

Assignment

1. Base address :

An address that is used as the origin in the calculation of addresses in the execution of a computer program.

2. Batch processing :

A process pertaining to the technique of executing a set of computer programs such that each is completed before the next program of the set is started.

3. Binary semaphore :

A semaphore that takes on only the values 0 and 1. A binary semaphore allows only one process or thread to have access to a shared critical resource at a time.

4. Block :

- (1) A collection of contiguous records that are recorded as a unit; the units are separated by interblock gaps.
- (2) A group of bits that are transmitted as a unit.

5 B-tree :

A technique for organizing indexes. In order to keep access time to a minimum, it stores the data keys in a balanced hierarchy that continually realigns itself as items are inserted and deleted. Thus, all nodes always have a similar number of keys.

6 Busy Waiting :

The repeated execution of a loop of code while waiting for an event to occur.

7 Cache memory :

A memory that is smaller and faster than main memory and that is interposed between the processor and main memory. The cache acts as a buffer for recently used memory locations.

8 Central Processing Unit (CPU) :

The portion of a computer that fetches and executes instructions. It consists of an Arithmetic and Logic unit (ALU), a control unit, and registers. Often simply referred to as a processor.

9 Cluster:

A group of interconnected, whole computers working together as a unified computing resource that can create the illusion of being one machine. The term whole computer means a system that can run on its own, apart from the cluster.

10 Concurrency:

Pertaining to processes or threads that take place within a common interval of time during which they may have to alternately share common resources.

11 Consumable resource:

A resource that can be created (produced) and destroyed (consumed). When a resource is acquired by a process, the resource ceases to exist. Examples of consumable resources are interrupts, signals, messages, and information in I/O buffers.

12 Database:

A collection of interrelated data, often with controlled redundancy, organized according to a scheme to serve one or more applications; the data are stored so that they can be used by different programs without concern for the data structure or

Organization. A common approach is used to add new data and to modify and retrieve existing data.

13. Deadlock :

(1) An impasse that occurs when multiple processes are waiting for the availability of a resource that will not become available because it is being held by another process that is in a similar wait state.

(2) An impasse that occurs when multiple processes are waiting for an action by or a response from another process that is in a similar wait state.

14. Demand paging :

The transfer of a page from secondary memory to main memory storage at the moment of need. Compare pre-paging.

15. Device driver :

An operating system module (usually in the kernel) that deals directly with a device or I/O module.

16. Direct Access :

The capability to obtain data from a storage device or to enter data

into a storage device in a sequence independent of their relative position by means of addresses that indicate the physical location of the data.

17 Direct Memory Access (DMA):

A form of I/O in which a special module, called a DMA module, controls the exchange of data between main memory and I/O device. The processor sends a request for the transfer of a block of data to the DMA module and is interrupted only after the entire block has been transferred.

18 Disabled interrupt:

A condition, usually created by the operating system, during which the processor will ignore interrupt request signals of a specified class.

19 Disk allocation table:

A table that indicates which blocks on secondary storage are free and available for allocation to files.

20 Distributed operating system:

A common operating system shared by a network of computers. The distributed operating system provides support for interprocess communication, process

migration, mutual exclusion, and the prevention or detection of deadlock.

21 Dispatch:

To allocate time on a processor to jobs or tasks that are ready for execution

22 Dynamic relocation:

A process that assigns new absolute addresses to a computer program during execution so that the program may be executed from a different area of main storage.

23 Enabled interrupt:

A condition, usually created by the operating system, during which the processor will respond to interrupt request signals of a specified class.

24 external fragmentation:

Occurs when memory is divided into variable-size partitions corresponding to the blocks of data assigned to the memory (e.g., segments in main memory). As segments are moved into and out of the memory, gaps will occur between the occupied portions of memory.

25 File :

A set of related records treated as a unit.

26 Field :

(1) Defined logical data that are part of a record.

(2) The elementary unit of a record that may contain a data item, a data aggregate, a pointer, or a link.

27 File Allocation Table (FAT) :

A table that indicates the physical location on secondary storage of the space allocated to a file. There is one file allocation table for each file.

