CIT211 INTRODUCTION TO OPERATING SYSTEMS SUMMARY

An _____ can be defined as a set of computer programs that manage the hardware and software resources of a computer.

Operating System (OS)

An Operating System (OS) can be defined as a set of computer _____that manage the hardware and software resources of a computer.

programs

An Operating System (OS) can be defined as a set of computer programs that manage the _____and software resources of a computer.

Hardware

An Operating System (OS) can be defined as a set of computer programs that manage the hardware and _____resources of a computer.

software

An Operating System (OS) can be defined as a set of computer programs that manage the _____ and_____ resources of a computer.

hardware and software

_____ is the core of computer programming that primarily deals with computer architecture.

Operating System

Operating System is the core of computer programming that primarily deals with computer_____.

architecture

_____ is basically an application program that serves as an interface to coordinate different resources of computer.

Operating system

An _____ processes raw system and user input and responds by allocating and managing tasks and internal system resources as a service to users and programs of the system.

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operating system

But simply put, an _____can be defined as a suite (set) of programs implemented either in software or firmware (hardwired instructions on chips usually in ROM) or both that makes the hardware usable.

Operating system

At the foundation of all system software, an operating system performs basic tasks such as_____

Controlling and allocating memory, prioritizing system requests, controlling input and output devices, facilitating networking and managing file systems

Most operating systems come with an application that provides an interface to the OS managed resources.

True

Most operating systems come with an application that provides an _____to the OS managed resources.

Interface

GUI is an acronym for_____

Graphical User Interface

The _____ forms a platform for other system software and for application software.

operating system

The operating system forms a platform for other _____and for application software.

system software

The operating system forms a platform for other system software and for_____.

application software

Windows, Linux, and Mac OS are some of the most popular examples of_____

operating system

When there is no OS, users of computer system will need to write _____ in order to manipulate the hardware.

machine-level program

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_____ provide a convenient interface for using the computer system.
OS

An _____ allows computer system resources to be used in an efficient manner.
OS

An OS allows computer system resources to be used in an _____manner.
efficient

A _____can be viewed as a layered or hierarchical structure consisting of the hardware, operating system, utilities, application programs and users.
computer system

A computer system can be viewed as a layered or hierarchical structure consisting of the_____, operating system, utilities, application programs and users.
hardware

A computer system can be viewed as a layered or hierarchical structure consisting of the hardware, _____, utilities, application programs and users.
operating system

A computer system can be viewed as a layered or hierarchical structure consisting of the hardware, operating system, _____, application programs and users.
utilities

A computer system can be viewed as a layered or hierarchical structure consisting of the hardware, operating system, utilities, _____and users.
application programs

A computer system can be viewed as a layered or hierarchical structure consisting of the hardware, operating system, utilities, application programs and_____.
users

The users of application programs are called the _____and are generally not concerned with the computer's architecture.
end-users

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The _____ views the computer system in terms of an application.
end-user

The users of application programs are called the end-users and are generally not concerned with the_____.
computer's architecture

The end-user views the computer system in terms of an_____.
Application

The _____ is developed by the application programmer who uses a programming language and a language translator.
application

The application is developed by the _____who uses a programming language and a language translator.
application programmer

The application is developed by the application programmer who uses a _____and a language translator.
programming language

The application is developed by the application programmer who uses a programming language and a_____.
language translator

A set of programs called the _____is provided to assist the programmer in program creation, file management and the control of Input/Output (I/O) devices.
Utilities

A set of programs called the utilities is provided to assist the programmer in program creation, file management and the control of _____devices.
Input/Output (I/O)

The most important system program, _____masks the details of the hardware from the programmer and provides a convenient interface for using the system.
operating system

_____ acts as a mediator, making it easier for the programmer and for application programs to access and use the available services and facilities.

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operating system

A computer system has a set of _____ for the movement, storage and processing of data
resources

The _____ directs the processor in the use of the other system resources and in the timing of its execution of other programs.
OS

The portion of the OS that is always in main memory is called the _____or nucleus
Kernel

The portion of the OS that is always in main memory is called the kernel or _____
nucleus

The kernel is also called_____
nucleus

The services provided by the OS can be categorised into _____
two

CDROM means_____
Compct Disc Read Only Memory

There are_____ major ways in which communication can occur
Two
In the area of system efficiency, the OS offer the following services:
i. System Access or Protection
ii. Resources Allocation
iii. Accounting
iv. Ease of Evolution of OS
v. New Services
vi. Error correction

Other features provided by the OS includes

- Defining the user interface
- Sharing hardware among users
- Allowing users to share data
- Scheduling resources among users

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- Facilitating I/O
- Recovering from errors

The conveniences offered the user are in diverse and following ways:
i. Program Creation
ii. Program Execution
iii. Access to I/O devices
iv. Controlled Access
v. Communications

Operating system was absent in the first commercial form of electronic computer launched in_____.
1940's

_____ of mechanical switches were used to enter programs.
Rows

_____ was a master of program debugging on the early Manchester Mark I machine
Alan Turing

Alan Turing was a master of program debugging on the early _____ machine
Manchester Mark I

To facilitate the use of the_____, operating systems were developed
hardware

To facilitate the use of the hardware, _____were developed
operating systems

The history of computer operating systems parallels that of computer hardware which can be generally divided into five distinct time periods called_____
generations

The term _____ is used to refer to the period when there was no OS.
zeroth generation

_____ is the period before the commercial production and sale of computer equipment.
zeroth generation

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The development of the first commercial computer took place in_____
1951

The first electronics digital computers on the ABC was designed by _____in 1940
John Atanasoff

The first electronics digital computers on the ABC was designed by John Atanasoff in _____
1940

The Mark I, built by Howard Aiken and a group of IBM engineers at Harvard in _____
1944

