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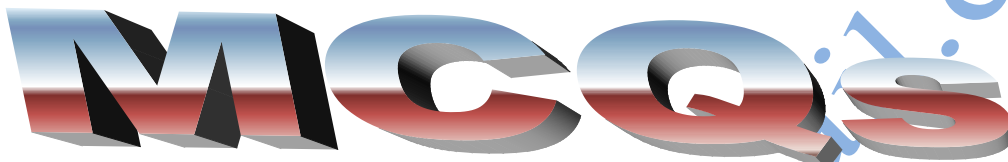
Finalterm-13

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1. A----- also called a **lightweight process (LWP)**, is a basic unit of CPU utilization.

Thread

Swapper

Scheduler

Interrupt

2. Wait and signal operations of semaphores were originally termed -----

P and V respectively.

V and P respectively.

P and P respectively.

V and V respectively.

3. When drawing the resource allocation graph, processes are represented by -----and resources by -----

Circles, Circles

Circles, squares

Squares, Circles

Squares, Squares

4. Variable names are ----- addresses

Physical

Relocatable

Relative

Symbolic

5. When the address used in a program gets converted to an actual physical RAM address, it is called -----

Execution

Loading

Address Binding

Compiling



6. Object files and libraries are combined by a ----- program to produce the executable binary

Compiler

Linker

Text editor

Loader

7. _____ is created by the system when a symbolic link is created to an existing file, allowing you to rename the existing file and share it without duplicating its contents

Directory

Character-special file

Ordinary File

Link File

8. UNIX recognizes _____ modes of access

One

Two

Three

Four

9. The _____ algorithm selects the request with the minimum seek time from the current head position

Scan

SSTF

Look

C-Look

10. The integer value of _____ semaphores can not be greater than 1.

Bounded buffer

Counting

Binary

Mutex

11. A process is _____ if it is spending more time on paging

Thrashing

Demand paging

Paging

Fixed Allocation

12. A dashed line is used to represent a _____ in Resource Allocation Graph.

Claim edge

Request edge

Assignment edge

Allocation edge

13. _____ is caused due to un-used space in physical memory.

Internal fragmentation

External fragmentation

Paging

MVT

14. Address Binding will be _____ in Multiprogramming with Variable Tasks (MVT)

Dynamic

Static

Variable

Fixed

15. The segment table maps the _____ to physical addresses.

Page addresses

Shared page addresses

One-dimensional logical addresses

Two-dimensional logical addresses

16. In paged segmentation, the logical address is legal if **d** is _____ segment length.

Less than

Greater than

Equal to

Greater than or equal to

17. The logical address of Intel 80386 is _____

36 bits

48 bits

64 bits

128 bits

18. _____ is a variation of fork system call in several Unix operating system used for Virtual Memory.

vfork ()

wfork ()

avfork ()

bfork ()

19. In a UNIX system, _____ system call can be used to request the operating system to memory map an opened file.

mmap ()

fork ()

exec ()

read ()

20. _____ is used to request the OS by the process to take an I/O or initiating child process

System call

Interrupt

Trap

Signal

21. Deadlock ----- allow all deadlock conditions, but calculate cycles about to happen and stop dangerous operations.

Prevention

Recovery

Detection

Avoidance

22. Preventing the condition of _____ to happen, deadlocks can be prevented to happen.

Critical region

Monitors

Circular wait

Critical section

23. A modification of free-list approach in free space management is to store the addresses of n free blocks in the first free block is known as ____.

counting

linked list

bit vector

grouping

24. You can compile your program in a UNIX/LINUX system by the ----- command

\$rm

\$cp

\$mv

gcc

25. _____ commands in Linux help to create a new directory.

Ls

cp

mv

mkdir

26. _____ is the name of the technique that is designed to get rid of deadlocks by changing the specifications of the system.

Deadlock avoidance

Deadlock prevention

Deadlock

Deadlock free

27. Semaphore can be used for solving ____.

Wait & signal

Deadlock

Synchronization

Priority

28. In memory management, a technique called as paging, physical memory is broken into fixed-sized blocks called ____.

Pages

Frames

Blocks

Segments

29. Under _____ scheduling, once the CPU has been allocated to a process, the process keeps the CPU until either it switches to the waiting state, finishes its CPU burst, or terminates.

Short-term scheduler

Preemptive

Non-preemptive

Both preemptive and non-preemptive

30. Switching the CPU from one process to another requires saving the context of the current process and loading the state of the new process is called ____.

Context switching

Process control block

Scheduling

Context block unit

31. Wrong use of wait and signal operations (in context with semaphores) can cause _____ problem(s).

Mutual Exclusion

Deadlock

Bounded Waiting

Busy waiting

32. Purpose of _____ is to lock the shared resource being used.

Busy waiting

Index

Semaphore

Deadlock

33. The collection of processes, waiting on the disk to be brought into the memory for execution, forms the _____.

Wait queue

Device queue

Input queue

Output queue

34. -----is the separation of user logical memory from physical memory.

