EDO STATE POLYTECHNIC, USEN

SCHOOL OF APPLIED SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

COMPUTER ARCHITECTURE COM 314

Question 1

(a) Using a diagram, explain the IAS computer and list the content
(b) The control unit and the ALU contain storage locations, called registers, list and explain the operationsthey perform

Question 2

(a) List and explain three approaches to increase processor speed

(b) What is RC delay?

Question 3

Write a brief history on the evolution of intel x86 architecture

Question 4

Explain memory module and its set of locations using a diagram

Question 5

With the aid of a diagram, explain the instruction cycle

Question 6

With the aid of a diagram, explain the instruction state process

Question 7

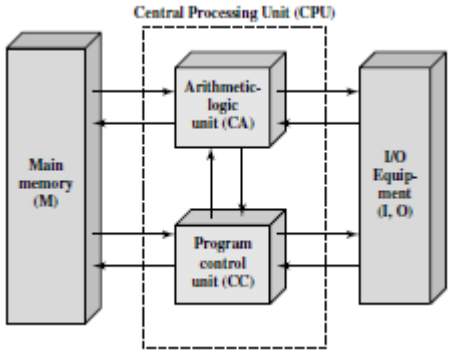
(a) Explain the concept of an interrupt, and while is interrupt necessary
(b) Using a diagram, give five examples of interrupt

Question 8

(a) With the aid of a diagram, explain the concept of a bus
(b) List and explain the classification of a Bus according to its functional group

Solutions

Question 1



- ✓ A main memory, which stores both data and instruction
- ✓ An arithmetic and logic unit (ALU) capable of operating on binary data
- ✓ A control unit, which interprets the instructions in memory and causes them to be executed
- ✓ Input and output (I/O) equipment operated by the control unit

(b)

• Memory buffer register (MBR): Contains a word to be stored in memory or sent to the I/O unit, or is used to receive a word from memory or from the I/O unit.

• Memory address register (MAR): Specifies the address in memory of the word to be written from or read into the MBR.

• Instruction register (IR): Contains the 8-bit opcode instruction being executed.

• Instruction buffer register (IBR): Employed to hold temporarily the right-hand instruction from a word in memory.

• Program counter (PC): Contains the address of the next instruction-pair to be fetched from memory.

• Accumulator (AC) and multiplier quotient (MQ): Employed to hold temporarily operands and results of ALU operations.

Question 2

(a)

• Increase the hardware speed of the processor.

• Increase the size and speed of caches that are interposed between the processor and main memory. In particular, by dedicating a portion of the processor chip itself to the cache, cache access times drop significantly.

• Make changes to the processor organization and architecture that increases the effective speed of instruction execution.

(b)

This isthe speed at which electrons can flow on a chip between transistors, it is limited by

the resistance and capacitance of the metal wires connecting them; specifically, delay increases as the RC product increases.

Question 3

There are two computer families: the Intel x86 and the ARM architecture. The current x86 offerings represents the result of decades of design effort on complex instruction set computers (CISCs). The x86 incorporates the sophisticated design principles once found only on mainframes and supercomputers and serves as an excellent example of CISC design. An alternative approach to processor design in the reduced instruction set computer (RISC). The ARM architecture is used in a wide variety of embedded systems and is one of the most powerful and best-designed RISC-based systems on the market. some of the highlights of the evolution of the Intel product line:

• 8080: The world's first general-purpose microprocessor. This was an 8-bit machine, with an 8-bit data path to memory. The 8080 was used in the first personal computer, the Altair.

• 8086: A far more powerful, 16-bit machine. In addition to a wider data path and larger registers, the 8086 sported an instruction cache, or queue, that prefetches a few instructions before they are executed. A variant of this processor, the 8088, was used in IBM's first personal computer, securing the success of Intel. The 8086 is the first appearance of the x86 architecture.

• 80286: This extension of the 8086 enabled addressing a 16-MByte memory instead of just 1 MByte.