The ENIAC was designed and constructed at the University of Pennsylvania by_____.
Wallace Eckert and John Mauchly

EDVAC was developed in 1944-46 by_____
John von Neumann, Arthur Burks, and Herman Goldstine

The development of _____ set the stage for the evolution of commercial computing and operating system software.
EDVAC

The hardware component technology of the computer development period was _____.
electronic vacuum tubes

The mode of operation was called _____and this meant that users signed up for computer time and when a user's time arrived, the entire (in those days quite large) computer system was turned over to the user.
open-shop

The _____ generation marked the beginning of commercial computing.
first

The first generation marked the beginning of _____computing.
Commercial

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Operation continued without the benefit of an operating system for a time. The mode was called _____
closed shop

IPL means_____
Initial Program Load

The _____ generation saw the evolution from hands-on operation to closed shop operation to the development of mono-programmed operating systems.
First

FORTRAN (Formula Translator) was developed by _____in 1956.
John W. Backus

FORTRAN (Formula Translator) was developed by John W. Backus in_____.
1956

FORTRAN stands for_____
Formula Translator

The _____ generation of computer hardware was most not ably characterized by transistors replacing vacuum tubes as the hardware component technology.
Second

The _____ allowed some I/O to be buffered.
data channel

The _____ generation was a period of intense operating system development.
Second

Compatible Time Sharing System (CTSS) was developed at MIT during the early _____
1960s

CTSS means_____
Compatible Time Sharing System

The _____ generation officially began in April 1964 with IBM's announcement of its System/360 family of computers.
third

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The third generation officially began in _____ with IBM's announcement of its System/360 family of computers.
April 1964

The third generation officially began in April _____ with IBM's announcement of its System/360 family of computers.
1964
The third generation hardware technology used_____
integrated circuits

The _____ generation is characterized by the appearance of the personal computer and the workstation.
fourth

The fourth generation is characterized by the appearance of the _____and the workstation.
personal computer

The fourth generation is characterized by the appearance of the personal computer and the_____.
Workstation

LSI means_____
Large Scale Integration

VLSI means_____
Very Large Scale Integration

The component technology of the third generation was replaced by _____
Very Large Scale Integration (VLSI)

In computer science, the _____ is the central component of most computer operating systems (OS).
kernel

The responsibilities of_____ include managing the system's resources and the communication between hardware and software components.
kernel

Most operating systems rely on the _____ concept.
Kernel

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While it is today mostly called the_____, the same part of the operating system has also in the past been known as the nucleus or core.
kernel

While it is today mostly called the kernel, the same part of the operating system has also in the past been known as the_____.
nucleus or core

The term core has also been used to refer to the _____of a computer system
primary memory

Early computers used a form of memory called _____
Core memory

The kernel typically provides a loop that is executed whenever no processes are available to run, this is often called the_____.
idle process

The kernel's primary purpose is_____
to manage the computer's resources and allow other programs to run and use these resources

The CPU is frequently called the _____
processor

_____ is used to store both program instructions and data.
Memory

The _____ is responsible for deciding which memory each process can use, and determining what to do when not enough is available.
Kernel

Kernels also usually provide methods for synchronization and communication between processes called _____
inter-process communication or IPC

The main task of a _____ is to allow the execution of applications and support them with features such as hardware abstractions.
kernel

The main task of a kernel is_____

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to allow the execution of applications and support them with features such as hardware abstractions

The kernel generally also provides these processes a way to communicate this is known as _____
inter-process communication (IPC)

A situation where each process is allowed to run uninterrupted until it makes a special request that tells the kernel it may switch to another process. Such requests are known as _____
Yielding

_____ allows creation of virtual partitions of memory in two disjointed areas, one being reserved for the kernel (kernel space) and the other for the applications (user space).
Virtual addressing

PCI means_____
Peripheral Component Interconnect

USB means_____
Universal Serial Bus

Most commercial computer architectures lack _____support for capabilities.
MMU

Most commercial computer architectures lack MMU support for capabilities.
True

Approaches that delegate enforcement of security policy to the compiler and/or the application level are often called_____.
language-based security

_____ proved that from a logical point of view, atomic lock and unlock operations operating on binary semaphores are sufficient primitives to express any functionality of process cooperation.
Edsger Dijkstra

In Hansen's description of this, the "common" processes are called_____,
internal processes

The I/O devices are called_____.

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external processes

The Xen hypervisor, for example, is an_____.
Exokernel

Most kernels do not fit exactly into one of these categories, but are rather found in between these two designs. These are called_____.
hybrid kernels

The principle of _____ is the substantial difference between the philosophy of micro and monolithic kernels.
separation of mechanism and policy

A _____is the support that allows the implementation of many different policies
mechanism

A _____ is a particular "mode of operation".
Policy

PCI stand for_____
Peripheral Component Interconnect

The idea of a kernel where I/O devices are handled uniformly with other processes,as parallel co-operating processes, was first proposed and implemented by _____
Brinch Hansen

The has full access to the system's memory and must allow processes to access this memory safely as they require it _____
Kernel

When a program needs data which is not currently in RAM, the CPU signals to the kernel that this has happened, and and replacing it with the data requested by the program. The program can then be resumed from the point where it was stopped. This scheme is generally known as _____
demand paging

The computer is higher than the maximum number of processes the computer is physically able to run simultaneously_____
Multi-tasking kernels

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Kernels usually provide methods for synchronization and communication between processes called _____
inter-process communication

The data channel was controlled by a channel program set up by the operating system I/O control routines and initiated by a special instruction executed by the_____
CPU

A program's input data could be read "ahead" from data cards or tape into a special block of memory called a_____
Buffer

The Mark I was built by _____
Howard Aiken

Operating system was absent in the first commercial form of electronic computer launched in _____
1940