Virtual Memory

RAM

Physical memory

ROM

35. Address Binding will be performed at _____ in Multiprogramming with Fixed Tasks (MFT)

Load time

Run time

Compile time

Execution time

36. In _____ scheme, number of frames allocated to a process is proportional to its size.

Proportional Allocation

Priority Allocation

Variance Allocation

Fixed Allocation

37. In the Scan algorithm, disk _____ starts at one end of the disk, and moves toward the other end, servicing requests as it reaches each cylinder, until it gets to the other end of the disk.

Arm

Cylinder

Head

Vector

39. In -s command is used to create a _____ link.

Soft

Hard

Direct

Indirect

40. ISR stands for_____.

Inter Service Rollback

Interrupt Signal Recovery

Interrupt Service Routine

Interrupt System Runtime

1. The semaphore empty is initialized to the value -----; the semaphore full is initialized to the value -----.

0,n

n,0

n,n

0,0

3. ----- register contains the size of the process

Base register

Index register

Limit register

Stack pointers register

4. -----refers to the situation when free memory space exists to load a process in the memory but the space is not contiguous.

External Fragmentation

Swapping

Segmentation

Internal fragmentation

5. The high paging activity is called _____

Segmentation

Page Fault

Multiprogramming

Thrashing

6. _____ brings all the pointers to the block together into a disk block

None of the given options

Indexed Allocation

Linked Allocation

Contiguous Allocation

8. Utilities used for system administration (halt, ifconfig, fdisk, etc.) are stored in _____ directory.

/dev

/boot

/sbin

/lib

11. Assume a logical address space of 16 pages of 1024 words, each mapped into a physical memory of 32 frames. Each word consists of 2 bytes. What will be the total number of bits required for **p (page number)**?

4 bits

8 bits

16 bits

32 bits

13. Intel 80386 used paged segmentation with _____ level paging.

One

Two

Three

Four

15. When the process tries to access locations that are not in memory, the hardware traps the operating system. This is called as _____.

Page Fault

Page replacement

Segmentation

Paging

16. _____ is the operating system's attempt to improve the computer system's utilization and throughput.

Exec

Fork

Demand Paging

Thrashing

17. ----- automatically holds for printers and other non-sharables

Hold and wait

Circular wait

Mutual exclusion

No preemption:

19. The systems that control scientific experiments, medical imaging systems, industrial control systems and certain display systems are examples of systems.

Real Time system

Batch

Multi programmed

Time-sharing system

20. A process terminates by calling the -----system call.

wait

fork

exec

exit

21. The file descriptor for Standard Input (stdin) is -----

0

1

2

3

22. Which one of the following indicates end of the file in a read () system call?

-1

0

1

2

3

23. _____ main problems arise due to wrong/ Incorrect use of semaphores i.e. Incorrect sequence of wait and signal operations in different programs.

7

5

6

3

24. In one of the deadlock prevention methods, impose a total ordering of all resource types, and require that each process requests resources in an increasing order of enumeration. This violates the _____ condition of deadlock

Mutual exclusion

Hold and Wait

Circular Wait

No Preemption Right

25. Which of the following is NOT a valid deadlock prevention scheme?

Release all resources before requesting a new resource

Number the resources uniquely and never request a lower numbered resource than the last one requested.

Never request a resource after releasing any resource

Request and all required resources be allocated before execution.

26. Thrashing _____.

Reduces page I/O

Decreases the degree of multiprogramming

Implies excessive page I/O

Improve the system performance

28 Which of the following memory allocation scheme suffers from External fragmentation?

Segmentation

Pure demand paging

Swapping

Paging

29. Command-line interpreter is also called _____ in some operating systems.

Kernel

Shell

Signal

API

30. Due to which of the following reason, a parent may terminate the execution of one of its children.

Use more resources than allocated

Busy other than assigned task

Start abnormal behavior

Many jobs in a system

31. The Swap instruction which is the hardware solution to synchronization problem does not satisfy the _____ condition, hence not considered to be a good solution.

Progress

Bounded waiting

Mutual exclusion

No preemption

32. Purpose of _____ is to lock the shared resource being used.

Busy waiting

Index

Semaphore

Deadlock

33. While accessing the buffer pool, the _____ semaphore provides mutual exclusion and is initialized to 1.

mutex

binary

counting

spinlock

34. _____ is best suited to resolve the problems caused by incorrect use of wait and signal operations.

Monitor

Semaphore

Deadlock

Starvation

35. What do we name to an address that is generated by the CPU?

Logical address

Physical address

Binary address

Virtual address

36. In _____ scheme, free frames are equally divided among processes.

Fixed Allocation

Proportional Allocation

Priority Allocation

Variance Allocation

37. For page replacement algorithms, the page fault rate may increase as the number of allocated frames _____.

Keep Constant

Increases

Decreases

Available

38. _____ is the time for the disk arm to move the head to the cylinder containing the desired sector.

Rotational Latency

Access Time

I/O time

Seek time

39. In case of thrashing, if CPU utilization is too low, the operating system _____ the degree of multiprogramming

Increases

Decreases

Increases or Decreases

Keeps constant

40. When there is no external fragmentation, free memory blocks are scattered on hard disk then _____ is used in order to utilize these blocks for space management.

