



# CSCI 1108

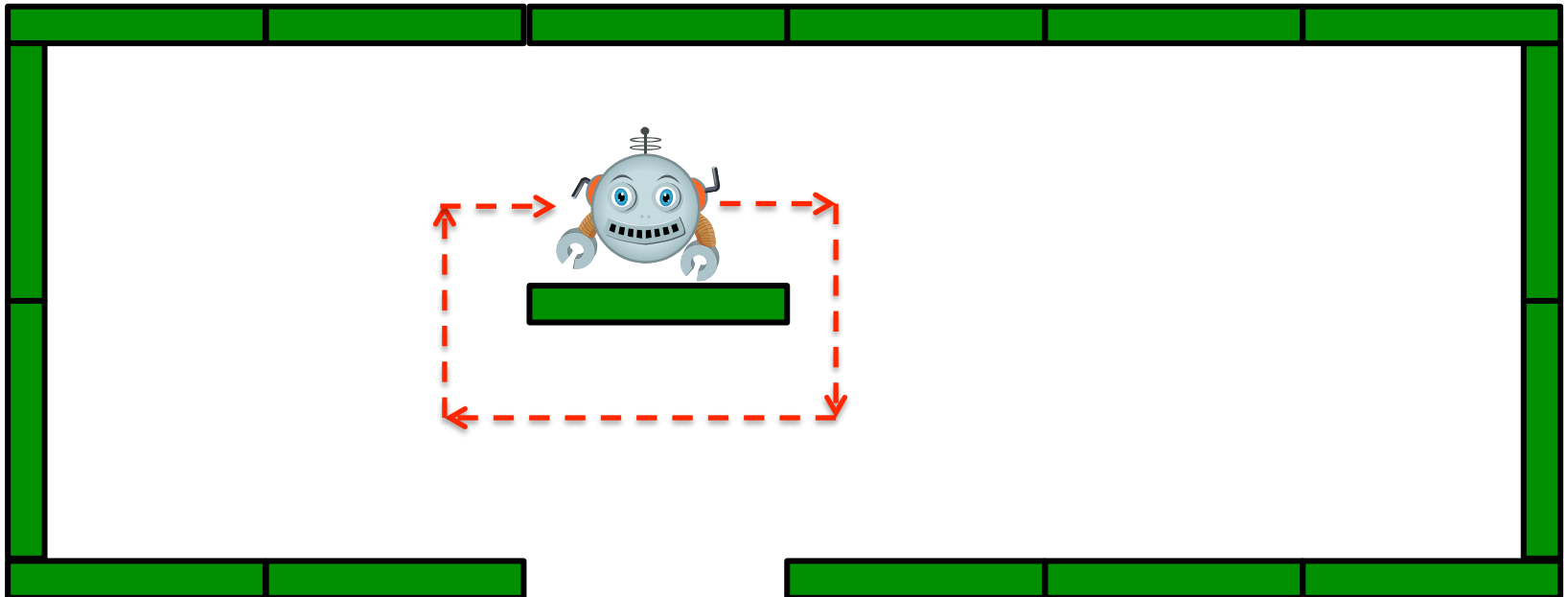


## Search



# 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

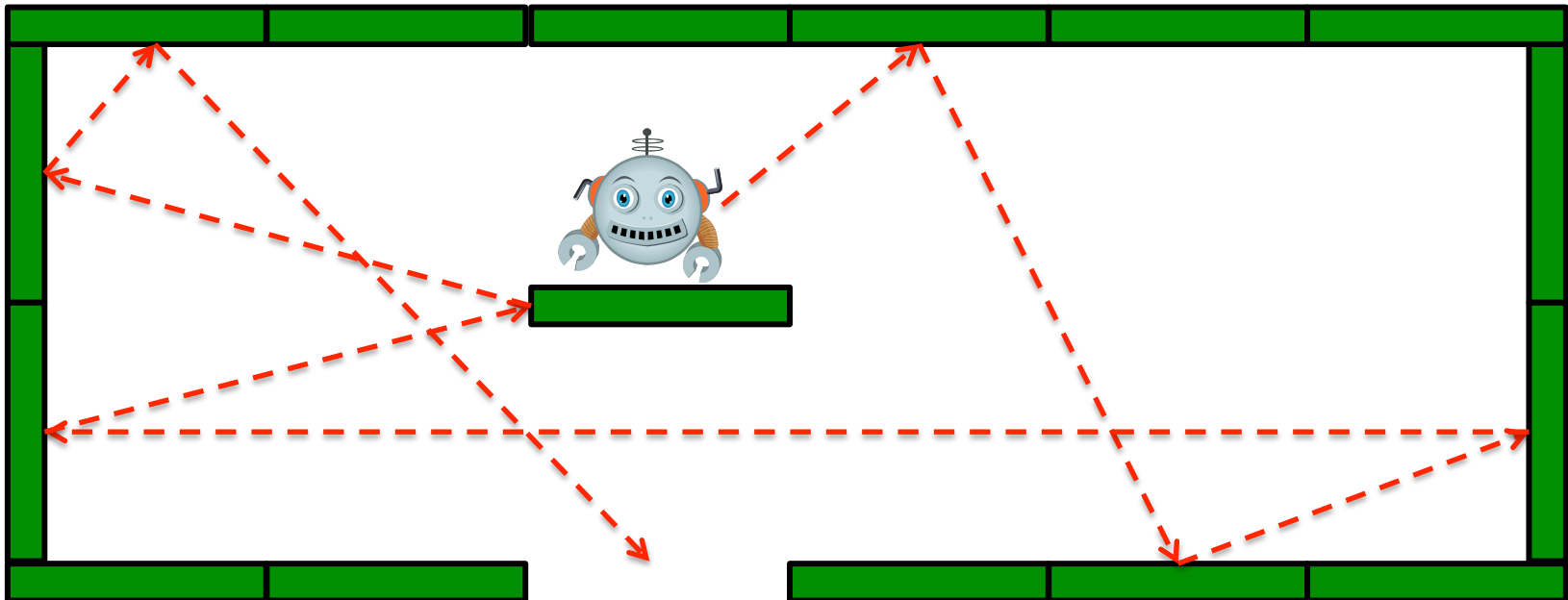
- Algorithm:

