Unit-1 : Operating System Overview.

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Introduction.

Computer software can be divided into two main categories : application software and system software.

Application software is used by the user to perform certain task. They are installed according to user's requirements. Some examples: Photoshop, VLC player, etc.

On the other hand, system software is meant to administer the system resources. It serves as a platform for running the application software. Examples: Operating system(OS), windows defender, etc.

Definition: Operating Software(OS)

It is a collection of programs that acts as an interface between a user, apps and the computer hardware. It hides the complexities of hardware from the users and serves as a platform for running the application softwares. Ex: Windows, Linux

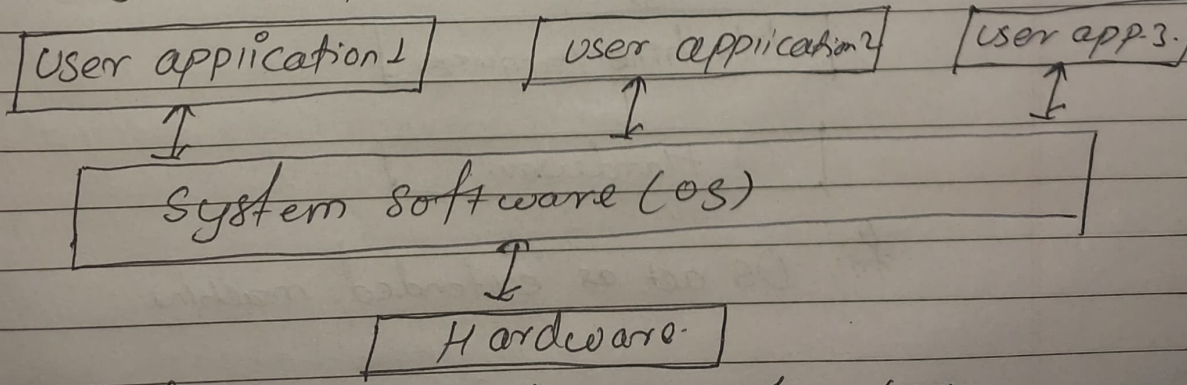

fig: Overview of Comper system (OS)

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* Aspects (views) of operating system.

(user view)

1) Operating system as an extended machine.

As we know, a computer user is never interested how a computer works, how complex are its hardwares, how those components work together to perform the task and so on. The user only needs the task to be completed. In this aspect, the function of the OS is to present the user with the equivalence or extended machine or virtual machine that is easier to program than the underlying hardware. To achieve it all, the OS provides a variety of service that programs can obtain using special instruction called system calls.

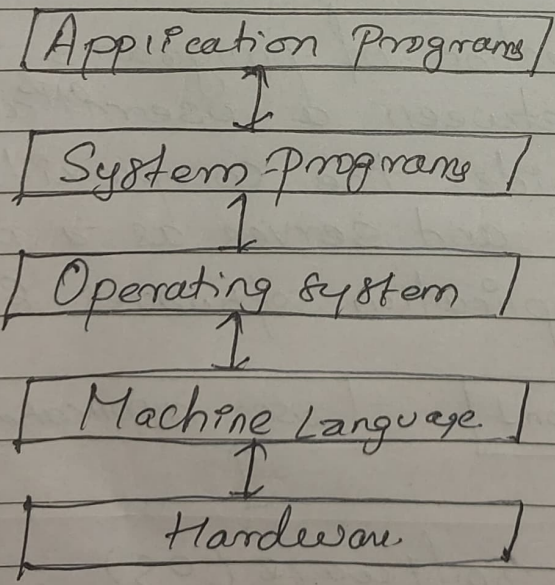

fig: OS act as extended machine.

2) Operating System as a Resource Manager.

OS is also known as resource manager. There are varieties of resources available in the computer system. One of the main task is to manage the available resources

The resources such as processor time, RAM space, I/o storage, files, directories, variables should be properly managed for the computer to work with higher reliability and better performance. The better the OS manages the resources, the quicker the user gets their job done.

