Exercise walk-through

Input and output devices ▪ 3.2

eXercise

You must be able to

- describe how input devices (scanner, sensor, touch screen) work
- describe how output devices (printers, actuator, speaker) work
- choose a suitable device for a task

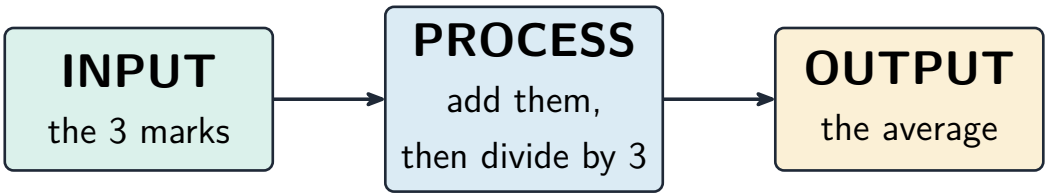
Method — Input and output

- **input:** barcode scanner (reads reflected light), sensor (measures a quantity), touch screen.
- **output:** inkjet/laser/3D printer, monitor, speaker, **actuator** (signal $\rightarrow$ movement).

Method — Input and output

A finger touching a touch screen

Method — Input and output



Input devices feed the processor, which drives output devices

Method — The stages, and where the addresses come from

A packet 数据包 has three parts: a **header** (the sender's and receiver's IP addresses, the packet number, and how many packets there are), the **payload** (the piece of the data), and a **trailer** (a way to tell the packet has ended, and an error-checking value such as a checksum).

Packet switching 分组交换, in the order the marks are given:

1. The data is split into equal-sized packets and each is numbered.
2. Each packet is sent separately and routers choose the route for each one, using the shortest or least congested path available at that moment.
3. Packets may take different routes and arrive out of order.
4. At the destination they are reassembled into the original order using the packet numbers.
5. Any packet that does not arrive is requested again.

Method — The stages, and where the addresses come from

Why it is used: there is no need to reserve a whole line for the transfer; if one route is busy or broken, packets take another; and many transfers share the same network. The drawback is that packets can be delayed or lost, which matters for real-time video or voice, and reassembly takes time.

Worked example. A 2 MB file is split into 2 KB packets. How many packets are needed, and what happens if packet 47 does not arrive? 2 MB $= 2048$ KB, so $2048 \div 2 = 1024$ packets. If packet 47 is missing, the receiver notices the gap in the numbering and asks the sender to transmit that packet again; the rest of the file does not need resending.

Practice 2.1 ▪ 1 mark

State whether a sensor is an input or an output device.

Solution 2.1

Method: Input and output

Worked steps

an input device B1.

Practice 2.2 ▪ 1 mark

State what an actuator does.

Solution 2.2

Worked steps

it turns an electrical signal into movement B1.

Practice 2.3 ▪ 3 marks

Identify the three parts of a packet.

Solution 2.3

Method: The stages, and where the addresses come from

Worked steps

Header, payload, trailer B3.

Practice 2.4 ▪ 2 marks

Identify two pieces of information stored in a packet header.

Solution 2.4

Method: The stages, and where the addresses come from

Worked steps

Any two of: the sender's IP address; the receiver's IP address; the packet number; the total number of packets B2.

Practice 2.5 ▪ 2 marks

Explain why packets may arrive out of order.

Solution 2.5

Method: The stages, and where the addresses come from

Worked steps

Each packet is routed separately, so different packets take different routes B1; routes differ in length and congestion, so packets arrive at different times B1.

Exam-style 3.1 ▪ 1 mark

Which is an output device?

A keyboard

B microphone

C speaker

D barcode scanner

Solution 3.1

A keyboard

B microphone

C speaker ✓

D barcode scanner

Worked steps

C. A speaker is an output device.

Exam-style 3.2 ▪ 2 marks

A supermarket uses a barcode scanner at the checkout.
(a) Describe how a barcode scanner inputs data.
(b) Name a suitable output device to print a paper receipt, and say why.

Solution 3.2

Method: Input and output

Worked steps

(a) it shines light at the bars and reads the pattern reflected back M1; this is sent to the computer as the product code A1.
(b) an inkjet (or laser) printer M1; because it can print the receipt quickly on paper A1.

Exam-style 3.3 ▪ 2 marks

A user downloads a 6 MB file. It is sent using packet switching in packets of 3 KB.
(a) Calculate the number of packets needed.
(b) Identify the three parts of a packet and state what each contains.
(c) Describe how the packets travel from the server to the user's computer.
(d) Explain what happens if one packet fails to arrive.
(e) Give one situation in which packet switching is a poor choice, and explain why.

Solution 3.3

> Method: The stages, and where the addresses come from

Worked steps

(a) 6 MB $= 6144$ KB **M1**; $6144 \div 3 = 2048$ packets **A1**.
(b) Header: the sender's and receiver's IP addresses and the packet number **B1**. Payload: the piece of the file being carried **B1**. Trailer: a marker showing the end of the packet and an error-checking value such as a checksum **B1**.
(c) The file is split into numbered packets of equal size **B1**; each packet is sent separately, and routers choose a route for each one based on the shortest or least congested path **B1**; the packets may take different routes and arrive out of order **B1**; the receiving computer reassembles them into the correct order using the packet

Solution 3.3

numbers B1.
(d) The receiver notices the missing number in the sequence B1 and asks the sender to transmit that packet again, so only the lost packet is resent B1.
(e) Real-time video calls or live streaming B1, because a delayed or lost packet arrives too late to be useful and the picture or sound breaks up B1.