# Escape Room

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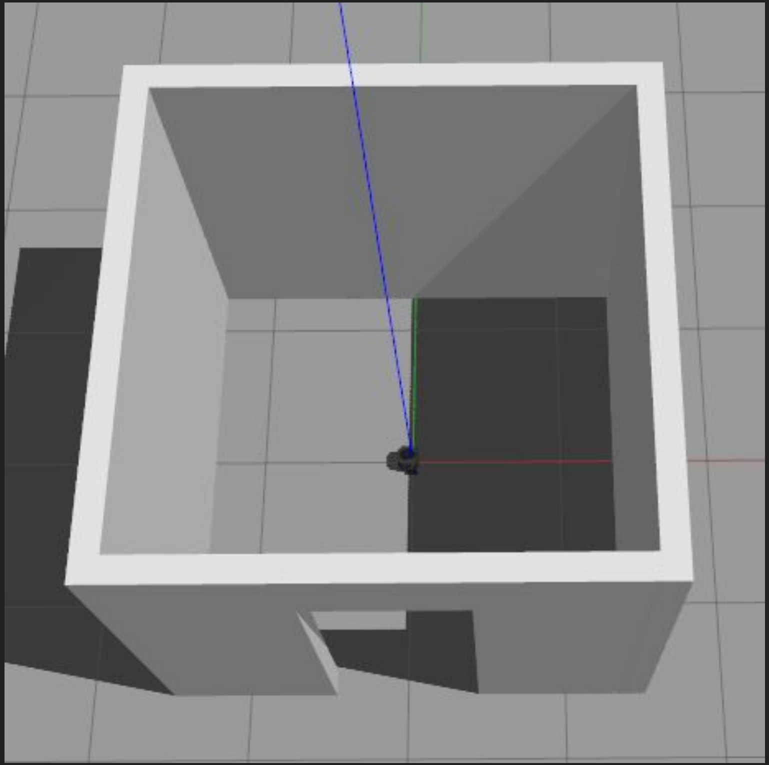
# What?

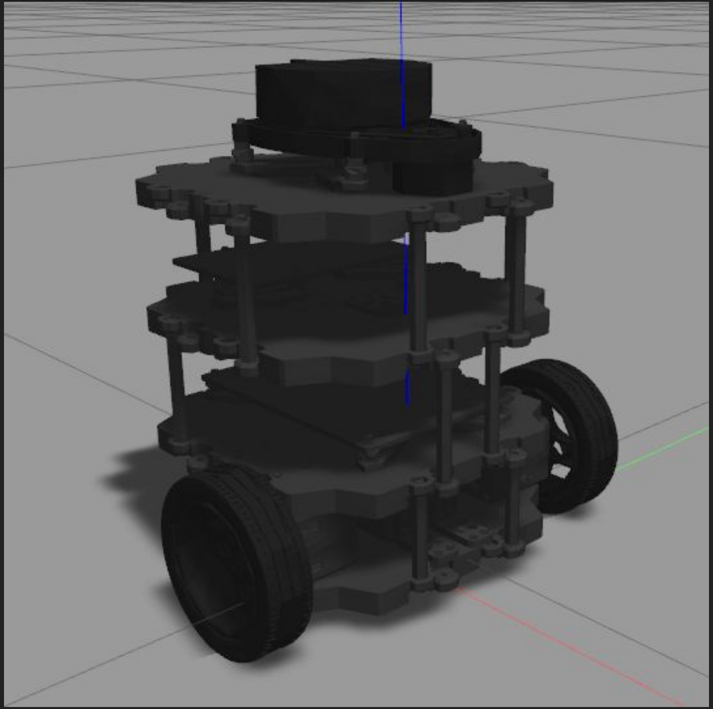
Given a robot placed in a room the task is to

1. Escape the room
2. Sense and avoid hitting **static** obstacles (viz. walls)
3. Sense and avoid hitting **dynamic** obstacles (viz. humans)



