic. Different from the traditional route planning in which the cost of each edge in the network graph is constant, we should considers more about the time-related changes happened in the traffic network. So, in this case, we can't compute the fastest route from any given starting point to all possible destinations by just using Dijkstra's well-known shortest path algorithm, as the weight of each road is changing all the time and the route planning with uncertain travel times is *time-dependent*.
To formulate this problem, the road network is a direct graph $M = (V, E, F)$ and V is a vertexes set and $E \subseteq V \times V$ is the set of edge. $v_i \in V$ represent a road intersection or an end of a road and $e_i = \{v_i, v_j\} \in E$ represent a road in the map. And function $F : V \cup E \rightarrow Geometries$ represents the geometries information of the road model M. A route $R =< r_1, r_2, ..., r_p >$ where $p \geq 1$ is the sequence of edges, where $r_i \in E$ and $r_i \neq r_j$. While travelling, the value of each edge changes depending on the time. Our goal is to re-plan the route and find the optimal one.

2 Case study & Concepts

Because of the limit of the time and resource, we can not get the real-time road map and the traffic information. So we plan to generate a direct map with no more than 500 vertexes randomly. And the traffic information, we also plan to generate them randomly. To verify our algorithm's correctness, we plan to test it on a small map such as only 20 vertexes and prove it by hand.
As for the concepts that we plan to study, **time independent** is the difference between the traditional route planning and our problem. Some article proposed that we must maintain a set of undominated paths with each node encountered, rather than a single best found so far. So **Priority-first Search** came out to solve this question. Also some previous study has a build a model for this kind of question named **multi-cost, time-dependent, uncertain graph (MTUG)**, which is also the concept we plan to study. And there are also a bunch of

algorithms to solve this kind of problem in recent year's papers, such as **LDA*, D* Lite**, all these kind of algorithms base on the **A*** algorithm. We plan to implement these algorithms and compare the results of time cost, the length of the final route and other parameters indicating the quality of the algorithm.

3 Aim & Task List & Work Plan

Our aim is 2 in *Dr*, 3 in *Br*, 3 in *Im*, and 2 in *An*.

1. **50% work**
   1) Finish reading the basic articles(all of us, 8ph); 2) Determine the function to generate the test graph(Tao & Shinping, 4ph); 3) Build a module to approximate the varying of time cost due to the traffic congestion(Tao & Shiping, 14ph); 4) Build the framework of this project(Xingjiang & Yuan, 10ph); 5) Implement the Classical algorithm: *Flord* and *Dijkstra* algorithm(Xingjiang & Yuan, 8ph).

2. **100% work**
   1) Implement two another advanced algorithms(all of us 30ph); 2) Compare the results of these algorithms(Tao & Shiping, 4ph); 3) Discuss the difference between the algorithms(Tao & Shiping, 10ph); 4) Think of some way to optimal or improve the performance of our algorithm(Xingjiang & Yuan, 14ph); 5) Finish the final report(all of us, 6ph)

4 Reference Books and Articles

We plan to read Kim et al.'s work [1] and Wellman et al.'s work [2] and Yang et al.'s work [3]. And other people's work will be also added to our reference in the future.

References

[1] Seongmoon Kim, Mark E Lewis, and Chelsea C White. Optimal vehicle routing with real-time traffic information. *IEEE Transactions on Intelligent Transportation Systems*, 6(2):178–188, 2005.

[2] Michael P Wellman, Matthew Ford, and Kenneth Larson. Path planning under time-dependent uncertainty. In *Proceedings of the Eleventh conference on Uncertainty in artificial intelligence*, pages 532–539. Morgan Kaufmann Publishers Inc., 1995.

[3] Bin Yang, Chenjuan Guo, Christian S Jensen, Manohar Kaul, and Shuo Shang. Multi-cost optimal route planning under time-varying uncertainty. In *Proceedings of the 30th International Conference on Data Engineering (ICDE), Chicago, IL, USA*, 2014.