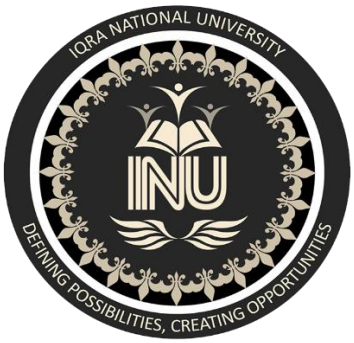
:: ASSIGNMENT # 1 ::

ID: 11533

Name: Ashir Ali Khan

Subject: Computer Architecture

Teacher: Sir Muhammad Amin



Iqra National University

Assignment # 1 :-

Question : 1 :- PART : A :-

What are four main functions of a computer?

Answer :-

Computers operate through four functions : input, out-put, processing and storage.

Input :-

The transfer of information into the system (e.g. through a keyboard).

Output :-

The presentation of information to the user (e.g. on a screen).

Processing :-

The retrieval or manipulation of information into a new form (e.g results from search engine).

Storage :-

The storage or preservation of information for later use (e.g files stored on a hard drive).

Part : B :-

Answer :-

The following functional areas are on each core, as shown in the figure above :

Instruction sequence unit (ISU) :-

This unit enables the out-of-order (OOO) pipeline. It tracks register names, OOO instruction dependency and handling of instruction resource dispatch. This unit is also central to performance measurement through a function called instrumentation.

Instruction Fetching unit (IFU) (prediction) :-
These units contains the instruction cache, branch prediction logic, instruction fetching controls, and buffers. Its relative size is the result of the elaborate branch prediction design.

Instruction decode unit (IDU) :-
The IDU is fed from the IFU buffers, and is responsible for parsing and decoding of all z/Archictecture operation codes.

Load - store unit (LSU) :-
The LSU contains the data cache. It is responsible for handling all types of operand accesses of all lengths, modes, and formats as defined in the z/Architecture.

Translation unit (XU) :-
The XU has a large translation look aside buffer (TLB) and the Dynamic Address Translation (DAT) function that handles the dynamic translation of logical to physical addresses.

Fixed-point unit (FXU) :-
The FXU handles fixed-point arithmetic.

Binary floating-point unit (BFU) :-
The BFU handles all binary and hexadecimal floating-point and fixed-point multiplication operations.

Decimal floating-point unit (DFU) :-
The DU runs both floating-point and decimal fixed-point operations and fixed point division operations.

Recovery unit (RU) :-
The RU keeps a copy of the complete state of the system that includes all registers, collects hardware fault signals, and manages the hardware recovery actions.

Dedicated Co-Processor (COP) :-
The dedicated coprocessor is responsible for data compression and encryption function for each core.

I-cache :-
This is a 65 Kb L1 instruction cache, allowing the IFU to prefetch instructions before they are needed.

L2-Control :-
This is the control logic that manages the traffic through the two L2 caches.

Data-L2 :-
1mb L2 data cache for all memory traffic other than instructions.

Instra-L2 :-
1mb L2 instructions cache.

Part : C :-

Answer :-

Data transfer :-
Move data between memory and ALU registers or between two ALU registers.

Unconditional branch :-
Normally, the control unit executes instructions in sequence from memory. This sequence can be changed

by a branch instruction, which facilitates repetitive operations.

Conditional branch:-

The branch can be made dependent on a condition, thus allowing decision paths.

Arithmetic:-

Operations performed by the ALU.

Address modify:-

Permits addresses to be computed in the ALU and then inserted into instruction stored in memory. This allows a program considerable addressing flexibility.

X————————X

PART:- D:-

Answer:-

~~(a) Are programs that understand physics and/or hardware embedded? For example, one that uses finite element methods to predict fluid flow over airplane wings? X~~

~~(b)~~

(A) No. These programs are never considered to be embedded because they are not an integral component of a larger system.

(B) Yes, regardless of what the disk drive is used for. The software (firmware, actually) within the disk drive controls the HDA (head disk assembly) hardware and is hard real-time as well.

(C) No, Input-Output drivers donot represent the embedded system.

(D) Yes, a PDA (Personal digital Assistant) is an embedded system.

(E) Yes, the firmware in the cell phone is controlling the radio hardware.

(F) Yes, these computers were generally some of the most powerful computers available when the system was built, are located in a large computer room occupying almost one whole floor of a building and maybe hundreds of meters away from the radar hardware. However, the software running in these computers control the radar hardware; therefore, the computers are an integral component of a large system.

(G) If the FMS is not connected to the avionics and is used only for logistics computerization, a function readily performed on a laptop, then the FMS is clearly not embedded

(H) Yes, both in the simulator, and in the thing being tested in the HIL simulator. Hardware is being controlled on both sides.