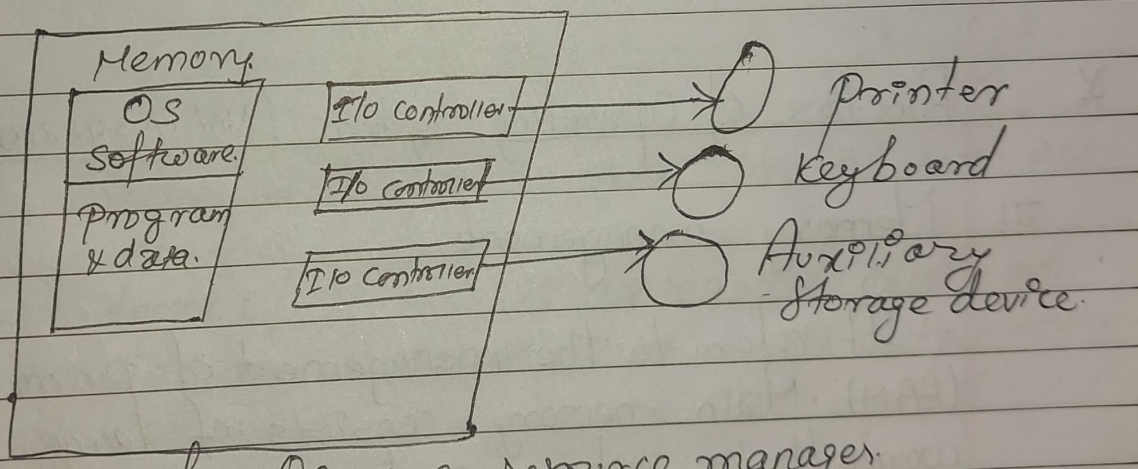

Fig: OS as a resource manager.

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* Objectives and Goal of OS.

The purpose of OS is to provide an environment in which a user can execute programs. The primary goal of OS is to make computer convinent to use. A secondary goal is to use the computer hardware in an efficient manner.

The objectives are as follows:-

1. To hide the details of the hardware
2. To allocate resources to process
3. To provide pleasant and effective user interface.

* Functions of Operating System. (Not in syllabus but imp)

a) Memory management

It refers to the management of primary memory (RAM). Main memory consists of large array of words/bytes where each word/byte has its own address.

- OS keeps track of primary memory ie. what part of it is used by whom, which parts are not in use
- In multiprogramming, OS decides which process will get memory when and how much.
- Allocate & deallocate the memory for process when needed and terminated.

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b) Process Management

In multiprogramming environment, OS decides which process get the processor and for how much time. The function is called process scheduling.

- OS keeps track of processor and its status
- Allocate processor to process
- Deallocate processor - when process no longer needs it

c) Device Management

OS manages device communication through respective drivers.

- It decides which process gets the OS when and how much time.
- Keep track of all devices using I/O controllers.
- Allocate and deallocate the input output device in effective way.

d) File Management

A file system is organised. input directories for easy navigation & use. These directories contain different types of file.

- OS keeps track of location & status of file
- Allocate & deallocate the ~~input/output~~ resources for the file managing system.

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Some Secondary functions of os include:
→ Security
→ Job Accounting
→ Error detection
→ co-ordination between other software & users.

* Views of Operating System

1) User View.

* Evolution / History of OS

The first true digital Computer was designed by the English mathematician; Charles Babbage, but this computer was purely mechanical and did not have an operating system. Later, he hired Ada Lovelace as the worlds first programmer to make the software.

Operating system are closely tied to the architecture of the computers on which they run. So, successive generations of computers describes describes what their operating systems were like.

1st generation (1945-1955)
→ Vacuum tubes were used as building machine
→ Programming language & Operating System were unknown
→ A single group of people designed, built, programmed, operated & maintained each machine.

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→ All programming was done in absolute machine code.

2nd generation (1955-1965):

→ Transistors were used as building machine
→ Introduction to punch cards.
→ Programs were written in FORTAN & Assembly language.
→ Typical OS were used FMS(FORTON Monitor System) & IBSYS (IBM's Operating system)

3rd generation (1965-1980)

→ Integrated circuits (IC's) were used for building machines
→ Multiprogramming came into existence so that processors could be kept busy 100 % all the time.
→ OS: OS/360, MULTICS, CTSS were used.

