Simpson's Seeking Spectacular

ECE 497 – Mobile Robotics

Final Project Competition

Robot Navigation

HMU, Kahn Room

Thursday, 5/21/09

7^{th} – 8^{th} hours

(1:35 – 3:30 p.m.)

Simpson's Seeking Spectacular

Competition Rules

Navigation Task

The goal of the final project competition is for each team to use wavefront propagation to plan the robot's path from a start location to a goal given the world map as a *.txt* file. The team's algorithm must use the wavefront to generate a set of move commands that the robot will use to execute the path. The teams will be scored on path execution, efficiency and accuracy.

Maps

The competition occupancy maps *(.txt format)* will be uploaded onto Angel and accessible at **12 pm on Thursday, 5/21/09**. The maps are a 12 x 12 array of 0's and 1's that represent free space and occupied space in the world, respectively. There will be 3 heat maps and 6 tie breaker maps. The heat maps are labeled "*heat 1"*, "*heat 2"* and "*heat 3*" and are progressively more difficult in terms of number of obstacles and number of steps in the path. The title for each map in Angel will indicate map name, start location and goal location. The start and goal locations will be expressed in terms of a zero-indexed row and column as measured from the top-left corner of the arena. For example, "heat 1 start (2, 4)" indicates that for heat 1 the robot will start 3 cells from the left wall and 5 cells from the top wall or 15 inches from the left wall and 27 inches from the top wall of the arena. The robot's center should be placed at this cell location in the arena with the front facing the top of the map.

Arena

The arena will be 6' x 6' and tessellated into 6" x 6" cells. The world will have between 3 and 6 obstacles and should be solvable even if the obstacles are grown by an 8-neighborhood. Each obstacle will be 1' x 1' and will be aligned with the grid. The start location for the robot will be marked with an 'X' and the goal location will be marked with a 'Δ'. Figure 1 shows an example of a robot world.

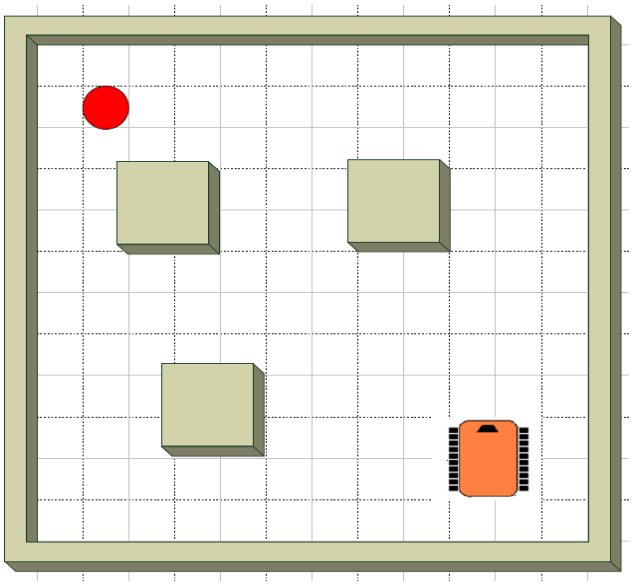


Figure 1: Robot World or Arena

Heats

Each team will compete in 3 heats. All teams will use the same robot arena for each heat. The heats will become increasingly more difficult in terms of number of steps in the path and number of obstacles in the arena. After each heat, the score will be tabulated and the overall winner will be determined by summing the scores from all 3 heats together. The team with the most points after 3 heats will be the first place winner. The team with the second most overall points will be the second place winner. The team with the third most overall points will be the third place winner. The first place team will receive **10** bonus points on their final project grade. The second place team will receive **7** bonus points on their final project grade. The third place team will receive **5** bonus points on their final project grade.

Set Up Time

Once the world has been set up, each team will have exactly 2 minutes to get their robot in the arena, laptop set up and start executing the path.

Failures

You are allowed to have **one** failure during path execution. If this happens you can reset the robot to the start position, the time will be reset to 0, hits will be set to 0 and the robot can attempt to execute the path again. After the second failure, your team is automatically disqualified and you must remove your robot from the world.

Scoring

The team score for each round will be based upon the number of obstacle or wall hits, the distance the robot stops from the goal and the execution time. The initial team score will be 300 and the execution time in seconds will be deducted from 300. Each wall or obstacle hit will be a one point deduction. After the robot stops moving, there will be a one point deduction for every 6 inches the robot is from the goal. The distance will be measured from the center of the goal cell to the center of the robot. Therefore the formulas for the score is

$$\text{Score} = 300 - \text{execution time(s)} - \text{number of hits} - \text{floor}(\text{distance}/6)$$

Obstacle Hits

If the robot hits a wall or obstacle and cannot extract itself such as if it is riding the wall, a team member can step in and set the robot back on the floor and straighten up the obstacle or wall and robot. If the team decides to continue with this path execution they will be given one hit unless the robot hits again. If this is the team's first failure, they have the option of resetting the robot at the start and using their second attempt. After two attempts, the team is automatically disqualified.

Tie Breaker

For each heat, if two teams have the exact same overall score then those two teams will navigate a new world map until the tie is broken.

Judges

Name	Role
 Mu, Xiaoyan	Distance Judge and Arena Set Up
 Voltmer, Dave	Obstacle Judge and Arena Set Up
 Walter, Phillip	Timekeeping and Arena Set Up
 Walter, Deborah	Master Scorekeeper
 Berry, Carlotta	Head Judge

The *timekeeping judge* will use the stop watch to time the path execution in seconds from the time the robot starts moving until the time it stops.