(I) Yes, in this case of the "system" is the combination of the pacemaker and the person's heart.

(J) Yes, it is the part of a large system, the engine, and it is directly monitoring and controlling the engine through special hardware.

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Question : 2 :-

Part : A :-

Answer :-

Main structural components of a Computer :-

Structural Components of a computer :-

A computer has four main components : the central processing unit or CPU, the primary memory, input units and output unit. A system bus connects all four components, passing and relaying information among them. This type of computer organization and architecture is called a "Von Neumann machine" after john von Neumann, who finalized the theory and design of the first modern digital computer.

CPU :-

Computer scientists typically call the CPU the "brain" of the computer because this is where programs are executed. A program is a set of instructions that tells the computer how to accomplish a specific task, such as sending a file to the printer, opening a browser window, or playing music or video.

The CPU is further broken up into three smaller components : the arithmetic unit handles all the simple mathematical computation ; the control unit interpret the instructions in a computer program ; and the instruction decoding unit converts computer programming instructions into machine code. Machine code is the basic language understood by all the components in a computer.

Memory :-

Once the CPU converts a specific set of computer program instruction into machine code, it stores that machine code in primary storage or memory.

The machine code will be treated as either data or instruction. The CPU fetches data and instructions from memory, uses an instruction to manipulate the data, and then sends the result and the next set of instructions back to memory.

Input units:-

Input units are all the devices you use to feed information to the computer, such as keyboard, a hard drive or a networking card. These devices, in essence, bring data from the "outside world" into your computer, in much the same way that your eyes and ears bring information to your brain. Each input device has its own hardware controller that connects to the CPU and primary memory, and it has a set of instructions that tells the CPU how to use it.

Output units:-

Output units are the devices your computer uses to relay information to the user, such as a printer, monitor, speakers. For example, every thing you see on your computer monitor starts as a machine code in memory. The CPU takes that machine code and converts it into a format required by your monitors hardware. Your monitor's hardware then convert that information into different light intensities so that you see words or pictures.

The System Bus:-

The system bus lets the four components of the computer communicate with one another. The system bus transmits data and instructions. It also sends

addresses that tell the CPU where in primary memory the data and instructions are coming from and where the result should go.

Part : B :-

Answer :-

The key characteristics of a computer family :-

- Similar or identical instruction set : In many cases, the exact-same set of machine instructions are supported on all members of the family. Thus, a program that executes on one machine will also execute on any other. In some cases, the lower end of the family has an instruction set that is a subset of that of the top end of the family. This means that programs can move up but not down.
- Similar or identical operation system : The same basic operating system is available for all family members. In some cases, additional features are added.
- Increasing speed : The rate of instruction execution increases in going from lower to higher family member.
- Increasing number of I/O ports : In going from lower to higher family members.
- Increasing memory size : In going from lower to higher family members.
- Increasing cost : In going from lower to higher family members.

Part : C :-

Stored program computer :-

A stored-program computer is a computer that stores program instructions in electronic memory. This contrasts with machines where the program instructions are stored on plug boards or similar mechanisms.

A computer with a von Neumann architecture stores program data and instruction data in the same memory; a computer with a Harvard architecture has seperate memories for storing program and data. Both are stored-programs design. Stored-program computer is sometimes used as a synonym for von Neumann architecture, however Professor Jack Copeland considers that it is "historically inappropriate, to refer to electronic stored-program digital computers as "von Neumann machines". Hennessy and Patterson write that the early Harvard machines were regarded as "religiously by the advocates of stored-program computers."

X——————X

Part : D :-

Moore's Law :-

Moore's Law is a computing term which originated around 1970; the simplified version of this law states that processor speeds, or overall processing power for computers will double every two year. A quick check among technicians in different

computer companies shows that the term is not very popular but the rule is still accepted.

To break down the law even further, it is specifically stated that the number of transistors on an affordable CPU would double every two years (which is essentially the same thing that was stated before) but 'more transistors' is more accurate.

The law is named after intel co-founder Gordon Moore who described the trend in his 1965 paper. The paper stated that the number of components in integrated circuit had doubled every year from the invention of the integrated circuit in 1958 until 1965 and predicted that the trend would continue "for at least ten years". His prediction has proved very accurate. The law is used in the semiconductor industry to guide long-term planning and to set targets for research and developement.

The capabilities of many digital electronic devices are strongly linked to Moore's law: processing speed, memory capacity, sensors and even the number and size of pixels in digital cameras. All of these are improving at (roughly) exponential rates as well.