Indexed Allocation

Contiguous Allocation

Linked Allocation

Variable Allocation

1. A----- also called a **lightweight process (LWP)**, is a basic unit of CPU utilization.

Thread

2. Wait and signal operations of semaphores were originally termed -----

P and V respectively.

3. When drawing the resource allocation graph, processes are represented by -----and resources by -----**Circles, squares**

4. Variable names are ----- addresses **Symbolic**

5. When the address used in a program gets converted to an actual physical RAM address, it is called ----- **Address Binding**

6. Object files and libraries are combined by a ----- program to produce the executable binary **Loader**

7. the system when a symbolic link is created to an existing file, allowing you to rename the existing file and share it without duplicating its contents **Link File**

8. UNIX recognizes ____ modes of access **Three**

9. The____ algorithm selects the request with the minimum seek time from the current head position **SSTF**

10. The integer value of ____ semaphores cannot be greater than 1. **Mutex**

11. A process is _____ if it is spending more time on paging **Thrashing**

12. A dashed line is used to represent a _____ in Resource Allocation Graph. **Claim edge**

13. _____ is caused due to un-used space in physical memory. **Internal fragmentation**

14. Address Binding will be _____ in Multiprogramming with Variable Tasks (MVT) **Dynamic**

15. The segment table maps the _____ to physical addresses. **Two-dimensional logical addresses**

16. In paged segmentation, the logical address is legal if **d** is _____ segment length. **Less than**

17. The logical address of Intel 80386 is _____ **48 bits**

18. _____ is a variation of fork system call in several Unix operating system used for Virtual Memory. **vfork ()**

19. In a UNIX system, _____ system call can be used to request the operating system to memory map an opened file. **mmap()**

20. _____ is used to request the OS by the process to take an I/O or initiating child process **System call**

21. Deadlock ----- allow all deadlock conditions, but calculate cycles about to happen and stop dangerous operations. **Prevention**

22. Preventing the condition of _____ to happen, deadlocks can be prevented to happen. **Monitors**

23. A modification of free-list approach in free space management is to store the addresses of n free blocks in the first free block is known as _____. **grouping**
24. You can compile your program in a UNIX/LINUX system by the ----- command **gcc**
25. _____ commands in Linux help to create a new directory. **mkdir**
27. Semaphore can be used for solving _____. **Wait & signal**
28. In memory management, a technique called as paging, physical memory is broken into fixed-sized blocks called _____. **Frames**
29. Under _____ scheduling, once the CPU has been allocated to a process, the process keeps the CPU until either it switches to the waiting state, finishes its CPU burst, or terminates.
- Non-preemptive**
30. Switching the CPU from one process to another requires saving the context of the current process and the state of the new process is called **Context switching**
31. Wrong use of wait and signal operations (in context with semaphores) can cause _____ problem(s). **Mutual Exclusion**
33. The collection of processes, waiting on the disk to be brought into the memory for execution, forms the _____. **Input queue**
34. ----- is the separation of user logical memory from physical memory. **Virtual Memory**
35. Address Binding will be performed at _____ in Multiprogramming with Fixed Tasks (MFT) **Load time**
36. In _____ scheme, number of frames allocated to a process is proportional to its size. **Proportional Allocation**
37. In the Scan algorithm, disk _____ starts at one end of the disk, and moves toward the other end, servicing requests as it reaches each cylinder, until it gets to the other end of the disk. **Arm**
39. In -s command is used to create a _____ link. **Soft**
40. ISR stands for _____. **Interrupt Service Routine**
1. The semaphore empty is initialized to the value -----; the semaphore full is initialized to the value -----. **$n, 0$**
3. ----- register contains the size of the process **Limit register**
4. ----- refers to the situation when free memory space exists to load a process in the memory but the space is not contiguous. **External Fragmentation**
5. The high paging activity is called _____. **Thrashing**
6. _____ brings all the pointers to the block together into a disk block **Indexed Allocation**
8. Utilities used for system administration (halt, ifconfig, fdisk, etc.) are stored in _____ directory. **/sbin**
11. Assume a logical address space of 16 pages of 1024 words, each mapped into a physical memory of 32 frames. Each word consists of 2 bytes. What will be the total number of bits required for **p (page number)**? **4 bits**
13. Intel 80386 used paged segmentation with _____ level paging. **Two**
15. When the process tries to access locations that are not in memory, the hardware traps the operating system. This is called as _____. **Page Fault**
16. _____ is the operating system's attempt to improve the computer system's utilization and throughput. **Demand Paging**

