

TRIBHUVAN UNIVERSITY

Institution of Science and Technology

Course Title: Introduction to Information Technology

Course No: CSC109

Nature of the Course: Theory + Lab

Semester: I

Full Marks: 60 + 20
Pass Marks: 24 + 8

Credit Hours

TU QUESTIONS-ANSWERS 2075

Long Questions (Section A)

Attempt any two questions:

1. Discuss the concept behind the fixed point number representation. What can be the fixed point representation of a signed number 87.76 (14.14)₁₀ into binary and octal.

Ans: This representation has fixed number of bits for integer part and fractional part. A fixed-point representation of a number may be thought to consist of 3 parts: the sign field, integer field, and fractional field. One way to store a number using a 32-bit format is to reserve 1 bit for the sign, 15 bits for the integer part and 16 bits for the fractional part. A number whose representation exceeds 32 bits would have to be stored inexactly. On a computer, 0 is used to represent + and 1 is used to represent -. For example, if given fixed-point representation is 1111.1111, then you can store minimum value is 0000.0001 and maximum value is 9999.9999.

Unsigned fixed point

Integer	Fraction
---------	----------

Signed fixed point

Sign	Integer	Fraction
------	---------	----------

First converting decimal value 14 into binary

2	14	0
2	7	1
2	3	1
1		

14=1110₂

Second converting .14 into binary

14x2=28	= 0
28x2=56	= 0
56x2=112 (1.12)	= 1
12x2=24	= 0
24x2=48	= 0
48x2=96	= 0
96x2=192 (1.92)	= 1
92x2=184 (1.84)	= 1
84x2=168 (1.68)	= 1
68x2=136 (1.36)	= 1
36x2=76	= 0

.14=00100011110

Hence, (14.14)₁₀=1110.00100011110₂

2. What is switching? How can you differentiate packet switching from circuit switching? What are the advantages of using optical fibers?

Ans: switching (also known as the Data Link layer switching) is the process of using devices' MAC addresses to decide where to forward frames in a LAN. Layer 2 switching is efficient because there is no modification to the data packet, only to the frame encapsulation of the packet.

Layer 2 switches are much faster than routers because they don't take up time looking at the Network layer header information. Instead, they look at the frame's hardware addresses to decide whether to forward, flood, or drop the frame. Here are the major advantages of Layer 2 switching:

- Hardware-based bridging (using ASICs)
- Wire speed
- Low latency
- Low cost

Switches usually perform these three functions:

- Address learning - switches learn MAC addresses by examining the source MAC address of each frame received by the switch.
- Forward/filter decisions - switches decide whether to forward or filter a frame, based on the destination MAC address.
- Loop avoidance - switches use Spanning Tree Protocol (STP) to prevent network loops while still permitting redundancy.

The main difference between circuit switching and packet switching is that Circuit Switching is connection oriented whereas, Packet Switching is connectionless. Let us learn some more differences between Circuit Switching and Packet Switching is shown below.

Circuit switching	Packet switching
Connection oriented.	Connectionless.
Initially designed for Voice communication.	Initially designed for Data Transmission.
Inflexible, because once a path is set all parts of a transmission follows the same path.	Flexible, because a route is created for each packet to travel to the destination.
Message is received in the order, sent from the source.	Packets of a message are received out of order and assembled at the destination.
Circuit switching can be achieved using two technologies, either Space Division Switching or Time-Division Switching.	Packet Switching has two approaches Datagram Approach and Virtual Circuit Approach.
Circuit Switching is implemented at Physical Layer.	Packet Switching is implemented at Network Layer.

There are many advantages of optical fiber. Some of them are given below:

- Higher bandwidth support
- High carrying capacity.
- Immunity to electromagnetic interference and tapping.
- Optical fibers are so flexible.
- Optical fiber cables take up less space.
- Less signal attenuation.
- Resistance to corrosive materials.