The *distance judge* will use the yard stick to measure the distance from the goal cell center to the robot's center.

The *obstacle judge* will count the number of obstacle or wall hits during path execution.

The *master scorekeeper* will keep a record of path execution time, number of wall or obstacle hits and distance from goal to calculate an overall heat score.

The *head judge* will resolve all discrepancies in scoring or the competition rules.

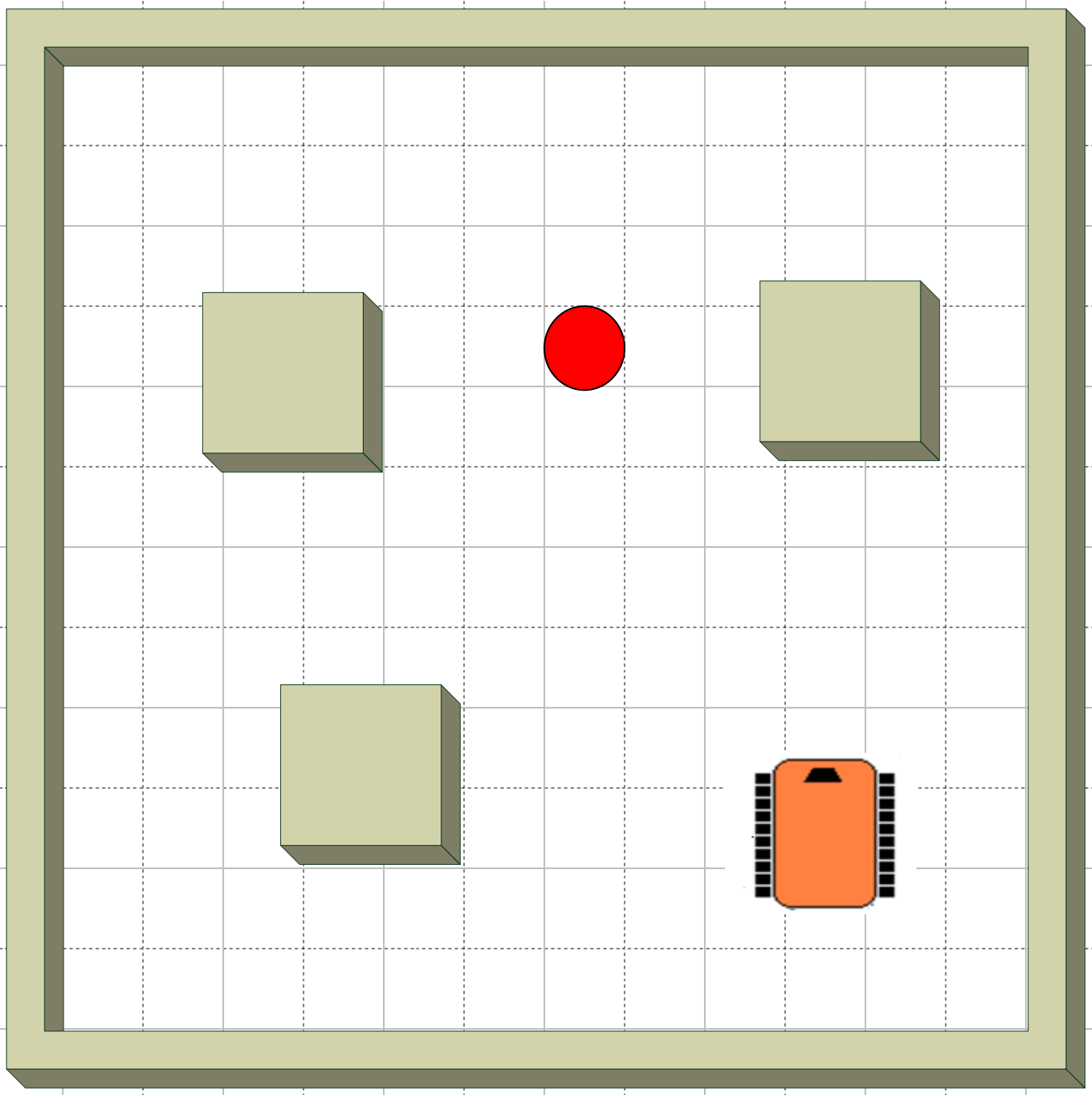
Teams

Team Name	Map		
Flanders	 Baty, David	 Davis, Cody	 Telljohann, Brian
Homer	 Kavanaugh, Kyle	 Weaver, Robert	
Lisa	 DeVries, Matthew	 Dick, Samantha	
Maggie	 Effinger, Adam	 Sullivan, Johnathan	
Marge	 Leigh, Peter	 Narayanan, Anirudh	

Millhouse	 Quick, Christopher	 Weintraub, Isaac	
Moe	 Buckner, Glen	 Hamilton, Nicolas	

