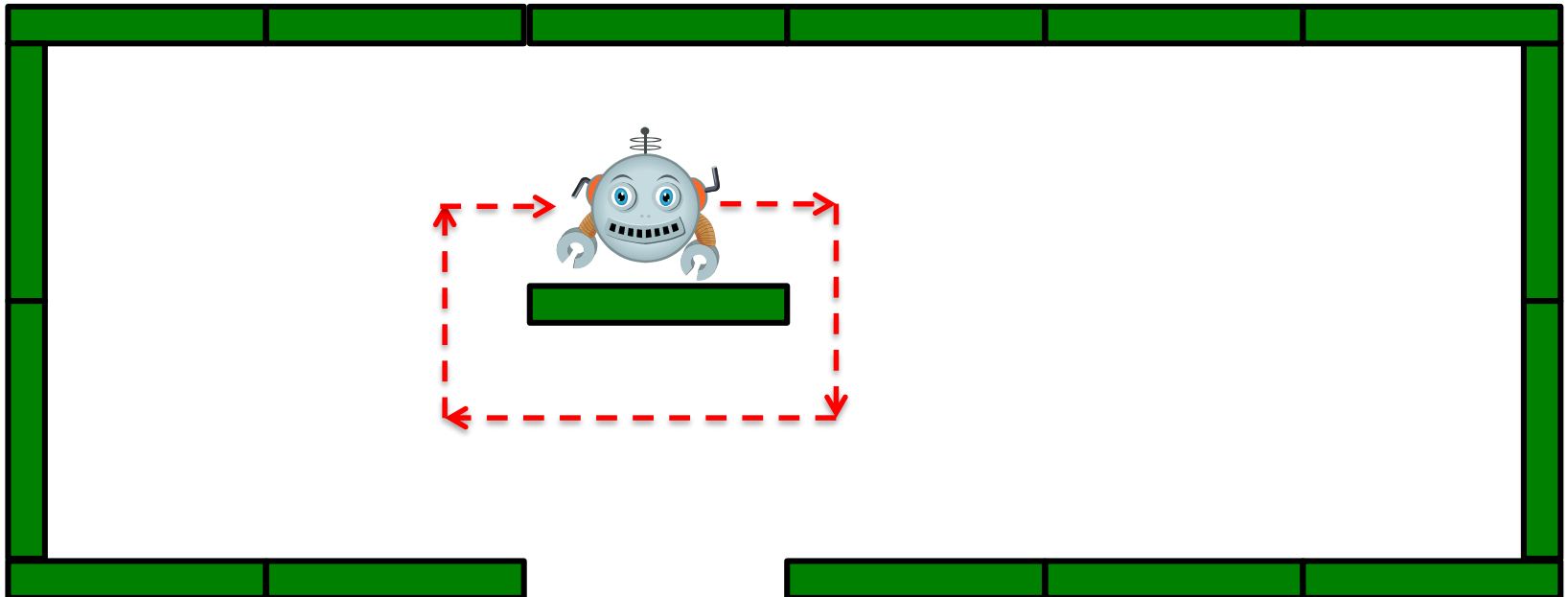# CSCI 1108

Search

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)
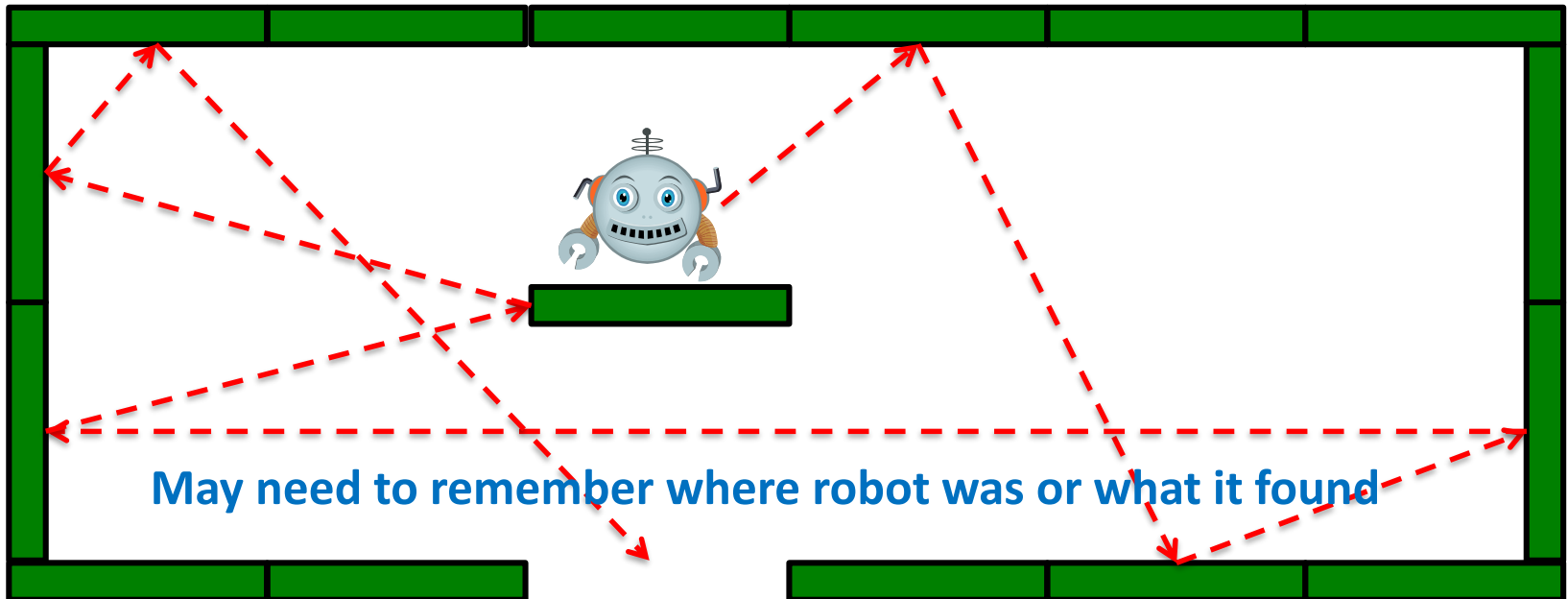- Example: Can the exit be found without location tracking?

