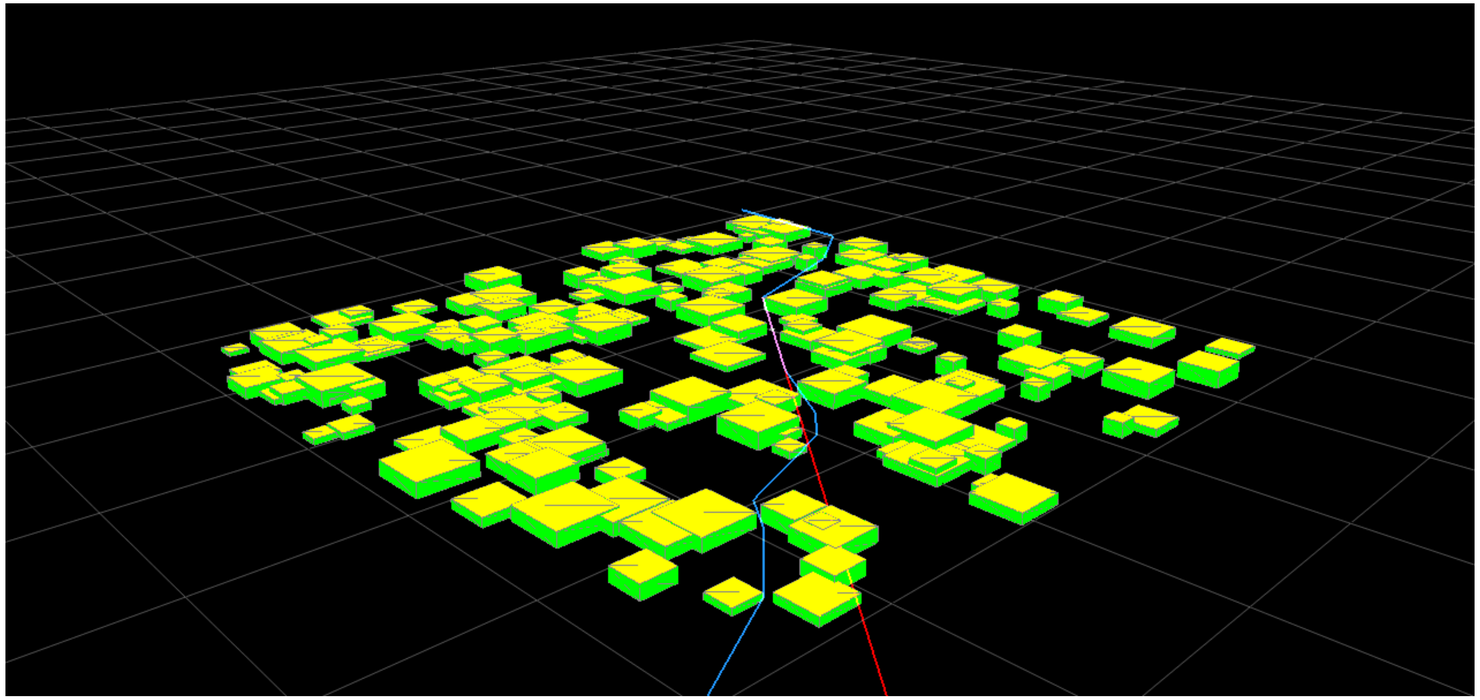
Path Planning with A* and Voronoi Diagrams