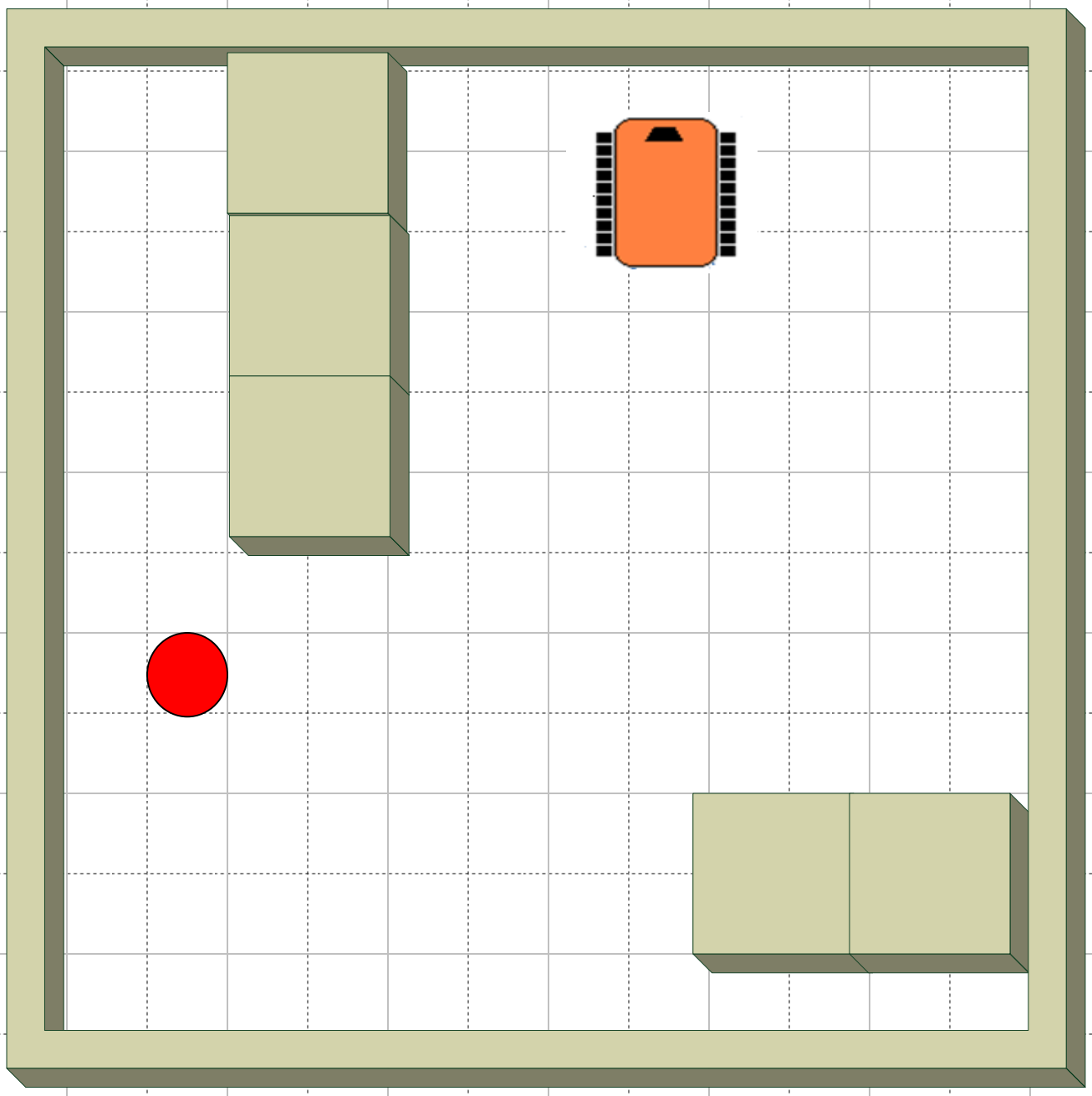
Robot: (9, 9) or (57 in, 57 in)
Goal: (6, 3) or (39 in, 21 in)