# Why?

1. Has sensing, planning and acting components.
2. Building blocks for building more sophisticated robots.
3. Sort of like a “basis set” for the “robot problem space”. :)



# CSci 5551 relevance

1. Deals with the basic math behind robots in the aspects of sensing, planning and acting, which is the essence of CSci 5551
2. Uses ROS

# Roadmap

- Assume static obstacles are known and no dynamic obstacles and plan for this
  - Build configuration space with obstacles
  - Build a Probabilistic Roadmap
  - Use A* like search to find a path from start to finish positions
  - Move the Turtlebot along the path
- Get static obstacle information from sensors
  - Use laser scan for detecting obstacles
  - Keep track of them
  - Plan using currently known obstacles, replan if new ones found on path (spirit of D*Lite)
- Have dynamic obstacles
  - Assume friendly behaviour
  - Use repulsive force methods to avoid collision from dynamic obstacles

# Progress

- Assume static obstacles are known and no dynamic obstacles and plan for this
  - Build configuration space with obstacles
  - Build a Probabilistic Roadmap
  - Use A* like search to find a path from start to finish positions
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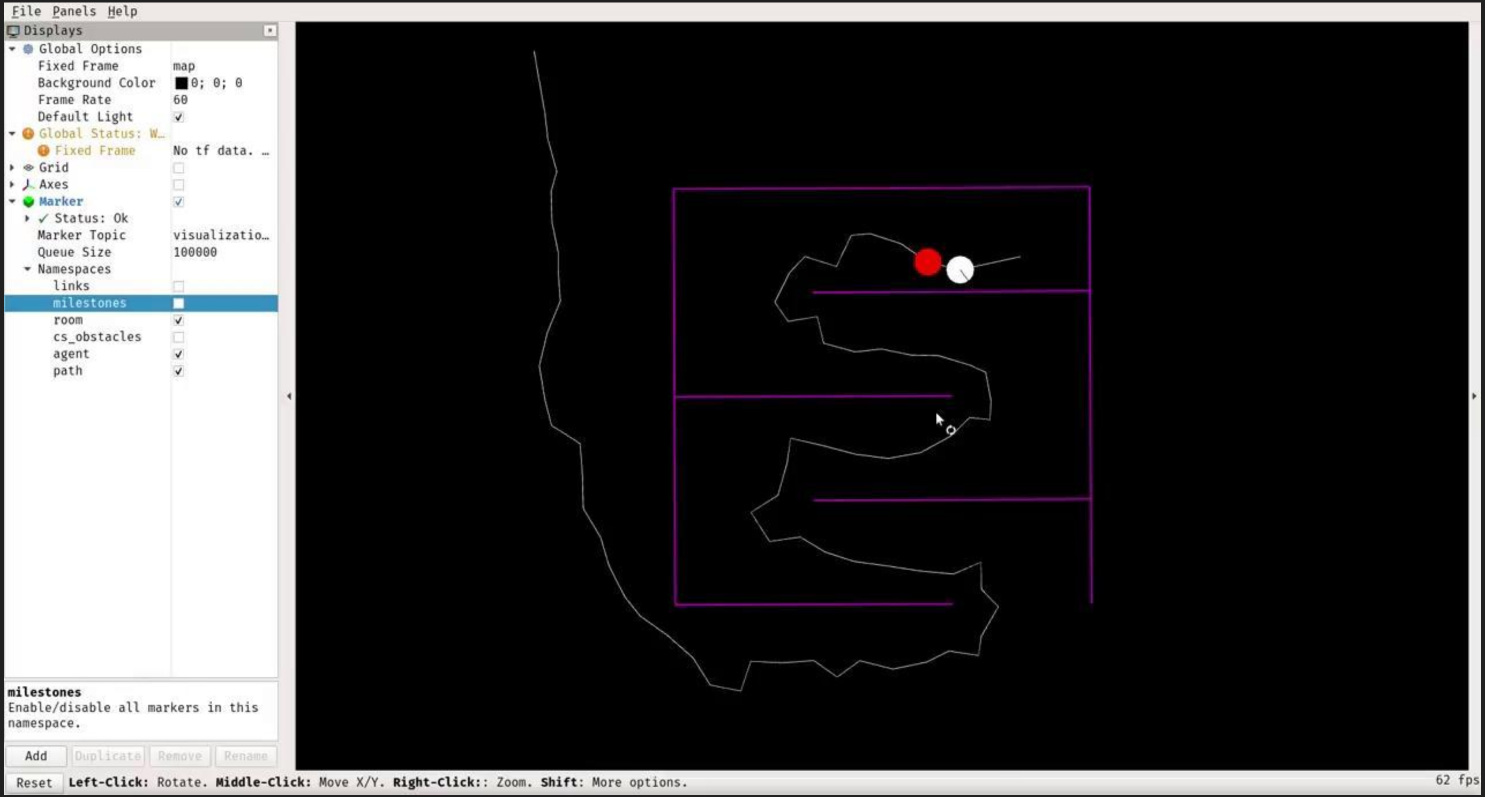
# Results: Path generation for known obstacles