- 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



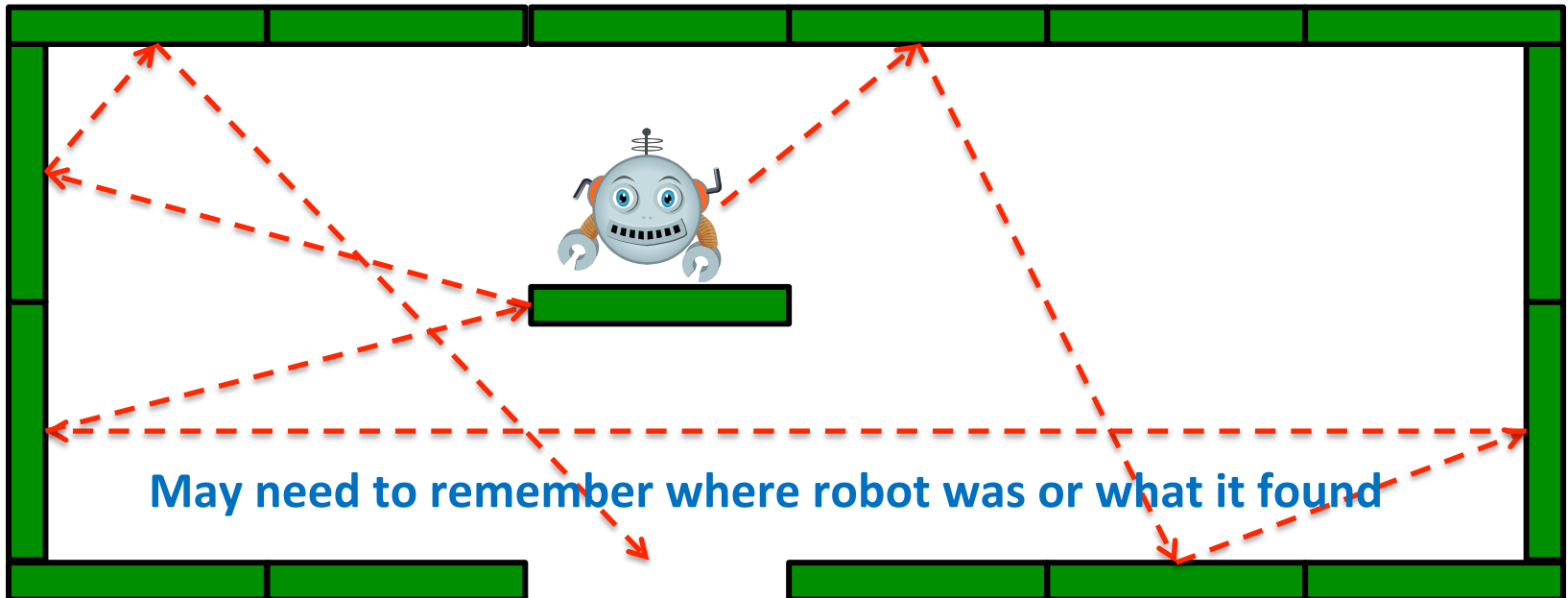
# Random Search

## Pros

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