HEAT 1



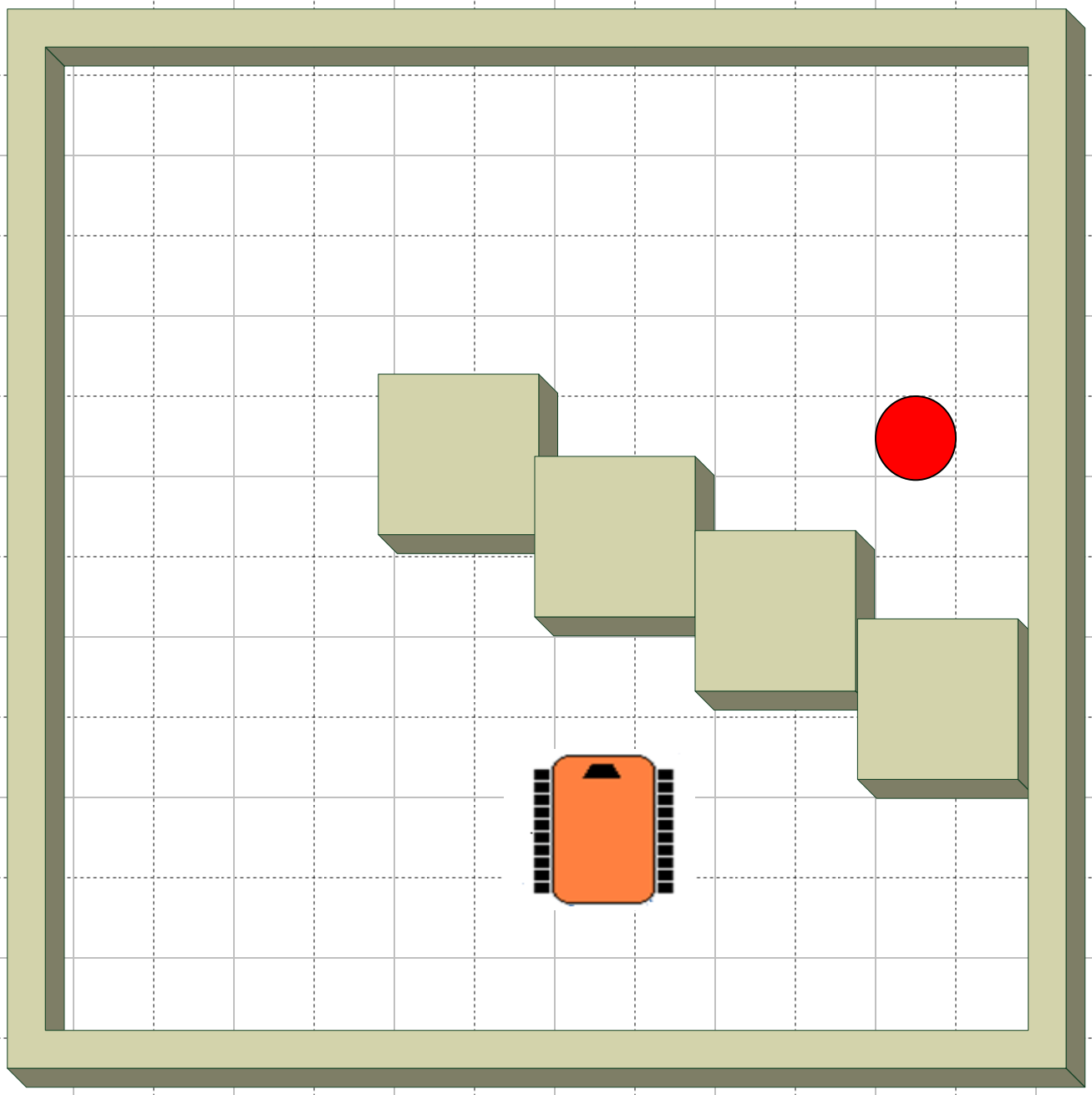
Robot: (7, 1) or (45", 9")
Goal: (1, 7) or (9", 45")

HEAT 2



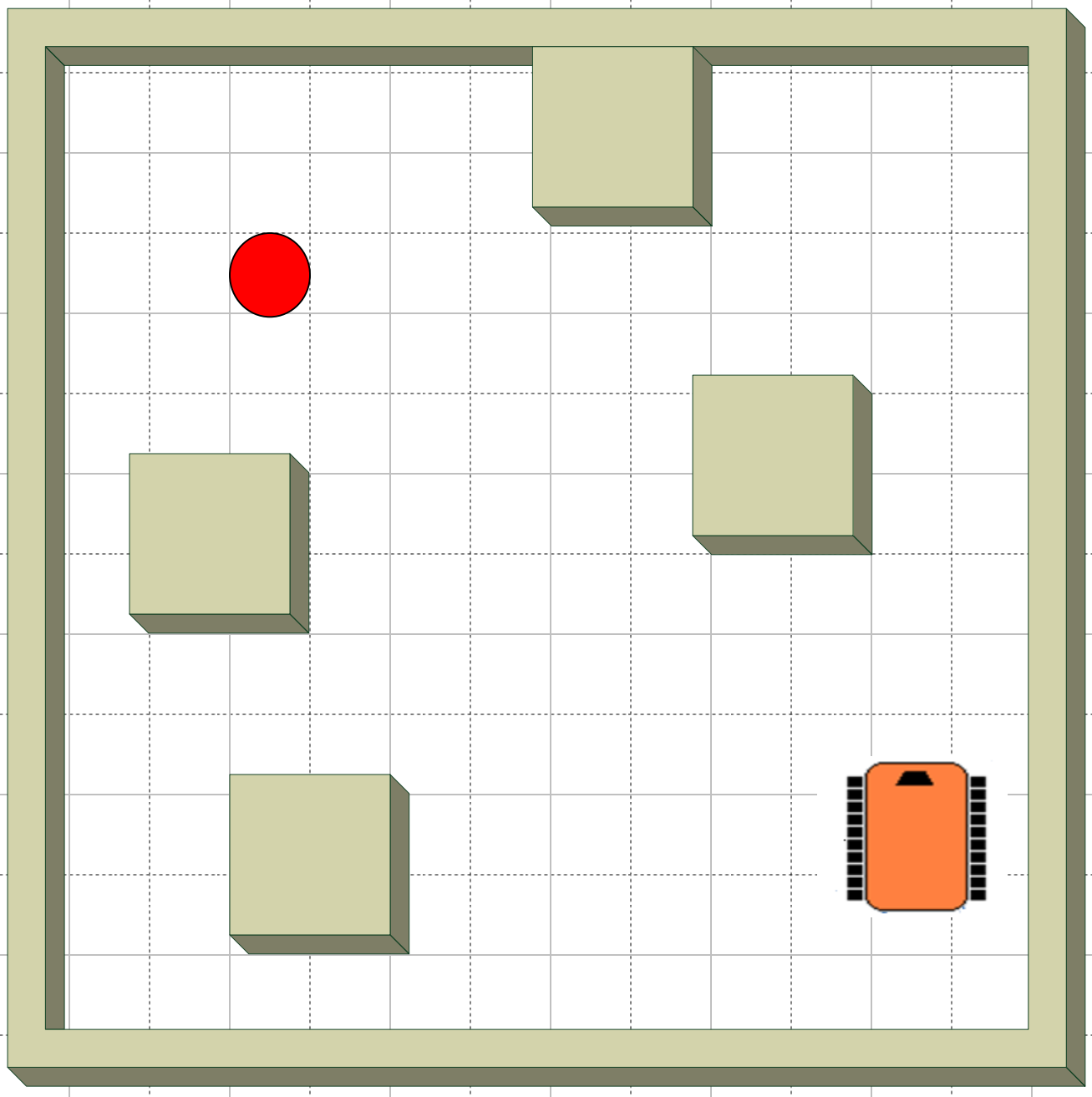
Robot: (6, 9) or (39", 57")
Goal: (10, 4) or (63", 27")

