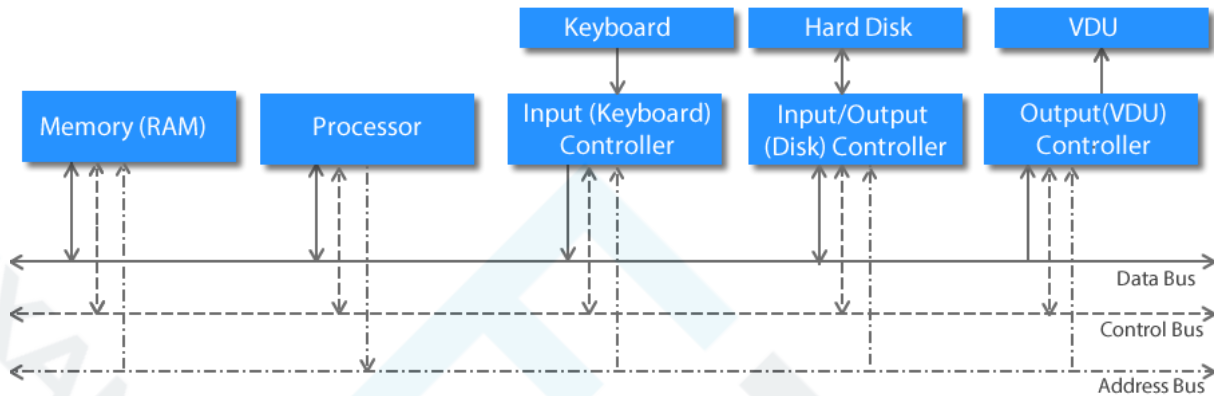


Processor Architecture Questions

1. Draw and label the architecture of the main internal components of a computer including the buses, input output controllers, processor and main memory [12 marks]



2. Explain the role of main memory [2 marks]

To store the instructions from the programs currently running on a computer system and to temporarily hold the data needed by those programs

3. Explain the purpose of a bus and explain the difference between a control bus, data bus and address bus [4 marks]

Buses are a set of wires that connect the internal components of a computer

4. Explain the stored program concept [3 marks]

Instructions are stored in main memory, the instructions are fetched, decoded and executed by the processor

5. Explain the difference between the Harvard and Von Neumann architectures [4 marks]

With von Neumann architecture the instructions and data are stored in the same memory and share the same buses. With Harvard architecture the instructions and data are stored in separate memories and use dedicated buses.

6. What is the purpose of the opcode and operand part of a machine code instruction? [2 marks]

Opcode determines the operation to be performed, operand the value or memory address that the operation is performed on.

7. What is the purpose of the address mode? [1 mark]

Determines whether the operand is for immediate or direct addressing

8. Explain the difference between immediate and direct addressing mode. [2 marks]

For immediate addressing mode, the data value is the operand part, for direct addressing the operand specifies the memory address

9. Discuss six factors that impact the performance of a processor [15 marks].

Clock speed

- ✓ This is the number of cycles that a processor carries out in an second.
- ✓ Nowadays a typical processor on a PC can have a clock speed ranging between 2GHz and 4GHz. That means there can be 2-4 billion cycles per second.
- ✓ Each cycle of the CPU allows a single instruction to be carried out.
- ✓ Thus the greater the clock speed, the greater the number of operations and the faster the computer will run.

Number of processor cores

- ✓ A core is processor in its own right.
- ✓ The number of transistor on a chip has reached a physical limit, so no more transistors can be added to a chip.
- ✓ Instead manufacturers add more cores.
- ✓ Processors will have at least one core.
- ✓ Nowadays, most processors have multiple dual (2) or quad (4) cores to boost performance.
- ✓ Having multiple cores allows instructions to be carried out in parallel (at the same time), whereas a single core will only allow carry out instructions in serial (one at a time), thereby speeding up performance

Cache size

- ✓ Cache is a volatile memory store on the processor, and is not to be confused with RAM and registers.
- ✓ Cache is much faster but smaller than RAM.

- ✓ Frequently used data and instructions within an application can be stored in cache instead of fetching from RAM which is quite slow. In other words there is greater latency - Delay in transfer of data after the execution of an instruction.
- ✓ The bigger the cache the greater the volume of data and instructions that can be stored at a time and consequently increases the performance of the CPU as latency is reduced.

Cache type

- ✓ Cache Level is a trade off between size and speed
- ✓ Level 1 Cache - This is closest to the CPU and is the fastest cache because of the lowest latency, but does not have much capacity
- ✓ Level 2 Cache – is slower and further away from the CPU than Level 1 cache because of increased latency, but has more storage capacity.
- ✓ Level 3 Cache – is the slower than L1 and L2 cache but still much faster than RAM, but has greater capacity than L1 and L2.

Word length

- ✓ The word length is the number of bits that can be processed in one CPU cycle.
- ✓ Typical word length of most processor architectures are 32 or 64 bits.
- ✓ The greater the word length the more bits that can be processed in one cycle.

Address bus width

- ✓ The address bus width determines the number of locations in main memory that can be accessed.
- ✓ For instance if the bus address bus width is 32 bits then 2^{32} address locations can be accessed.

Data bus width

- ✓ The data bus width refers to the number of bits that can be transferred at a time between the main memory and the processor. Increasing the data bus width can reduce the number of read/write operations.
- ✓ If the data bus width is the same as the word length then one instruction can be transferred at a time.
- ✓ If the data bus width is twice the word length then two instructions can be transferred at a time.
- ✓ If the data bus width is half the word length then two read requests will need to be made for a single instruction.