4th generation (1980-present)

→ Large scale Integration (LSI) & Very Large Scale Integration (VLSI) were used as building machines.
→ Microcomputers came into existence: IBM PC, Apple MAC.
→ Introduction to Windows & their different versions like XP, Windows 7, 8, 10, etc.

Evolution of OS: 1969: UNIX OS was developed in Bell lab

1991: Linux
1993: Windows NT
2007: IOS
2008: Android OS.

1972: IBM comes out with VM virtual machine OS
1973: UNIX 4th edition published
1976: Apple II
1981: IBM introduced IBM PC
1983: Microsoft works on MS-windows
1984: Apple Macintosh
1990: Microsoft windows 3.0

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* Types of Operating Systems.

i) Mainframe Operating System:

→ The operating systems used in mainframe computers are called mainframe operating systems.
→ OS/390 is an example of Mainframe OS
→ Mainframe OS have very high I/O capacity.
→ They provide three types of service: batch processing, transaction processing & timesharing

ii) Server Operating System:

→ The OS which run on servers, which are either very large personal computers, workstations or even mainframes, are called server OS.
→ Linux, Windows 2000 are its example
→ They serve multiple users at once over a network and allow the users to share software and hardware resources.
→ They provide services like print service, file Service or web service.

iii) Multiprocessor Operating Systems:

→ If more than one processor is used to handle multiple tasks at a time & reduce systems work load then, this is called a multiprocessor OS.

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→ By connecting multiple CPU's into a single system we can get heavy computing power out of the machine.
→ In multiprocessor system, all processor operate under single OS
→ Depending upon how they are connected & what is shared, these systems are called parallel computers, multicomputers or multiprocessors.

iv) PC Operating System.

→ Operating system used in personal computers
→ They have comparatively less processing power and memory than mainframes
→ Windows-7, Macintosh, Linux are its examples
→ They are widely used for word processing, spreadsheet, and internet access

v) Real-time operating system

→ The OS which are time sensitive are called RTOS
→ QNX, RT Linux, HART etc are its examples
→ It provides maximum time for each of the critical operation it performs Ex: OS calls.
→ They provide quick event response, & thus meet the scheduling deadlines

Real-time operating systems (RTOS) are used in environments where a large number of events, mostly external to the computer system, must be accepted and processed in a short time or within certain deadlines. such applications are industrial control, telephone switching equipment, flight control, and real-time simulations.

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vii) Embedded OS

→ The OS which run on embedded device such as microwave, TVs, washing machines etc.
→ Example: palm os, windows customer electronics, etc.
→ These processors have generally low processing power, memory size and battery life.

viii) Smart card OS

→ The smallest OS running on smart card.
→ The smart card are credit card devices containing CPU, OS and memory.
→ Resource management & protection are two of the main tasks of smart card OS.

viii) Multiprogramming OS

→ Multiprogramming is a technique to execute no. of programs simultaneously in a single processor.
→ Multitasking & multiprocessing are two different forms of multiprogramming.
→ In this system, OS executes the jobs from memory. It switches to another job once the job needs an I/O operations.
→ If several jobs are running at same time, then system choses which one to run through process of CPU scheduling.
→ In multiprogramming, CPU will never be idle & keeps on processing.

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Operating System Structure.

Operating system is divided into two categories:

a) Simple Structure.

These type of operating system have simple system and rapidly expanded much further than their scope. Ex: Ms-Dos. It was designed simply for a small groups of people and company.