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

May need to remember where robot was or what it found

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
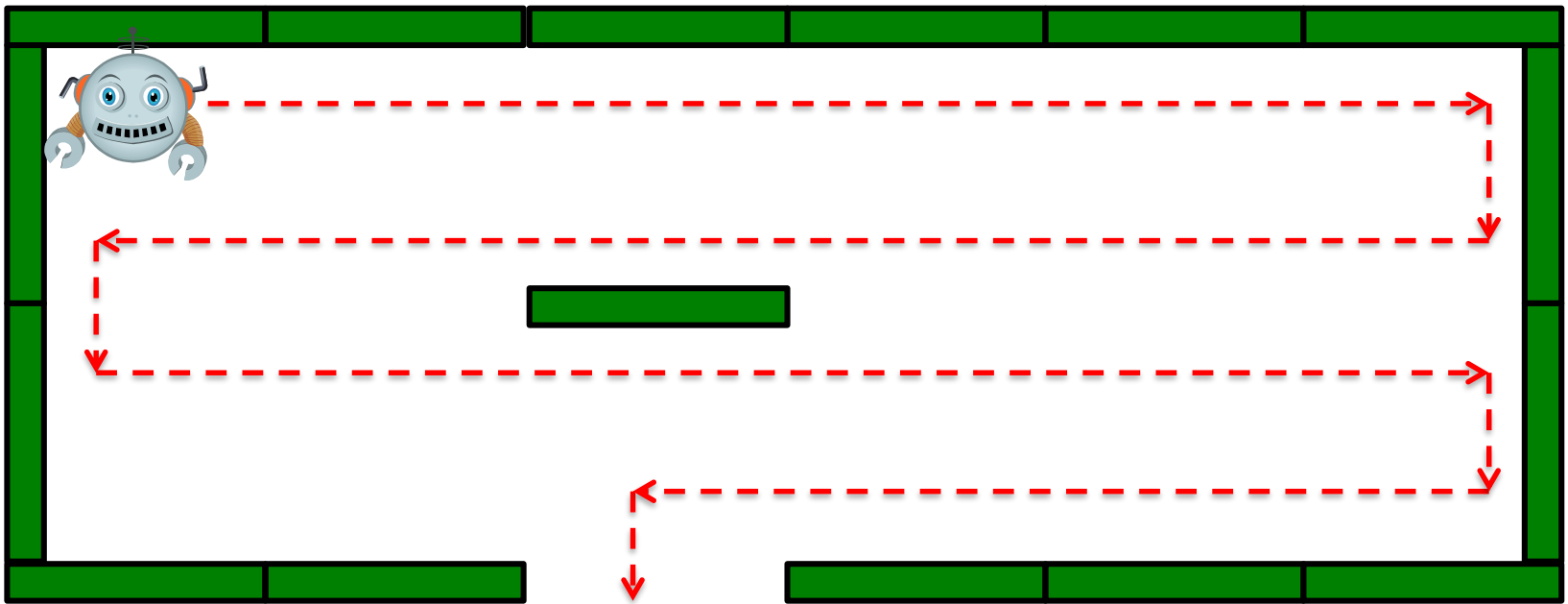 - Determining where to start is relatively easy