28 File Management system :

A set of system software that provides services to users and applications in the use of files, including file access, directory maintenance, and access control.

29 File organization :

The physical order of records in a file, as determined by the access method used to store and retrieve them.

30 First in First out :

A queuing technique in which the next item to be retrieved is the item that has been in the queue for the longest time.

31 Hash file :

A file in which records are accessed according to the values of a key field. Hashing is used to locate a record on the basis of its key value.

32 hashing :

The selection of a storage location for an item of data by calculating the address as a function of the contents of the data. This technique complicates the storage allocation function but results in rapid random retrieval.

33 hit ratio :

In a two-level memory, the fraction of all memory accesses that are found in the faster memory.

34 Indexed access :

Pertaining to the organization and accessing of the records of a storage structure through a separate index to the locations of the stored

records.

35 Index file:

A file in which records are accessed according to the value of key fields. An index is required that indicates the location of each record on the basis of each key value.

36 Index Sequential access:

Pertaining to the organization and accessing of the records of a storage structure through an index of the keys that are stored in arbitrarily partitioned sequential files.

37 Index sequential file:

A file in which records are ordered according to the values of a key field. The main file is supplemented with an index file that contains a partial list of key values; the index provides a lookup capability to quickly reach the vicinity of a desired record.

38 Instruction cycle:

The time period during which one instruction is fetched from memory and executed when a computer is given an instruction in machine language.

39 Internal fragmentation:

Occurs when memory is divided into fixed-size partitions. If a block of data is assigned to one or more partitions, then there may be wasted space in the last partition. This will occur if the last portion of data is smaller than the last partition.

40 interrupt:

A suspension of a process, such as the execution of a computer program, caused by an event external to the process and performed in such a way that the process can be resumed.

41 interrupt handlers:

A routine, generally part of the operating system. When an interrupt occurs, control is transferred to the corresponding interrupt handler, which takes some action in response to the condition that caused the interrupt.

42 job:

A set of computational steps packaged to run as a unit.

43 Kernel:

A portion of the operating

System that includes the most heavily used portions of software. Generally, the kernel is maintained permanently in main memory. The kernel runs in a privileged mode and responds to calls from processes and interrupts from devices.

44 Kernel mode :

A privileged mode of execution reserved for the kernel of the operating system. Typically, kernel mode allows access to regions of main memory that are unavailable to processes executing in a less-privileged mode, and also enables execution of certain machine instructions that are restricted to the kernel mode. Also referred to as System mode or privileged mode.

45 Last in first Out :

A queueing technique in which the next item to be retrieved is the item most recently placed in the queue.

46 Livelock :

A condition in which two or more processes continuously change their state in response to changes in the other process(es) without doing any useful work. This is similar to deadlock in that no progress is

mode, but it differs in that neither process is blocked on waiting for anything

47 Logical address :

A reference to a memory location independent of the current assignment of data to memory. A translation must be made to a physical address before the memory access can be achieved.

48 Logical record :

A record independent of its physical environment; portions of one logical record may be located in different physical records or several logical records or parts of logical records may be located in one physical record.

49 Main memory malicious software:

Any software designed to cause damage to or use up the resources of a target computer. Malicious software is frequently concealed within or masquerades as legitimate software. In some cases, it spreads itself to other computers via e-mail or infected disks.

Types of malicious software include viruses, Trojan horses, worms and hidden software for launching denial-of-service

cutbacks.

50 Memory cycle time:

The time it takes to read one word from or write one word to memory. This is the inverse of the rate at which words can be read from or written to memory.

51 Memory Partitioning:

The subdividing of storage into independent sections.

52 Micro Kernel:

A small privileged operating system core that provides process scheduling, memory management, and communication services and relies on other processes to perform some of the functions traditionally associated with the operating system kernel.

53 Multiprocessing:

A mode of operation that provides for parallel processing by two or more processors of a multiprocessor.

54 Multiprogramming:

A mode of operation that provides for the interleaved execution

of two or more computer programs by a single processor. The same as multitasking, using different terminology.

55 multiprogramming level:

The number of processes that are partially or fully resident in main memory.