## Cons

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



# Pattern Based Search

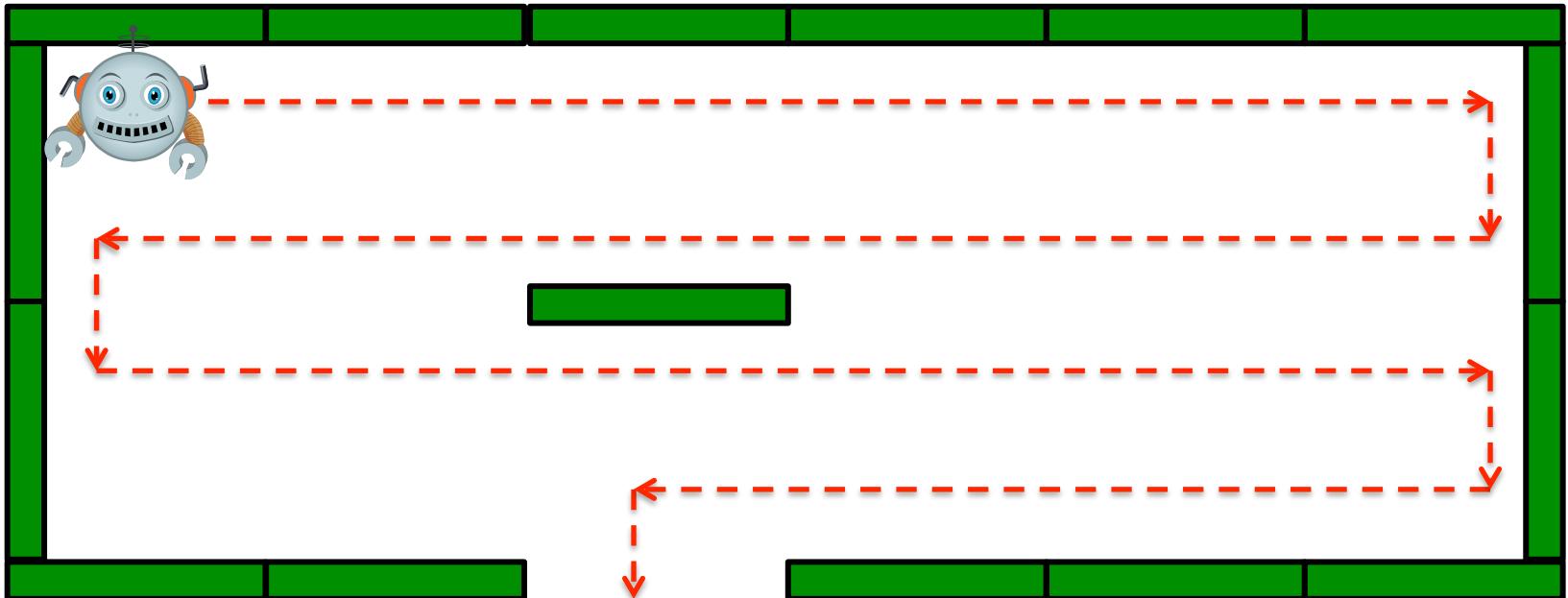
(e.g., Lawnmower)

