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Contents

1 Chapter

1.1

The most common secondary storage device is _____.

    A) ❑ random access memory

    B) ❑ DVD

    C) ❑ tape drives

    D) ✓ magnetic disk

1.2

Which of the following would lead you to believe that a given system is an SMP-type system?

    A) ❑ Each processor is assigned a specific task.

    B) ❑ There is a boss-worker relationship between the processors.

    C) ✓ Each processor performs all tasks within the operating system.

    D) ❑ None of the above

1.3

A _____ can be used to prevent a user program from never returning control to the operating system.

    A) ❑ portal

    B) ❑ program counter

    C) ❑ firewall

    D) ✓ timer

1.4

Embedded computers typically run on a _____ operating system.

    A) ✓ real-time

    B) ❑ Windows XP

    C) ❑ network

    D) ❑ clustered

1.5

What are some other terms for kernel mode?

    A) ❑ supervisor mode

    B) ❑ system mode

    C) ❑ privileged mode

    D) ✓ All of the above

1.6

Which of the following statements concerning open source operating systems is true?

    A) ❑ Windows is open source.

    B) ✓ Source code is freely available.

    C) ❑ They are always more secure than commercial, closed systems.

    D) ❑ All open source operating systems share the same set of goals.

1.7

Which of the following operating systems is not open source?

A) ✓ Windows

B) ❑ BSD UNIX

C) ❑ Linux

D) ❑ PCLinuxOS

2 Chapter

2.1

A _____ is an example of a systems program.

A) ✓ command interpreter

B) ❑ Web browser

C) ❑ text formatter

D) ❑ database system

2.2

If a program terminates abnormally, a dump of memory may be examined by a _____ to determine the cause of the problem.

A) ❑ module

B) ✓ debugger

C) ❑ shell

D) ❑ control card

2.3

A message-passing model is _____.

A) ✓ easier to implement than a shared memory model for intercomputer communication

B) ❑ faster than the shared memory model

C) ❑ a network protocol, and does not apply to operating systems

D) ❑ only useful for small simple operating systems

2.4

A microkernel is a kernel _____.

A) ❑ containing many components that are optimized to reduce resident memory size

B) ❑ that is compressed before loading in order to reduce its resident memory size

C) ❑ that is compiled to produce the smallest size possible when stored to disk

D) ✓ that is stripped of all nonessential components

2.5

A boot block _____.

    A) ✓ typically only knows the location and length of the rest of the bootstrap program

    B) ❑ typically is sophisticated enough to load the operating system and begin its execution

    C) ❑ is composed of multiple disk blocks

    D) ❑ is composed of multiple disk cylinders

2.6

_____ provide(s) an interface to the services provided by an operating system.

    A) ❑ Shared memory

    B) ✓ System calls

    C) ❑ Simulators

    D) ❑ Communication

2.7

_____ allow operating system services to be loaded dynamically.

    A) ❑ Virtual machines

    B) ✓ Modules

    C) ❑ File systems

    D) ❑ Graphical user interfaces

2.8

Microkernels use _____ for communication.

    A) ✓ message passing

    B) ❑ shared memory

    C) ❑ system calls

    D) ❑ virtualization

2.9

The Windows CreateProcess() system call creates a new process. What is the equivalent system call in UNIX:

    A) ❑ dish()

    B) ❑ spoon()

    C) ✓ fork()

    D) ❑ knife()

2.10

Android runs Java programs _____

    A) ✓ in the Dalvik virtual machine.

    B) ❑ natively.

    C) ❑ in the Java virtual machine.

    D) ❑ Android does not run Java programs.

2.11

_____ is/are not a technique for passing parameters from an application to a system call.

A) ✓ Cache memory

B) ❑ Registers

C) ❑ Stack

D) ❑ Special block in memory

3 Chapter

3.1

The _____ of a process contains temporary data such as function parameters, return addresses, and local variables.

A) ❑ text section

B) ❑ data section

C) ❑ program counter

D) ✓ stack

3.2

A process control block _____.

A) ✓ includes information on the process's state

B) ❑ stores the address of the next instruction to be processed by a different process

C) ❑ determines which process is to be executed next

D) ❑ is an example of a process queue

3.3

The list of processes waiting for a particular I/O device is called a(n) _____.

A) ❑ standby queue

B) ✓ device queue

C) ❑ ready queue

D) ❑ interrupt queue

3.4

When a child process is created, which of the following is a possibility in terms of the execution or address space of the child process?

A) ❑ The child process runs concurrently with the parent.

B) ❑ The child process has a new program loaded into it.

C) ❑ The child is a duplicate of the parent.