17. ----- automatically holds for printers and other non-sharables **Hold and wait**
19. The systems that control scientific experiments, medical imaging systems, industrial control systems and certain display systems are systems. **Real Time system**
20. A process terminates by calling the -----system call. **exit**
21. The file descriptor for Standard Input (stdin) is ----- **0**
24. In one of the deadlock prevention methods, impose a total ordering of all resource types, and require that each process requests resources in an increasing order of enumeration. This violates the -----condition of deadlock **Circular Wait**
26. Thrashing _____. **Improve the system performance**
- 28 Which of the following memory allocation scheme suffers from External fragmentation?
Paging
29. Command-line interpreter is also called _____ in some operating systems. **Shell**
30. Due to which of the following reason, a parent may terminate the execution of one of its children. **Busy other than assigned task**
31. The Swap instruction which is the hardware solution to synchronization problem does not satisfy the _____ condition, hence not considered to be a good solution. **Progress**
33. While accessing the buffer pool, the _____ semaphore provides mutual exclusion and is initialized to 1. **mutex**
34. _____ is best suited to resolve the problems caused by incorrect use of wait and signal operations. **Semaphore**
35. What do we name to an address that is generated by the CPU? **Logical address**
36. In _____ scheme, free frames are equally divided among processes. **Fixed Allocation**
37. For page replacement algorithms, the page fault rate may increase as the number of allocated frames _____. **Increases**
38. _____ is the time for the disk arm to move the head to the cylinder containing the desired sector. **Seek time**
39. In case of thrashing, if CPU utilization is too low, the operating system _____ the degree of multiprogramming **Increases**
40. When there is no external fragmentation, free memory blocks are scattered on hard disk then _____ is used in order to utilize these blocks for space management. **Linked Allocation**

Subjective

41. How can you define compile time?

Ans: Compile time: if you know at compile where the process will reside in memory, the **absolute addresses** can be assigned to instructions and data by the compiler.

42. What are the conditions in Resource Allocation Graph by which we can say that the set of processes may or may not be in Deadlock state?

Ans: A set of processes are said to be in a deadlock state if every process is waiting for an event that can be caused only by another process in the set. Here are a couple of examples of deadlocks in our daily lives. ☐ Traffic deadlocks ☐ One-way bridge-crossing

43. Which anomaly is involved in FIFO page replacement?

Ans: The problem with this algorithm is that it suffers from Belady's anomaly: For some page replacement algorithms the page fault rate may increase as the number of allocated frames increases, whereas we would expect that giving more memory to a process would improve its performance.

44. Differentiate between local and global replacement with respect to page replacement algorithms.

Ans: Local vs Global Replacement If process P generates a page fault, page can be selected in two ways: ☐ Select for replacement one of its frames.

☐ Select for replacement a frame from a process with lower priority number. Global replacement allows a process to select a replacement frame from the set of all frames, even if that frame belongs to some other process; one process can take a frame from another. Local replacement requires that each process select from only its allocated frames.

45. List down two major benefits of Virtual Memory

Ans: There are basically three approaches to implementing virtual memory: Paging, segmentation, and a combination of the two called paged segmentation. We'll look at each of these approaches in turn.

47. What will be guaranteed if the following limits are checked in banker's algorithm? Is $Request1 \leq Need1$? Is $Request1 \leq Available$?

Ans: 1. Is Request0 \leq Need0? $(0,2,0) \leq (7,4,3) \Rightarrow \text{true}$
 $(0,2,0) \leq (3,3,2) \Rightarrow \text{true}$

2. Is Request1 \leq Available?

48. While managing computer system hardware efficiently, sometimes it seems reasonable to service all requests that are close to current head position. You are required to identify and analyze the technique that work on this policy.

Ans: **SSTF Scheduling** It seems reasonable to service all the requests close to the current head position, before moving the head far away to service other requests. This assumption is the basis for the shortest seek time first (SSTF) algorithm. The SSTF algorithm selects the request with

the minimum seek time from the current head position. Since seek time increases with the number of cylinders traversed by the head, SSTF chooses the pending request closest to the current head position.

49. There are two processes that could take place even at the same time. One process helps in getting amount from the ATM and the second helps in depositing the money in the bank account through a cheque. You ensure mutual exclusiveness by using semaphore with wait and signal operations

Write pseudo-code or algorithm for these two processes.

Ans: The n processes share a semaphore, **mutex** (standing for mutual exclusion) initialized to 1. Each process P_i is organized as follows:

Do { wait(mutex);

Critical section signal(mutex);

Remainder section } while(1);

51. Consider a scenario when no free frame is available on a page fault, we replace a page in memory to load the desired page. The page-fault service routine is modified to include page replacement. You are required to write down the steps needed for page replacement for this scenario.

Ans: The modified page fault service routine is: 1. Find the location of the desired page on the disk 2. Find a free frame a) If there is a free frame use it. b) If there is no free frame, use a page replacement algorithm to select a victim frame. 3. Read the desired page into the newly freed frame; change the page and frame tables. 4. Restart the user process.

52. One of the responsibilities of the operating system is to use the computer system hardware efficiently. To meet this responsibility, we require a disk drive with fast access time and more disk bandwidth. What do you think that how can we improve these two parameter values to make disk drive servicing efficient? Also identify different methods to improve these parameters.

Ans: The access time has two major components. The seek time is the time for the disk arm to move the heads to the cylinder containing the desired sector. The rotational latency is the additional time waiting for the disk to rotate the desired sector to the disk head. The disk bandwidth is the total number of bytes transferred, divided by the total time between the first request for service and the completion of the last transfer. We can improve both the access time and the bandwidth by scheduling the servicing of disk I/O requests in a good order. Some of the popular disk-scheduling algorithms are: ☐ First-come-first-serve (FCFS) ☐ Shortest seek time first (SSTF) ☐ Scan ☐ Look ☐ Circular scan (C-Scan) ☐ Circular look (C-Look)

42. What is the difference between deadlock prevention and deadlock avoidance?

Ans: 1. Deadlock prevention: is a set of methods for ensuring that at least one of the necessary conditions cannot hold. These methods prevent deadlocks by constraining how processes can request for resources. 2. Deadlock Avoidance: This method of handling deadlocks requires that processes Give advance additional information concerning which resources they will request and use during their lifetimes. With this information, it may be decided whether a process should wait or not.