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Namespaces
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milestones □
room ☑
cs_obstacles □
agent ☑
path ☑

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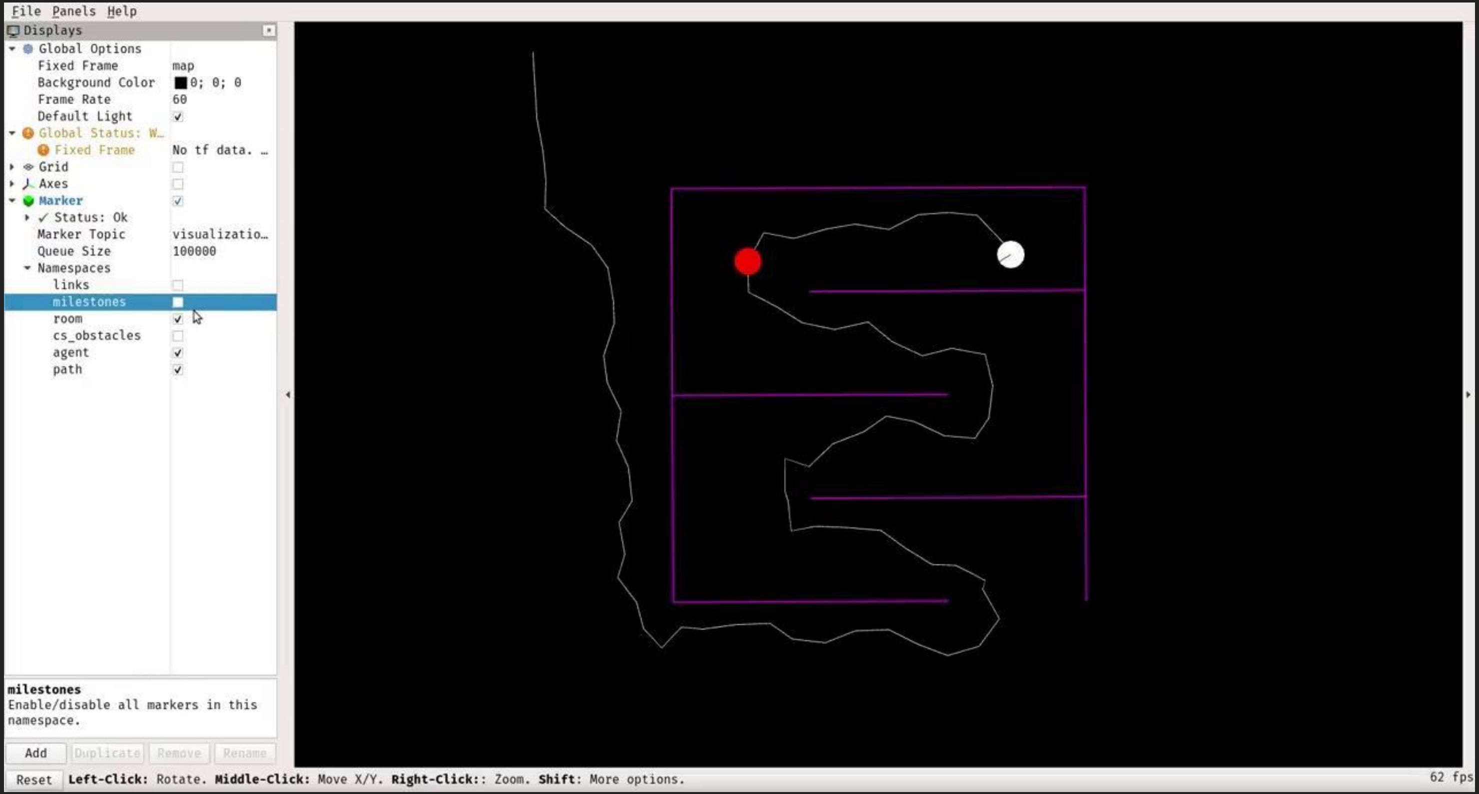
62 fps