• 80386: Intel's first 32-bit machine, and a major overhaul of the product. With a 32-bitarchitecture, the 80386 rivaled the complexity and power of minicomputers and mainframes introduced just a few years earlier. This was the first Intel processor to support multitasking, meaning it could run multiple programs at the same time.

• 80486: The 80486 introduced the use of much more sophisticated and powerful cache technology and sophisticated instruction pipelining. The 80486 also offered a built-in math coprocessor, offloading complex math operations from the main CPU.

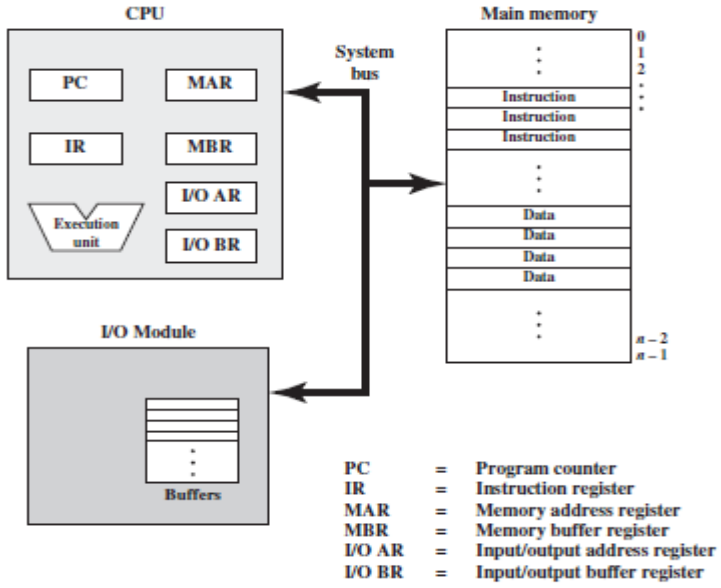
Question 4

A memory module consists of a set of locations, defined by sequentially numbered addresses.

Each location contains a binary number that can be interpreted as either an instruction or data. An

I/O module transfers data from external devices to CPU and memory, and vice versa. It contains

internal buffers for temporarily holding these data until they can be sent on.



Question 5

The basic function performed by a computer is execution of a program, the Program execution consists of repeating the process of instruction fetch and instruction execution. The processing required for a single instruction is called an instruction cycle.two steps are referred to as the fetch cycle and the execute cycle. Program execution halts only if the machine is turned off, some sort of unrecoverable error occurs, or a program instruction that halts the computer is encountered.

At the beginning of each instruction cycle, the processor fetches an instruction from memory. The program counter (PC) holds the address of the instruction to be fetched next, the processor always increments the PC after each instruction fetch so that it will fetch the next instruction in sequence.

The fetched instruction is loaded into a register in the processor known as the instruction register (IR). The processor interprets the instruction and performs the required action. In general, these actions fall into four categories:

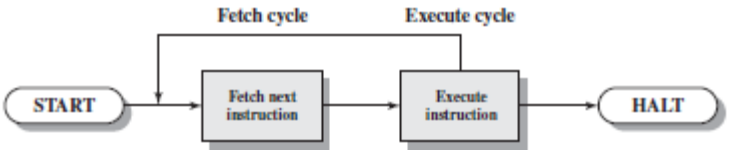
• Processor-memory: Data may be transferred from processor to memory or from memory to processor.

• Processor-I/O: Data may be transferred to or from a peripheral device by transferring between the processor and an I/O module.

• Data processing: The processor may perform some arithmetic or logic operation on data.

• Control: An instruction may specify that the sequence of execution be altered. For example, the processor may fetch an instruction from location 149, which specifies that the next instruction be from location 182. The processor will remember this fact by setting the program counter to 182.Thus,on the next fetch cycle, the instruction will be fetched from location 182 rather than 150.

An instruction's execution may involve a combination of these actions. Consider a simple example using a hypothetical machine that includes the characteristics listed in Figure 1.6. The processor contains a single data register, called an accumulator (AC). Both instructions and data are 16 bits long.


Fetch cycle
Execute cycle
START
Fetch next instruction
Execute instruction
HALT