



## CSCI 1106 Lecture 20



Search



# Announcements

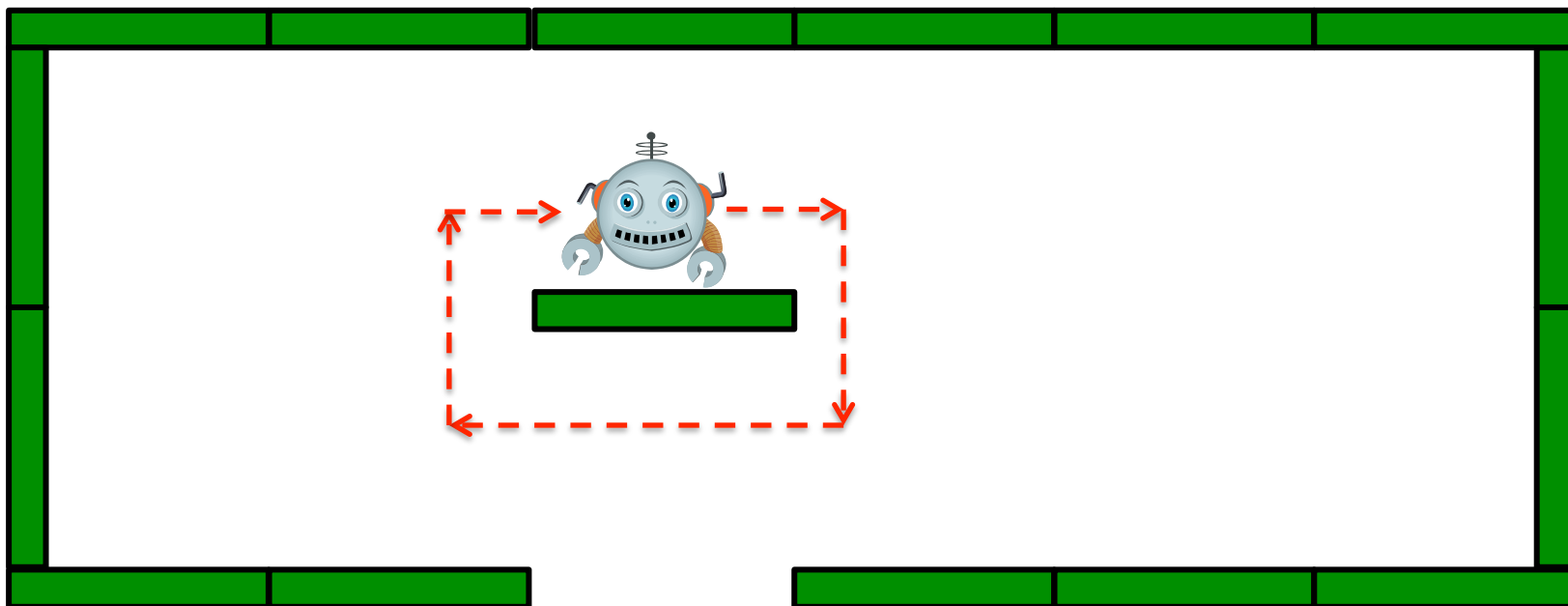
- Quiz #6 is this Friday, Dec. 4
- Robotics Olympics: Monday, Dec 7, 8:30-11
  - Location: TBA
  - Programs must be loaded on your robot at the start to compete in the Robot Olympics.
  - Files must be submitted to [prof1106@cs.dal.ca](mailto:prof1106@cs.dal.ca) on **December 6** before your presentation period
- Technical Report in PDF or Word format
  - 8 pages
  - Must be submitted by email to prof1106 with subject line “report” to prof1106@cs.dal.ca of **Dec 10**

# Announcements

- Today's Topics
  - Introduction to Search
  - Random Search
  - Fixed Pattern Search
  - Mark and Sweep

# Introduction to Search

- One of the most common tasks in robotics is to map (explore) a given environment
  - Robot must know where it is and where it was
  - This includes searching (avoid searching same place twice)
- Example: Can the exit be found without location tracking?