HEAT 3



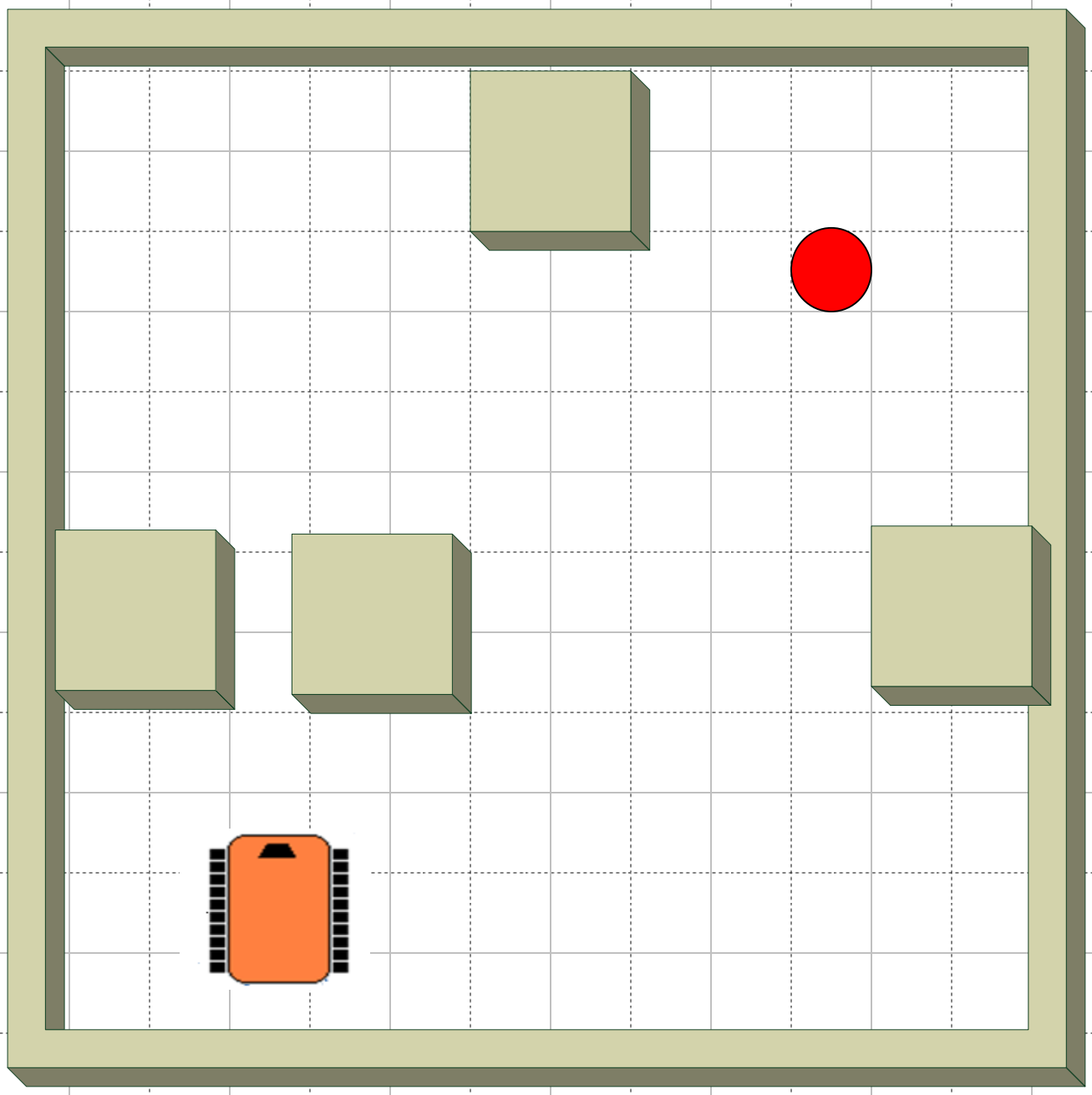
HEAT 1
Tie Breaker 1

Robot: (10, 9) or (63 in, 57 in)
Goal: (2,2) or (15 in, 15 in)



Robot: (2, 10) or (15", 63")
Goal: (8, 2) or (51", 15")

