CS 110: Solving Problems with Algorithms
Final Project Proposal

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I.   Introduction

For our final project, we tackle question 3 - Implementation, by constructing a package of computational geometry algorithms geographic information systems. All the 6 algorithms we implement include heavy and creative use of data structures, thus offering ample room to apply what we learnt in class. Application-wise, we intend to demonstrate the use of computational geometry algorithms in Yelp-like apps, for querying and navigation purposes.

II.   Scope

a/ Algorithms

- Delaunay triangulation
- Voronoi diagram
- Range search algorithms
    - Kd-tree
- Fixed-Radius Near Neighbors
- Point location algorithm
    - Trapezoidal map
    - Randomization algorithms
- Other data structures
    - Interval tree
    - Priority search tree

b/ Application

Computational geometry is a field with rich applications. We intend to apply the results in this field for applications in Google map:

- Windowing & clipping: Given the finite size of the computer screen, at any moment the computer can only render a finite field of interest. Computational geometry is applied in the clipping algorithm of the Google map app as we scroll to new map region, new area is loaded on our screen.
- Point location: We utilize advanced data structures such as trapezoidal map and different techniques to pinpoint a location on the map.
- Database Queries & restaurant searching: We can utilize the power of computational geometry by transforming database to geometry form and use computational geometry to process them. We can apply this algorithm in restaurant searching, an app that is similar to Yelp.
- Shortest path: We apply geometric tools to triangularize a graph and find the shortest path from one vertex to another. We hope to generalize the idea to find the shortest path between two points on a map.

c/ LOs covered
- #searchtrees
- #randomization
- #sort
- #hashing
- (#greedy)
- #complexity
- #otimalalgorithm
- #novelapplication

III.   Division of tasks

	Hoang	Long
Theory	- Sort algorithms - Search trees - Randomized algorithms	- Search trees - Hash - Sort algorithms - Randomized algorithms
Implementation (main)	- Clipping algorithms - Range search algorithms (Kd-tree,...) - Other data structures for geometric computation (Fenwick tree,...)	- Fixed-Radius Near Neighbors - Delaunay triangulation - Voronoi diagram
Application	Range search, windowing query and restaurant searching	Path finding and Restaurant Searching

Overall, we split strictly 50-50 of work for each person over each part of the project.

IV.   Resources
General
http://codeforces.com/blog/entry/48868
http://www.cs.umd.edu/~mount/754/Lects/754lects.pdf
https://hal.inria.fr/inria-00167202/file/hal.pdf
http://blancosilva.github.io/post/2014/10/28/Computational-Geometry-in-Python.html
https://www.maa.org/sites/default/files/pdf/upload_library/22/Ford/Graham-Yao687-701.pdf

Delaunay algorithm
http://web.mit.edu/mobility/publications/IV2012_Anderson_Karumanchi_Iagnemma.pdf

Path finding
https://cs.brown.edu/people/rt/sdcr/chen/chen.html
http://cs.rkmvu.ac.in/~sghosh/public_html/nitt_igga/lec-trichy-jan2010.pdf

http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=4539713

https://www.researchgate.net/profile/Santiago_Garrido2/publication/260287339_Mobile_Robot_Path_Planning_using_Voronoi_Diagram_and_Fast_Marching/links/548fe1230cf214269f2640ea/Mobile-Robot-Path-Planning-using-Voronoi-Diagram-and-Fast-Marching.pdf

Air traffic management

https://dl.acm.org/citation.cfm?id=2519947