Question : 3 :-

Part : A :-

Answer :-

Computer Organization and Computer Architecture :-

Computer Architecture	Computer Organization
1) Computer Architecture is concerned with the way hardware components are connected together to form a computer system.	1) Computer Organization is concerned with the structure and behaviour of a computer system as seen by the user.
2) It acts as the interface between hardware and software	2) It deals with the components of a connection in a system.
3) Computer Architecture helps us to understand the functionalities of a system.	3) Computer organization tells us how exactly all units in the system are arranged and interconnected.
4) A programmer can view architecture in terms of instructions, addressing modes and registers.	4) whereas Organization expresses the realization of architecture.
5) while designing a computer system architecture is considered first.	5) An organization is done on the basis of architecture
6) Computer Architecture deals with high-level design issues	6) Computer organization deals with low-level design issues
7) Architecture involves logic (Instruction sets, Addressing modes, Data Types, Cache Optimization	7) Organization involves Physical Components (Circuit design, Adders, Signals, Peripherals)

Part : B :-

RISC and CISC :-

RISC	CISC
1) RISC stands for Reduced Instruction Set Computer.	1) CISC stands for complex Instruction set Computer.
2) RISC processors have simple instructions taking about one clock cycle. The average clock cycle per instruction (CPI) is 1.5.	2) CSIC processor has complex instructions that take up multiple clocks for execution. The average clock cycle per instruction (CPI) is in the range of 2 and 15.
3) Performance is optimized with more focus on software	3) Performance is optimized with more focus on hardware
4) It has no memory unit and uses seperate hardware to implement instruction.	4) It has a memory unit to implement complex instruction.
5) It has a hard-wired unit of programming.	5) It has a micro-programming unit.
6) The decoding of instruction is simple.	6) Decoding of instructions is complex.
7) The instruction set has a variety of different instruction that can be used for complex operations.	7) CISC has many different addressing modes and can thus be used to represent higher-level programming language statements more efficiently.
8) RISC architecture is used in high-end application such as video processing, telecommunication and image processing	8) CISC architecture is used in low-end application such as security systems, home automation, etc.

Part : C :-

Microprocessor and Microcontrollers :-

Microprocessor	Microcontroller
1) Microprocessor is the heart of computer system.	1) Micro controller is the heart of a embedded system.
2) It is only a processor, so memory and I/O components need to be connected externally.	2) Micro Controller has a processor along with internal memory and I/O components.
3) Memory and I/O has to be connected externally, so the circuit becomes large.	3) Memory and I/O are already present, and the internal circuit is small.
4) You can't use it in compact systems.	4) You can used it in compact systems.
5) Cost of the entire system is high.	5) Cost of the entire system is low.
6) Most of the microprocessors do not have power saving feature	6) Most of the microcontrollers offer power-saving mode.
7) It has no RAM, ROM, Input-Output units, timers and other peripherals on the chip.	7) It has a CPU along with RAM, ROM, and other peripherals embedded on a single chip.
8) Its complex and expensive, with a large number of instruction to process.	8) It's simple and inexpensive with less number of instructions to process.
9) Microprocessor are based on Von Neumann model.	9) Micro controllers are based on Havard architecture.

Part : D :-

Cortex - A, Cortex - R and Cortex - M :-

Cortex-A	Cortex-R	Cortex-M.
1) Application processors.	1) Real time processors.	1) Micro controllers.
2) Used in wide range of devices that have fully functional processors.	2) Used in critical systems where data interpretation is essential.	2) Designed for small devices and mixed signal processing.
3) It runs at relatively high clock frequency.	3) It runs on high clock frequency.	3) It runs at slower clock speed.
4) It is connected to large amount of memory	4) ----------	4) It is connected to less memory.
5) It handles large ammount of application and is capable of running complex operating system directly.	5) It is designed to handle fast changing data, and to be sufficiently responsive to handle data throughput without slowing down	5) It is built into micro controller with I/O lines and designed for small factors systems that rely on heavy digital input and output.
6) Applications:- Mobiles, telephones, tablets, laptops etc	6) Application- Medical devices, Car system.	6) Applications:- Robotic systems, small consumer electronics

Question : 4 :-

Part : A :-

Answer :-

(A) Show the assembly language codes for the program, stating at address 08A.

Address	Contents
08A	LOAD M(0FA)
	STOR M(0FB)
08B	LOAD M(0FA)
	JUMP+M(08D)
08C	LOAD- M(0FA)
	STOR M(0FB)
08D	

(b) This program is to store the absolute value of content at memory location 0FA into memory location 0FB.

Part : B :-

Answer :-

Opcode	Operand
00000001	0000000000010

In the beginning, the CPU have to fetch the instruction from the memory. Then, the instruction will include the address of the data which is required to load. Through the execution time, the memory will be accessed in that time to load the data contents which is located at that address for a total of two trips to memory.

Part: C :-

Answer :-

- Overall data paths to/from MBR is 40bits.
- Overall data paths to/from MAR is 12bits.
- All paths to/from AC is 40bits.
- All paths to/from MQ is 40bits.