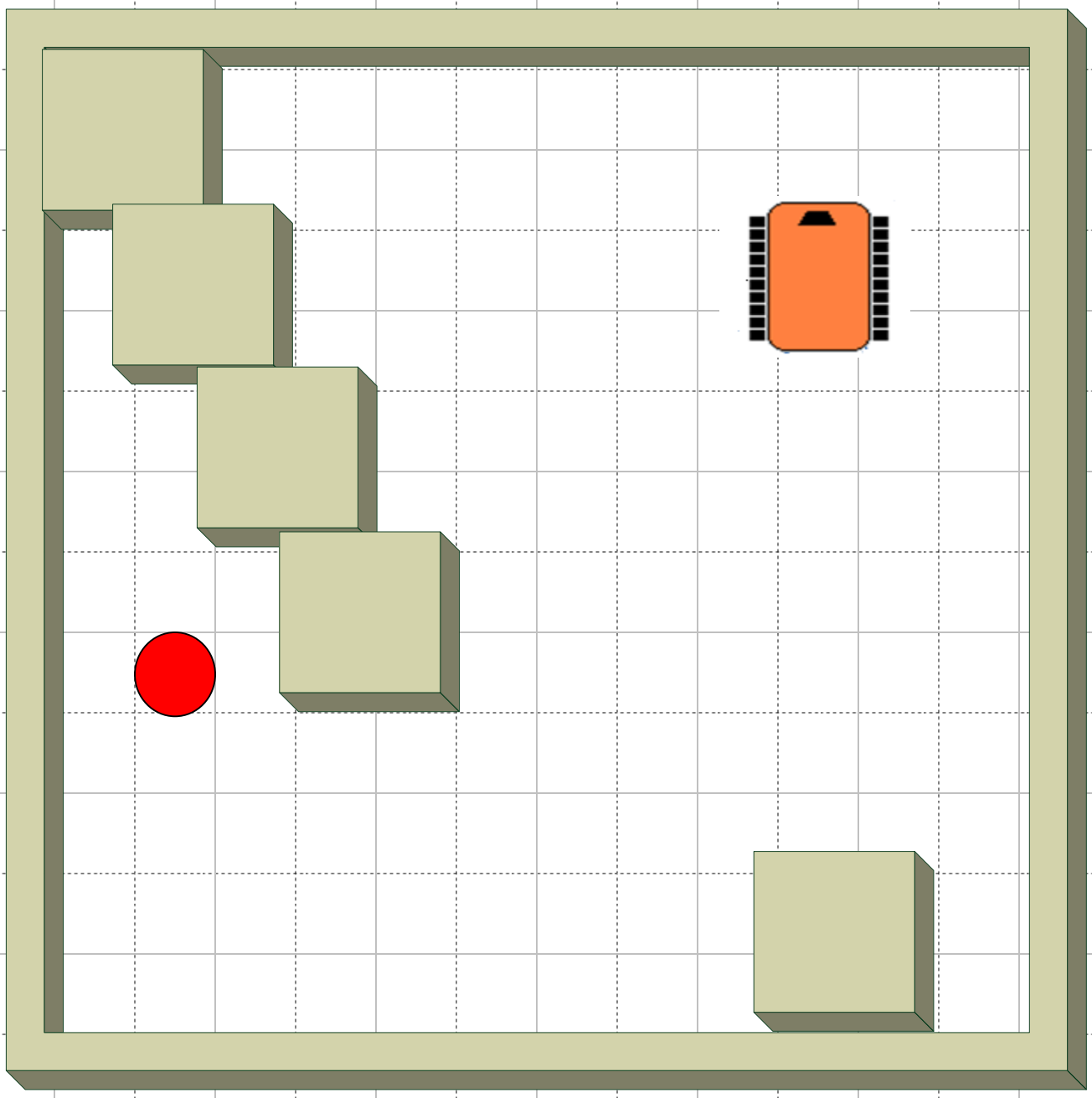
HEAT 1
Tie Breaker 2



Robot: (9, 2) or (57 in, 15 in)

