Output devices

An output device is any piece of computer hardware equipment used to communicate the results of data processing carried out by a computer; the device converts the computer's digital information into a human-readable form.

Printers

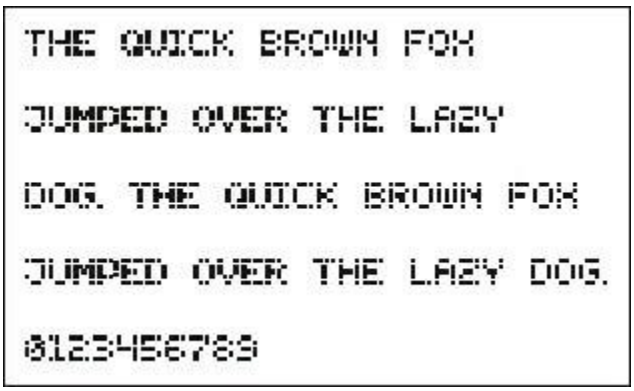
The three most common types of printer are: laser, inkjet and dot matrix. The following table compares the features of all three printers.

Type of printer	Advantages	Disadvantages
Laser printer	• very high quality of printing • relatively inexpensive to buy printer • large toner cartridges and large paper trays • very fast printing of multiple documents	• can be expensive to maintain (e.g. fusers) • produce health hazards such as ozone or toner particles in the air
Inkjet printer	• high quality of printing • very suitable for printing photos • inexpensive to buy printer	• ink is expensive to buy and quickly runs out on a large print run • usually have small paper trays • can be noisy in operation compared to laser printer

Dot matrix printer	• not adversely affected by damp or dirty/dusty atmospheres • allows use of multi-part stationery (i.e. carbon copies) • allows use of continuous/fanfolded stationery	• relatively expensive to buy printer • poor print quality • very noisy and very slow at printing

The full description of how these printers work can be found in the Student's Book. However, to summarise:

- **Laser printers** rely on positive and negative charges on the print drum and paper; (dry powder) toner sticks to the paper in only certain areas and is permanently fixed using a fuser.
- **Inkjet printers** rely on a liquid ink system which sprays ink onto the paper line by line as thepaper advances; the ink system uses ither thermal bubble or piezoelectric technologies.
- **Dot matrix** printers use a matrix of pins which strike an inked ribbon (either black or up to 4 coloured) to produce characters in a matrix on the paper, e.g.



3D printers

3D printers produce actual solid objects which work; they are built up in the printer in a number of very thin layers of varying materials, such as: powdered resin, powdered metal, ceramic powder or even paper. Some 3D printers use binder technology which involves the use of a binder (a type of 'glue') to form the solid layers.

Since they build up objects layer by layer, they are often referred to as additive. Some of the present applications include: making prosthetic limbs, assisting precision reconstructive surgery, manufacture of aerospace parts, fashion and art, and making parts no longer in production by conventional manufacturing.

2D/3D cutters

These are used to cut into materials to form 3D objects and are controlled by computers and software (such as CAD/CAM). Common materials include: glass, crystal, metal, polymers and wood.

Loudspeakers

Loudspeakers convert analogue voltages into sound. If the output is from a computer, the digital signals are first converted into analogue voltages using a DAC.

The rate at which the DAC can translate digital output into analogue voltages is called the sampling rate – usually 44 100 samples/second for a typical 16-bit system.

LCD and LED monitors

Modern liquid crystal display/diode (LCD) monitors and televisions are back-lit using light-emitting diodes (LEDs) rather than cold cathod fluorescent lamps (CCFLs). LCD monitors and televisions need to be back-lit since LCD does not produce its own light. The advantages of using LEDs (rather than CCFLs) to back-light the display are:

- they reach maximum brightness much faster
- they give a whiter light making the image more vivid
- the brighter light improves colour definition
- the displays can be much thinner and lighter in weight
- LEDs last almost indefinitely
- they consume much less power and therefore also run much cooler.

Newer monitors and televisions use organic light-emitting diodes (OLEDs). These produce their own light and therefore don't need any form of back-lighting. The advantages of using OLED when compared to older LED technology include:

- they allow for very thin and very flexible screens which are very light weight
- they produce a much brighter light than LEDs
- they don't require any form of back-lighting
- they allow for a much larger field of view.

Light projectors

There are two common types: digital light projectors (DLP) and LCD projectors.

DLP relies on millions of micro mirrors which can switch on or off several thousand times a second creating various shades of grey. Colour filters allow the shades of grey to be converted into colours which are projected onto a large screen thus representing the output from the computer.

LCD projectors use chromatic-coated mirrors which reflect light at different wavelengths. The light components pass through three LCD screens which are then recombined using a prism to produce the colour image which is projected onto a large screen.