ANSWERS

4.1 What the camera sees

Vision · Robot club · about 15 min

What this lesson is about

set_cv, the tag list, pixels and distance, empty lists.

- One detector at a time
- The list
- Watch the distance fall
- When there is nothing to see

Questions

7 marks in all

1. A program calls `apriltags()` before it has called `set_cv`. What does it get? [1 mark]

- ☐ **A** An empty list, because no detector is switched on
- ☐ **B** Every tag the camera can see
- ☐ **C** An error saying the camera is off
- ☐ **D** The tags from the last program that ran

> **Answer:** A. The camera runs one detector at a time, and until you pick one the vision functions return nothing. Always start with `set_cv("apriltag")`.

2. Each entry in `apriltags()` is `[id, cx, cy, distance]`. What is `tag[3]`? [1 mark]

- ☐ **A** How far away the tag is, in cm
- ☐ **B** The number printed on the tag
- ☐ **C** How far across the picture it is, in pixels
- ☐ **D** How far down the picture it is, in pixels

> **Answer:** A. Lists count from 0, so index 3 is the fourth number: the distance in cm.

3. The picture is 320 pixels wide. What `cx` does a tag straight ahead of the robot have? [1 mark]

> **Answer:** 160. Half of 320 is 160, so `cx = 160` is dead centre. Smaller is left, bigger is right.

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

```
tag = [7, 160, 120, 45.0]
print(f"marker {tag[0]} at {tag[3]} cm")
```

> **Answer:**
>
> ```
> marker 7 at 45.0 cm
> ```
>
> `tag[0]` is the id and `tag[3]` is the distance, so this is exactly the line the task asks for.

5. The robot turns away so no tag is in view, then runs `tag = apriltags()[0]`. What happens? [1 mark]

- ☐ **A** An error, because there is no first item in an empty list
- ☐ **B** `tag` becomes 0
- ☐ **C** `tag` becomes an empty list
- ☐ **D** It waits until a tag comes into view

> **Answer:** A. An empty list has no item 0, so Python stops with an error. Check the list is not empty before you read from it.

6. Which of these are true of the list `apriltags()` gives you? [1 mark]

Tick every answer that is true.

- ☐ **A** The nearest tag comes first
- ☐ **B** There is one entry for each tag it can read
- ☐ **C** `cx` is measured in cm
- ☐ **D** An empty list means something has gone wrong

> **Answer:** A, B. Tags come nearest first, one entry each. `cx` is in pixels, and an empty list just means no tag is in view.

7. Marker 7 is 45 cm away. The robot drives forward 8 cm towards it. About what distance, in cm, should the next `apriltags()` report? [1 mark]

> **Answer:** 37 (accept within 1). 45 minus 8 is 37, and that is what the camera reports after the first 8 cm.

The task: find the marker

Switch on the tag detector and print `marker 7 at 45.0 cm` using the id and distance from the list. Do not drive.

```
# the two lines every program starts with: the commands, then the robot
from bugbot import *
connect()

print(apriltags())
```

The hint students can ask for: Switch the camera to the tag detector, read the tag in front of you, and print `marker 7 at 45.0 cm` (id and distance from the list). Do not drive.

A solution

```
from bugbot import *
connect()
set_cv('apriltag')
tags = apriltags()
tag = tags[0]
print('marker', tag[0], 'at', tag[3], 'cm')
```

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