3. Why system software is needed in computers? Discuss various types of operating system.

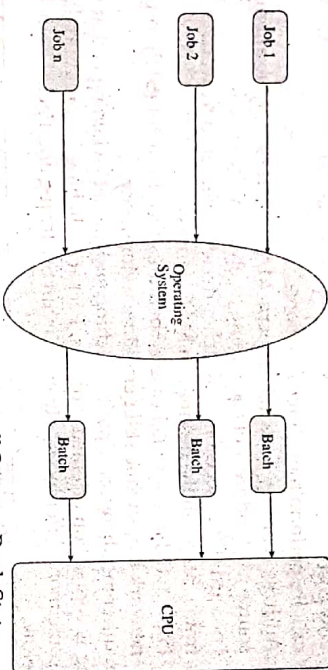
Ans: System software is software designed to provide a platform for other software. Examples of system software include operating systems like macOS, Linux OS and Microsoft Windows, computational science software, game engines, industrial automation, and software as a service application.

The purpose of system software (any form of middleware) is to make it easy for applications to run on a variety of hardware.

Some of the widely used operating systems are as follows:

1. Batch Operating System

This type of operating system does not interact with the computer directly. There is an operator which takes similar jobs having same requirement and group them into batches. It is the responsibility of operator to sort the jobs with similar needs.



Examples of Batch based Operating System: Payroll System, Bank Statements etc.

2. Time-Sharing Operating Systems

Time-sharing is a technique which enables many people, located at various terminals, to use a particular computer system at the same time. Time-sharing or multitasking is a logical extension of multiprogramming. Processor's time which is shared among multiple users simultaneously is termed as time-sharing.

Multiple jobs are executed by the CPU by switching between them, but the switches occur so frequently. Thus, the user can receive an immediate response. For example, in a transaction processing, the processor executes each user program in a short burst or quantum of computation. That is, if n users are present, then each user can get a time quantum. When the user submits the command, the response time is in few seconds at most.

3. Distributed operating System

Distributed systems use multiple central processors to serve multiple real-time applications and multiple users. Data processing jobs are distributed among the processors accordingly. The processors communicate with one another through various communication lines (such as high-speed buses or telephone lines). These are referred as loosely coupled systems or distributed systems. Processors in a distributed system may vary in size and function. These processors are referred as sites, nodes, computers, and so on.

4. Network operating System

A Network Operating System runs on a server and provides the server the capability to manage data, users, groups, security, applications, and other networking functions. The primary purpose of the network operating system is to allow shared file and printer access among multiple computers in a

network, typically a local area network (LAN), a private network or to other networks. Examples of network operating systems include Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, and BSD.

5. Real Time operating System

A real-time system is defined as a data processing system in which the time interval required to process and respond to inputs is so small that it controls the environment. The time taken by the system to respond to an input and display of required updated information is termed as the response time. So in this method, the response time is very less as compared to online processing. A real-time operating system must have well-defined, fixed time constraints, otherwise the system will fail. For example, scientific experiments, medical image systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.

There are two types of real-time operating systems:

5.1 Hard real-time systems

Hard real-time systems guarantee that critical tasks complete on time. In hard real-time systems, secondary storage is limited or missing and the data is stored in ROM. In these systems, virtual memory is almost never found.

5.2 Soft real-time systems

Soft real-time systems are less restrictive. A critical real-time task gets priority over other tasks and retains the priority until it completes. Soft real-time systems have limited utility than hard real-time systems. For example, multimedia, virtual reality, Advanced Scientific Projects like undersea exploration and planetary rovers, etc.

Attempt any eight questions:

(8×5=40)

4. What is the role of control unit in CPU? How analog computers differ from digital?

Ans: The control unit (CU) is a component of a computer's central processing unit (CPU) that directs the operation of the processor. It tells the computer's memory, arithmetic and logic unit and input and output devices how to respond to the instructions that have been sent to the processor.

Functions of the Control Unit

- It coordinates the sequence of data movements into, out of, and between a processor's many sub-units.
- It interprets instructions.
- It controls data flow inside the processor.
- It receives external instructions or commands to which it converts to sequence of control signals.
- It controls many execution units (i.e. ALU, data buffers and registers) contained within a CPU.
- It also handles multiple tasks, such as fetching, decoding, execution handling and storing results.

Difference between Analog and Digital Computer

Analog Computer	Digital Computer
It is difficult to use.	They are easy to use.
Mainly used in the science field.	It can be used in all fields.
They work on a continuous signal.	It works on the discrete signal.
The analog computer uses the network of the capacitors and resistors.	They use a large number of logic gates and microprocessors.

