



U1.1 Sense, decide, act

The robot as a system · University · about 20 min

Name _____

Class _____

Date _____

What this lesson is about

The control loop, its period, and the deadman that stops a robot whose program has gone quiet.

- A loop you can watch
- The period
- The deadman
- Blocking and non-blocking

Questions

7 marks in all

1. Put the body of the control loop in order, as it runs on every pass. [1 mark]

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

___ `act(command)`
___ `wait(period)`
___ `command = decide(measurement)`
___ `measurement = sense()`

2. A loop ends each pass with `wait(0.1)` and does nothing else that takes noticeable time. How often does it run, and roughly what is the fastest disturbance its measurements can represent properly? [1 mark]

- ☐ A 10 Hz, and disturbances slower than about 5 Hz
☐ B 10 Hz, and disturbances up to about 10 Hz
☐ C 0.1 Hz, and disturbances slower than about 0.05 Hz
☐ D 10 Hz, and disturbances up to about 20 Hz

3. A loop has a period of 0.04 s. What is its rate in Hz? [1 mark]

4. A loop calls `wait(0.1)`, and the sensor reads and arithmetic in each pass take a further 0.03 s. This works out the rate it really runs at. What does it print? [1 mark]

```
work = 0.03
period = 0.1 + work
print("rate:", round(1 / period, 1), "Hz")
```

5. A program calls `forward(60)` once and then `wait(2)`, with no other commands. What does the robot do? [1 mark]

- ☐ A Drives for about half a second, then stops itself because no new command arrived
☐ B Drives at 60 for the full 2 seconds, then stops
☐ C Does not move at all, because `wait()` blocks the command from being sent
☐ D Drives 60 cm and then stops

6. Why does every controller in the course use `forward(60)` followed by `wait(0.1)`, rather than `forward(60, distance=40)`? [1 mark]
- ☐ A The non-blocking form returns at once, so the loop can change the command on the next pass
 - ☐ B The blocking form is less accurate about the distance it drives
 - ☐ C The deadman does not apply to blocking calls, which makes them unsafe
 - ☐ D The non-blocking form drives the motors harder

7. Which of these are set directly by the loop's period? [1 mark]

Tick every answer that is true.

- ☐ A How often the controller can react to what the world does
- ☐ B The fastest motion the measurements can represent properly
- ☐ C The robot's top speed
- ☐ D The size of the drive's dead band

The task: run a loop at 10 Hz

Without driving, read the depth sensor thirty times at ten times a second, print each reading, and print how long the loop actually took on average, as `period: 0.1`.

```
from bugbot import *
connect()

# clock() is the seconds since the program started
start = clock()
```

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



Do it on the robot

www.bugbotlab.com/learn/u1-1-the-loop/

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

Challenges

1. Print `clock()` inside the loop. Is the spacing exactly 0.1 s?
2. Change the wait to 0.02 s and run it. What is the period now, and what does that tell you about how much work the loop itself costs?
3. Put `forward(60)` in a loop of thirty with no wait at all in it. Why does the robot not move in the simulator, and what would a real BugBot do?