# Random Search

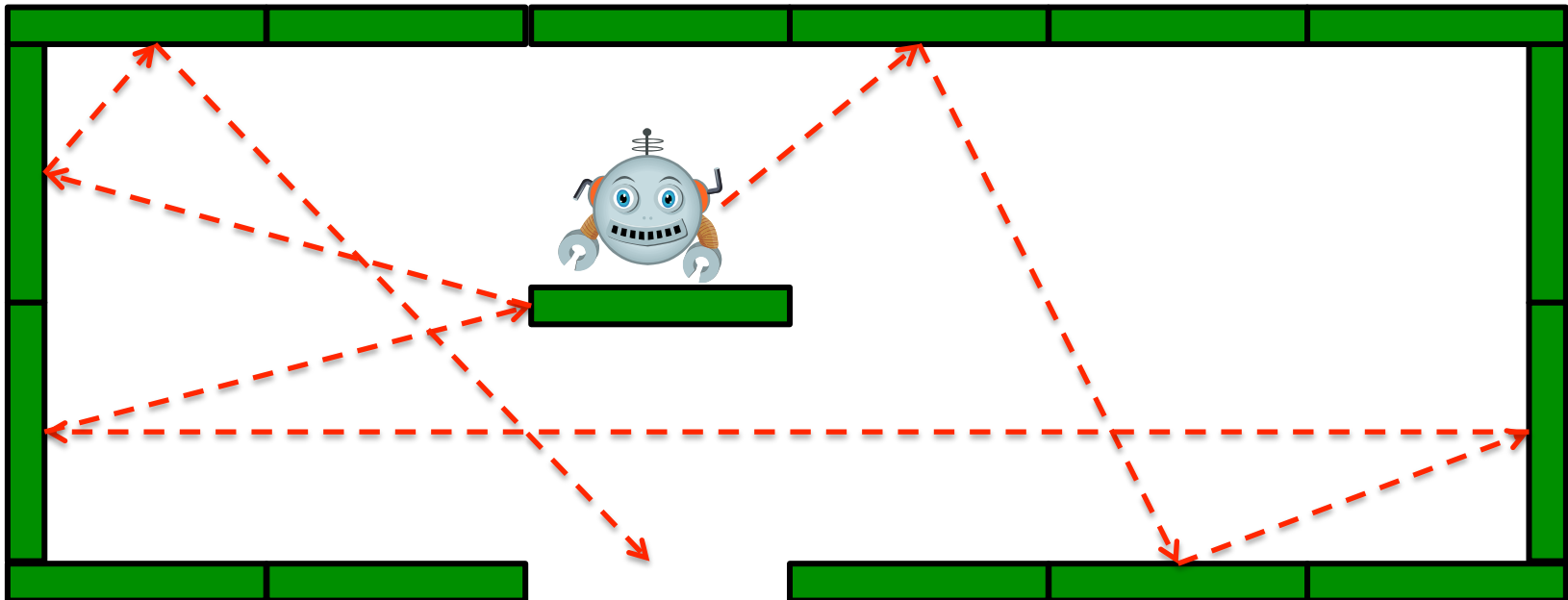
- Algorithm:

- Loop:

- Move in a straight line
    - Turn random amount when obstacle encountered

- Reasoning:

- Robot selects random direction regularly
  - Robot is given sufficient time
  - Robot should eventually visit every location in area



