ME/AER 676 Robot Modeling & Control
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Sampling-Based Motion Planning

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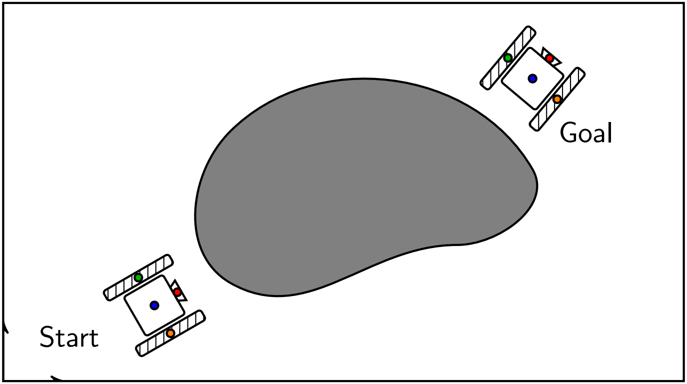
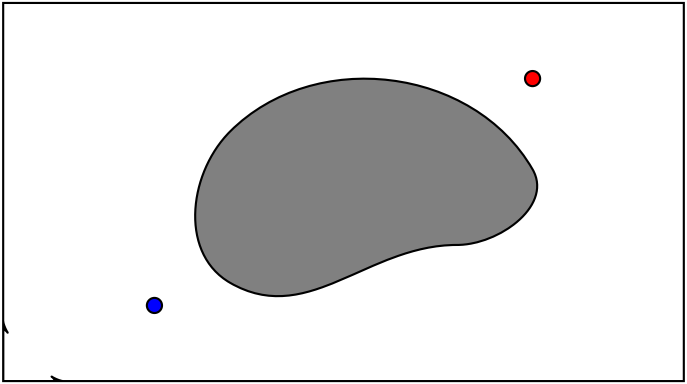
Motion Planning



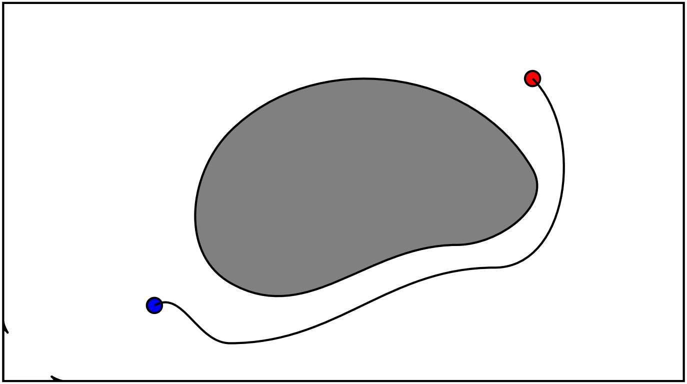
Motion Planning Problem

Motion Planning



Over-simplify the problem

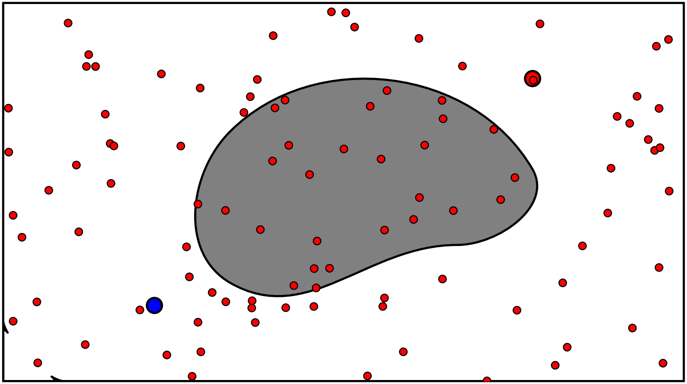
Motion Planning



A valid continuous path

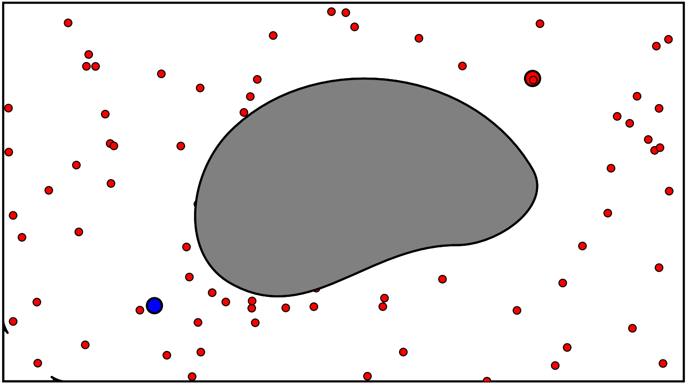
How would we obtain such a path using graph search?