56 multitasking:

A mode of operation that provides for the concurrent performance on interleaved execution of two or more computer tasks. The same as multiprogramming, using different terminology.

57 mutual exclusion:

A condition in which there is a set of processes, only one of which is able to access a given resource or perform a given function at any time. See critical section.

58 Operating System:

Software that controls the execution of programs and that provides services such as resource allocation, scheduling, input/output control and data management.

59 Page :

In virtual storage, a fixed-length block that has a virtual address and that is transferred as a unit between main memory and secondary memory.

60 Page fault :

Occurs when the page containing a referenced word is not in main memory. This causes an interrupt and requires that the proper page be brought into main memory.

61 Page frame :

A fixed-size contiguous block of main memory used to hold a page.

62 Paging :

The transfer of pages between main memory and secondary memory.

63 Physical address :

The absolute location of a unit of data in memory. (e.g. word or byte in main memory, block on secondary memory).

64 Pipe :

A circular buffer allowing two processes to communicate on the producer-

consumer model. Thus, it is a first-in-first-out queue, written by one process and read by another. In some systems, the pipe is generalized to allow any item in the queue to be selected for consumption.

65 Preemption :

Reclaiming a resource from a process before the process has finished using it.

66 Prepaging :

The retrieval of pages other than the one demanded by a page fault. The hope is that the additional pages will be needed in the near future, conserving disk I/O. Compare demand paging.

67 Process :

A program in execution. A process is controlled and scheduled by the operating system. Same as task.

68. process control block :

The manifestation of a process in an operating system. It is a data structure containing information about the characteristics and state of the process.

69 Process State:

All of the information that the operating system needs to manage a process and that the processor needs to properly execute the process. The process state includes the contents of the various processor registers, such as the program counter and data registers; it also includes information of use to the operating system, such as the priority of the process and whether the process is waiting for the completion of a particular I/O event. Some as execution context.

70 Processor:

In a computer, a functional unit that interprets and executes instructions. A processor consists of at least an instruction control unit and an arithmetic unit.

71 Program Counter:

Instruction address register.

72 Programmed I/O:

A form of I/O in which the CPU issues an I/O command to an I/O module and must then wait for the

Operation to be complete before proceeding

73 Real-time system:

An operating system that must schedule and manage real-time tasks.

74 Real-time task:

A task that is executed in connection with some process or function on set of events external to the computer system and that must meet one or more deadlines to interact effectively and correctly with the external environment.

75 Registers:

High-speed memory internal to the CPU. Some registers are user visible - that is, available to the programmer via the machine instruction set. Other registers are used only by the CPU, for control purposes.

76 Relative address:

An address calculated as a displacement from a base address.

77 Response time :

In a data system, the elapsed time between the end of transmission of an enquiry message and the beginning of the receipt of a response message, measured at the enquiry terminal.

78 Round robin :

A scheduling algorithm in which processes are activated in a fixed cyclic order; that is, all processes are in a circular queue. A process that can not proceed because it is waiting for some event (e.g. termination of a child process or an input/output operation) returns control to the scheduler.

79 Scheduling :

To select jobs or tasks that are to be dispatched. In some operating systems other units of work such as input/output operations, may also be scheduled.

80 Secondary memory :

Memory located outside the computer system itself; that is, it cannot be processed directly by the processor. It must first be copied into

main memory. Examples include disk and tape.

81 Segment :

In virtual memory, a block that has a virtual address. The blocks of a program may be of unequal length and may even be of dynamically varying lengths.

82 Segmentation :

The division of a program or application into segments as part of a virtual memory scheme.

83 Semaphore:

An integer value used for signaling among processes. Only three operations may be performed on a semaphore, all of which are atomic: initialize, decrement, and increment.

Depending on the exact definition of the semaphore, the decrement operation may result in the blocking of a process, and the increment operation may result in the unblocking of a process. Also known as a counting semaphore or a general semaphore.

84 Sequential file :

A file in which records are ordered according to the values of one or more key fields and processed in the same sequence from the beginning of the file.