The speed of the analog computer is slow.	It is faster than the analog computer.
It is less reliable.	They are more reliable than analog computers.
The output of this computer is in the graphical form and is a voltage signal.	The output of this computer is in numbers.
It has some limited ability to act as the digital system.	It has the ability to emulate the behavior of analog computers.
It measures quantities like voltage, temp, etc.	It is used to calculate the mathematical operations, and to solve the complex calculations, etc.
Analog computer has low memory.	The digital computer has a large memory.
It is less accurate.	They are more accurate than the analog computer.
They are a specific purpose.	It is general-purpose.

5. How RISC architecture differ from CISC architecture?

Ans: A complex instruction set computer is a computer where single instructions can perform numerous low-level operations like a load from memory, an arithmetic operation, and a memory store or are accomplished by multi-step processes or addressing modes in single instructions, as its name propose "Complex Instruction Set".

A reduced instruction set computer is a computer which only uses simple commands that can be divided into several instructions which achieve low-level operation within a single CLK cycle, as its name propose "Reduced Instruction Set".

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. CISC 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 separate hardware to implement instructions.	4. It has a memory unit to implement complex instructions.
5. It has a hard-wired unit of programming.	5. It has a microprogramming unit.
6. The instruction set is reduced i.e. it has only a few instructions in the instruction set. Many of these instructions are very primitive.	6. The instruction set has a variety of different instructions that can be used for complex operations.

7. The instruction set has a variety of different instructions 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. Complex addressing modes are synthesized using the software.	8. CISC already supports complex addressing modes
9. Multiple register sets are present	9. Only has a single register set
10. RISC processors are highly pipelined	10. They are normally not pipelined or less pipelined
11. The complexity of RISC lies with the compiler that executes the program	11. The complexity lies in the micro-program
12. Execution time is very less	12. Execution time is very high
13. Code expansion can be a problem	13. Code expansion is not a problem
14. The decoding of instructions is simple.	14. Decoding of instructions is complex
15. It does not require external memory for calculations	15. It requires external memory for calculations
16. The most common RISC microprocessors are Alpha, ARC, ARM, AVR, MIPS, PA-RISC, PIC, Power Architecture, and SPARC.	16. Examples of CISC processors are the System/360, VAX, PDP-11, Motorola 68000 family, AMD, and Intel x86 CPUs.
17. RISC architecture is used in high-end applications such as video processing, telecommunications and image processing.	17. CISC architecture is used in low-end applications such as security systems, home automation, etc.

6. What is the purpose of cache memory? How sequential accesses differ from direct access?

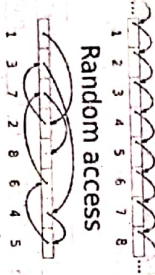
Ans: Cache memory, also called CPU memory, is high-speed static random access memory (SRAM) that a computer microprocessor can access more quickly than it can access regular random access memory (RAM). This memory is typically integrated directly into the CPU chip or placed on a separate chip that has a separate bus interconnect with the CPU. The purpose of cache memory is to store program instructions and data that are used repeatedly in the operation of programs or information that the CPU is likely to need next. The computer processor can access this information quickly from the cache rather than having to get it from computer's main memory. Fast access to these instructions increases the overall speed of the program.

Data is stored in the computer in many forms. One way of storing data in computers is in magnetic tapes also known as magnetic drives or hard drives. In hard drives data is kept for long period of time. We can store files, movies, songs, databases in hard drives which we need on daily basis. Some type of data that we don't need is erased from the computer by us. But that deleted data still exists on hard drives and can be retrieved by different recovery software.

For accessing data faster, we use random access memory also known as RAM. Since RAM data is temporarily stored in random locations. Each location is given an ID to identify it. Data is stored in RAM in an index form like we store data in arrays. In indexing, each item is recognized by an item number also known as the index. For reading data from RAM, we use direct access method. As operating system knows all the indexes stored in the RAM, it can access data directly. Indirect memory access we need extra memory for storing index locations, header, footer etc.