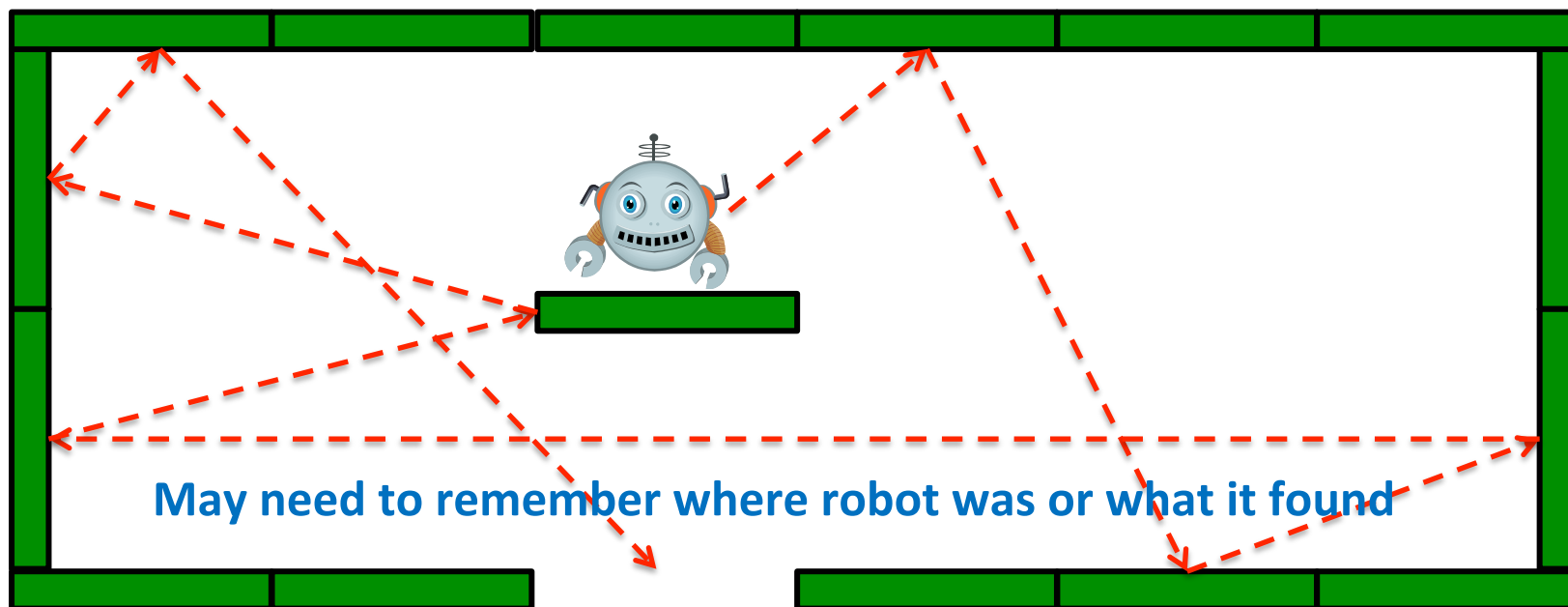
# Random Search

## Pros

- Easy to implement
- Almost guaranteed to work
- Odometry not needed

## Cons

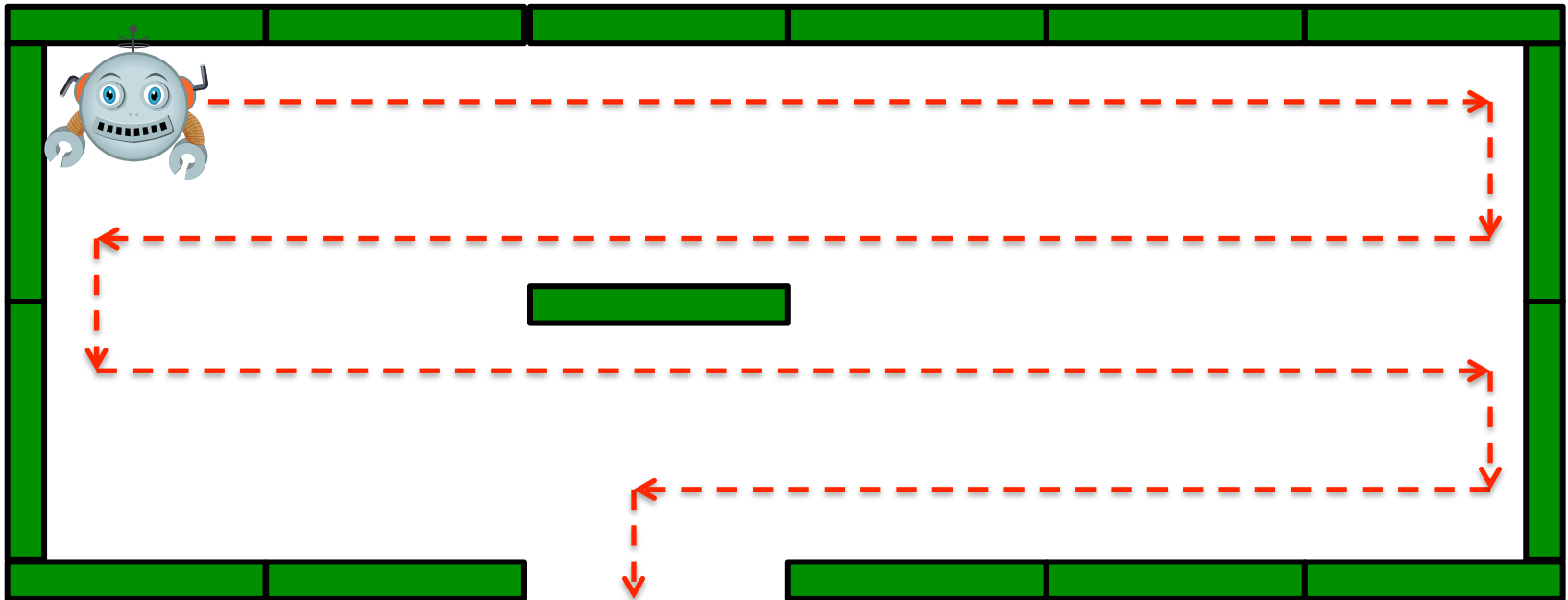
- Inefficient
- Some locations visited multiple times
- Can't reproduce search