85 Shell :

The portion of the Operating System that interprets interactive user commands and job control language commands. It functions as an interface between the user and the operating system.

86 Stack :

An ordered list in which items are appended to and deleted from the same end of the list known as the top. That is, the next item appended to the list is put on the top, and the next item to be removed from the list is the item that has been in the list the shortest time. This method is characterized as last in first out.

87 Starvation :

A condition in which a process is indefinitely delayed

because other processes are always given preference.

88 Strong Semaphore :

A semaphore in which all processes waiting on the same semaphore are queued and will eventually proceed in the same order as they executed the wait (P) operations (FIFO order).

89 Swapping :

A process that interchanges the contents of an area of main storage with the contents of an area in secondary memory.

90 Symmetric multiprocessing (SMP) :

A form of multiprocessing that allows the operating system to execute on any available processor or on several available processors simultaneously.

91 Synchronous Operation:

An operation that occurs regularly or predictably with respect to the occurrence of a specified event in another process. For example, the calling of an input/output

routine that receives control at a pre-coded location in a computer program.

92 Synchronization :

Situation in which two or more processes coordinate their activities based on a condition.

93 System bus :

A bus used to interconnect major computer components (CPU, memory, I/O).

94 Thread :

A dispatchable unit of work. It includes a processor context (which includes the program counter and stack pointer) and its own dedicated area for a stack (to enable subroutine branching). A thread executes sequentially and is interruptible so that the processor can turn to another thread. A process may consist of multiple threads.

95 Thread switch :

The act of switching processor control from one thread to another within the same process.

96 Time sharing:

The concurrent use of a device by a number of users.

97 Time slice:

The maximum amount of time that a process can execute before being interrupted.

98 Trap:

An unprogrammed conditional jump to a specified address that is automatically activated by hardware; the location from which the jump was made is recorded.

99 Trojan horse:

Secret undocumented routine embedded within a useful program. Execution of the program results in execution of the secret routine.

100 User mode:

The least-privileged mode of execution. Certain regions of main memory and certain machine instructions cannot be used in this mode.

101 Virtual address:

The address of a storage location in virtual memory.

102 Virtual memory:

The storage space that may be regarded as addressable main storage by the user of a computer system in which virtual addresses are mapped into real addresses. The size of virtual storage is limited by the addressing scheme of the computer system and by the amount of secondary memory available and not by the actual number of main storage locations.

103 Virus:

Secret undocumented routine embedded within a useful program.

Execution of the program results in execution of the secret routine.

104 Weak semaphore:

A semaphore in which all processes waiting on the same semaphore proceed in an unspecified order (i.e., the order is unknown or indeterminate).

105 word :

An ordered set of bytes or bits that is the normal unit in which information may be stored, transmitted, or operated on within a given computer. Typically, if a processor has a fixed-length instruction set, then the instruction length equals the word length.

106 Thrashing :

A phenomenon in virtual memory schemes, in which the processor spends most of its time swapping pieces rather than executing instructions.

107 Time slicing :

A mode of operation in which two or more processes are assigned a quota of time on the same processor.

108 Trace :

A sequence of instructions that are executed when a process is running.

109 Translation lookaside buffer (TLB) :

A high-speed cache used to hold recently referenced page table entries as part of a paged virtual memory scheme. The TLB reduces the frequency of access to main memory to retrieve page table entries.

110 Trap door :

Secret undocumented entry point into a program, used to grant access without normal methods of access authentication.

111 Trusted system :

A computer and operating system that can be verified to implement a given security policy.

112 Session :

A collection of one or more processes that represents a single interactive user application on operating system function. All key-board and mouse input is directed to the display screen.

113 Spin lock :

Mutual exclusion mechanism in which a process executes in an infinite loop waiting for the value of a lock variable to indicate availability.

114 Spooling :

The use of secondary memory as buffer storage to reduce processing delays when transferring data between peripheral equipment and the processors of a computer.

115 Working Set :

The working set with parameter Δ for a process at virtual time t , $w(t, \Delta)$ is the set of pages of that process that have been referenced in the last Δ time units. Compare resident set.