Motion Planning



Randomly pick configurations to be nodes

Motion Planning



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Discard nodes in obstacles

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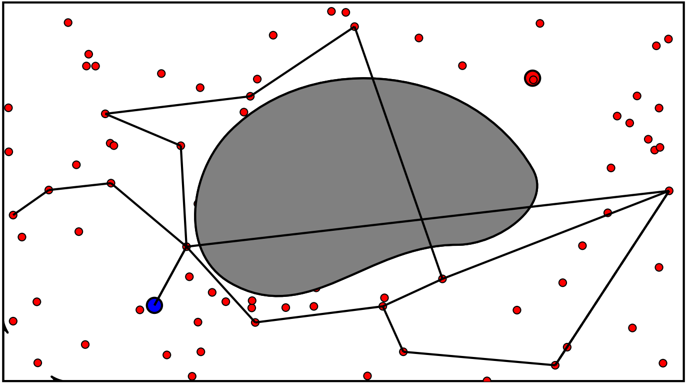

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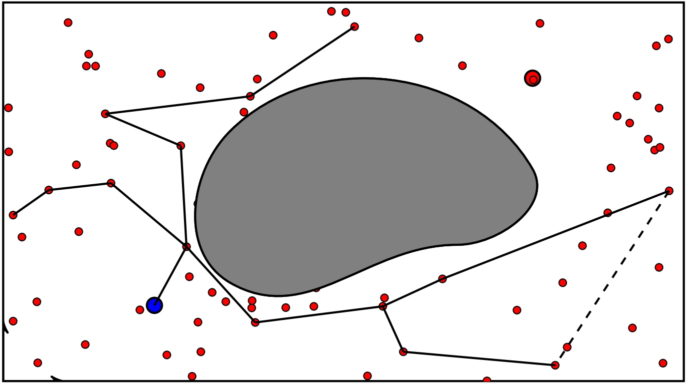

Randomly pick configurations to be nodes

Discard nodes in obstacles

Build graph by adding edges that can be physically realized

Motion Planning Continuous Space

Sampling-based motion planning (MP) algorithms define nodes/edges for continuous space and then develop a graph (PRM/RRG) or a tree (RRT).

- PRM: Probabilistic Road Map
- RRT: Rapidly-Expanding Random Tree
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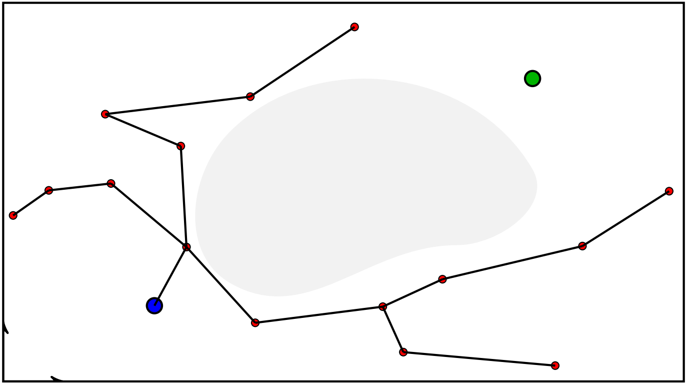
The large variety in sampling-based motion planning algorithms are variations of the two following steps.

1. Randomly sample configurations to create ‘nodes’
2. Use motion models/constraints to ‘connect’ samples

Motion Planning Continuous Space

Every algorithm has

- Sampling mechanism + collision check for creating nodes
- Select existing nodes to try and connect new samples to
- Local planner to check if we can connect new sample with selected existing nodes (dynamics, obstacles along path, local planner, etc.)