Sequential access

Random access



7. Explain the working mechanism of a keyboard.

Ans: A computer keyboard is an input device used to enter characters and functions into the computer system by pressing buttons, or keys. It is the primary device used to enter text. A keyboard typically contains keys for individual letters, numbers and special characters, as well as keys for specific functions. A keyboard is connected to a computer system using a cable or a wireless connection.

Inside the keyboard, there are metallic plate, circuit board (key matrix) and processor, which are responsible for transferring information from the keyboard to the computer. Depending upon the working principle, there are two main types of keys, namely, capacitive and hard-contact.

Capacitive Key

On the underside of a capacitive key, a metal plunger is fixed, which helps in activating the circuit flow. When a capacitive key is pressed, the metal plunger applies a gentle pressure to the circuit board. The pressure is identified by the computer and the circuit flow is initiated, resulting in the transfer of information from the circuit to the currently installed software.

Hard Contact Key

A hard contact key is attached with a metallic plate that helps in connecting the circuit board. When the hard contact key is pressed, it pushes a metallic plate, which in turn, touches the metallic portion of the circuit plate. This overall process of completing a circuit results in a circuit flow, allowing the transfer of the message to the central processing unit (CPU), which is further transmitted to the software.

In both the key types, the circuit signals the processor to read and/or identify the character that has been pressed. For example, in a hard contact key, the processor reads that pressing shift and 'a' keys at the same time corresponds to 'A'. Hence accordingly, the letter, sign or symbol is displayed on the screen. Releasing the pressed key breaks the circuit flow, after which the key retains its original position. The communication between a computer keyboard and main computer is bi-directional, meaning that message or information can be sent within each other.

8. Why IP address is used in internet? Mention the significance of domain names in internet.

Ans: The Internet Protocol Address (or IP Address) is a unique address that computing devices such as personal computers, tablets, and smart phones use to identify itself and communicate with other devices in the IP network. Any device connected to the IP network must have a unique IP address within the network. An IP address is analogous to a street address or telephone number in that it is used to uniquely identify an entity.

An IP address serves two principal functions. It identifies the host, or more specifically its network interface, and it provides the location of the host in the network, and thus the capability of establishing a path to that host. Its role has been characterized as follows: "A name indicates what we seek. An address indicates where it is. A route indicates how to get there." The header of each IP packet contains the IP address of the sending host, and that of the destination host.

Domain names in internet

Each computer on the Internet has an Internet protocol (IP) address: a unique string of four numbers separated by periods, such as 165.166.0.2. Since remembering the IP addresses of all of your favorite Web sites would be nearly impossible, a group of computer scientists created the domain name system to assign a unique name to each numeric IP address.

Importances of domain name are listed below:

- A domain name adds credibility to your small business.
 - A domain name says you're forward-thinking.
 - A domain name adds mobility to your Internet presence
 - The right domain name can attract walk-in business
 - A domain name builds your brand
9. Define computer network. Suppose you have a two story building having 15 computers in each of two floors. Now if you are asked to create a network of these computers, what type of network will you create? Give proper justification to your answer.

Ans: A computer network is a set of computers connected together for the purpose of sharing resources. The most common resource shared today is connection to the Internet. Other shared resources can include a printer or a file server. The Internet itself can be considered a computer network.

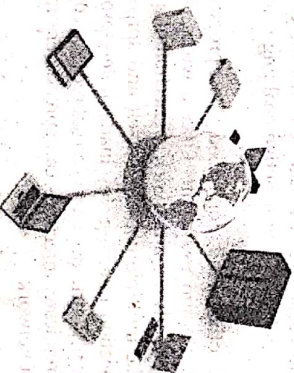
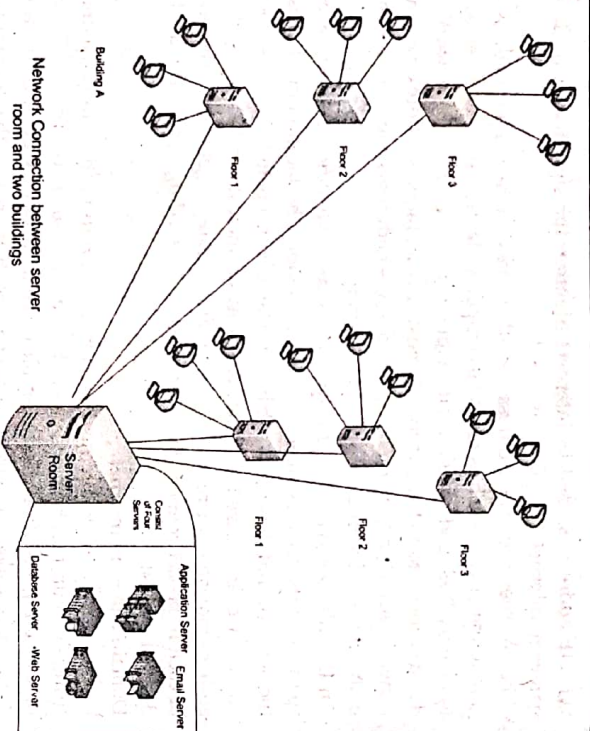