43. When there is no free frame available, page replacement is required. What will be the criteria in the selection of a particular page replacement algorithm?

Ans: When there is no free frame available, page replacement is required, and we must select the pages to be replaced. This can be done via several replacement algorithms, and the major criterion in the selection of a particular algorithm is that we want to minimize the number of page faults. The victim page that is selected depends on the algorithm used; it might be the least recently used page, or the most frequently used etc depending on the algorithm.

44. Why scan algorithm is sometimes called the elevator algorithm? Give proper reason to justify your answer.

Ans: The Scan algorithm is sometimes called the **elevator algorithm**, since the disk arm behaves like an elevator in a building servicing all the requests (people at floors), going Up and then reversing to service the requests going down.

46. Out of MFT and MVT which one do you think is best suitable for a situation in which job can be moved i.e. might be swapped back in a different place and which one is best suitable to waste space inside a block?

Ans: **MFT** can have large **internal fragmentation**, i.e., wasted space *inside* a Region. **MVT** Job can move (might be swapped back in a different place).

47. You are required to identify the primary protection scheme under paging that guards a process trying to access a page that does not belong to its address space. Name the scheme with brief description.

Ans: The primary protection scheme guards against a process trying to access a page that does not belong to its address space. This is achieved by using a valid/invalid (v) bit. This bit indicates whether the page is in the process address space or not. If the bit is set to invalid, it indicates that the page is not in the process's logical address space. Illegal addresses are trapped by using the valid-invalid bit and control is passed to the operating system for appropriate action.

48. Is it necessary to have a reference count within a file descriptor in order to implement soft links? Justify the answer.

Ans: The reason for this selection is that an actively used page should have a large reference count. This algorithm suffers from the situation in which a page is used heavily during the initial phase of a process, but then is never used again.

50. Out of MVT (Multiprogramming with Variable Tasks) and MFT (Multiprogramming with Fixed Tasks), which one do you think is best suited to cause internal fragmentation and which one is best suited to cause external fragmentation? Also differentiate briefly between MVT and MFT.

Ans: MFT can have large **internal fragmentation**, i.e., wasted space *inside* a Region. MVT. external fragmentation (i.e. total memory space exists to



satisfy a space allocation request for a segment, but memory space is not contiguous), when all blocks of memory are too small to accommodate a segment.

51. In Linux operating system, you are required to write down the working of copy on write technique with respect to virtual memory with the help of an example.

Ans: Copy on Write fork() Demand paging is used when reading a file from disk into memory and such files may include binary executables. However, process creation using fork() may bypass initially the need for demand paging by using a technique similar to page sharing. This technique

provides for rapid process creation and minimizes the number of new pages that must be allocated to newly created processes.

52. In UNIX /Linux environment you are required to write down the name of system call for each of the following operation.

Ans: Reposition within file (lseek) — A directory is searched for the appropriate entry and the current-file-position is set to a given value. This is often known as a file seek.  Dlete (unlink) — Search the directory for the named file, and then release the file space and erase the directory entry. File can be deleted using the unlink system call.  Truncate (creat) — A

user may want to erase the contents of the file but keep its attributes. This function allows all attributes to be unchanged except for file length., which is set to zero and file space is released. This can be achieved using creat with a special flag

☐ Close (close) — When a file is closed, the OS removes its entry in the open-file table.

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☐ Delete (unlink) — Search the directory for the named file, and then release the file space and erase the directory entry. File can be deleted using the unlink system call.

☐ Truncate (creat) — A user may want to erase the contents of the file but keep its attributes. This function allows all attributes to be unchanged except for file length, which is set to zero and file space is released. This can be achieved using creat with a special flag

☐ Close (close) — When a file is closed, the OS removes its entry in the open-file table.

41. How can you define compile time?

Ans: Compile time: if you know at compile where the process will reside in memory, the **absolute addresses** can be assigned to instructions and data by the compiler.

42. What are the conditions in Resource Allocation Graph by which we can say that the set of processes may or may not be in Deadlock state?

Ans: A set of processes are said to be in a deadlock state if every process is waiting for an event that can be caused only by another process in the set. Here are a couple of examples of deadlocks in our daily lives. ☐ Traffic deadlocks ☐ One-way bridge-crossing

43. Which anomaly is involved in FIFO page replacement?

Ans: The problem with this algorithm is that it suffers from Belady's anomaly: For some page replacement algorithms the page fault rate may increase as the number of allocated frames increases, whereas we would expect that giving more memory to a process would improve its performance.

44. Differentiate between local and global replacement with respect to page replacement algorithms.

Ans: Local vs Global Replacement

If process P generates a page fault, page can be selected in two ways:

☐ Select for replacement one of its frames.

☐ Select for replacement a frame from a process with lower priority number.