D) ✓ All of the above

3.5

A _____ saves the state of the currently running process and restores the state of the next process to run.

A) ❏ save-and-restore

B) ❏ state switch

C) ✓ context switch

D) ❏ none of the above

3.6

A blocking send() and blocking receive() is known as a(n) _____

A) ❏ synchronized message

B) ✓ rendezvous

C) ❏ blocked message

D) ❏ asynchronous message

3.7

A/an _____ allows several unrelated processes to use the pipe for communication.

A) ✓ named pipe

B) ❏ FIFO pipe

C) ❏ LIFO

D) ❏ ordinary pipe

3.8

Which of the following statements is true?

A) ✓ Shared memory is typically faster than message passing.

B) ❏ Message passing is typically faster than shared memory.

C) ❏ Message passing is most useful for exchanging large amounts of data.

D) ❏ Shared memory is far more common in operating systems than message passing.

3.9

Child processes inherit UNIX ordinary pipes from their parent process because:

A) ❏ The pipe is part of the code and children inherit code from their parents.

B) ✓ A pipe is treated as a file descriptor and child processes inherit open file descriptors from their parents.

C) ❏ The STARTUPINFO structure establishes this sharing.

D) ❏ All IPC facilities are shared between the parent and child processes. 3.10 A process that has terminated, but whose parent has not yet called wait(), is known as a

3.10

A process that has terminated, but whose parent has not yet called wait(), is known as a _____ process.

A) ✓ zombie

B) ❏ orphan

C) ❏ terminated

D) ❏ init

3.11

The _____ process is assigned as the parent to orphan processes.

A) ❑ zombie

B) ✓ init

C) ❑ main

D) ❑ renderer

4 Chapter

4.1

The _____ multithreading model multiplexes many user-level threads to a smaller or equal number of kernel threads.

A) ❑ many-to-one model

B) ❑ one-to-one model

C) ✓ many-to-many model

D) ❑ one-to-some model

4.2

Thread-local storage is data that _____.

A) ❑ is not associated with any process

B) ❑ has been modified by the thread, but not yet updated to the parent process

C) ❑ is generated by the thread independent of the thread's process

D) ✓ is unique to each thread

4.3

For threads, Windows uses the _____.

A) ✓ one-to-one model

B) ❑ many-to-one model

C) ❑ one-to many-model

D) ❑ many-to-many model

4.4

_____ is not considered a challenge when designing applications for multicore systems.

A) ❑ Deciding which activities can be run in parallel

B) ✓ Ensuring there is a sufficient number of cores

C) ❑ Determining if data can be separated so that it is accessed on separate cores

D) ❑ Identifying data dependencies between tasks.

4.5

In Pthreads, a parent uses the pthread_join() function to wait for its child thread to complete. What is the equivalent function in Win32?

A) ❏ win32_join()

B) ❏ wait()

C) ✓ WaitForSingleObject()

D) ❏ join()

4.6

A _____ uses an existing thread — rather than creating a new one — to complete a task.

A) ❏ lightweight process

B) ✓ thread pool

C) ❏ scheduler activation

D) ❏ asynchronous procedure call

4.7

_____ is a formula that identifies potential performance gains from adding additional computing cores to an application that has a parallel and serial component.

A) ❏ Task parallelism

B) ❏ Data parallelism

C) ❏ Data splitting

D) ✓ Amdahl's Law

5 Chapter

5.1

Which of the following is true of cooperative scheduling?

A) ❏ It requires a timer.

B) ✓ A process keeps the CPU until it releases the CPU either by terminating or by switching to the waiting state.

C) ❏ It incurs a cost associated with access to shared data.

D) ❏ A process switches from the running state to the ready state when an interrupt occurs.

5.2

_____ is the number of processes that are completed per time unit.

A) ❏ CPU utilization

B) ❏ Response time

C) ❏ Turnaround time

D) ✓ Throughput

5.3

_____ scheduling is approximated by predicting the next CPU burst with an exponential average of the measured lengths of previous CPU bursts.

A) ❑ Multilevel queue

B) ❑ RR

C) ❑ FCFS

D) ✓ SJF

5.4

Which of the following scheduling algorithms must be nonpreemptive?

A) ❑ SJF

B) ❑ RR

C) ✓ FCFS

D) ❑ priority algorithms

5.5

In Little's formula, λ, represents the _____.

A) ❑ average waiting time in the queue

B) ✓ average arrival rate for new processes in the queue

C) ❑ average queue length

D) ❑ average CPU utilization

5.6

_____ allows a thread to run on only one processor.

A) ✓ Processor affinity

B) ❑ Processor set

C) ❑ NUMA

D) ❑ Load balancing

5.7

A significant problem with priority scheduling algorithms is _____.