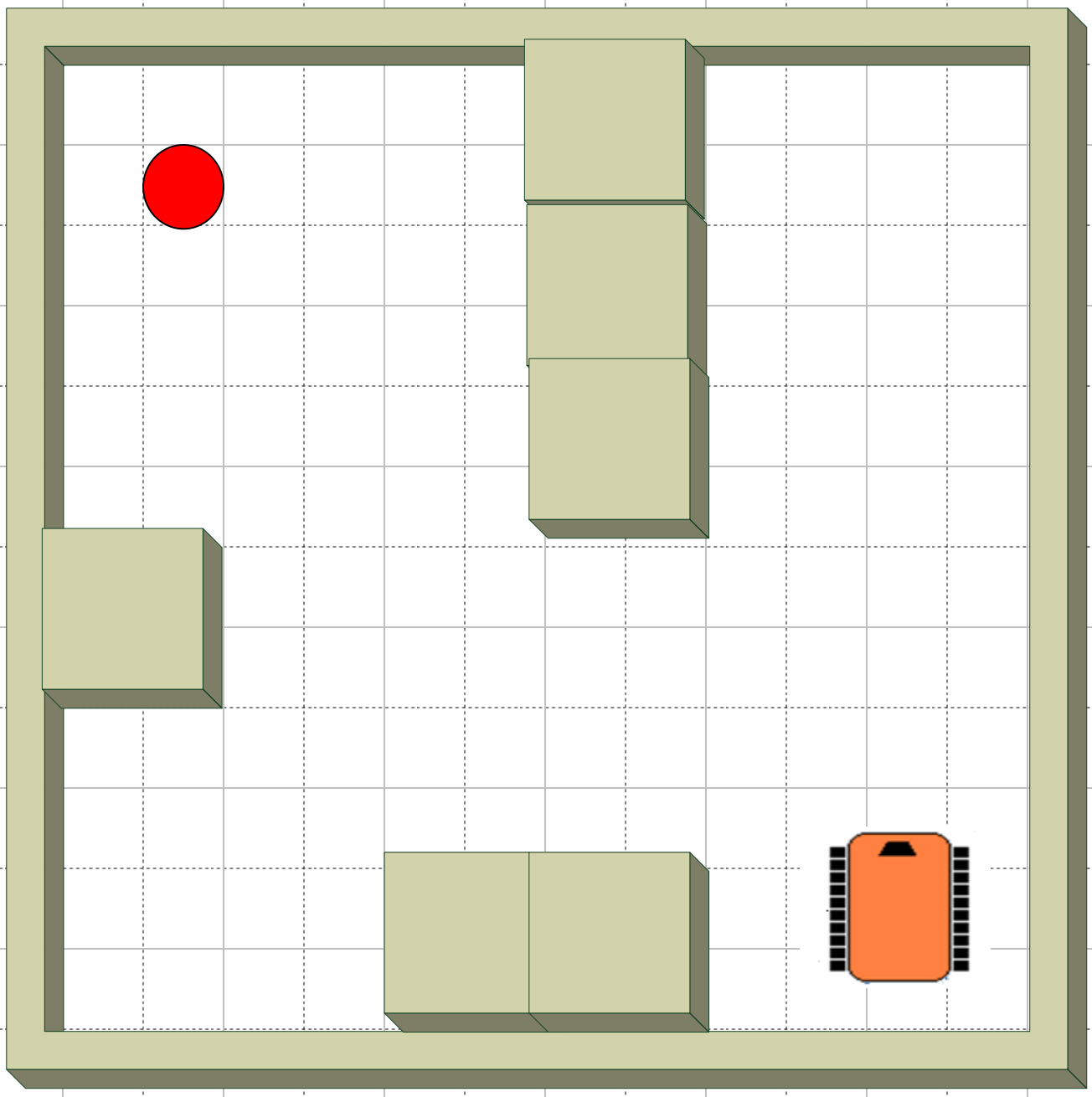
Goal: (1, 8) or (9 in, 51 in)

HEAT 2
Tie Breaker 1



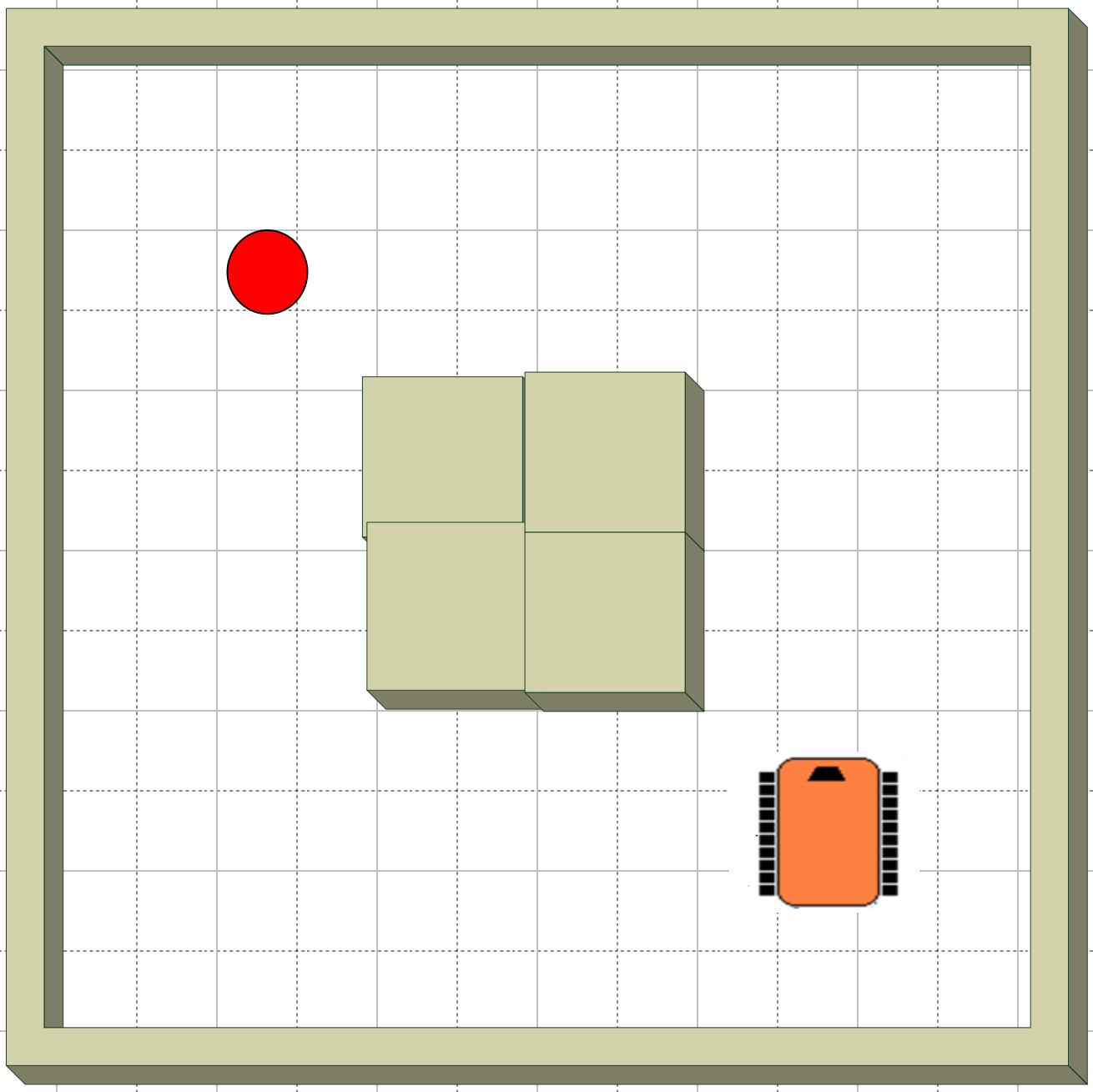
Robot: (1, 1) or (9 in, 9 in)
Goal: (10, 10) or (63 in, 63 in)