Global replacement allows a process to select a replacement frame from the set of all frames, even if that frame belongs to some other process; one process can take a frame from another. Local replacement requires that each process select from only its allocated frames.

45. List down two major benefits of Virtual Memory

Ans: There are basically three approaches to implementing virtual memory: Paging, segmentation, and a combination of the two called paged segmentation. We'll look at each of these approaches in turn.

47. What will be guaranteed if the following limits are checked in banker's algorithm?

1. **Is Request1 \leq Need1?**
2. **Is Request1 \leq Available?**

Ans: 1. Is Request0 \leq Need0? $(0,2,0) \leq (7,4,3) \Rightarrow \text{true}$

2. Is Request1 \leq Available? $(0,2,0) \leq (3,3,2) \Rightarrow \text{true}$

48. While managing computer system hardware efficiently, sometimes it seems reasonable to service all requests that are close to current head position. You are required to identify and analyze the technique that work on this policy.

Ans: **SSTF Scheduling**

It seems reasonable to service all the requests close to the current head position, before moving the head far away to service other requests. This assumption is the basis for the shortest seek time first (SSTF) algorithm. The SSTF algorithm selects the request with the minimum seek time from the current head position. Since seek time increases with the number of cylinders traversed by the head, SSTF chooses the pending request closest to the current head position.

49. There are two processes that could take place even at the same time. One process helps in getting amount from the ATM and the second helps in depositing the money in the bank account through a cheque. You ensure mutual exclusiveness by using semaphore with wait and signal operations

Write pseudo-code or algorithm for these two processes.

Ans: The n processes share a semaphore, **mutex** (standing for mutual exclusion) initialized to 1. Each process P_i is organized as follows:

```
Do {
wait(mutex);
Critical section
signal(mutex);
Remainder section
} while(1);
```

50. Consider the following table for 2 resources and 4 processes. Identify whether system is in safe state or not? If yes then determine the safe sequence from given information and if not then give proper reason to support your answer.

	Current Allocation		Max		Available		Need	
	A	B	A	B	A	B	A	B
P0	2	0	2	4	2	7	0	4
P1	3	2	9	2			6	0
P2	1	1	4	1			3	0
P3	1	2	6	4			5	2

51. Consider a scenario when no free frame is available on a page fault, we replace a page in memory to load the desired page. The page-fault service routine is modified

to include page replacement. You are required to write down the steps needed for page replacement for this scenario.

Ans: The modified page fault service routine is:

1. Find the location of the desired page on the disk
2. Find a free frame a) If there is a free frame use it. b) If there is no free frame, use a page replacement algorithm to select a victim frame.
3. Read the desired page into the newly freed frame; change the page and frame tables.
4. Restart the user process.

52. One of the responsibilities of the operating system is to use the computer system hardware efficiently. To meet this responsibility, we require a disk drive with fast access time and more disk bandwidth. What do you think that how can we improve these two parameter values to make disk drive servicing efficient? Also identify different methods to improve these parameters.

Ans: The access time has two major components. The seek time is the time for the disk arm to move the heads to the cylinder containing the desired sector. The rotational latency is the additional time waiting for the disk to rotate the desired sector to the disk head. The disk bandwidth is the total number of bytes transferred, divided by the total time between the first request for service and the completion of the last transfer. We can improve both the access time and the bandwidth by scheduling the servicing of disk I/O requests in a good order. Some of the popular disk-scheduling algorithms are:

- ☐ First-come-first-serve (FCFS) ☐ Shortest seek time first (SSTF) ☐ Scan
- ☐ Look ☐ Circular scan (C-Scan) ☐ Circular look (C-Look)



Main Points

Problems with Semaphores

Here are some key points about the use of semaphores:

- ☐ Semaphores provide a powerful tool for enforcing mutual exclusion and coordinating processes.
- ☐ The wait(S) and signal(S) operations are scattered among several processes. Hence, it is difficult to understand their effects.
- ☐ Usage of semaphores must be correct in all the processes.
- ☐ One bad (or malicious) process can fail the entire system of cooperating processes.

Deadlocks and Starvation :A set of processes are said to be in a deadlock state if every process is waiting for an event that can be caused only by another process in the set. Here are a couple of examples of deadlocks in our daily lives.

- ☐ Traffic deadlocks
- ☐ One-way bridge-crossing Semaphores

There are two kinds of semaphores:

- ☐ **Counting semaphore** whose integer value can range over an unrestricted integer domain.

- ☐ **Binary semaphore** whose integer value cannot be > 1 ; can be simpler to implement.

Classic Problems of Synchronization

Three classic problems of synchronization are:

- ☐ Bounded-Buffer Problem
- ☐ Readers and Writers Problem
- ☐ Dining Philosophers Problem

Readers Writers Problem A data object (such as a file or a record) is to be shared among several concurrent processes. Some of these processes, called **readers**, may want only to read the content of the shared object whereas others, called **writers**, may want to update (that is to read and write) the shared object.

Critical regions:Although semaphores provide a convenient and effective mechanism for process synchronization, their incorrect usage can still result in timing errors that are difficult to detect, since these errors occur only.