A policy is a particular "_____"
mode of operation

A _____ kernel instead tends to include many policies, therefore restricting the rest of the system to rely on them
monolithic

A _____instead tends to include many policies, therefore restricting the rest of the system to rely on them
monolithic kernel

In a_____, all OS services run along with the main kernel thread
monolithic kernel

In a _____ kernel, all OS services run along with the main kernel thread
Monolithic

The main disadvantages of monolithic kernels are_____

- the dependencies between system components
- a bug in a device driver might crash the entire system
- large kernels can become very difficult to maintain

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In the _____approach, the kernel itself only provides basic functionality that allows the execution of servers, separate programs that assume former kernel functions, such as device drivers, GUI servers, etc.
Microkernel

The _____approach consists of defining a simple abstraction over the hardware, with a set of primitives or system calls to implement minimal OS services such as memory management, multitasking, and inter-process communication.
Microkernel

The kernel such as networking are implemented in user-space programs referred to as_____.
Servers

Microkernels are easier to maintain than monolithic kernels
True

_____ generally underperform traditional designs, sometimes dramatically.
Microkernels

A _____ allows the implementation of the remaining part of the operating system as a normal application program written in a high-level language, and the use of different operating systems on top of the same unchanged kernel.
Microkernel

_____ argued that while microkernel designs were more aesthetically appealing, monolithic kernels were easier to implement.
Ken Thompson

_____ kernel proponents reason that incorrect code does not belong in a kernel, and that microkernels offer little advantage over correct code.
Monolithic

_____ are often used in embedded robotic or medical computers where crash tolerance is important and most of the OS components reside in their own private, protected memory space
Microkernels

_____ is a kernel architecture based on combining aspects of microkernel and monolithic kernel architectures used in computer operating systems.

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Hybrid kernel

_____ kernel is a kernel architecture based on combining aspects of microkernel and monolithic kernel architectures used in computer operating systems.
Hybrid

The _____ kernel approach tries to combine the speed and simpler design of a monolithic kernel with the modularity and execution safety of a microkernel.
Hybrid

_____ kernels are essentially a compromise between the monolithic kernel approach and the microkernel system.
Hybrid

Hybrid kernels are essentially a compromise between_____
the monolithic kernel approach and the microkernel system

The term_____ is sometimes used informally to refer to a very light-weight microkernel such as L4.
Nanokernel

A _____ is a very minimalist operating system kernel.
nanokernel or picokernel

A nanokernel is also known as_____
Picokernel

The _____ represents the closest hardware abstraction layer of the operating system by interfacing the CPU, managing interrupts and interacting with the MMU.
nanokernel

The nanokernel represents the closest hardware abstraction layer of the operating system by interfacing the CPU, managing interrupts and interacting with the_____.
MMU

The interrupt management and MMU interface are not necessarily part of a nanokernel
True

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A _____ delegates virtually all services – including even the most basic ones like interrupt controllers or the timer – to device drivers to make the kernel memory requirement even smaller than a traditional microkernel.
Nanokernel

A nanokernel is considered to be slower than a typical monolithic kernel due to_____
the management and communication complexity caused by the separation of its components

_____ of monolithic kernels (as present in for example the Linux kernel) are often considered to be very unstable and quite mutable.
APIs

_____ are often considered to be very unstable and quite mutable
APIs of monolithic kernels

_____ kernels generally suffer from a considerably bad security architecture because an inaccurate and insecure part directly affects the whole operating system.
Monolithic

Monolithic kernels generally suffer from a considerably bad security architecture because_____
an inaccurate and insecure part directly affects the whole operating system

_____ are not independently executable operating systems
Nanokernels

Nanokernels are not independently executable operating systems
True

A program running on an exokernel can link to a _____that uses the exokernel to simulate the abstractions of a well-known OS
library operating system

RTOS means_____
Real-Time Operating Systems

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_____ are used to control machinery, scientific instruments and industrial systems.
Real-Time Operating Systems

An _____ typically has very little user-interface capability and no end-user utilities since the system will be a sealed box when delivered for use.
RTOS

A very important part of an _____is managing the resources of the computer so that a particular operation executes in precisely the same amount of time every time it occurs.
RTOS

RTOS can be _____ or _____.
hard or soft

A _____RTOS guarantees that critical tasks are performed on time.
hard

A _____ RTOS is less restrictive.
Soft

_____ operating system is designed to manage the computer so that one user can effectively do one thing at a time.
Single-User

_____operating system is designed to manage the computer so that one user can effectively do one thing at a time.
Single-Tasking Operating System

_____ is the type of operating system most people use on their desktop and laptop computers today.
Single-User, Multi-Tasking Operating System

_____ are both examples of an operating system that will let a single user have several programs in operation at the same time.
Windows 98 and the Mac O.S.

A _____ allows many different users to take advantage of the computer's resources simultaneously.
multi-user operating system

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Unix, VMS, and mainframe operating systems, such as **MVS**, are examples of multi-user operating systems.

Modern computer operating systems may be classified into _____ groups
Three

Modern computer operating systems may be classified into three groups called_____, time-shared and real time operating systems.
batch

Modern computer operating systems may be classified into three groups called batch, _____and real time operating systems.
time-shared

Modern computer operating systems may be classified into three groups called batch, time-shared and_____
real time operating systems

Modern computer operating systems may be classified into three groups called_____
batch, time-shared and real time operating systems

In a _____ environment, users submit jobs to a central place where these jobs are collected into a batch, and subsequently placed on an input queue at the computer where they will be run.
batch processing operating system

In _____environment a computer provides computing services to several or many users concurrently on-line.
Time Sharing OS

_____ are designed to service those applications where response time is of the essence in order to prevent error, misrepresentation or even disaster.
real time operating systems

Examples of real time operating systems are those which handle airlines reservations, machine tool control, and monitoring of a nuclear power station.