# Pattern Based Search

(e.g., Lawnmower)

- Algorithm:
  - Move to one corner
  - Sweep back and fourth until area is covered
- Reasoning:
  - Fixed pattern in a regular space will cover entire area
  - Determining where to start is relatively easy



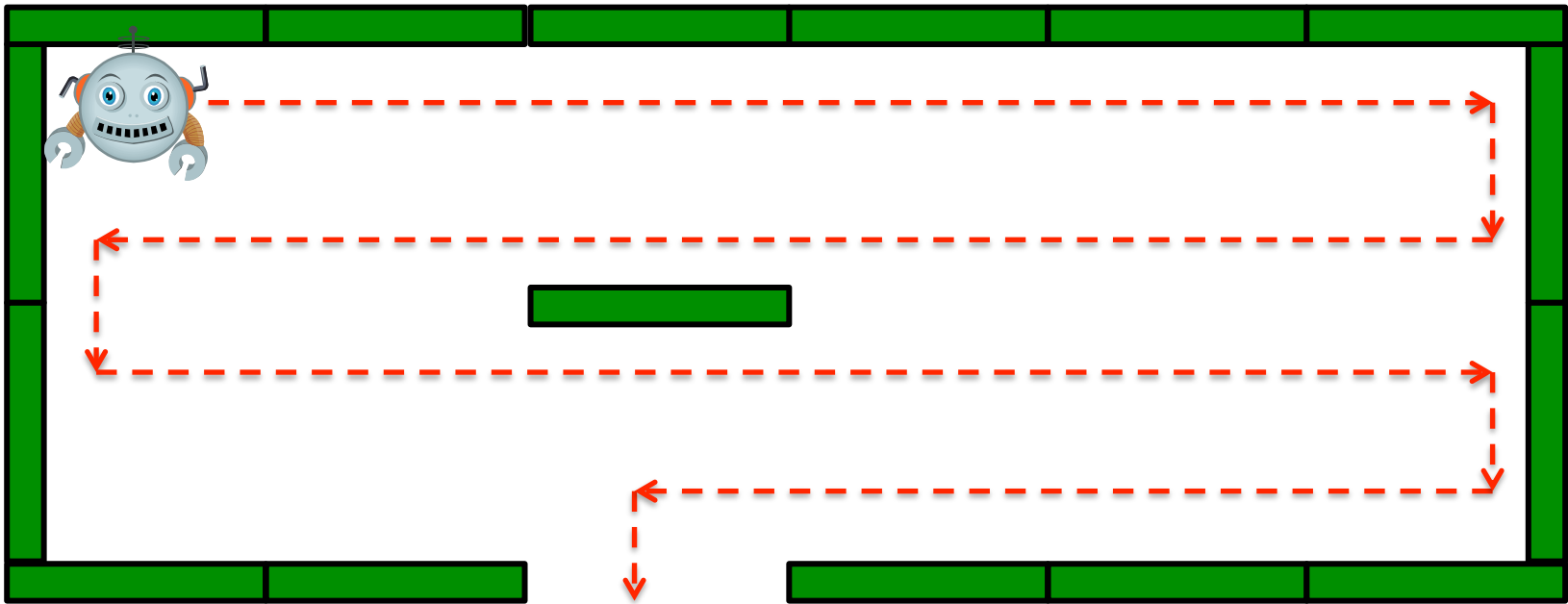
# Pattern Based Search

## Pros:

- Simple and easy to implement