Ryan Day - 13 April 2020

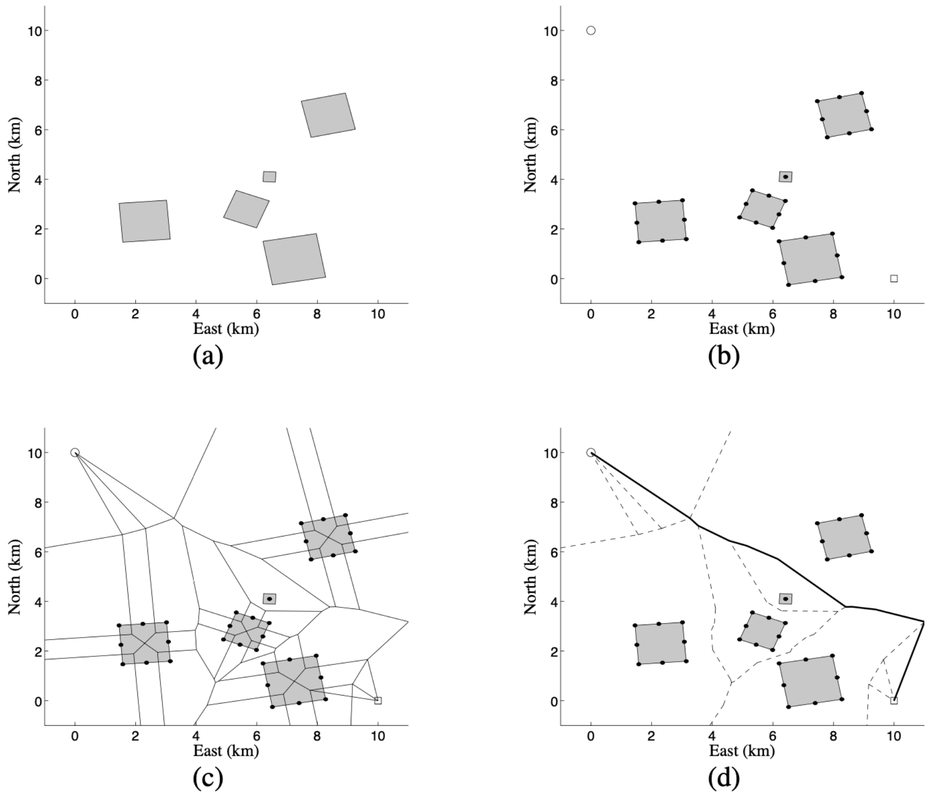
Environment Setup

- Map size 10000 by 10000
- 200 random buildings with width from 200-700 and random height
- Complicated enough to have fun



Generate Graph with Voronoi Diagram

- Voronoi Diagram creates graph which we must then traverse to get from start until finish
- Vertices are removed that are outside of bounds or inside points
- Graph edges - I evaluated 100 closest connections as candidates, and removed if edge intersected obstacles
- Graph can be used for multiple path plans