A _____ is a system that allows more than one active user program (or part of user program) to be stored in main memory simultaneously.
multiprogramming operating system

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A _____ is a computer hardware configuration that includes more than one independent processing unit.
multiprocessing system

The term _____is generally used to refer to large computer hardware complexes found in major scientific or commercial applications.
Multiprocessing

A _____ is a collection of physical interconnected computers.
networked computing system

In a _____ operating system, the users are aware of the existence of multiple computers, and can log in to remote machines and copy files from one machine to another.
Network

Network operating systems are not fundamentally different from single processor operating systems.
True

A _____ consists of a number of computers that are connected and managed so that they automatically share the job processing load among the constituent computers, or separate the job load as appropriate particularly configured processors.
distributed computing system

The _____ computing environment and its operating systems, like networking environment, are designed with more complex functional capabilities.
Distributed

True distributed operating systems require more than just adding a little code to a uniprocessor operating system because_____
distributed and centralized systems differ in critical ways

DOS means_____
Disk Operating System

_____ refer to operating system software used in most computers that provides the abstraction and management of secondary storage devices and the information on them

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Disk Operating System

In some cases, the disk operating system component (or even the operating system) was known as_____.
DOS

On the PC compatible platform, an entire family of operating systems was called_____.
DOS

MS-DOS Version 1.0 was also referred to as _____
PC-DOS MS-DOS

A _____is a multitasking operating system intended for real-time applications.
real-time operating system (RTOS)

An _____ facilitates the creation of a real-time system, but does not guarantee the final result will be real-time this requires correct development of the software.
RTOS

In typical designs, a task has ____states
three

In typical designs, a task has three states:
1) Running
2) Ready
3) Blocked

Most tasks are_____, most of the time.
Blocked

The real key is designing the_____.
Scheduler
The critical response time, sometimes called the_____, is the time it takes to queue a new ready task and restore the state of the highest priority task.
flyback time

_____ operating systems usually do not allow user programs to mask (disable) interrupts, because the user program could control the CPU for as long as it wished.

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General-purpose

On a _____ processor, task switch times run about 20 microseconds with two tasks ready.
20MHz 68000

_____ ARM CPUs switch in a few microseconds.
100 MHz

A significant problem that multitasking systems must address is_____
sharing data and hardware resources among multiple tasks

It is usually _____for two tasks to access the same specific data or hardware resource simultaneously.
"**unsafe**"

_____ means the results are inconsistent or unpredictable, particularly when one task is in the midst of changing a data collection.
Unsafe

A binary _____ is either locked or unlocked.
Semaphore

A binary semaphore is either locked or_____.
Unlocked

A _____ semaphore is either locked or unlocked.
binary

A binary semaphore is either _____or unlocked.
Locked

In_____, a high priority task waits because a low priority task has a semaphore.
priority inversion

Problems with semaphore based designs are well known: _____and deadlocks.
priority inversion

Problems with semaphore based designs are well known: priority inversion and_____.

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deadlocks

Problems with semaphore based designs are well known:_____ and_____.
priority inversion and deadlocks

In a_____, two or more tasks lock a number of binary semaphores and then wait forever (no timeout) for other binary semaphores, creating a cyclic dependency graph.
Deadlock

Handling multiple levels of inheritance without introducing instability in cycles is not straightforward.
True

_____ is usually prevented by careful design, or by having floored semaphores (which pass control of a semaphore to the higher priority task on defined conditions).
Deadlock

The _____ deadlock scenario occurs when two tasks lock two semaphores in lockstep, but in the opposite order.
simplest

The simplest deadlock scenario occurs_____
when two tasks lock two semaphores in lockstep, but in the opposite order

The approach to resource sharing is for tasks to send_____.
Messages

_____ deadlocks occur when two or more tasks wait for each other to send response messages.
Protocol

Protocol deadlocks occur _____
when two or more tasks wait for each other to send response messages

_____ occurs when a task is working on a low-priority message, and ignores a higher-priority message (or a message originating indirectly from a high priority task) in its in-box.
Priority inversion

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Priority inversion occurs_____
when a task is working on a low-priority message, and ignores a higher-priority message (or a message originating indirectly from a high priority task) in its in-box

The _____ often provides the ability to unblock a task from interrupt handler
Scheduler

A standard _____ scheme scans a linked list of indeterminate length to find a suitable free memory block
memory allocation

Memory allocation is more critical in an RTOS than in other operating systems.
True

An _____ is an operating system which internally uses object-oriented methodologies.
object-oriented operating system

An _____ is in contrast to an object-oriented user interface or programming framework, which can be placed above a non-object-oriented operating system like DOS, Microsoft Windows or Unix.
object-oriented operating system

During the late_____, Steve Jobs formed the computer company NeXT.
1980s

During the late 1980s, _____ formed the computer company NeXT.
Steve Jobs

During the late 1980s, Steve Jobs formed the computer company_____.
NeXT

_____ is an object-oriented operating system that was developed at the University of Illinois at Urbana-Champaign.
Choices

Choices has been ported to and runs on_____
SPARC, x86 and ARM

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_____ is an object based operating system first released in 2000 by Rocklyte Systems.
Athene

Athene is an object based operating system first released in _____ by Rocklyte Systems
2000

Athene is an object based operating system first released in 2000 by _____
Rocklyte Systems

DML means_____
Dynamic Markup Language

The _____ of the mid 1990s used objects and the C++ language for the application programming interface (API).
BeOS

