Hardware

## Input Devices

Bar code scanner
The bar code scanner emits laser light and detects reflected light off the bar code. The columns of the bar code which are coloured black and white are evenly spaced and correspond to a bit. The white columns reflect the laser light and this corresponds to a 0. The black columns do not reflect back the reflected light and this is encoded as a 1. Parity error checking allows the scanner to determine which way round the scanner has read the bar code.

1010001110011110100011
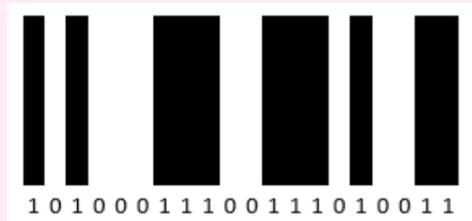
RFID (Radio Frequency Identification)
RFID can **uniquely** identify an object. Passive RFID chips do not have their own power source which allows for them to be small. The RFID chips get their power source from nearby radio transmitters (or RFID detectors) that are constantly emitting radio waves. When an RFID chip comes within range of an RFID detector, the chip is powered by the radio waves which activates the chip to transmit a signal to the detector that uniquely identifies the chip. Active RFID has its own power source which means that it can transmit over longer distances.

Digital camera
A digital camera uses a charged couple device (CCD). This is an array of tiny light detectors that measures the intensity of light at red green and blue wavelengths that passes though the camera lens. The intensity of light is then converted to an electrical signal that is then encoded into binary values for each colour. This occurs across all detectors in the CCD array and so a complete picture can be captured. Nowadays we can get cameras on phones that can take 40 Mega pixel images.

Output Devices

Laser Printer
1. At the core of the laser printer is a drum that turns and rubs against an electrically charged roller.
2. As it rotates the drum gets completely covered in electrons.
3. As the drum turns it gets hit by a laser beam, areas on the drum that are exposed to the laser beam become neutrally charged.
4. The toner which is negatively charged in the hopper is put onto another roller.
5. The toner is attracted to the neutrally changed areas and repelled by the negatively charged areas on the drum.
6. The toner is them transferred from the drum onto the positively charged paper.
7. Finally the paper passes through a heated roller to dry the ink.

Secondary Storage Devices

Secondary storage is non-volatile and necessary for saving files. In addition storage is used for holding software including the operating system itself. Even when the computer is turned off, the files are stored and the data remain unchanged, and can be accessed again once the power supply has been turned on.

Magnetic Disk Drives
Tracks on the disk platters contain tiny magnets, each holding 1 bit of data. The polarity (negative or positive) of the magnets determines whether the bits are 0 or 1. The write head modifies the polarity of the magnet as appropriate. The read head identifies whether each magnet is negative or positive. The tracks are laid out as a series of concentric rings.
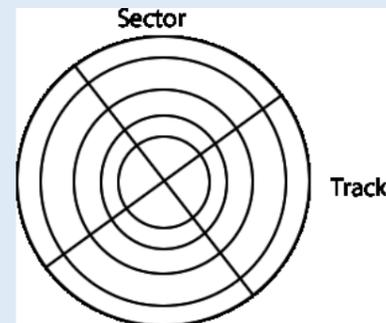
Advantages
- Cheap form of storage
- Can now store massive volumes of data of the order of Terrabytes)

Disadvantages
- Less reliable because it contains moving parts that can break
- Electromagnetic surge can corrupt the data held
- Slow speed of read / write data transfer

Optical Disks
Tracks on an optical disk contain pits and lands. The track is a spiral and rotates and is read from inside to outside. A laser is emitted and the laser light is reflected when it hits the lands, but is scattered when it hits the pits. Depending on whether the light is scattered light is encoded as a binary value of 0 and reflected light is encoded as a 1. The sensor is able to detect light reflected, but not the scattered light.

Example of optical disks

| Blue-Ray	25 GB	HD films
DVD	4.7 GB	Regular films
CD	700MB	Music

Advantages
- Can transfer easily between computers

Disadvantages
- Can scratch easily
- Not much storage compared with other methods.
- No unlimited writes to the disks

Solid State Drive
- Solid state Drives (SSDs) consist of NAND flash memory. Flash stores data on microchips in arrays of memory cells made up of switches called floating gate transistors. Cells can contain 1 or more bits of information depending on the architecture.
- Electrons are trapped and stored in gates and a bit is encoded as a 0 when there is an electron present and the bit is encoded as a 1 when there is no electron present. The electrons remain trapped even when there is no flow of electricity.
- The memory cells are grouped into blocks and each block contains a number of pages.
- Before writing to memory the blocks need to be erased. Only whole blocks can be erased. All the bits are set to 1 when a block is erased.
- Pages are the smallest element that can be written to and will have many memory cells.
- Pages are typically 8-16 kB in size, blocks 4-8 MB.
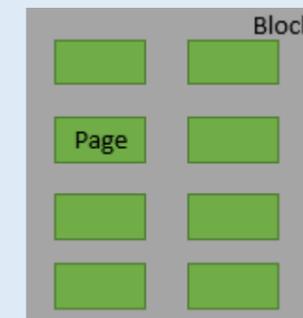
Advantages
- They haver lower latency are much faster at transferring data than other had disk drives
- Solid state devices contain no moving parts and are therefore more robust than optical and magnetic storage.
- SSDs are quiet
- Requires less power than magnetic hard disk drive

Disadvantages
- It is more expensive per volume of storage
- Reliability might be an issue if you do a lot of writing to a solid state storage device because there is a limit to NAND flash blocks can be erased and written to.