HEAT 2
Tie Breaker 2



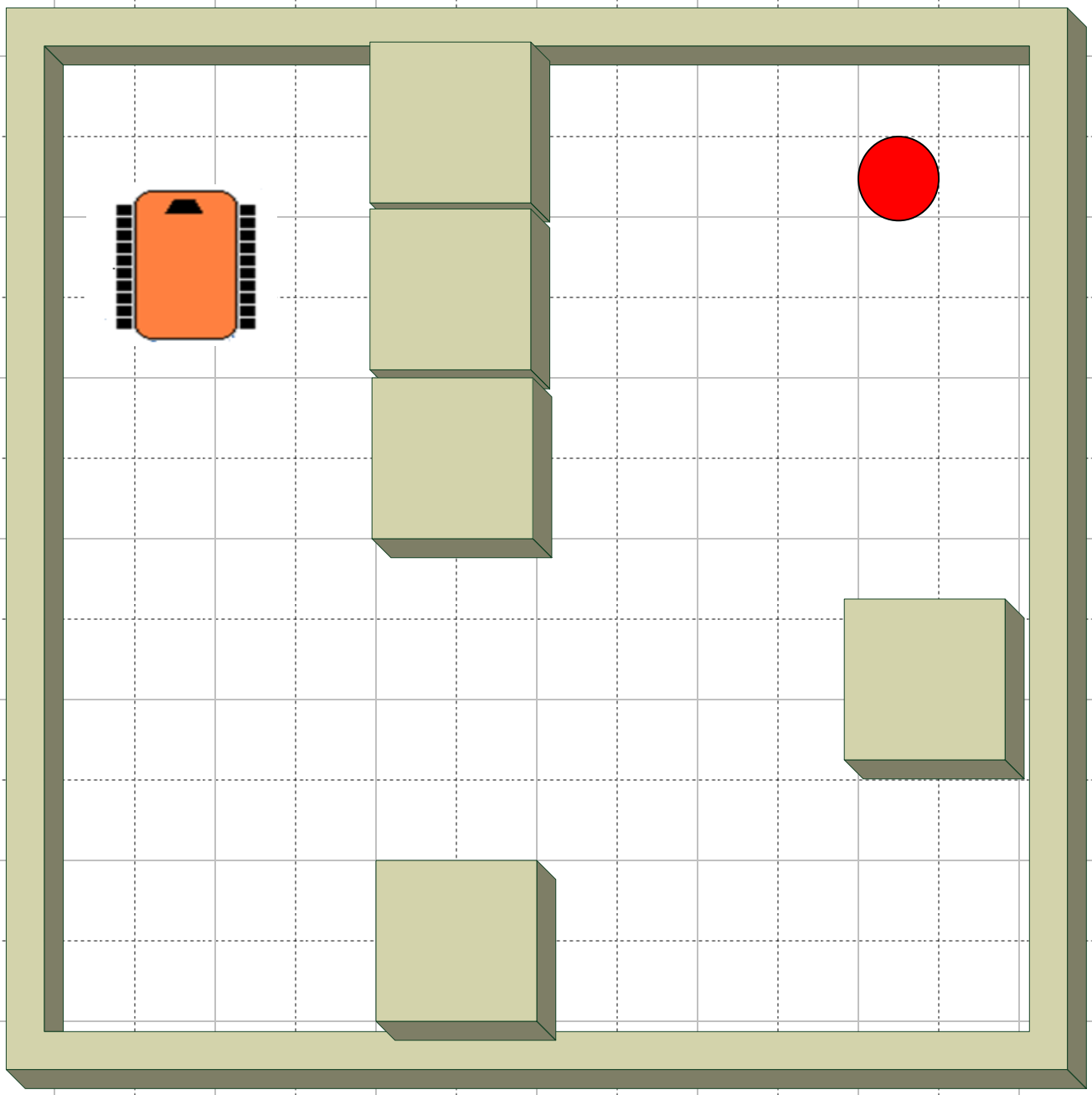
Robot: (8, 9) or (51 in, 57 in)
Goal: (2, 2) or (15 in, 15 in)

HEAT 3
Tie Breaker 1



Robot: (1, 2) or (9 in, 15 in)
Goal: (10, 1) or (63 in, 9 in)

HEAT 3
Tie Breaker 2



Robot: (2, 8) or (15 in, 51in)
Goal: (7, 4) or (45 in, 27 in)

HEAT 3
Tie Breaker 3