_____ makes heavy use of C++ and for that reason is often compared to BeOS.
Syllable

_____ is India's first object oriented operating system. It is made in C++ with some part in assembly.
TAJ

_____ is a multitasking, multithreading and multiuser operating system.
TAJ OS

TAJ OS is developed by_____.
Viral Patel

_____ refers to sharing a computing resource among many users by multitasking.
Time-sharing

The rise of microcomputing evolved in the early_____
1980's

The _____ has brought the general concept of time-sharing back into popularity.
Internet

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The concept was first described publicly in early _____ by Bob Bemer as part of an article in Automatic Control Magazine.
1957

The concept was first described publicly in early 1957 by _____as part of an article in Automatic Control Magazine.
Bob Bemer

The concept was first described publicly in early 1957 by Bob Bemer as part of an article in_____.
Automatic Control Magazine

The first project to implement a time-sharing system was initiated by _____ in late 1957
John McCarthy

The first project to implement a time-sharing system was initiated by John McCarthy in late _____
1957

The Compatible Time Sharing System or CTSS was demonstrated in November,_____.
1961

CTSS means_____
Compatible Time Sharing System

The first commercially successful time-sharing system was the _____
Dartmouth Time-Sharing System (DTSS)

DTSS means_____
Dartmouth Time-Sharing System

Dartmouth Time-Sharing System (DTSS) was first implemented at Dartmouth College in _____
1964

Early computer systems allowed _____ program to be executed at a time.
one

Early computer systems allowed one program to be executed at a time.

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True

A _____ is the unit of work in a modern time-sharing system.
Process

PCB means_____
Process Control Block

Informally, a _____ is a program in execution or simply an instance of a computer program that is being executed.
Process

A _____ generally includes the process stack, which contains temporary data (such as method parameters, return addresses, and local variables), and a data section, which contains global variables.
Process

A program is a _____ entity such as the content of the file stored on disk
passive

A process is an _____ entity
active

The _____ of a process is defined in part by the current activity of that process.
State

A _____ contains many pieces of information associated with a specific process
PCB

PCB means_____
Process Control Block

The _____ indicates the address of the next instruction to be executed for this process.
Counter

_____ information includes a process priority, pointers to scheduling queues, and any other scheduling parameters.
CPU-Scheduling information

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_____ information may include such information as the value of the base and limit registers, the page tables, or the segment tables, depending on the memory system used by the operating system.
Memory-management information

_____ information includes the amount of CPU and real time used, time limits, account numbers, job or process numbers, etc.
Accounting information

_____ information includes the list of I/O devices allocated to this process, a list of open files, etc.
I/O status

The _____ simply serves as the repository for any information that may vary from process to process.
PCB

As processes enter the system they are put into a_____.
job queue

The processes that are residing in main memory and are ready and waiting to execute are kept on a list called the_____.
ready queue

_____ queue is generally stored as a linked list.
Ready queue

The list of processes waiting for a particular I/O device is called a_____.
device queue

The list of processes waiting for a particular I/O device is called a _____queue.
device

A common way of representing process scheduling is by using a _____ diagram
queueing

The selection process is carried out by the appropriate_____.
Scheduler

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A _____ migrates between the various scheduling queues throughout its lifetime.
process

A process migrates between the various _____ throughout its lifetime.
scheduling queues

A process migrates between the various scheduling queues throughout its_____.
Lifetime

The operating system must select, for scheduling purposes, processes for these queues in some fashion. The selection process is carried out by the appropriate_____.
Scheduler

Switching the CPU to another process requires saving the state of the old process and loading the saved state for the new process. This task is known as_____.
context switch

The _____ of a process is represented in the PCB of a process
context

The context of a process is represented in the _____ of a process
PCB

A process may create several new processes, via a create-process system call, during the course of execution. The creating process is called a _____
parent process

The new processes are called the _____ of that process.
Children

Each process may create many child processes but will have only one parent process, except for the very first process which has no parent. The first process, called _____in UNIX
init

The _____ identifies each process by its process identifier (PID).
kernel

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The kernel identifies each process by its _____
process identifier (PID)

A parent will typically retrieve its child's exit status by calling the wait system call. However, if a parent does not do so, the child process becomes a _____ process.
Zombie

On Unix and Unix-like operating systems, a _____is a process that has completed execution but still has an entry in the process table, this entry being still needed to allow the process that started the zombie process to read its exit status.
zombie process or defunct process

A process _____ mwhen it finishes executing its final statement and asks the operating system to delete it by using exit system call.
terminates

_____ occurs under additional circumstances
Termination

The _____ executing in the operating system may be either independent processes or co-operating processes.
concurrent processes

A process is _____ if it cannot be affected by the other processes executing in the system.
independent

A process is _____ if it can be affected by the other processes executing in the system.
co-operating

A _____ process produces information that is consumed by a consumer process.
producer

A producer process produces information that is consumed by a _____ process.
Consumer

Processes can communicate with each other via_____.

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Inter-process communication (IPC)

_____ provides a mechanism to allow processes to communicate and to synchronise their actions without sharing the same address space.
IPC

The function of a _____ is to allow processes to communicate with one another without the need to resort to shared data.
message system

The function of a message system is to_____
allow processes to communicate with one another without the need to resort to shared data

If processes P and Q want to communicate, they must send messages to and receive message from each other, a _____ must exist between them.
communication link
With_____, each process that wants to communicate must explicitly name the recipient or sender of the communication.
direct communication

With_____, the messages are sent to and received from mailboxes or ports.
indirect communication

Two processes can communicate only_____
if they share a mailbox

Message passing may be either blocking or nonblocking – also known as _____
synchronous and asynchronous.

In_____ the sending process is blocked until the message is received by the receiving process or by the mailbox.
Blocking send

In_____ the sending process sends the message and resumes operation.
Nonblocking send

In _____ the receiver blocks until a message is available.
Blocking receive

In _____ the receiver retrieves either a valid message or a null.

