

4 a) SISD (single instruction single data)

- uses a single processor that can handle a single instruction which uses one data source at a time
- each task is processed in sequential order.

SIMD (single instruction multiple data)

- uses several processors which execute the same instruction set but use different data inputs
- all processes do same calculations but on different data sets simultaneously.

MISD (multiple instruction single data)

- uses several processors
- each processor uses different instructions but uses same shared data.

MIMD (multiple instruction multiple data)

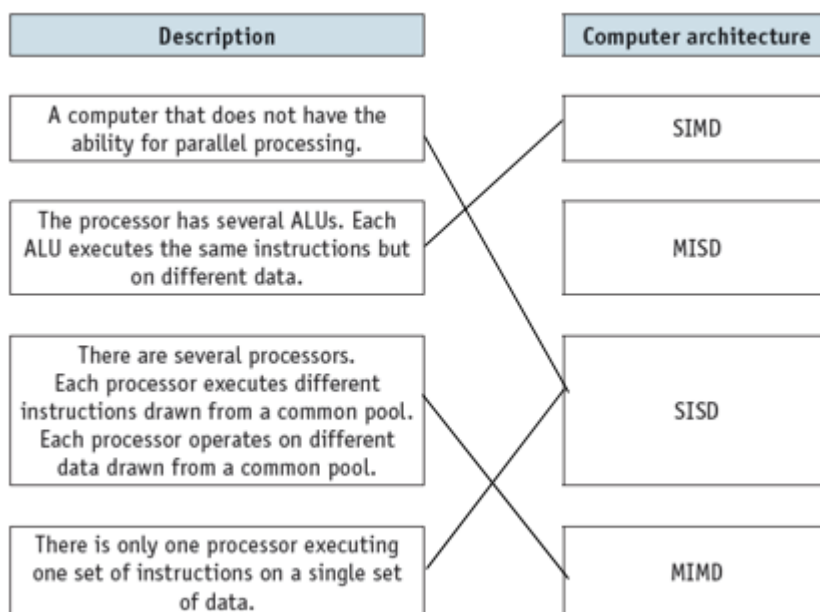
- uses several processors
- each processor can accept its own instructions independently
- each processor uses data from a separate data stream (e.g. single memory which has been partitioned).

b) Features of parallel processing:

- It is a much faster way to handle large volumes of independent data.
- The data used sometimes relies on the result of a previous operation, therefore such data cannot be handled in parallel.
- Data sets require the same processing for it to work.
- It overcomes the von Neumann bottleneck and therefore greatly improves CPU performance.
- Parallel processing requires more expensive hardware.

c)

- Eight instructions need 12 clock cycles when using pipelining.
- Without pipelining, it would require $8 \times 5 = 40$ clock cycles to complete (each of the 8 instructions requires 5 processing stages: IF, ID, OF, IF and WB).

5 a)

- b** i) Massive – many processors linked together.
ii) Parallel – to perform a set of coordinated computations simultaneously.
- c**) Hardware – processors need to be able to communicate so that processed data can be transferred from one processor to another.
Software – suitable software which allows data to be processed by multiple processors simultaneously.