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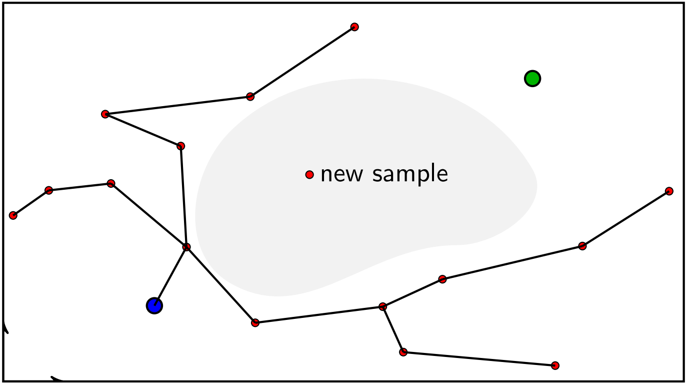

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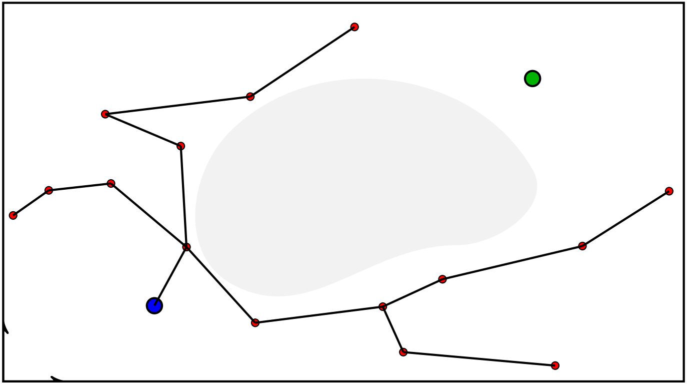

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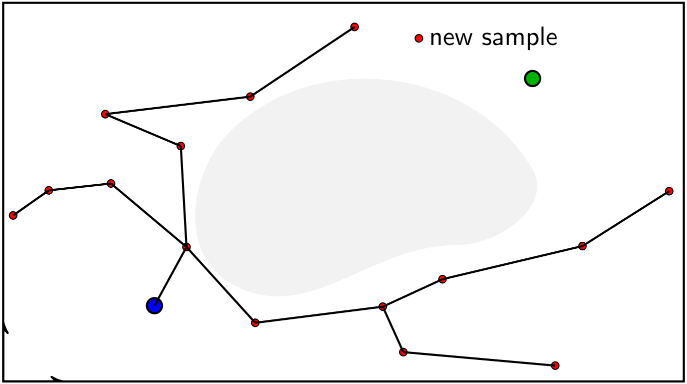

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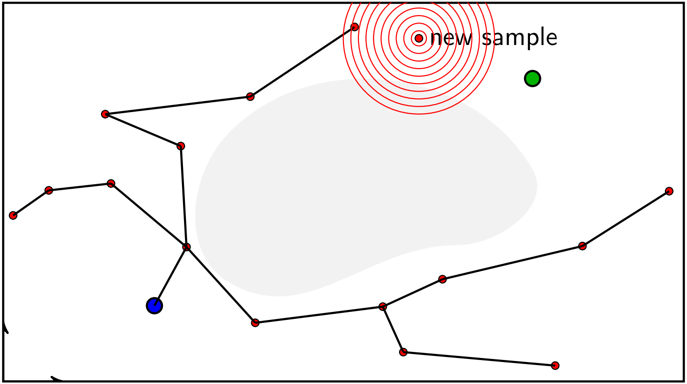

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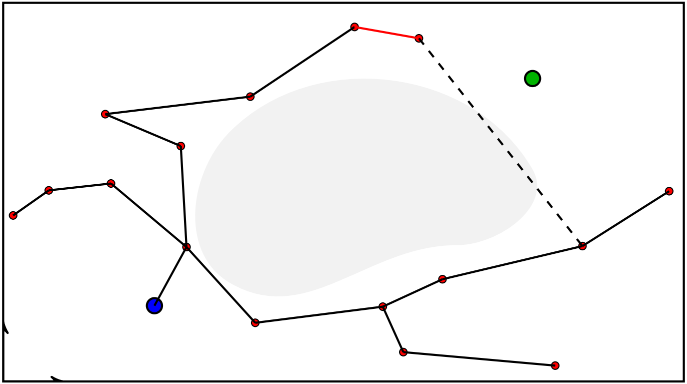