# Results: With trajectory optimization



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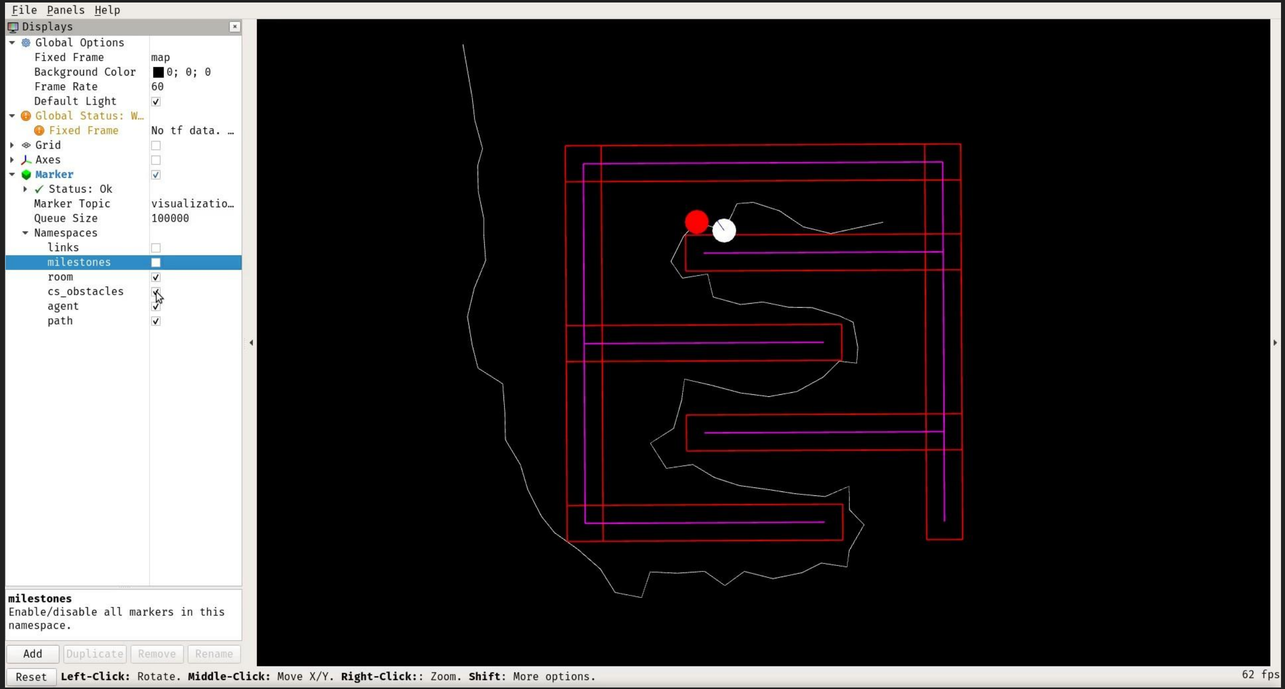
# Results: With trajectory optimization