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
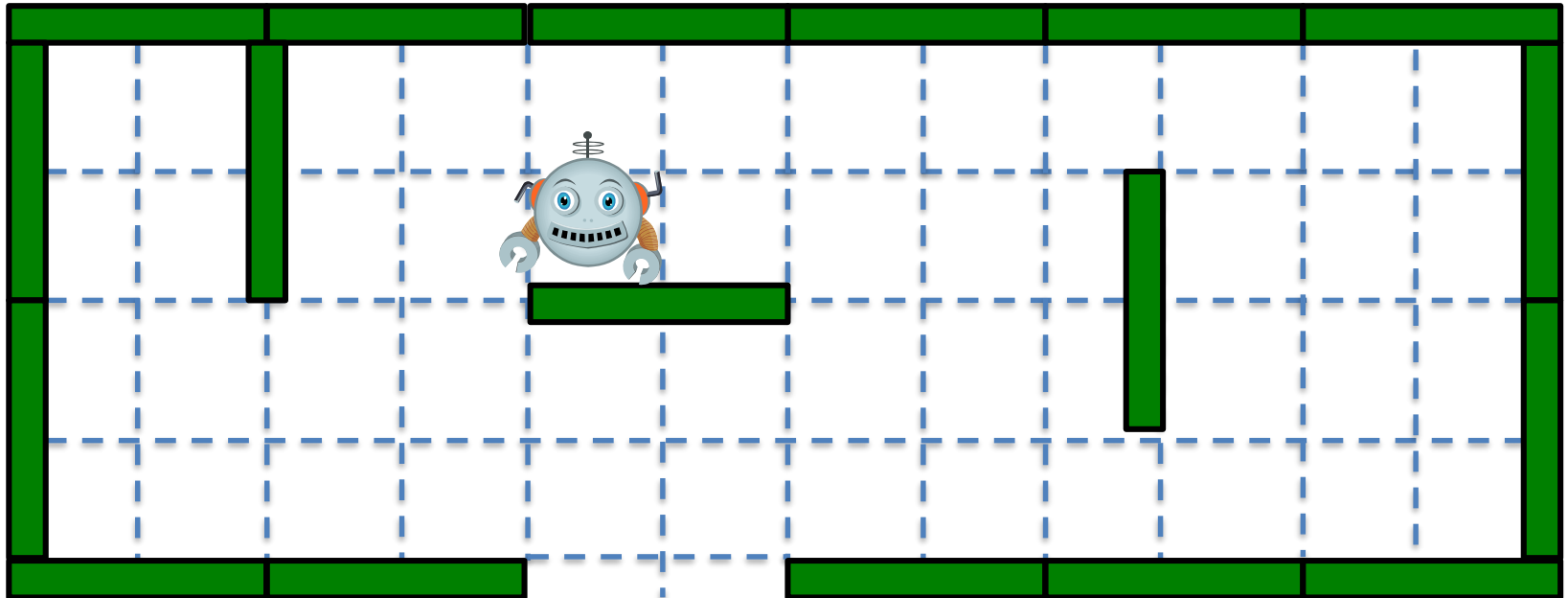 - All unvisited sections will eventually be visited
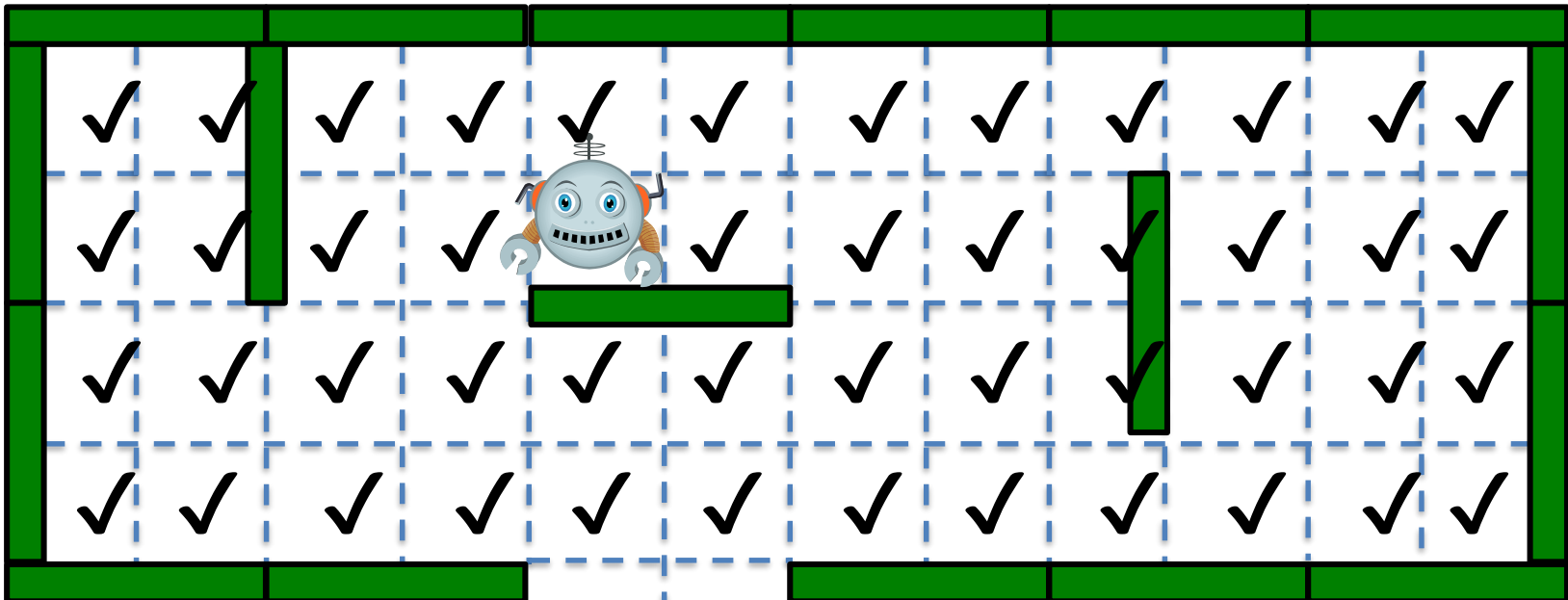
Mark and Sweep Search

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

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

Advanced search

- Advanced search methods exploit some known factors in the environment.
  For example, if we search the phone book we can already guess roughly where a name would be because of the alphabetical ordering

- Tree search (both of the above require some form of ordering)

- Evolutionary Algorithms