



U8.7 Project: map the mat

Mapping · University · about 50 min

Name _____

Class _____

Date _____

What this lesson is about

An unknown layout, a grid built from scratch, and a measurement taken off the map.

- What the program has to do
- Reading a doorway out of a grid
- The structure
- What to look at when it is wrong
- What comes next

Questions

6 marks in all

1. What does this program print?

[1 mark]

```
CELL = 5.0
T, F = True, False
band = [T, F, F, T, T, T, F, F, F, F, T, T, F, F]
best = None
c = 0
while c < len(band):
    if not band[c]:
        start = c
        while c < len(band) and not band[c]:
            c += 1
        bounded = start > 0 and c < len(band)
        if bounded and (best is None or c - start > best[1] - best[0]):
            best = (start, c)
    else:
        c += 1
print(best, (best[0] * CELL + best[1] * CELL) / 2)
```

2. When searching the band for the doorway, why must a clear run have wall on both sides?

[1 mark]

- ☐ A Beyond the ends of the wall there is also clear space, and it must not be mistaken for a door
- ☐ B Doorways are always narrower than the wall is thick
- ☐ C It removes the half-cell bias from the answer
- ☐ D Runs at the edge of the grid are always unknown

3. A program reports the wall at $y = 0$ on every run. What has it most likely found?

[1 mark]

- ☐ A The mat's own edge behind the robot, which is mapped as an obstacle
- ☐ B A timeout marked as a hit
- ☐ C The half-cell bias
- ☐ D A shadow behind the wall

4. The reported doorway is always off by exactly one cell. What should you check first? [1 mark]
- ☐ A Rounding: whether you are reporting the edge of a cell or its centre
 - ☐ B The heading error on each scan
 - ☐ C Whether the far side of the wall is unknown
 - ☐ D The value of L_OCC
5. Why does the project sweep from a second viewpoint as well as the first? [1 mark]
- ☐ A It fills in the first viewpoint's shadows and confirms the walls that both saw
 - ☐ B One rotation cannot cover 360 degrees of bearings
 - ☐ C The first sweep's cells are reset when the robot moves
 - ☐ D The clamp stops a single viewpoint from marking any cell
6. After a full turn on the spot, the robot calls forward() and drives sideways across the mat. Why? [1 mark]
- ☐ A It is left facing an arbitrary direction, and forward() is relative to the robot, not the mat
 - ☐ B The map has rotated the robot's coordinate frame
 - ☐ C The wheels slip after turning
 - ☐ D The inverse sensor model has changed the heading

The task: map the mat

The robot starts at (100, 25) facing up the mat. Map it, and print `explored:`, `wall y:` and `gap x:`. Do not touch anything.

```
from bugbot import *
import math
connect()

CELL, W = 5.0, 40
L_OCC, L_FREE, L_MAX, FAR = 0.85, -0.4, 8.0, 170.0
START_X, START_Y = 100.0, 25.0
grid = [0.0] * (W * W)
```

Plan your program here, then type it in and press Run.



Do it on the robot

www.bugbotlab.com/learn/u8-7-project-map-the-mat/

The simulator checks it and tells you when it passes. Nothing to install, no account.

Challenges

1. Report the width of the doorway as well as its middle, and say how accurate you expect that to be.
2. Build the map twice, once from one viewpoint and once from three, and compare how many cells are still unknown.
3. Add 5 degrees of error to every heading and measure how far the reported doorway moves.