A) ❑ complexity

B) ✓ starvation

C) ❑ determining the length of the next CPU burst

D) ❑ determining the length of the time quantum

5.8

The _____ occurs in first-come-first-served scheduling when a process with a long CPU burst occupies the CPU.

A) ❑ dispatch latency

B) ❑ waiting time

C) ✓ convoy effect

D) ❑ system-contention scope

5.9

Which of the following is true of earliest-deadline-first (EDF) scheduling algorithm?

A) ✓ When a process becomes runnable, it must announce its deadline requirements to the system.

B) ❑ Deadlines are assigned as following: the earlier the deadline, the lower the priority; the later the deadline, the higher the priority.

C) ❑ Priorities are fixed; that is, they cannot be adjusted when a new process starts running.

D) ❑ It assigns priorities statically according to deadline.

6 Chapter

6.1

A race condition _____.

A) ❑ results when several threads try to access the same data concurrently

B) ✓ results when several threads try to access and modify the same data concurrently

C) ❑ will result only if the outcome of execution does not depend on the order in which instructions are executed

D) ❑ None of the above

6.2

An instruction that executes atomically _____.

A) ❑ must consist of only one machine instruction

B) ✓ executes as a single, uninterruptible unit

C) ❑ cannot be used to solve the critical section problem

D) ❑ All of the above

6.3

What is the correct order of operations for protecting a critical section using mutex locks?

A) ❑ release() followed by acquire()

B) ✓ acquire() followed by release()

C) ❑ wait() followed by signal()

D) ❑ signal() followed by wait()

6.4

What is the correct order of operations for protecting a critical section using a binary semaphore?

A) ❑ release() followed by acquire()

B) ❑ acquire() followed by release()

C) ✓ wait() followed by signal()

D) ❑ signal() followed by wait()

6.5

A/an _____ refers to where a process is accessing/updating shared data.

A) ✓ critical section

B) ❑ entry section

C) ❑ mutex

D) ❑ test-and-set

6.6

_____ can be used to prevent busy waiting when implementing a semaphore.

A) ❑ Spinlocks

B) ✓ Waiting queues

C) ❑ Mutex lock

D) ❑ Allowing the wait() operation to succeed

6.7

How many philosophers may eat simultaneously in the Dining Philosophers problem with 5 philosophers?

A) ❑ 1

B) ✓ 2

C) ❑ 3

D) ❑ 5

6.8

When using semaphores, a process invokes the wait() operation before accessing its critical section, followed by the signal() operation upon completion of its critical section. Consider reversing the order of these two operations—first calling signal(), then calling wait(). What would be a possible outcome of this?

A) ❑ Starvation is possible.

B) ✓ Several processes could be active in their critical sections at the same time.

C) ❑ Mutual exclusion is still assured.

D) ❑ Deadlock is possible.

6.9

The OpenMP #pragma omp critical directive _____.

A) ✓ behaves much like a mutex lock

B) ❑ does not require programmers to identify critical sections

C) ❑ does not guarantee prevention of race conditions

D) ❑ is similar to functional languages

7 Chapter

7.1

One necessary condition for deadlock is _____, which states that at least one resource must be held in a nonsharable mode.

A) ❑ hold and wait

B) ✓ mutual exclusion

C) ❑ circular wait

D) ❑ no preemption

7.2

One necessary condition for deadlock is _____, which states that a process must be holding one resource and waiting to acquire additional resources.

A) ✓ hold and wait

B) ❑ mutual exclusion

C) ❑ circular wait

D) ❑ no preemption

7.3

One necessary condition for deadlock is _____, which states that a resource can be released only voluntarily by the process holding the resource.

A) ❑ hold and wait

B) ❑ mutual exclusion

C) ❑ circular wait

D) ✓ no preemption

7.4

One necessary condition for deadlock is _____, which states that there is a chain of waiting processes whereby P0 is waiting for a resource held by P1, P1 is waiting for a resource held by P2, and Pn is waiting for a resource held by P0.

A) ❑ hold and wait

B) ❑ mutual exclusion

C) ✓ circular wait

D) ❑ no preemption

7.5

In a system resource-allocation graph, _____.

A) ❑ a directed edge from a process to a resource is called an assignment edge

B) ❑ a directed edge from a resource to a process is called a request edge

C) ✓ a directed edge from a process to a resource is called a request edge

D) ❑ None of the above

7.6

A _____ could be preempted from a process.

A) ❑ mutex lock

B) ✓ CPU

C) ❑ semaphore

D) ❑ file lock

8 Chapter

8.1

Absolute code can be generated for _____.