116 Worm :

Program that can travel from computer to computer across network connections. May contain a virus or bacteria.

Assignment 2

Bunker's Algorithm

Process	Allocation			Max	Available	Need	(Max- allocation)
	A	B	C				(work)
P ₀	0	1	0	7 5 3	3 3 2		
P ₁	2	0	0	3 2 2			
P ₂	3	0	2	9 0 2			
P ₃	2	1	1	2 2 2			
P ₄	0	0	2	4 3 3			

→ process Allocation Max Available Need (Max-allocation)

Process	Allocation			Max	Available	Need	(Max-allocation)
	A	B	C				A B C
P ₀	0	1	0	7 5 3	3 3 2	7 4 3	
P ₁	2	0	0	3 2 2		1 2 2	
P ₂	3	0	2	9 0 2		6 0 0	
P ₃	2	1	1	2 2 2		0 1 1	
P ₄	0	0	2	4 3 3		4 3 1	

$$\Rightarrow \text{Need} \leq \text{Work} \Rightarrow \text{Work} = \text{Work} + \text{Allocation}$$

$$P_0 \ 743 \leq 332 \leftarrow \times \text{ condition fails}$$

$$P_1 \ 122 \leq 332 \cdot \text{condition true.}$$

$$W = \text{Work} + \text{Allocation}$$

$$= 332 + 200$$

$$= 532$$

P_2 Need \leq work
 $600 \leq 532$ Condition false

P_3 Need \leq work
 $011 \leq 532$ Condition true
 $w = w + \text{allocation}$
 $= 532 + 011$
 $= 743$

$\Rightarrow P_4$ Need \leq work
 $431 \leq 743$
 $\Rightarrow w = w + \text{allocation}$
 $= 743 + 002$
 $= 745$

$\Rightarrow P_0$ Need \leq work
 $743 \leq 745$
 $\Rightarrow w = w + \text{allocation}$
 $= 745 + 010$
 $= 755$

$\Rightarrow P_2$ Need \leq work
 $600 \leq 755$
 $\Rightarrow w = w + \text{allocation}$
 $= 755 + 302$
 $= 1057$

Safe sequence is $\Rightarrow \langle P_1, P_3, P_4, P_0, P_2 \rangle$

* FIFO

7, 0, 1, 2, 3, 0, 4, 2, 3, 0, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1

7	0	1	2	0	3	0	4	2	3	0	3	0
7	7	7	2	2	2	2	4	4	4	4	0	
0	0	0	0	3	3	3	2	2	2	2		
1	1	1	1	0	0	0	3	3				

3	2	1	2	0	1	7	0	1				
0	0	0	0	7	7	0	7	0	7	0	7	
1	1	1	1	1	0	0	0	0	0	0	0	
3	2	1	2	0	2	2	1	2	2	2	2	

page fault = 15 . no of frames = 3.

* LRU

7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1

7	0	1	2	0	3	0	4	2	3	0	3	0	3	2	1
7	7	7	2	2	2	4	4	4	4	0					1
0	0	0	0	0	0	0	0	3	3						3
1	1	1	3	3	2	2	2	2	2						2

2	0	2	0	1	7	0	1
6			1		1		
5			0		0		
2			2		7		

no. of frames = 3

page fault = 9

* Optimal

7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 0, 3, 2, 1, 2, 0, 1, 7,

0, 1

7	0	1	2	0	3	0	4	2	3	0	3	2	1
7	7	7	2	2	2	2	2	2	2	2	2	2	2
0	0	0	0	0	4			0				0	
1	1	1	3	3	3			3				1	

2 0 1 7 0 1

7
0

1

no. of frames - 3

page fault = 9

\Rightarrow EFO:

1, 3, 0, 3, 5, 6, 3

1	3	0	3	5	6	3
1	1	1		5	5	5
3	3			3	6	6
	0			0	0	3

page fault = 6 no of frames = 3

\Rightarrow optimal

7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 3

7	0	1	2	0	3	0	4	2	3	0	3	2	3
7	7	7	7		3		3						
0	0	0			0		0						
	1	1	1				1						

page fault = 6
no of frames = 4