- Works well in empty rectangular areas
- Very efficient (time-wise)
- No need to remember visited locations

## Cons:

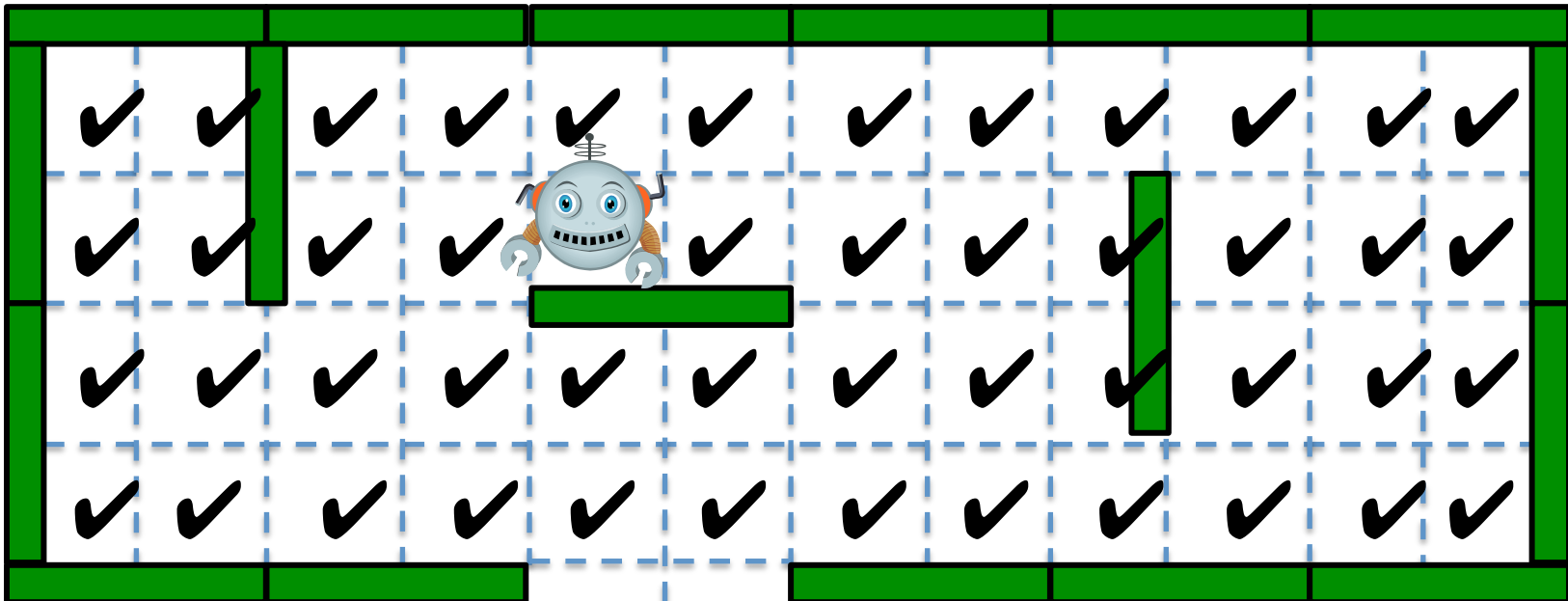
- Requires good odometry
- Does not work in odd shaped areas
- Requires a priori knowledge of area
- Hard to implement if area contains obstacles