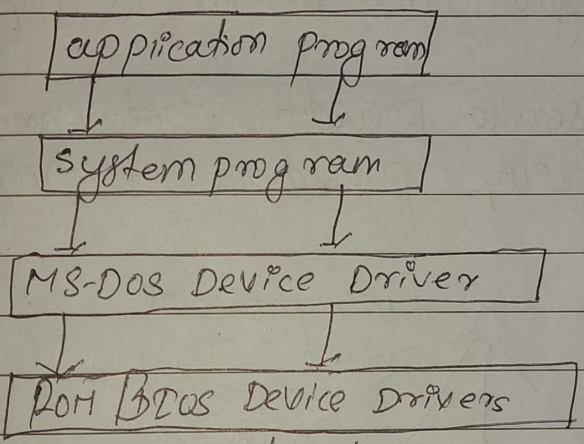


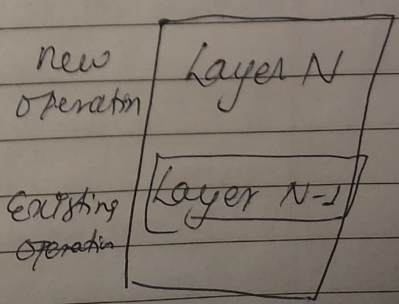
Fig: MS-DOS Structure.

b) Layered Structure.

Organizing Os as a hierarchy of layers, each one constructed upon one below it. One way to achieve modularity is layered approach. Bottom layer is hardware & topmost layer is UI.

Layers function:

5- operator
4- Uses program
3- I/o management
2- Operator proces
1- Memory management
0- processor allocation & multiprogramming



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c) Monothoilic System.

These systems are written as a collection of procedures, each of which can call any of the other ones whenever it needs to. When this technique is used, each procedure in the system has a well defined interface in terms of parameters & results, & each one is free to call any other one.

This organization suggests a basic structure for the os

→ A main program that invokes the requested service procedure.
→ A set of service procedures that carry out system calls
→ A set of utility procedures that help the service procedures

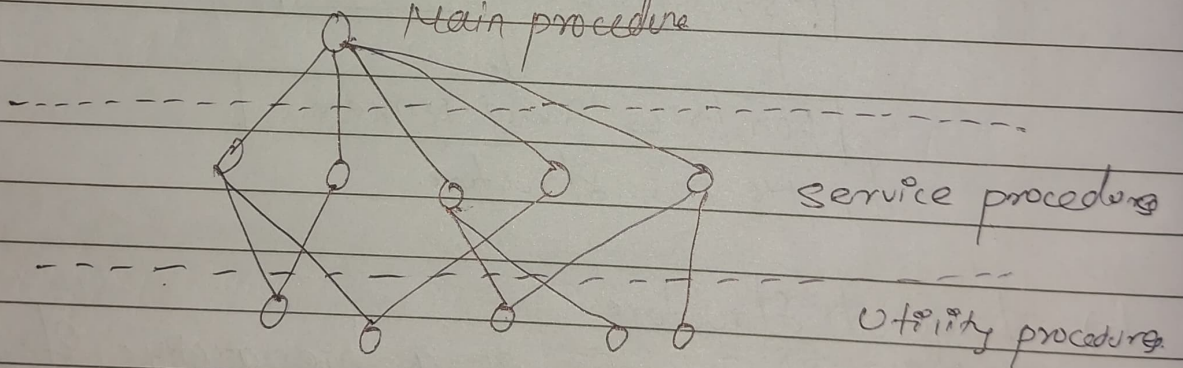

fig. A simple structuring model for monothoilic systems.

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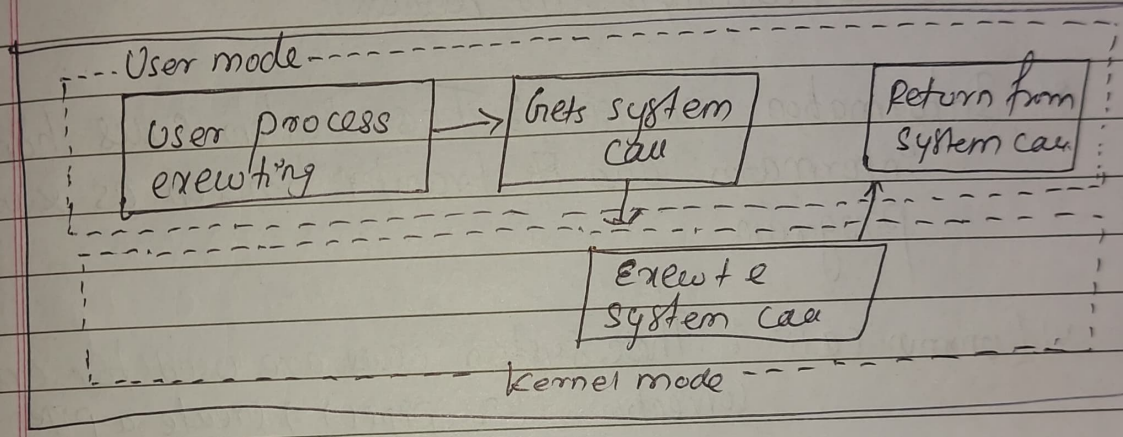
System call.