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Nonblocking receive

Different combinations of send and receive are possible. When both the send and receive are blocking, we have a _____ between the sender and the receiver.
rendezvous

The _____ is sometimes referred to as a message system with no buffering
zero capacity case

A thread, sometimes called a _____,is a basic unit of CPU utilization; it comprises a thread ID, a program counter, a register set, and a stack.
lightweight process (LWP)

A process that has only one thread is referred to as a _____ process
single-threaded

A process with multiple threads is referred to as a _____ process.
multithreaded

Many software packages that run on modern desktop PCs are _____
Multithread

The benefits of multithreaded programming can be broken down into _____major categories
four

The benefits of multithreaded programming can be broken down into four major categories:
1. Responsiveness
2. Resource sharing
3. Economy
4. Utilization of multiprocessor architectures

_____ on a multiCPU machine increases concurrency.
Multithreading

Multithreading on a multiCPU machine _____ concurrency.
increases

Support for threads may be provided at either the user level in which case the thread is referred to as _____

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user threads or fibers

_____ are supported above the kernel and are implemented by a thread library at the user level.
User threads (Fibers)

_____ are supported directly by the operating system.
Kernel threads

_____ is the task of terminating a thread before it has completed.
Thread Cancellation

A thread that is to be cancelled is often referred as the_____.
target thread

Cancellation of a target thread may occur in two different scenarios:_____ and _____
Asynchronous cancellation and Deferred cancellation

_____ is when one thread immediately terminates the target thread.
Asynchronous cancellation

_____ is when the target thread can periodically check if it should
Deferred cancellation

In UNIX systems, a _____ is used to notify a process that a particular event has occurred.
Signal

Whether a signal is synchronous or asynchronous, all signals follow the following pattern:
a) A signal is generated by the occurrence of a particular event.
b) A generated signal is delivered to a process.
c) Once delivered, the signal must be handled.

_____ signals are delivered to the same process that performed the operation causing the signal
Synchronous

An example of a _____ signal includes an illegal memory access or division by zero.
Synchronous

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When a signal is generated by an event external to a running process, that process receives the signal_____.
Asynchronously

Every signal may be handled by one of two possible handlers:
1. A default signal handler
2. A user-defined signal handler

Every signal has a _____ that is run by the kernel when handling the signal. This default action may be overridden by a user-defined signal handler function.
default signal handler

Every signal has a default signal handler that is run by the kernel when handling the signal. This default action may be overridden by a _____ function.
user-defined signal handler

Generally, a signal can be delivered in any of the following ways:

- Deliver the signal to the thread to which the signal applies.
- Deliver the signal to every thread in the process.
- Deliver the signal to certain threads in the process.
- Assign a specific thread to receive all signals for the process.

_____ belonging to a process share the data of the process.
Threads

A _____ is a flow of control within a process.
thread

A _____ process contains several different flows of control within the same address space.
multithreaded

The benefits of multithreading include

- increased responsiveness to the user
- resource sharing within the process
- economy
- the ability to take advantage of multiprocessor architectures.

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_____ are threads that are visible to the programmer and are unknown to the kernel.
Fibers

In general, fibers are faster to create and manage than are kernel threads.
True

_____ is the basis of multi-programmed operating systems.
CPU scheduling

_____ is fundamental to operating system function. Almost all computer resources are scheduled before use.
Scheduling

Process execution begins with a _____ burst.
CPU

Process execution begins with a_____.
CPU burst

FIFO means_____
first-in, first-out

The _____ in the queues are generally process control blocks (PCBs) of the processes.
records

The records in the queues are generally _____ of the processes.
process control blocks (PCBs)

CPU scheduling decisions may take place under the following circumstances:
1. When a process switches from the running state to the waiting state (for example, I/O request, or invocation of wait for the termination of one of the child processes)
2. When a process switches from the running state to the ready state (for example, when an interrupt occurs)
3. When a process switches from the waiting state to the ready state (for example, completion of I/O)
4. When a process terminates

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When scheduling takes place only under circumstances 1 and 4, we say the scheduling scheme is_____.
nonpreemptive

When scheduling takes place only under circumstances 1 and 4, we say the scheduling scheme is nonpreemptive. Otherwise, the scheduling scheme is_____.
Preemptive

Some of the disadvantages of preemptive scheduling are that:
• It incurs a cost
• It also has an effect on the design of the operating system kernel.

The _____ is the module that gives control of the CPU to the process selected by the short-term scheduler.
Dispatcher

The function of the dispatcher include the following
• Switching context
• Switching to user mode
• Jumping to the proper location in the user program to restart that program.

_____ is the interval from the time of submission of a process to the time of completion.
Turnaround time

_____ is the sum of the periods spent waiting to get into memory, waiting in the ready queue, executing on the CPU and doing I/O.
Turnaround time

_____ is the amount of time it takes to start responding but not the time it takes to output the response. i.e. the time from the submission of a request until the first response is produced.
Response time

_____ deals with the problem of deciding which of the processes in the ready queue is to be allocated the CPU.
CPU scheduling

_____ is the simplest CPU-scheduling algorithm.
First-Come, First Served (FCFS) Scheduling

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_____ algorithm associates with each process the length of the latter's next CPU burst.
Shortest-Job-First (SJF) Scheduling

A _____ is associated with each process and the CPU is allocated to the process with the highest priority.
Priority

_____ can be defined either internally or externally.
Priorities

_____ defined priorities use measurable quantity(ies) such as time limits, memory requirements, etc. to compute the priority of a process.
Internally

_____ priorities are set by criteria that are external to the operating system such as importance of the process, amount being paid for use of the compute, the owner of the process, and other
(political) factors.
External