# Challenges: Building a configuration space

- Taking extent of walls and turtlebot into account



Displays

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    - links: □
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    - room: ☑
    - cs_obstacles: ☑
    - agent: ☑
    - path: ☑

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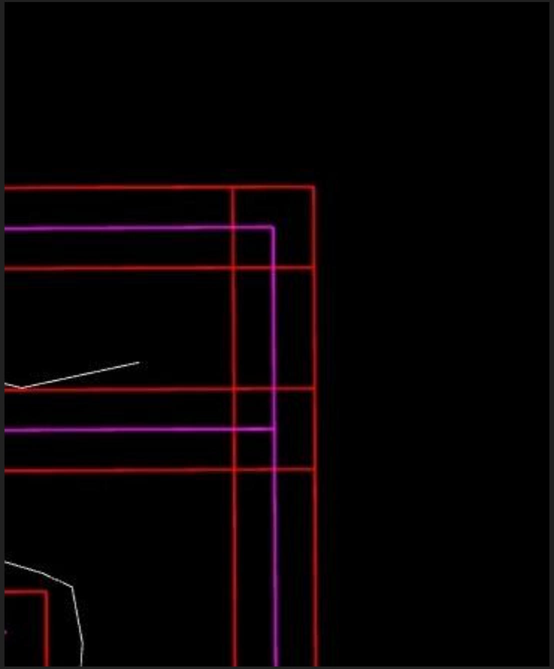
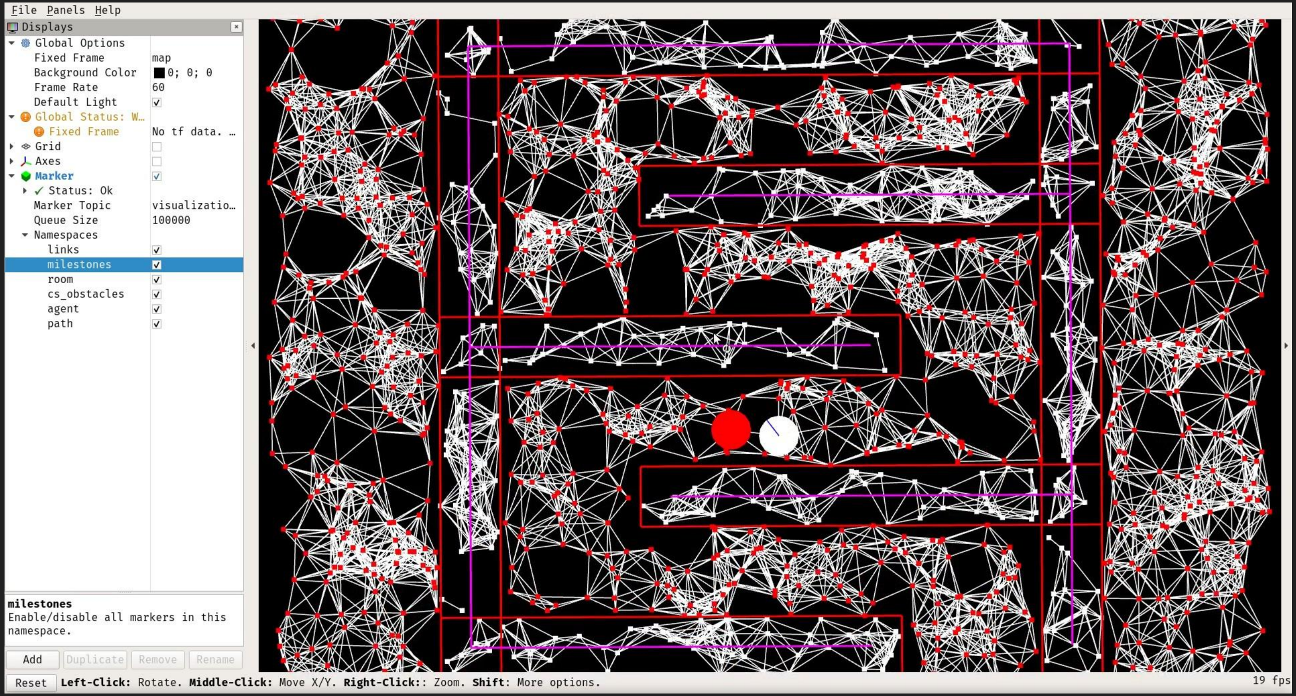
# Challenges: CSpace edges of walls