- 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



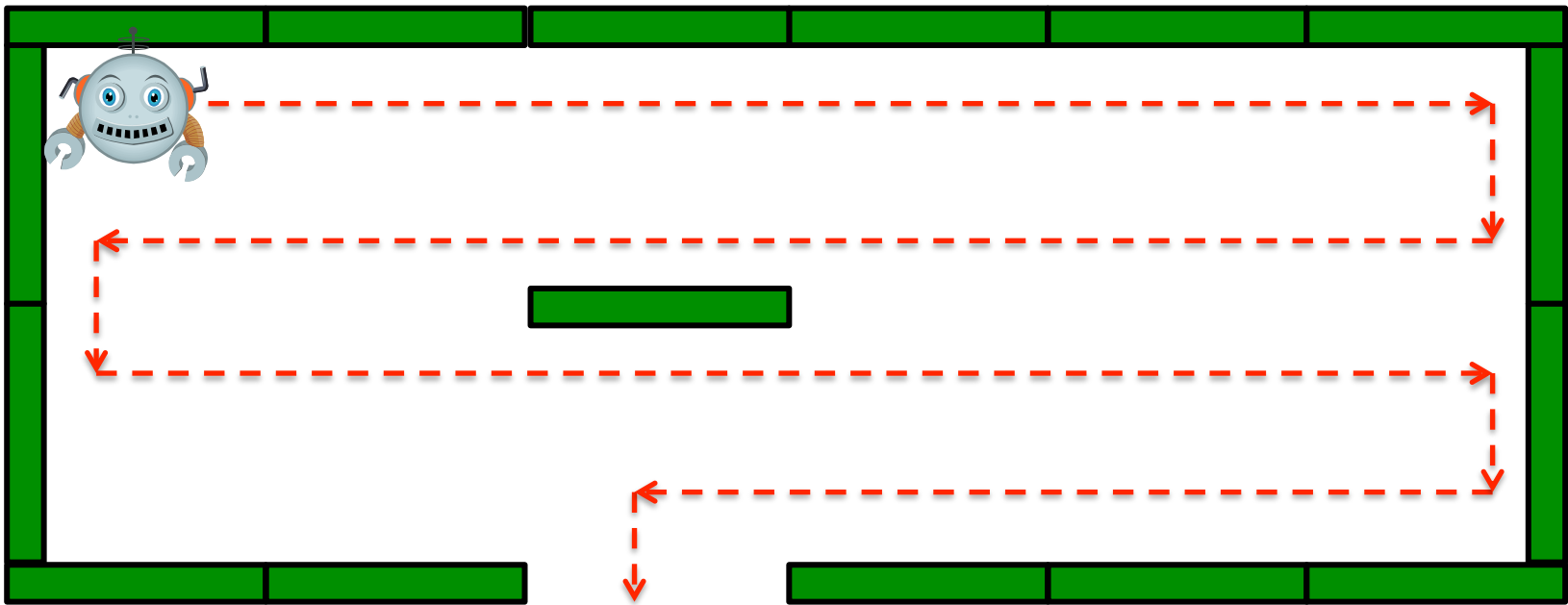
# Pattern Based Search

## Pros:

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

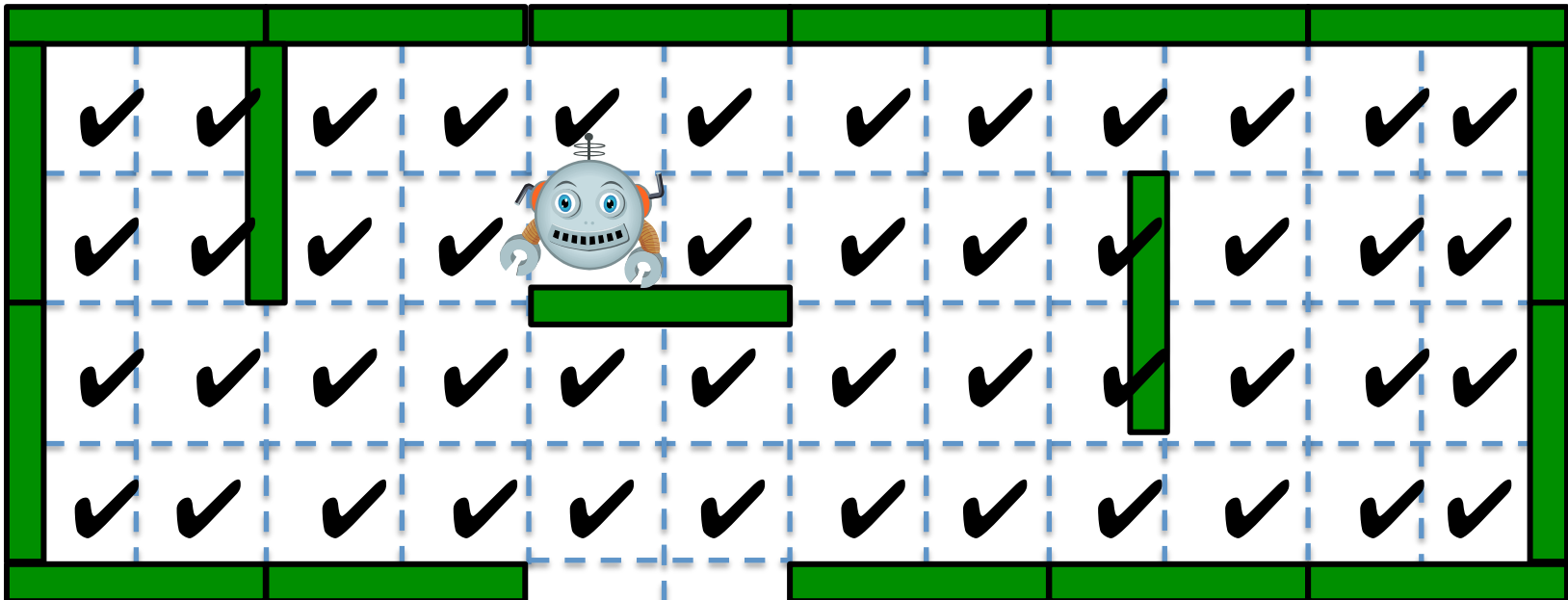
## Cons:

- 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



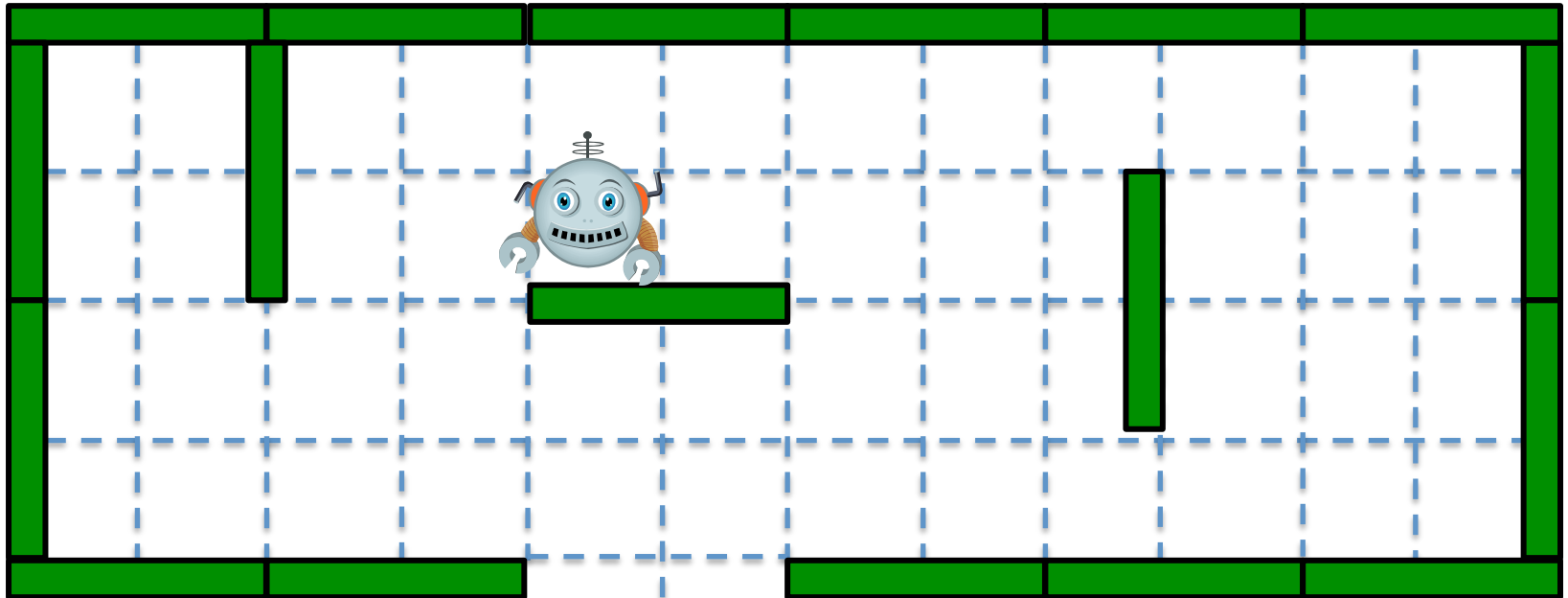
# Mark and Sweep Search

## 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