A) ✓ compile-time binding

B) ❑ load-time binding

C) ❑ execution-time binding

D) ❑ interrupt binding

8.2

An address generated by a CPU is referred to as a _____.

A) ❑ physical address

B) ✓ logical address

C) ❑ post relocation register address

D) ❑ Memory-Management Unit (MMU) generated address 8.3 Suppose a program is operating with execution-time binding and the physical address generated is 300. The relocation register is set to 100. What is the corresponding logical address?

8.3

Suppose a program is operating with execution-time binding and the physical address generated is 300. The relocation register is set to 100. What is the corresponding logical address?

A) ❑ 199

B) ❑ 201

C) ✓ 200

D) ❑ 300

8.4

The mapping of a logical address to a physical address is done in hardware by the _____.

A) ✓ memory-management-unit (MMU)

B) ❑ memory address register

C) ❑ relocation register

D) ❑ dynamic loading register

8.5

_____ is the dynamic storage-allocation algorithm which results in the smallest leftover hole in memory.

A) ❑ First fit

B) ✓ Best fit

C) ❑ Worst fit

D) ❑ None of the above

8.6

_____ is the dynamic storage-allocation algorithm which results in the largest leftover hole in memory.

A) ❑ First fit

B) ❑ Best fit

C) ✓ Worst fit

D) ❑ None of the above

8.7

Consider a logical address with a page size of 8 KB. How many bits must be used to represent the page offset in the logical address?

A) ❑ 10

B) ❑ 8

C) ✓ 13

D) ❑ 12

8.8

Assume a system has a TLB hit ratio of 90%. It requires 15 nanoseconds to access the TLB, and 85 nanoseconds to access main memory. What is the effective memory access time in nanoseconds for this system?

A) ✓ 108.5

B) ❑ 100

C) ❑ 22

D) ❑ 176.5

8.9

Given the logical address 0xAEF9 (in hexadecimal) with a page size of 256 bytes, what is the page number?

A) ✓ 0xAE

B) ❑ 0xF9

C) ❑ 0xA

D) ❑ 0x00F9

8.10

Given the logical address 0xAEF9 (in hexadecimal) with a page size of 256 bytes, what is the page offset?

A) ❑ 0xAE

B) ✓ 0xF9

C) ❑ 0xA

D) ❑ 0xF900

8.11

Assume the value of the base and limit registers are 1200 and 350 respectively. Which of the following addresses is legal?

A) ❏ 355

B) ✓ 1200

C) ❏ 1551

D) ❏ all of the above

9 Chapter

9.1

Suppose we have the following page accesses: 1 2 3 4 2 3 4 1 2 1 1 3 1 4 and that there are three frames within our system. Using the FIFO replacement algorithm, what is the number of page faults for the given reference string?

A) ❏ 14

B) ✓ 8

C) ❏ 13

D) ❏ 10

9.2

Belady's anomaly states that _____.

A) ❏ giving more memory to a process will improve its performance

B) ❏ as the number of allocated frames increases, the page-fault rate may decrease for all page replacement algorithms

C) ❏ for some page replacement algorithms, the page-fault rate may decrease as the number of allocated frames increases

D) ✓ for some page replacement algorithms, the page-fault rate may increase as the number of allocated frames increases

9.3

_____ allows the parent and child processes to initially share the same pages, but when either process modifies a page, a copy of the shared page is created.

A) ✓ copy-on-write

B) ❏ zero-fill-on-demand

C) ❏ memory-mapped

D) ❏ virtual memory fork

9.4

What size segment will be allocated for a 39 KB request on a system using the Buddy system for kernel memory allocation?

A) ❏ 39 KB

B) ❏ 42 KB

C) ✓ 64 KB

D) ❏ None of the above

9.5

_____ allows a portion of a virtual address space to be logically associated with a file.

A) ✓ Memory-mapping

B) ❏ Shared memory

C) ❏ Slab allocation

D) ❏ Locality of reference

9.6

Systems in which memory access times vary significantly are known as _____.

A) ❏ memory-mapped I/O

B) ❏ demand-paged memory

C) ✓ non-uniform memory access

D) ❏ copy-on-write memory

9.7

Which of the following is considered a benefit when using the slab allocator?

A) ❏ Memory is allocated using a simple power-of-2 allocator.

B) ✓ It allows kernel code and data to be efficiently paged.

C) ❏ It allows larger segments to be combined using coalescing.

D) ❏ There is no memory fragmentation.

10 Chapter

10.1

A shared lock _____.