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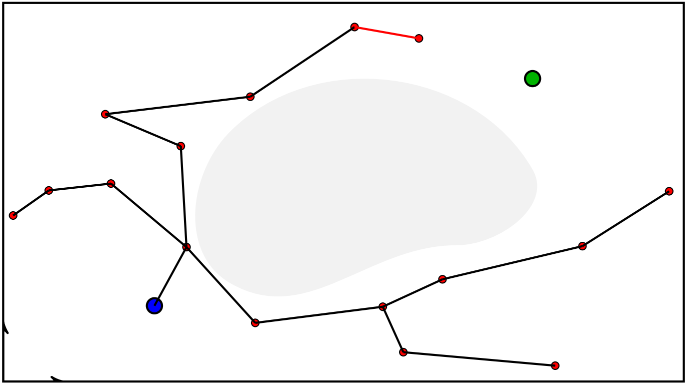
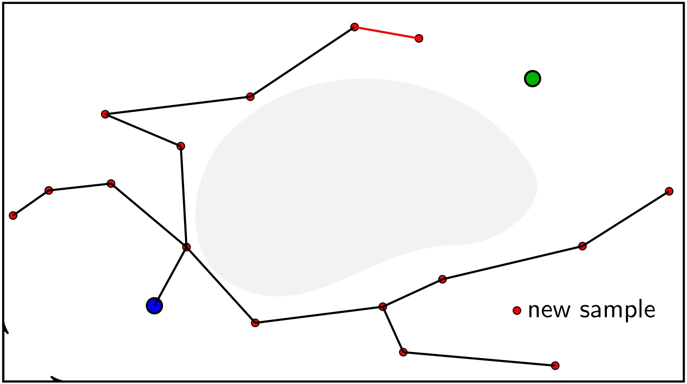
- RRG: Connect to multiple neighbors, use shortest-path algos later.