A **monitor** is characterized by local data and a set of programmer-defined operators that can be used to access this data; local data be accessed only through these operators.

The Deadlock Problems: A set of blocked processes each holding a resource and waiting to acquire a resource held by another process in the set. Here's an example:

- ☐ System has 2 tape drives.
- ☐ P1 and P2 each hold one tape drive and each needs another one.

System Model A system consists of a finite number of resources to be distributed among a finite number

of cooperating processes. The resources are partitioned into several types, each of which consists of some number of identical instances. Memory space, CPU cycles, disk drive, file are examples of resource types.

Deadlock Characterization: 1 Mutual exclusion, 2 Hold and wait, 3. No preemption, 4.

Circular wait:

Safe State: A state is safe if the system can allocate resources to each process in some order and still avoid a deadlock.

Data structures in the Banker's algorithm: \square **Available:** A vector of length m indicates the number of available instances of resources of each type. $Available[j] = k$ means that there are k available instances of resource R_j . \square **Max:** An $n \times m$ matrix defines the maximum demand of resources of each process. $Max[i, j] = k$ means that process P_i may request at most k instances of resource R_j .

\square **Allocation:** An $n \times m$ matrix defines the number of instances of resources of each type currently allocated to each process. $Allocation[i, j] = k$ means that P_i is currently allocated k instances of resource type R_j . \square **Need:** An $n \times m$ matrix indicates the remaining resource need of each process. $Need[i, j] = k$ means that P_i may need k more instances of resource type R_j to complete its task. Note that $Need[i, j] = Max[i, j] - Allocation[i, j]$.

Memory Management: The purpose of memory management is to ensure fair, secure, orderly, and efficient use of memory. The task of memory management includes keeping track of used and free memory space, as well as when, where, and how much memory to allocate and deallocate.

Logical- Versus Physical-Address Space: An address generated by the CPU is commonly referred to as a **logical address**, whereas an address seen by the memory unit—that is, the one loaded into the **memory-address register** of the memory—is commonly referred to as the **physical address**. In essence, logical data refers to an instruction or data in the process address space whereas the physical address refers to a main memory location where instruction or data resides. **Dynamic Loading:** The size of a process is limited to the size of physical memory. To obtain better memory space utilization, we can use **dynamic loading**. Physical memory is broken down into fixed-sized blocks, called **frames**, and logical memory is divided into blocks of the same size, called **pages**. Physical memory is broken down into fixed-sized blocks, called **frames**, and logical memory is divided into blocks of the same size, called **pages**. **Segmentation**

Segmentation is a memory management scheme that supports programmer's view of memory. A logical-address space is a collection of segments. A segment is a logical unit such as: main program, procedure, function, method, object, global variables, stack, and symbol table. **Segment-table base register (STBR)** points to the segment table's location in memory.

\square **Segment-table length register (STLR)** indicates number of segments used by a program.

Intel 80386 Example \square IBM OS/2, Microsoft Windows, and Linux run on it \square Paged segmentation with two-level paging

\square Logical address = 48 bits \square 16-bit selector and 32-bit offset \square Page size = 4 KB \square 4-byte page table entry \square 32-entry TLB, covering 32*4K (128 KB) memory ... TLB Reach

Real Mode 20-bit physical address is obtained by shifting left the Selector value by four bits and adding to it the 16-bit effective address.

Protected Mode \square 248 bytes virtual address space \square 232 bytes linear address space \square Max segment size = 4 GB \square Max segments / process = 16K \square Six CPU registers allow access to six segments at a time **Virtual Memory** is the separation of user logical memory from physical

memory. This separation allows an extremely large virtual memory to be provided for programmers when only a smaller physical memory is available. Virtual memory makes the task of programming easier because the programmer need not worry about the amount of physical memory, or about what code can be placed in overlays; she can concentrate instead on the problem to be programmed.

Demand Paging: A demand paging system is similar to a paging system with swapping. Processes reside on secondary memory (which is usually a disk). When we want to execute a process, we swap it into memory.

The procedure for handling a page fault is straightforward: 1. We check an internal table (usually kept with the process control block) for this process to determine whether the reference was valid or invalid memory access. 2. If the reference was invalid we terminate the process. If it was valid, but we have not yet brought in that page, we now page it in. 3. We find a free frame (by taking one from the free-frame list, for example) 4. We schedule a disk operation to read the desired page into the newly allocated frame.

Performance of demand paging. Demand paging can have a significant effect on the performance of a computer system.

To see why, let us compute the effective access time for a demand paged memory. For most computer systems, the memory access time, denoted m_a now ranges from 10 to 200 nanoseconds.

Performance of Demand Paging with Page Replacement: When there is no free frame available, page replacement is required, and we must select the pages to be replaced. This can be done via several replacement algorithms, and the major criterion in the selection of a particular algorithm is that we want to minimize the number of page faults.

Process Creation and Virtual Memory

Paging and virtual memory provide other benefits during process creation, such as copy on write and memory mapped files.

vfork() Several versions of UNIX provide a variation of the `fork()` system call—`vfork()` (for virtual memory fork). `vfork()` operates differently than `fork()` with copy on write.

mmap() System Call In a UNIX system, `mmap()` system call can be used to request the operating system to memory map an opened file. The following code snippets show “normal” way of doing file I/O and file I/O with memory mapped files.