A) ❏ behaves like a writer lock

B) ❏ ensures that a file can have only a single concurrent shared lock

C) ✓ behaves like a reader lock

D) ❏ will prevent all other processes from accessing the locked file

10.2

An exclusive lock _____.

A) ✓ behaves like a writer lock

B) ❏ ensures that a file can have only a single concurrent shared lock

C) ❏ behaves like a reader lock

D) ❏ will prevent all other processes from accessing the locked file

10.3

A _____ is used on UNIX systems at the beginning of some files to roughly indicate the type of the file.

A) ❏ file extension

B) ❏ creator name

C) ❏ hint

D) ✓ magic number

10.4

Which of the following is true of the direct-access method for files?

A) ❏ It is the most common mode of access.

B) ✓ It allows programs to read and write records in no particular order.

C) ❏ Files are made up of variable-length records.

D) ❏ It is not a good method for accessing large amounts of data quickly.

10.5

_____ is a secure, distributed naming mechanism.

A) ✓ Lightweight directory-access protocol (LDAP)

B) ❏ Domain name system (DNS)

C) ❏ Common internet file system (CIFS)

D) ❏ Network information service (NIS)

10.6

A mount point is _____.

A) ❏ a root of the file system

B) ❏ a location of a shared file system

C) ❏ only appropriate for shared file systems

D) ✓ the location within the file structure where the file system is to be attached.

11 Chapter

11.1

Transfers between memory and disk are performed a _____.

A) ❏ byte at a time

B) ❏ file at a time

C) ✓ block at a time

D) ❏ sector at a time

11.2

Order the following file system layers in order of lowest level to highest level. [1] I/O control [2] logical file system [3] basic file system [4] file-organization module [5] devices

A) ❏ 1, 3, 5, 4, 2

B) ❏ 5, 1, 3, 2, 4

C) ❏ 1, 5, 3, 4, 2

D) ✓ 5, 1, 3, 4, 2

11.3

In the Linux VFS architecture, a/an _____ object represents an individual file.

A) ✓ inode

B) ❑ file

C) ❑ superblock

D) ❑ dentry

11.4

A disk with free blocks 0,1,5,9,15 would be represented with what bit map?

A) ❑ 0011101110111110

B) ✓ 1100010001000001

C) ❑ 0100010001000001

D) ❑ 1100010001000000

11.5

How many disk accesses are necessary for direct access to byte 20680 using linked allocation and assuming each disk block is 4 KB in size?

A) ❑ 1

B) ✓ 6

C) ❑ 8

D) ❑ 4

11.6

Consider a system crash on a log-structured file system. Which one of the following events must occur?

A) ❑ Only aborted transactions must be completed.

B) ✓ All transactions in the log must be completed.

C) ❑ All transactions in the log must be marked as invalid.

D) ❑ File consistency checking must be performed.

12   Chapter

12.1

The SSTF scheduling algorithm _____.

A) ❑ services the request with the maximum seek time

B) ✓ services the request with the minimum seek time

C) ❑ chooses to service the request furthest from the current head position

D) ❑ None of the above

12.2

Consider a disk queue holding requests to the following cylinders in the listed order: 116, 22, 3, 11, 75, 185, 100, 87. Using the SCAN scheduling algorithm, what is the order that the requests are serviced, assuming the disk head is at cylinder 88 and moving upward through the cylinders?

A) ❏ 116 - 22 - 3 - 11 - 75 - 185 - 100 - 87

B) ✓ 100 - 116 - 185 - 87 - 75 - 22 - 11 - 3

C) ❏ 87 - 75 - 100 - 116 - 185 - 22 - 11 - 3

D) ❏ 100 - 116 - 185 - 3 - 11 - 22 - 75 - 87

12.3

Consider a disk queue holding requests to the following cylinders in the listed order: 116, 22, 3, 11, 75, 185, 100, 87. Using the FCFS scheduling algorithm, what is the order that the requests are serviced, assuming the disk head is at cylinder 88 and moving upward through the cylinders?

A) ✓ 116 - 22 - 3 - 11 - 75 - 185 - 100 - 87

B) ❏ 100 - 116 - 185 - 87 - 75 - 22 - 11 - 3

C) ❏ 87 - 75 - 100 - 116 - 185 - 22 - 11 - 3

D) ❏ 100 - 116 - 185 - 3 - 11 - 22 - 75 - 87

12.4

Which of the following statements regarding solid state disks (SSDs) is false?

A) ✓ They generally consume more power than traditional hard disks.

B) ❏ They have the same characteristics as magnetic hard disks, but can be more reliable.

C) ❏ They are generally more expensive per megabyte than traditional hard disks.

D) ❏ They have no seek time or latency.