



7.7 Project: clear the mat

Hands and feet · Robot club · about 30 min

What this lesson is about

Every ball into the home zone.

- The loop
- Where it goes wrong
- Helpers
- Where next

Questions

6 marks in all

1. The first ball is home. On the second trip, what goes wrong with a plain `find_ball("red")`? [1 mark]

- ☐ A It can find the red ball already sitting in the home zone
- ☐ B The gripper only works once per run
- ☐ C `blobs()` can only see one ball per run
- ☐ D `fetch` always returns False after the first ball

Answer: A. A ball at home is still red. `balls_out` works out where each blob is and ignores the ones already home.

2. What does this program print? [1 mark]

```
def at_home(bx, by):  
    return abs(bx) < 15 and by < 16  
  
for bx, by in [(5, 10), (-20, 10), (0, 40)]:  
    print(bx, by, "home" if at_home(bx, by) else "still out")
```

Answer:

```
5 10 home  
-20 10 still out  
0 40 still out
```

Home needs x within 15 cm of the start on either side and y under 16. (-20, 10) is too far left and (0, 40) too far up.

3. What does this program print? [1 mark]

```
import math  
px, py = 0, 0  
heading = 90  
bearing = 0  
dist = 4 * 92 / 23  
h = math.radians(heading + bearing)  
print(round(px + math.sin(h) * dist), round(py + math.cos(h) * dist))
```

Answer:

```
16 0
```

The ball is 16 cm away. Heading 90 faces right (clockwise from up the mat), so the ball is 16 cm along x and 0 along y.

4. After opening the jaws at home, put the moves in order so the robot never drives through the ball it just dropped. [1 mark]

Number the lines 1 to 4 to put them in the right order.

___ gripper("open")
___ backward(50, distance=8)
___ forward(50, distance=20)
___ right(50, distance=14)

Answer:

```
gripper("open")
backward(50, distance=8)
right(50, distance=14)
forward(50, distance=20)
```

Let go, step back, step aside, and only then drive off for the next search.

5. Why step back and then sideways before driving away? [1 mark]
- ☐ A So the robot's body never passes through the spot where it left the ball
 - ☐ B To reset the gripper servo
 - ☐ C So the camera can count the balls at home
 - ☐ D Because `go_to` only works facing sideways

Answer: A. Driving straight off can shove the ball back out of the zone.

6. Three balls must be home within two minutes. On average, how many seconds can each ball take? [1 mark]

Answer: 40. 120 seconds divided by 3 balls is 40 seconds each.

The task: clear the mat

Bring all three red balls into the home zone within two minutes.

Any program that meets the task's checks is marked correct in the simulator; this is one way, not the only way.