- Simplifying assumption - rectangular CSpace obstacles



# Challenges: Detecting edges intersect that obstacles



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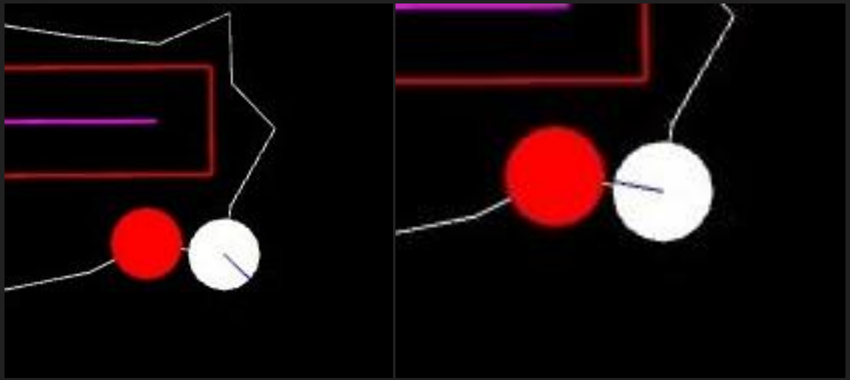
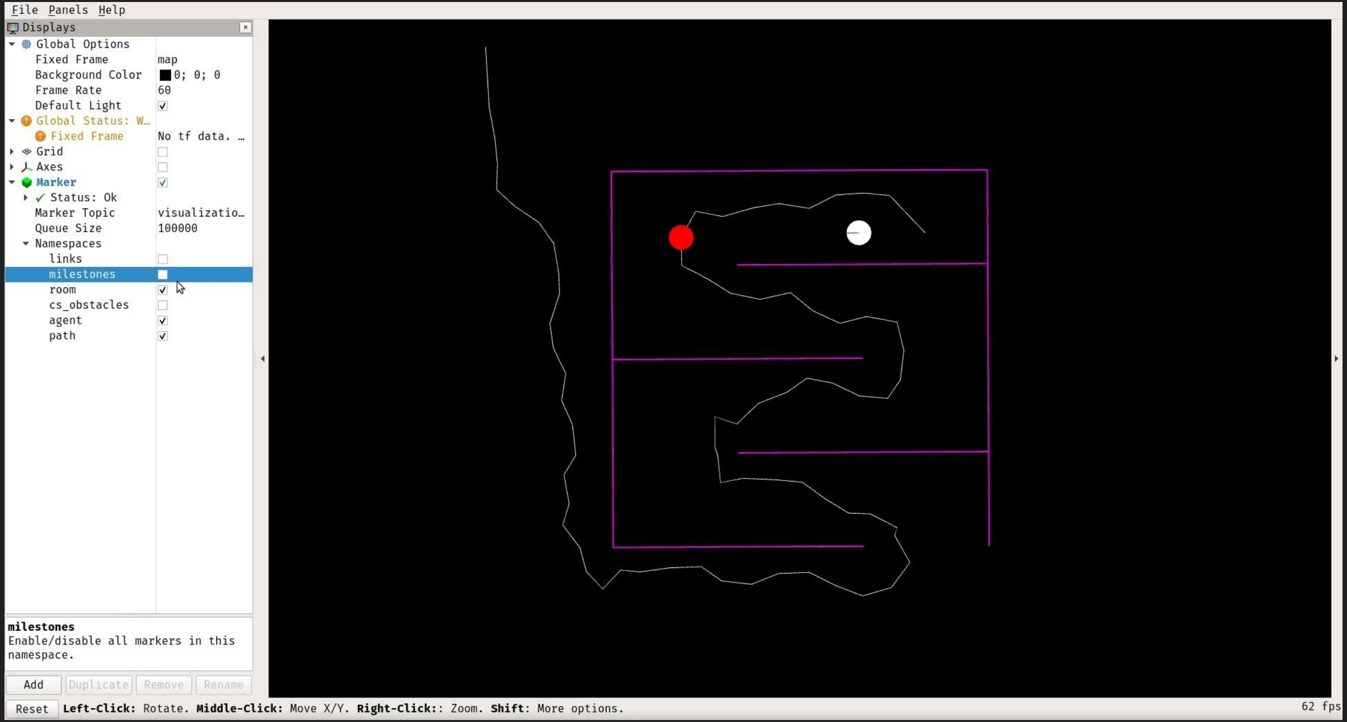
# Challenges: Moving the robot on path