→ The interface between a process and an OS is provided by system call.

→ System calls are usually made when a process in user mode requires access to resources. Then it requests their kernal to provide the resource through a system call.

Execution of system call:



System calls are required in following situations.

a) If a file system requires the creation or deletion of files, reading & writing from files.
b) Creation and management of new process
c) Network connection also requires system call
d) Access to hardware devices such as printer, scanner

Types of system calls:

There are five types:

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i) Process Management (contn) => These system deals with processes such as process creation, process termination. Ex: fork() => create a process, exit() => exit process & wait() => wait for single object

ii) File management : These system calls are responsible fore file manipulation such as creating a file, writing in file. Ex:- open() => open a file for read & write. read() => read a file, write() => write a file, close() =>

iii) Device Management : These system calls are responsible for device manipulation such as reading from I/O devices, writing to I/O devices.

iv) Information maintenance : These system calls handles information and its transfer between OS & user program.

v) Communication : These system calls are used for creating connection. Ex: pipe() => create a pipe

vi) Directory Management: Ex: mkdir() => create a new directory
rmdir() => remove an empty directory
unlink() => remove a directory entry
mount() => mount a file system
unmount() => unmount " "

* System programs

System programs provide an environment where programs can be developed and executed. They provide a bridge between the user interface & system calls. It serves as a part of OS. The user view of the

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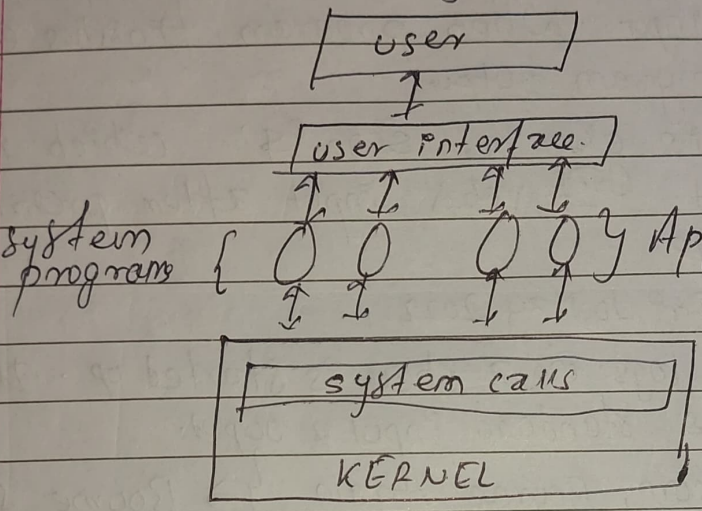
System is actually defined by system programs & not system calls because that is what they interact with & system programs are closer to the user interface. Eg: a Compiler is a complex system program. An image that describes system programs in the OS hierarchy is:



Here, System programs as well as application programs form a bridge between the user interface & the system calls. So, from the user view the operating system observed is actually the system programs & not the system calls.

* Handling system calls (How system call works?)

Note: Draw figure same as in system call figure

The steps in handling system calls are:

Step 1) The process executed in user mode till time a system call interrupts it.

Step 2) After that, the system call is executed in the kernel-mode on a priority basis.

Step 3) Once system call execution is over, control returns to the user mode.

Step 4) The execution of user processes resumed in kernel mode.

