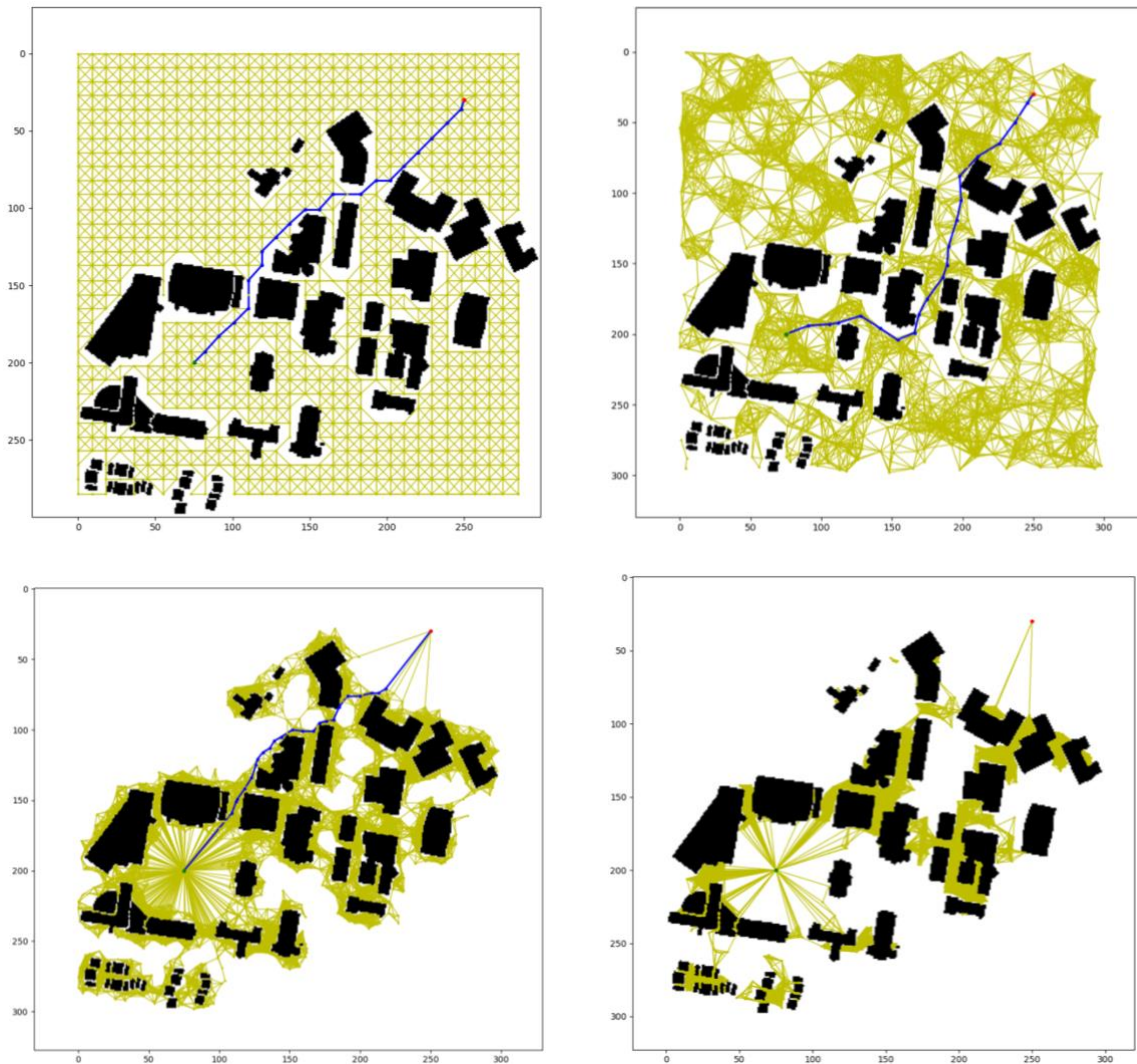


Advantages and disadvantages of the four sampling methods for PRM

	Advantages	Disadvantages
Uniform	Almost like a discrete planning method. Best suited for low-dimensionality	Sensitive to dimensionality. Requires tuning of resolution.
Random	Great for open areas, without too many narrow passages	Not good for map with many narrow passages. Fails to cover whole traversable areas.
Gaussian	Boosts performance of PRM in low-visibility spaces, near boundaries. E.g. near/between buildings. Can effectively capture the boundary of obstacles.	Extra tuning of sigma to trade off competing costs (for better performance). Not great for large, open areas without many obstacles.
Bridge	Great for narrow passages, as it specifically looks for a midpoint between two occupied (obstacle) points.	Not great for large, open areas without many obstacles.

Text Example, Test Result and Explanation



PRM results using different sampling methods. Start and goal points shown. Sampling methods included are uniform sampling with 1000 attempted sampling points (top-left), random sampling with 1000 attempted sampling points (top-right), gaussian sampling with 2000 attempted sampling points (bottom-left), and bridge sampling with 20000 attempted sampling points (bottom-right). All sampling methods but bridge sampling found a path from start to goal nodes. This was one run of the main program.

In terms of the number of nodes and edges constructed for each method, as well as the path lengths for the respective methods, below are the summarized results.

Uniform Sampling

- The constructed graph has 846 nodes and 4030 edges
- The path length is 263.18

Random Sampling

- The constructed graph has 997 nodes and 6831 edges
- The path length is 296.36

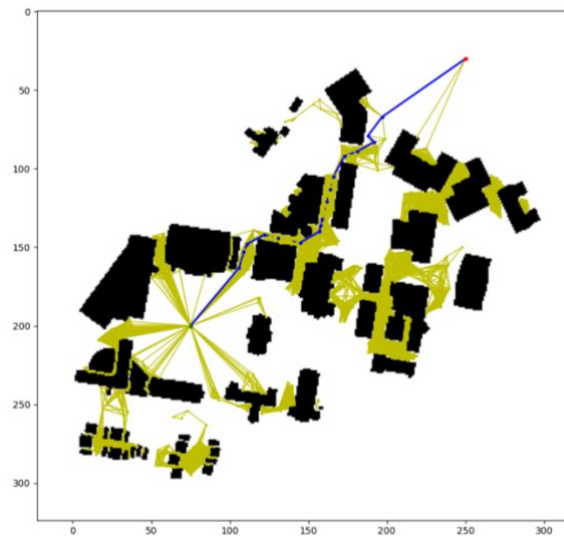
Gaussian Sampling

- The constructed graph has 1995 nodes and 14209 edges
- The path length is 261.44

Bridge Sampling

- The constructed graph has 1850 nodes and 55028 edges
- No path found

A few runs of the main program had to be ran until I was able to find a path through the Bridge sampling method. This shows that bridge sampling is only appropriate during certain scenarios, for example, when they're great for narrow passages but not open areas. The constructed graph has 1834 nodes and 54094 edges. The path length is 271.33 Below is the result:



Resources

- Prof. Li's lecture notes
- <https://stackoverflow.com/questions/13796782/networkx-random-geometric-graph-implementation-using-k-d-trees>
- <https://github.com/anushaihalapathirana/Bresenham-line-drawing-algorithm/blob/master/src/index.js> (For Bresenham's line algorithm for fast local planner)
- <http://motion.cs.illinois.edu/RoboticSystems/MotionPlanningHigherDimensions.html>