- Simple strategy orient and move



# Challenges: Too many maneuvers

- Use trajectory optimization



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    room               ☑
    cs_obstacles       □
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# Challenges - ROS/Gazebo

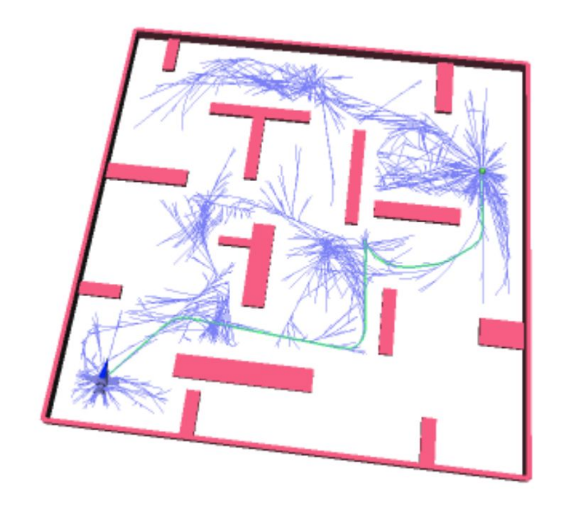
- Installing ROS and Gazebo
- Getting comfortable with ROS/rviz/Gazebo
- Gazebo is a resource hog!!

# Final project should...

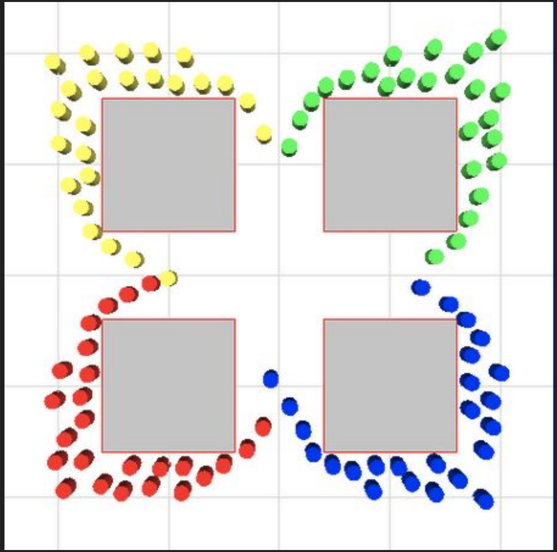
- Break “known” static obstacles assumption
  - Use laser scan for detecting obstacles
  - Keep track of them
  - Plan using currently known obstacles, replan if new ones found on path (spirit of D*Lite)
- Plan with dynamic obstacles
  - **May have to assume that the robot knows the position of humans**
  - Assume friendly behaviour
  - Use repulsive force methods to avoid collision from dynamic obstacles

# The potential

- Use better explorative techniques like RRTs
- Use better dynamic obstacle collision avoidance like TTC or RVO



RRT example



RVO example

Thank you!