Priority scheduling may be either ____ or nonpreemptive.
preemptive

Priority scheduling may be either preemptive or_____.
Nonpreemptive

A _____ priority-scheduling algorithm will simply put the new process at the head of the ready queue.
Nonpreemptive

The major disadvantage of priority-scheduling algorithms is _____
indefinite blocking or starvation

A solution to indefinite blocking of low-priority processes is_____.
aging

_____ is a technique of gradually increasing the priority of processes that wait in the system for a long time.
Aging

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_____ is one of the simplest scheduling algorithms for processes in an operating system.
Round-robin (RR)

_____ assigns time slices to each process in equal portions and in circular order, handling all processes without priority.
Round-robin (RR)

A _____ is generally from 10 – 100 milliseconds.
time quantum

A time quantum is generally from _____ milliseconds.
10 – 100

MLFQ means_____
Multilevel Feedback Queue

In general, MLFQ scheduler is defined by the following parameters:
• Number of queues
• Scheduling algorithms for each queue
• Criteria for determining when to upgrade a process to a higher-priority queue
• Criteria for determining when to demote a process to a lower-priority queue
• The criteria for determining which queue a process will enter when that process needs service.

_____ is the most general scheme and most complex.
MLFQ

FCFS algorithm is_____
non-preemptive

RR algorithm is_____.
preemptive

_____ is a type of analytical evaluation.
Deterministic modelling

_____ uses the given algorithm and the system workload to produce a formula or number that evaluates the performance of the algorithm for that workload.

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Analytical evaluation

_____ takes a particular predetermined workload and defines the performance of each algorithm for that workload.
Deterministic modelling

Advantages of Deterministic Modelling:
• It is simple and fast.
• It gives exact numbers, allowing the algorithms to be compared.

Disadvantages of Deterministic Modelling:
• It requires exact numbers for input and its answers apply to only those cases.
• It is too specific.
• It requires too much knowledge to be useful.

_____ employ probabilistic distributions for CPU and I/O bursts
Queuing models

The computer system is described as a_____.
network of servers

Knowing arrival rates and service rates, we can compute utilization, average queue length, average wait time, etc. This area of study is called_____.
queuing-network analysis

Advantages of Queuing Analysis:
• It can be useful in comparing scheduling algorithms

Disadvantages of Queuing Analysis:
• The classes of algorithms and distribution that can be handled is presently limited
• It is hard to express a system of complex algorithms and distributions.
• Queueing models are often an approximation of a real system. As a result, the accuracy of the computed results may be questionable.

_____ is used to get a more accurate evaluation of scheduling algorithms.
Simulations

_____ involve programming a model of the computer system.
Simulations

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A _____ is a flaw in a system or process whereby the output of the process is unexpectedly and critically dependent on the sequence or timing of other events.
race condition or race hazard

_____ is a flaw in a system or process whereby the output of the process is unexpectedly and critically dependent on the sequence or timing of other events.
Race condition

In_____, two or more programs may "collide" in their attempts to modify or access a file, which could result in data corruption.
file systems

_____ provides a commonly-used solution.
File locking

TOCTTOU stands for_____
time-of-check-to-time-of-use

_____ refers to one of two distinct, but related concepts: synchronization of processes, and synchronization of data.
Synchronization

_____ refers to the idea that multiple processes are to join up or handshake at a certain point, so as to reach an agreement or commit to a certain sequence of action
Process synchronization

_____ refers to the idea of keeping multiple copies of a dataset in coherence with one another, or to maintain data integrity
Data synchronization

_____ are commonly used to implement data synchronization.
Process synchronization primitives

_____ refers to the coordination of simultaneous threads or processes to complete a task in order to get correct runtime order and avoid unexpected race conditions.
Process synchronization

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A _____ is the location, in a process or collection of threads or processes, where the synchronization occurs.
synchronization point

Non-blocking is often_____: an algorithm with guaranteed system-wide progress.
called lock-free

An algorithm is _____ if the suspension of one or more threads will not stop the potential progress of the remaining threads.
non-blocking

CAS means_____
Compare And Swap

_____ is the strongest non-blocking guarantee of progress, combining guaranteed system-wide throughput with starvation-freedom.
Wait-freedom

An algorithm is _____if every operation has a bound on the number of steps it will take before completing.
wait-free

It was shown in the 1980s that all algorithms can be implemented wait-free and many transformations from serial code called _____
universal constructions

_____ allows individual threads to starve but guarantees system-wide throughput
Lock-freedom

An algorithm is _____ if every step taken achieves global progress (for some sensible definition of progress).
lock-free

All wait-free algorithms are lock-free.
True

In general, a lock-free algorithm can run in _____ phases
four

In general, a lock-free algorithm can run in four phases:_____

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completing one's own operation, assisting an obstructing operation, aborting an obstructing operation, and waiting

The decision about when to assist, abort or wait when an obstruction is met is the responsibility of a_____.
contention manager

_____ is possibly the weakest natural non-blocking progress guarantee.
Obstruction-freedom

An algorithm is _____ if at any point, a single thread executed in isolation (i.e. with all obstructing threads suspended) for a bounded number of steps will complete its operation.
obstruction-free

All lock-free algorithms are obstruction-free.
True

Recent research has yielded a promising practical contention manager, whimsically named _____
Polka

_____ algorithms are used in concurrent programming to avoid the simultaneous use of a common resource, such as a global variable, by pieces of computer code called critical sections.
Mutual exclusion (often abbreviated to mutex)

A _____is a common name for a program object that negotiates mutual exclusion among threads
mutex

A mutex is also called a_____.
Lock

Mutual exclusion has _____levels of concurrency
Two

Mutual exclusion has two levels of concurrency:
1. Concurrency among processes
2. Concurrency among activities (threads) with a single process