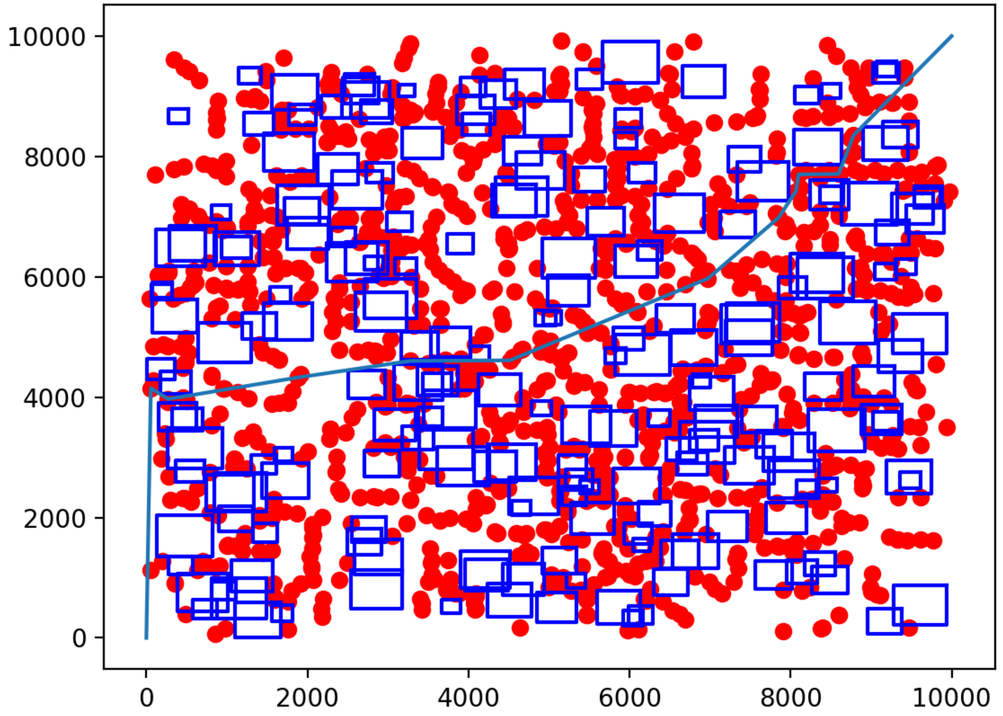
Lovingly lifted from our UAV textbook

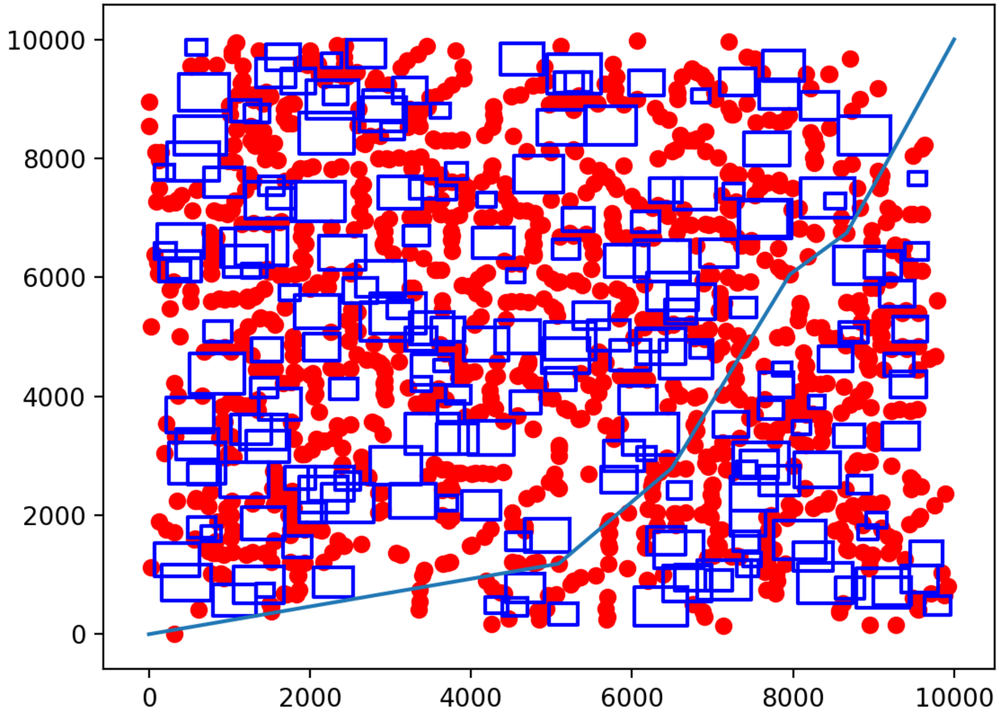
Path Planning with A* algorithm

- Since there were so many nodes and connections, I decided to use A*
- Node exploration influenced by lowest path cost and the Euclidian distance to the goal
- Fast, but you may not find the exact optimal path
- In worst case scenario, A* takes the same amount of time as Djikstras
- Wikipedia has good explanation for those interested in more details
- Used smoothing algorithm since many nodes were very close together

Examples

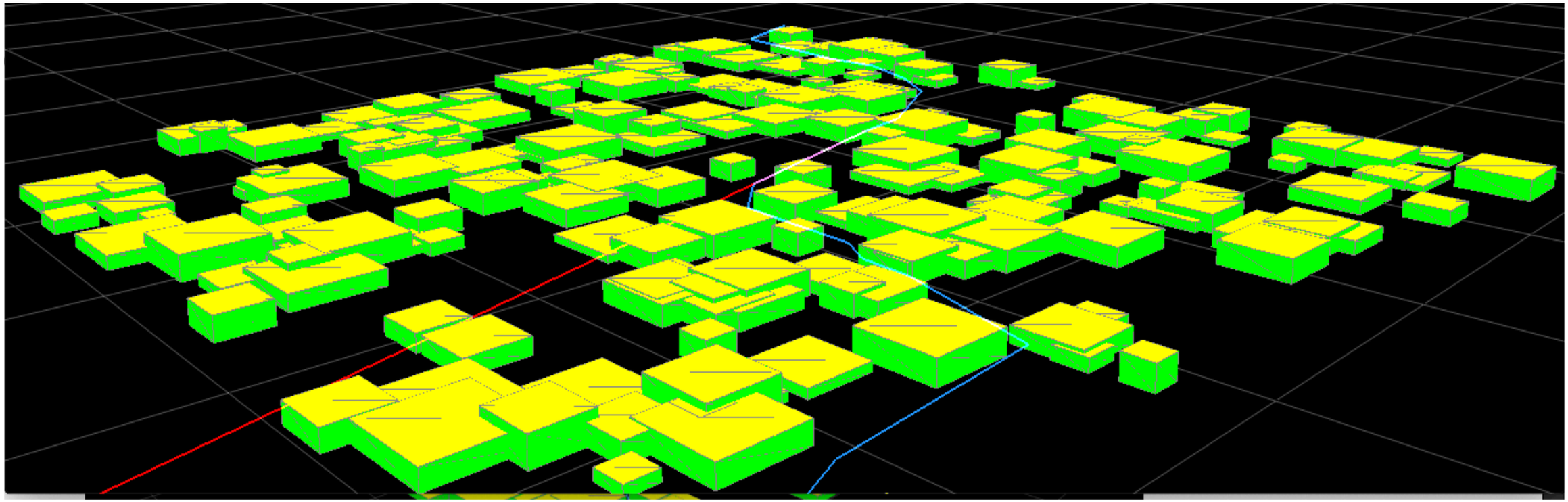
- Building are squares, nodes are represented by dots, and line plot is the final waypoints connected





I apologize if you are colorblind

Another Example



Conclusions

- Voronoi based graph is good for environments with lots of obstacles
- Voronoi guarantees some vertices in between buildings, where it can be hard to sample with RRT
- A* is good when there are tons of nodes, and where a good path is acceptable rather than an optimal path
- If there were less obstacles, randomly sampled points would need to be added to improve path
- I had to tune the building generation parameters to make sure a feasible path, sometimes exit node would be walled off

Thanks!