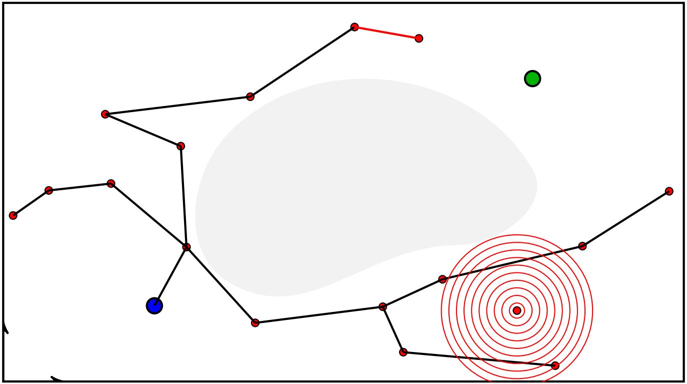
RRT



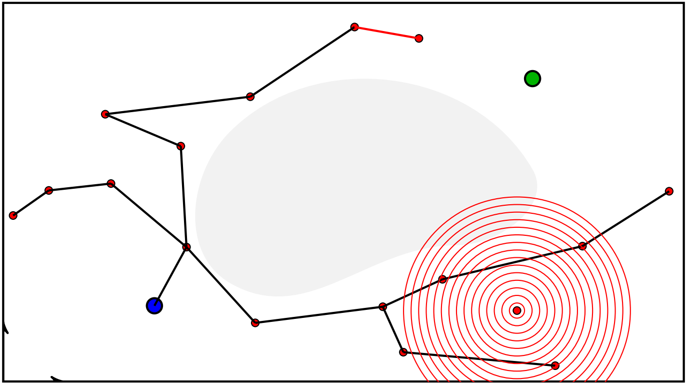
RRT



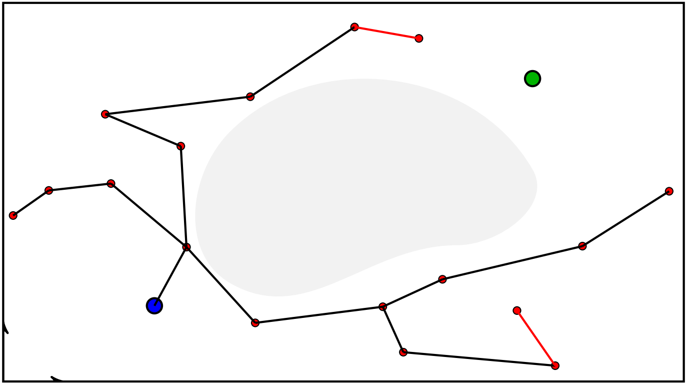
RRT



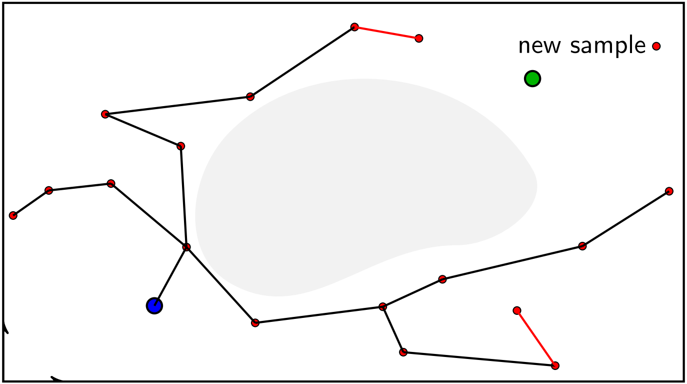
RRT



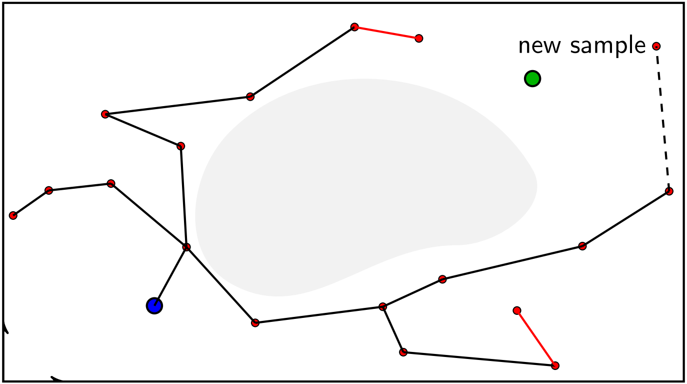
RRT



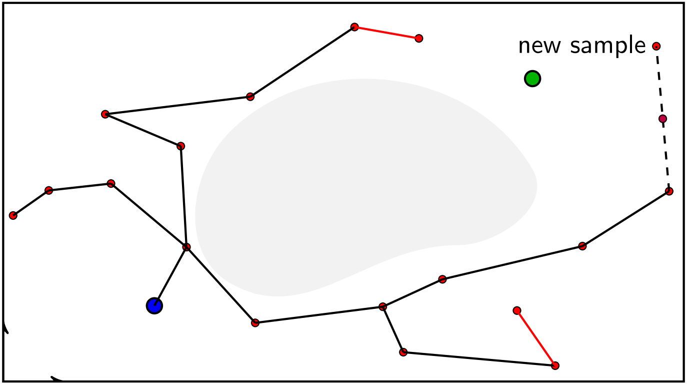
RRT



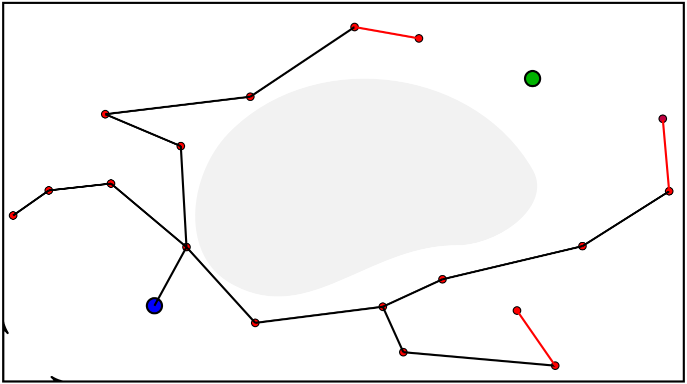
RRT



RRT



RRT



Implementing RRT

You need to implement the following functions that work with a tree data structure and the robot/environment model.

- *sample* (from state space)
- *nearest neighbor* (in state space distance)
- (*local*) *steer* (local planner)
- *collision check* (along steer solution)
- *cost* or *distance*
- *nearest vertex* (in tree distance)