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Deadlock prevention algorithms that avoid_____ are called non-blocking synchronization algorithms
mutual exclusion

A _____ is a piece of code that accesses a shared resource (data structure or device) that must not be concurrently accessed by more than one thread of execution.
critical section
A Win32 Critical Section is for _____ synchronization
inter-thread

_____ often allow nesting.
Critical sections

Critical sections often allow_____.
nesting

_____ allows multiple critical sections to be entered and exited at little cost.
Nesting

The first major advance in dealing with the problems of concurrent processes came in _____ with Dijkstra's treatise.
1965

In mutual exclusion, _____always occur before signals
waits

Monitors are actually a much nicer way of implementing mutual exclusion than semaphores.
True

_____ can be used to solve various synchronization problems and can be implemented efficiently.
Semaphores

A deadlock is also called a_____.
deadly embrace

_____ occur most commonly in multitasking and client/server environments.
Deadlocks

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In a_____, processes never finish executing and system resources are tied up, preventing other jobs from starting.
Deadlock

A deadlock situation can arise if the following conditions hold simultaneously in a system:
1. Mutual exclusion condition
2. Hold-and-wait condition
3. No-preemption condition
4. Circular-wait condition

Deadlocks can be described more precisely in terms of a directed graph called a_____.
system resource-allocation graph

A directed edge from resource type Rj to process Pi is denoted by Rj → Pi ; it signifies that an instance of resource type Rj has been allocated to process Pi . A directed edge Pi → Rj is called a _____
request edge

A directed edge Rj → Pi is called an_____.
assignment edge

Principally, we can deal with the deadlock problem in one of three ways:
• We can use a protocol to prevent or avoid deadlocks, ensuring that the system will never enter add state.
• We can allow the system to enter a deadlock state, detect it, and recover.
• We can ignore the problem altogether, and pretend that deadlocks never occur in the system.

_____ consists in allowing processes to wait for resources, but ensure that the waiting cannot be circular.
Circular wait prevention

_____ assigns time slices to each process in equal portions and in circular order, handling all processes without priority
Round-robin scheduling

_____ is the sum of the periods spent waiting in the ready queue.
Waiting time

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_____is the amount of time it takes to start responding but not the time it takes to output the response
Response time

One measure of work is the number of processes completed per time unit called_____
Throughput

A state is _____ if the system can allocate resources to each process (up to its maximum) in some order and still avoid a deadlock.
Safe

A safe state is not a deadlock state.
True

In an _____ state, the operating system cannot prevent processes from request resources such that a deadlock occurs
Unsafe

At time t0, the system is in a _____state.
Safe

In addition to the request and assignment edges, we introduce a new type of edge, called a_____.
claim edge

The deadlock-avoidance algorithm that we describe next is applicable to such a system, but is less efficient than the resource allocation graph scheme. This algorithm is commonly known as the _____
"Banker's Algorithm"

The _____ is run by the operating system whenever a process requests resources.
Banker's algorithm

The _____prevents deadlock by denying or postponing the request if it determines that accepting the request could put the system in an unsafe state (one where deadlock could occur).
Algorithm

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The algorithm prevents_____ by denying or postponing the request if it determines that accepting the request could put the system in an unsafe state (one where deadlock could occur).
Deadlock

_____ can occur in distributed systems when distributed transactions or concurrency control is being used.
Distributed deadlocks

_____ are deadlocks that are detected in a distributed system but do not actually exist
Phantom deadlocks

_____ method clearly will break the deadlock cycle, but at a great expense; these processes may have computed for a long time, and the results of these partial computations must be discarded and probably recomputed later.
Abort all deadlocked processes

_____ method incurs considerable overhead, since, after each process is aborted, a deadlock detection algorithm must be invoked to determine whether any processes are still deadlocked.
Abort one process at a time until the deadlock cycle is eliminated

A livelock is similar to a deadlock, except that the states of the processes involved in the livelock constantly change with regard to one another, none progressing.

_____ is a special case of resource starvation
Livelock

The run-time mapping from virtual to physical addresses is done by a hardware device called the _____
memory-management unit (MMU)

The size of a process is limited to the size of physical memory. To obtain better memory-space utilization, we can use _____
dynamic loading

_____ is used to enable a process to be larger than the amount of memory allocated to it.
Overlays

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Address binding can be done at any of the following stages:
• Compile time
• Load time
• Execution time

An address generated by the CPU is called logical address while the one seen by the memory unit is called_____.
physical address

Memory allocation can be done in _____ways
two

Memory allocation can be done in two ways:
• fixed partition
• variable partition

In _____ algorithm, you allocate the first hole that is big enough.
first-fit

In _____ algorithm, you allocate the smallest hole that is big enough.
best-fit

In _____ algorithm, you allocate the largest available hole.
worst-fit

_____ is a solution to the problem of external fragmentation.
Compaction

The goal of compaction is_____
to shuffle the memory contents to place all free memory together in one large block

_____ avoids the considerable problem of fitting the varying-sized memory chunks onto the backing store from which most of the previous memory management schemes suffered.
Paging

_____ permits the logical address space to be mapped to a number of equal size blocks called page frames
Paging

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Paging permits the logical address space to be mapped to a number of equal size blocks called _____
page frames

TLB means_____
Translation Lookaside Buffer

_____ is a memory-management scheme that supports this user view of memory.
Segmentation

A logical-address space is a collection of_____.
segments

Advantages of segmentation include the following

• Operating system may allow segments to grow and shrunk dynamically with unchanging addressing
• Protection on segment level of related data
• Sharing on segment level is easy

Problems of segmentation include the following
• Contiguous allocation of memory with all its attendant problems as you learnt from unit 2 of this module
• May cause external fragmentation
• Dynamic shrinking/growing is expensive

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