Fig: Computer network



10. What is malicious software? How virus differ from worms?

Ans: Malicious software, commonly known as malware, is any software that brings harm to a computer system. Malicious Malware Software attacks a computer or network in the form of viruses, worms, trojans, spyware, adware or rootkits. Their mission is often targeted at accomplishing unlawful tasks such as robbing, protected data, deleting confidential documents or adds software without the user consent.

An important distinction between computer viruses and worms is that viruses require an active host program or an already-infected and active operating system in order for viruses to run, cause damage and infect other executable files or documents, while worms are stand-alone malicious programs that can self-replicate and propagate via computer networks, without human help.

• Viruses are typically attached to an executable file or a word document. They often spread via P2P file sharing, infected websites, and email attachment downloads. Once a virus finds its way onto your system, it will remain dormant until the infected host file or program is activated, which in turn makes the virus active enabling it to run and replicate on your system.

• Worms, on the other hand, don't need a host program in order for them to run, self-replicate and propagate. Once a worm has made its way onto your system, usually via a network connection or as a downloaded file, it can then make multiple copies of itself and spread via the network or internet connection infecting any inadequately-protected computers and servers on the network. Because each subsequent copy of a network worm can also self-replicate, infections can spread very rapidly via the internet and computer networks.

11. Discuss the characteristics of multimedia.

Ans: A Multimedia system has four basic characteristics:

- Multimedia systems must be computer controlled.
- Multimedia systems are integrated.
- The information they handle must be represented digitally.
- The interface to the final presentation of media is usually interactive.

12. What is database system? How data can be stored using relational model.

Ans: A database system consists of database, database Management system, and application programs. Simply, we can say that application software that uses DBMS for data management is called database system. For example, in a database management system, the Human Resource (HR) system, accounting management system, Project management system and Budget management programs would have a common database. This database based approach to data processing is shown in fig below:

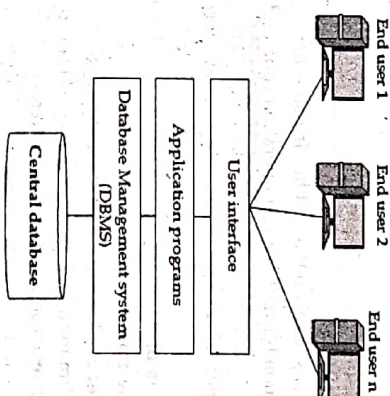


Figure: Database system approach to data processing

In this model, data is organized in two-dimensional tables and the relationship is maintained by storing a common field i.e. by using primary key and foreign key. The basic structure of data in the relational model is tables. All the information related to a particular type is stored in rows of that table. Hence, tables are also known as relations in relational model. In the coming tutorials we will learn how to design tables, normalize them to reduce data redundancy and how to use Structured Query language to access data from tables.

Student			Course		
sid	sname	age	cid	Cname	teacher
1	Aabin	17	c1	C++	Mr. Bhupl
2	Aarav	22	c2	JAVA	Mr. Deepak
3	Ashana	15	c3	NM	Mr. IC
4	Anuj	34	cid	DBMS	Mr. Sukraj

Student-course		
sid	cid	marks
1	c1	77
2	c1	98
3	c3	67
4	c2	34
2	cid	98

Figure: Relational data model