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* Shell

→ A shell is an environment in which we can run our command, program & scripts.
→ It provides an interface to UNIX / LINUX System.
→ It gathers inputs from user & execute programs based on the input. When program finishes executing, it displays program output
→ Shell prompt is given by sign '$' which is called Command prompt. It takes input after pressing 'Enter'
Ex: $ date
Fri 10 May 2022
→ When any user logs in, a shell is started up. It has the terminal as standard input & output.
→ Type: Bourne, korn, Bourne Again } → Bourne shell
C shell, TENEX/ TOPS C shell } C type shell
→ Bourne shell was 1st shell in UNIX OS.

* Open Source OS.

→ The operating systems that are open to all, anyone can get the source code and make desirable changes are called open-source operating systems
→ They are released under a license where copyright holder allows other to study, change as well as distribute the software to other people.
→ Ex. Android is open source, so phones of different manufacturer have different look and feel to it.

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The different types of Open source OS are:

i) Cosmos (Open source managed operating system)
- This is an open source OS written in C#
- It hides the inner workings of hardware from developers thus providing data abstraction.
- Till 2016, cosmos did not intend to be a fully fitted with features but this system allowed other developers to easily build their own OS.

ii) Free Dos.
- Free Dos was developed for system compatible with IBM computers.
- It provides a complete environment to run legacy softwares.
- It can be easily booted from USB, floppy disk.
- It is licensed under GNU (General Public License) & contains free and open source software.

iii) Genode.
- This OS contains a Microkernel layer & different user components.
- It is one of the few open source os not derived from unix.
- It can be used as an OS for computer, tablets etc.

iv) Ghost OS

v) Phantom OS

Some popular open source OS in 2022:
- Ubuntu, Linux lite, Linux mint, chrome OS, etc.

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Q. What are the two modes of operating system?

⇒ The operating system has two modes of operation to ensure it works correctly: User mode & Kernel mode.

1. User mode

When the computer system runs user applications like file creation or any other application program in the user mode, this mode does not have direct access to the computer's hardware. For performing hardware related tasks, the system must switch to kernel mode. To access the RAM or other hardware resources, it has to make system calls to the underlying API's to access these resources. The bit mode is 1.

2. Kernel mode.

The system starts in kernel mode when it boots up. The kernel mode has direct access to all the underlying hardware resources so, it handles all the processes which require hardware support. Apart from this, the main functionality of the kernel mode is to execute privileged instructions. Privileged instructions are not provided with user access, so they can't be processed in user mode. The bit mode is 0.

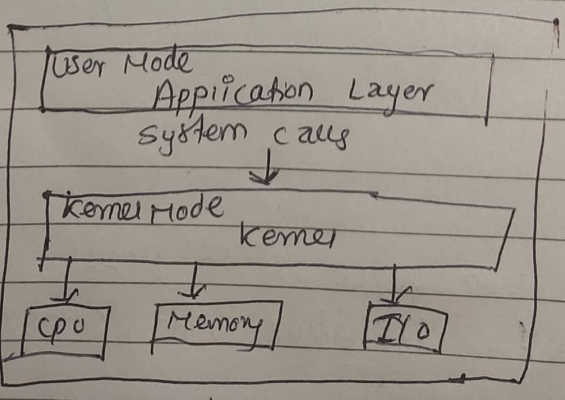

fig: User mode & Kernel mode.

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Some questions asked in Exam

Q. Define Monotholic & Layered systems (2075 - 5 marks)

Q. What are two modes of os? Discuss different OS Structures briefly? (2076 - 5 marks)

Q. Differentiate between time sharing & real time systems (2074 (2072)

Q. Classify the following applications as batch-oriented or interactive & explain the reason (2073 - 5 marks)

a) word processing
b) Generating monthly bank statement.
c) Computing Pi to a million decimal places.

Q. How operating system is a resource manager? (2071) (2075)

Q. How physical address is generated from logical address? Explain process of system call with diagram? (2072)

Q. Distinguish between Batch system & Time sharing sys (2075)

Q. "OS is broker between computer system & user" justify (2071)