# Mark and Sweep Search

- Algorithm:
  - Represent area by a grid
  - Mark keep track of all visited sections
  - Visit nearest unvisited sections
- Reasoning:
  - Grids are easy to store
  - Easy to determine which section to visit next
  - All unvisited sections will eventually be visited



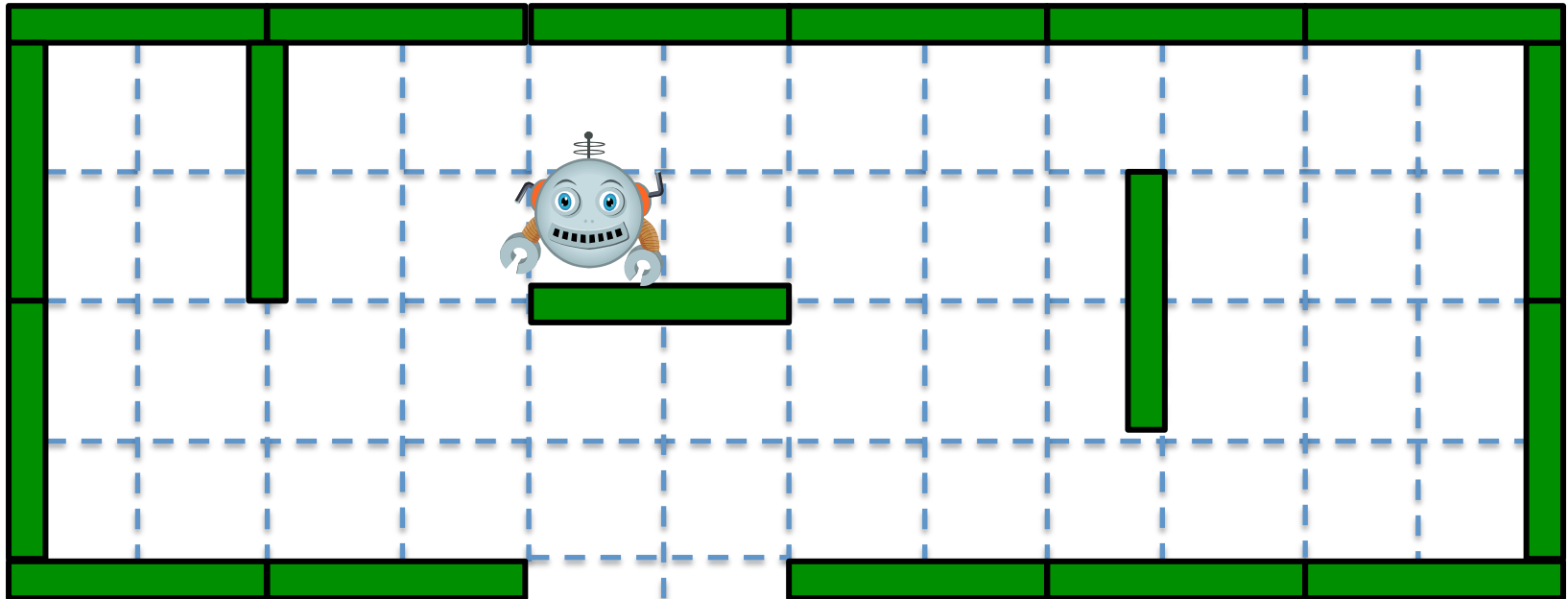
# Mark and Sweep Search

## Pros:

- Efficient
- Works with obstacles and all areas
- Easy to track objects in the area
- Still relatively simple to implement

## Cons:

- Requires good odometry
- Uses more memory



# Discussion

- Q: What separates simple from complex search?
- A: How the search determines which section to visit next
- I.e.,
  - Simple search bases its decisions on simple things:
    - E.g., where is the nearest unvisited section?
  - Complex search usually considers a number of factors in determining the next section to visit

# Challenges

- Robot does not move where it is instructed to move
- Localization (knowing where you are) is hard
- Search area is typically not known
- Search area can contain hazards that affect robot's position and/or speed
- Search area is typically irregular or unbounded