

Exercise walk-through

6.2

Robotics

IGCSE Computer Science

Robotics

A robot has a **physical structure** (a mechanical body, such as arms), **electrical components** (motors, sensors, wiring), and **programmable instructions** it follows and that can be changed.

A robot **cannot think for itself**. Ask it to handle something it was not programmed for and it stops – a **lack of independent decision-making**.



A robot vacuum drives itself around to clean

What robots do



An industrial robot arm – reprogrammable for a new job

Robots can perform many roles, for example:

- **Factory equipment** : building cars, welding, moving heavy parts.
- **Domestic appliances** : a robotic vacuum cleaner.
- They do dull or dangerous jobs quickly and accurately, and never get tired.
- They are expensive to buy and maintain, and can replace human workers.

Where automated systems are used, and what a robot is

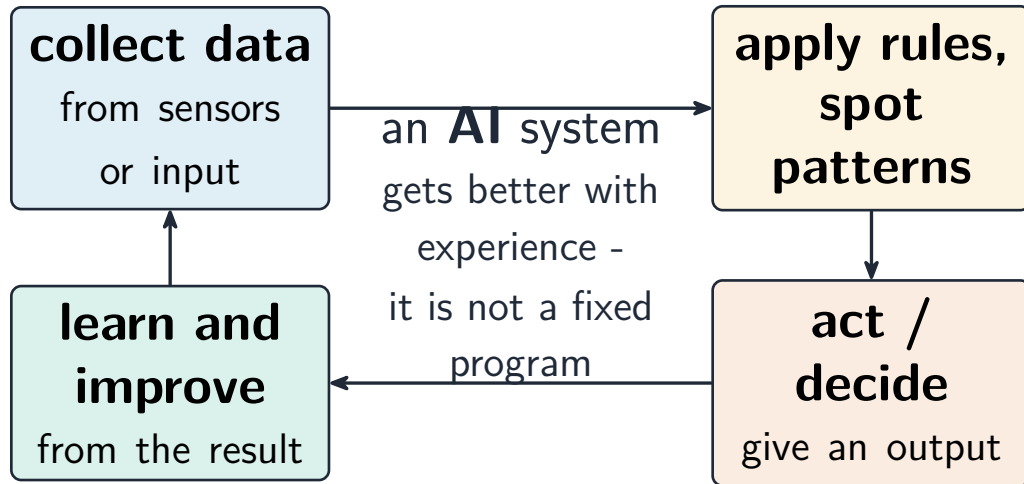
the applications	industry, transport, agriculture, weather monitoring, gas and oil, and a greenhouse for growing plants
the sensor types	temperature, pressure, light, moisture, pH, motion, magnetic field (door contacts, compasses), and flow or level (pipes, tanks)
the loop	sensor → microprocessor → actuator, repeating continuously
robotics	the branch of technology dealing with the design, building and operation of robots
what makes a robot	a mechanical structure, electrical components, and programmability
characteristics of AI	a collected data set, a set of rules for using it, the ability to reason, and the ability to learn and adapt

A robot follows a fixed program; an AI system changes its own rules from data. That difference is what the comparison question tests.

Characteristics of AI

- they **collect data** and the **rules** for using that data;
- they have the ability to **reason** (work things out using the rules);
- they have the ability to **draw conclusions**, which may be **approximate** (a best guess) or **definite** (certain);
- they have the ability to **learn** from data;

What makes a system “AI”



Artificial intelligence is the **simulation** of human intelligence by a computer. Such a system:

- collects **data** and the **rules** for using it;
- can **reason** and **draw** conclusions – approximate or definite ;
- can **learn** from data and **adapt** its behaviour.

Exercises 2.1-2.3

2.1 State two characteristics of a robot.

[2]

2.2 Give one example of a robot used in the home.

[1]

2.3 Identify the flowchart shape used for a decision, and for an input.

[2]

Exercises 2.1-2.3

2.1 State two characteristics of a robot. [2]

2.1

- any **two** of: a **physical structure** / **electrical components** / **programmable instructions**

2.2 Give one example of a robot used in the home. [1]

2.2

- e.g. a **robotic vacuum cleaner**

2.3 Identify the flowchart shape used for a decision, and for an input. [2]

2.3

- decision: a **diamond**
- input: a **parallelogram**

Exercises 2.4-2.5

2.4 Explain the difference between a monitoring system and a control system. [2]

2.5 Give one example each of a monitoring system and a control system. [2]

Exercises 2.4-2.5

2.4 Explain the difference between a monitoring system and a control system. [2]

2.4

- **monitoring**: only reads and reports, or gives a warning
 - **control**: also sends signals that **change the process**
-

2.5 Give one example each of a monitoring system and a control system. [2]

2.5

- monitoring: a patient's heart rate / burglar alarm / pollution measurement
- control: central heating / greenhouse / traffic lights / automatic door

Exercise 3.1

3.1 A key limitation of a robot is that it:

[1]

☐

A never breaks down

B cannot make independent decisions

C works for free

D gets tired

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[1]

☐

A never breaks down

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C works for free

D gets tired

3.1 B

- a robot **cannot make independent decisions**
- A, C and D are not true limitations in the syllabus sense

Exercise 3.2 (a)

3.2 A factory uses robot arms on a production line.

(a) State two advantages of using robots here.

[2]

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(a)

- any **two** of: dull/dangerous jobs / quick and accurate / do not tire

Exercise 3.2 (b)

3.2 A factory uses robot arms on a production line.

(b) State one disadvantage of using robots.

[1]

Exercise 3.2 (b)

3.2 A factory uses robot arms on a production line.

(b) State one disadvantage of using robots.

[1]

(b)

- any **one** of: expensive to buy/maintain / replace human workers / cannot make its own decisions

Exercise 3.3 (a)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(a) Describe how the microprocessor uses the sensor readings to keep the temperature in range. [5]

Exercise 3.3 (a)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(a) Describe how the microprocessor uses the sensor readings to keep the temperature in range. [5]

(a)

- the temperature sensor sends readings continuously
- the ADC converts each reading to digital
- the microprocessor compares with the stored 30 °C and 35 °C
- above 35 °C it switches the cooler **on**; below 30 °C it switches it **off**
- the process **repeats continuously**

Exercise 3.3 (b)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(b) Explain why this is a control system and not a monitoring system. [2]

Exercise 3.3 (b)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(b) Explain why this is a control system and not a monitoring system. [2]

(b)

- it does not only record readings: it **switches the cooler** and changes the temperature
- that makes it a **control** system

Exercise 3.3 (c)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(c) State the purpose of the analogue-to-digital converter in this system. [1]

Exercise 3.3 (c)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(c) State the purpose of the analogue-to-digital converter in this system. [1]

(c)

- it converts the sensor's **analogue** signal into **digital** values the microprocessor can process

Exercise 3.3 (d)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(d) The process must also raise an alarm if the temperature goes above 40 °C. Describe the extra comparison the microprocessor makes, and the shape a flowchart would use for it.

[2]

Exercise 3.3 (d)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(d) The process must also raise an alarm if the temperature goes above 40 °C. Describe the extra comparison the microprocessor makes, and the shape a flowchart would use for it. [2]

(d)

- compare each reading with 40 °C; if greater, sound the alarm
- a flowchart shows this as a **diamond** (decision) with Yes and No branches

Exercise 3.3 (e)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(e) Give two advantages of using a microprocessor rather than a person to control this process. [2]

Exercise 3.3 (e)

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(e) Give two advantages of using a microprocessor rather than a person to control this process. [2]

(e)

- any **two** of: reacts faster / never gets tired / more accurate / can work in unsafe conditions