File I/O with mmap()

```
files = open(...) address = mmap((caddr_t) 0, len, (PROT_READ | PROT_WRITE),  
MAP_PRIVATE, files, offset); /* use data at address
```

Page Replacement Algorithms: In general we want a page replacement algorithm with the lowest page-fault rate. We evaluate an algorithm by running it on a particular string of memory references (reference string) and computing the number of page faults on that string.

FIFO Page Replacement: The simplest page-replacement algorithm is a FIFO algorithm. A FIFO replacement algorithm associates with each page the time when that page was brought into memory. Optimal Algorithm An optimal page-replacement algorithm has the lowest page fault rate of all algorithms, and will never suffer from the Belady's algorithm.

LRU Page Replacement: If we use the recent past as an approximation of the near future, then we will replace the

page that has not been used for the longest period of time. Stack Replacement Algorithms These are a class of page replacement algorithms with the following property: *Set of pages in the main memory with n frames is a subset of the set of pages in memory with $n+1$ frames.* These algorithms do not suffer from Belady's Anomaly. An example is the LRU

algorithm. Consider the following example which shows that LRU does not suffer from Belady's anomaly for the given reference string.

☐ Number of frames allocated = 3 ☐ Reference string: 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5 ☐ Number of page faults = 10 There are three major allocation schemes:

☐ **Fixed allocation** In this scheme free frames are equally divided among processes

☐ **Proportional Allocation** Number of frames allocated to a process is proportional to its size in this scheme ☐ **Priority allocation** Priority-based proportional allocation.

A process is **thrashing** if it is spending more time paging (i.e., swapping pages in and out) than executing. Thrashing results in severe performance problems: ☐ Low CPU utilization ☐ High disk utilization ☐ Low utilization of other I/O devices

The File Concept Computers can store information on several different storage media, such as magnetic disks, magnetic tapes and optical disks. The operating system abstracts from the physical properties of its storage devices to define a logical storage unit (the file). Files are mapped by the OS onto physical devices. File Structure A file has certain defined structure characteristics according to its type. A few common

types of file structures are: **None** – file is a sequence of words, bytes

Simple record structure Lines Fixed length Variable length **Complex Structures**

Formatted document, Relocatable load file, File Operations, Various operations can be performed on files. Here are some of the commonly supported operations. In parentheses are written UNIX/Linux system calls for the corresponding

Operations Create (creat) —Open (open) —Write (write) —Read (read) —Reposition within file (lseek) —

Delete (unlink) —Truncate (creat) —Close (close) —

File Types: Extensions

A common technique for implementing files is to include the type of the file as part of the file name. The name is split into two parts, a name and an extension, usually separated by a period character. In this way, the user and the OS can tell from the name alone, what the type of a file is.

UNIX does not support supports seven types of file:.. Ordinary file: Directory, Block-special file. Character-special file: Link file, FIFO, Socket

File Access Files store information that can be accessed in several ways: **Sequential Access** Information in the file is processed in order, one record after the other. A read operation reads the next portion of the file and automatically advances a file pointer which tracks the I/O location. **Direct Access** A file is made up of fixed length logical record that allow program to read and write records in no particular order.

Create — mkdir ☐ Open — opendir ☐ Read — readdir ☐ Rewind — rewinddir ☐ Close — closedir ☐ Delete — rmdir

☐ **Change Directory — cd ☐ List — ls ☐ Search Efficient Searching**

2. **Naming** – should be convenient to users ☐ Two users can have same name for different files ☐ The same file can have several different names 3. **Grouping** – logical grouping of files by properties, (e.g., all Java programs, all games, ..)

File System Mounting: **Remote mount** Remote mounts are done on a remote system on which data is transmitted over a telecommunication line. **Local mounts** are mounts done on your local system.

File Sharing

Duplicating files: **Common login, Common groups, Links.**

UNIX Protection

UNIX recognizes three modes of access: **read**, **write**, and **execute** (r, w, x). The execute permission on a directory specifies permission to **search** the directory. The three classes of users are: **Owner:** user is the owner of the file **Group:** someone who belongs to the same group as the owner **Others:** everyone else who has an account on the system

Default Permissions: The default permissions on a UNIX/Linux system are 777 for executable files and directories and 666 for text files.

. File Allocation Table (FAT) The file system on an MS-DOS floppy disk is based on **file allocation table (FAT)** file system in which the disk is divided into a reserved area (containing the boot program) and the actual file allocation tables, a root directory and file space. Space allocated for files is represented by values in the allocation table, which effectively provide a linked list of all the blocks in the file. **Free-Space Management** Since disk space is limited, we need to reuse the space from deleted files for new files if possible. To keep track of free disk space, the system maintains a **free-space list**.

Bit vector: Frequently, the free space list is implemented as a bit map or bit vector. Each block is represented by 1 bit. If the block is free, the bit is 1; if it is allocated, the bit is 0.

Linked list (free list) Another approach to free space management is to link together all the free disk blocks, keeping a pointer to the first free block in a special location on the disk and caching it in memory.

With Best Wishes