

CSE 120 PRACTICE FINAL EXAM, WINTER 2019

For each question, select the *best* choice. In the space provided below each question, justify your choice by providing a succinct (one sentence) explanation.

1. In the Black/Red Hat Problem, say there are 3 people, 2 wearing black hats and 1 wearing a red hat, and all are told publicly the following: "At least one of you has a black hat." They are then repeatedly asked the question: "Is your hat black?" The one with black hat will say "Yes" after a minimum of how many times being questioned? (A) 1; (B) 2; (C) 3; (D) 4.
2. Static variables, local or global, are allocated in the (A) text segment; (B) data segment; (C) stack segment; (D) depends on whether it is local or global.
3. If $\text{sem} < 0$ and a process calls `Signal(sem)`, (A) the process will definitely block; (B) the process will cause another process to block; (C) it cannot be known whether the process will block; (D) another process may become ready.
4. Semaphores (A) are more powerful (have more functionality) than monitors; (B) are less powerful than monitors; (C) are equally as powerful as monitors; (D) are at least as powerful as message passing.
5. By ordering all resources and forcing all requests to follow the ordering, which condition for deadlock is being removed: (A) mutual exclusion; (B) hold and wait; (C) no preemption; (D) circular wait.
6. Given a 32 bit logical address with a 11 bit segment number and 11 bit offset, the number of entries in the segment table and page table are (A) 2048 and 1024; (B) 8192 and 4096; (C) 2048 and 2048; (D) 8192 and 8192.
7. Immediately after a successful store instruction to a page in memory, the corresponding page table entry would have the following values for the valid, reference, and modified bits: (A) 1, 0, 0; (B) 1, 0, 1; (C) 0, 0, 1; (D) 1, 1, 1.
8. Internal fragmentation does not occur in (A) segmentation; (B) paging; (C) combined segmentation and paging; (D) multi-level paging.
9. In UNIX, a directory is implemented as a table whose data is used to translate (A) branch names to inode numbers; (B) path names to data blocks; (C) inode numbers to data blocks; (D) branch names to data blocks.
10. Given a UNIX file system with 1024-byte blocks, how many disk accesses are needed to access bytes 2500-2503 of a file (assume the file control block is already in memory, but no data blocks are cached): (A) 1; (B) 2; (C) 3; (D) 4.
11. An in-memory disk block cache is useful only if (A) disk space usage is high; (B) there is locality in file accesses; (C) disk seek time is low; (D) disk crashes are frequent.
12. The key data structure used to build an in-memory software cache is (A) an array of 13 pointers; (B) a binary tree; (C) a hash table; (D) a hierarchical set of queues.
13. If revocation is the most important consideration, which protection scheme is best: (A) access control lists; (B) capability lists; (C) short passwords; (D) none of the above.

14. In UNIX, the SETUID mechanism allows a process to (A) prevent read access to a file; (B) prevent a file from being executed; (C) switch protection domains; (D) none of the above.
15. Which of the following I/O functions will typically be found in a device driver: (A) access control; (B) device-specific instructions; (C) locking; (D) device-independent buffering.
16. In UNIX, the Standard I/O library performs (A) buffering; (B) device-specific I/O operations; (C) interrupt handling; (D) caching.
17. Which of the following functions would you expect to find in an interrupt handler (that responds to a device hardware interrupt): (A) putting a process on the ready queue; (B) putting a process to sleep; (C) device access control; (D) locking.
18. Which of the following is not a reason for buffering: (A) smoothen a mismatch in data transfer units; (B) smoothen a mismatch in speeds of processes and devices; (C) allow for asynchrony; (D) reuse recently accessed device data.
19. Which of the following requires the least memory accesses: (A) buffered I/O; (B) unbuffered I/O; (C) use of standard I/O library; (D) use of buffer cache.
20. A bitmap indicating which storage blocks are free is typically contained in the (A) File System Metadata; (B) File Metadata; (C) Data Blocks; (D) Block Map.
21. Which of the following statements about the TLB is correct? (A) The TLB takes advantage of locality of reference; (B) The reason for having a TLB is that address translation is a software operation; (C) The larger the TLB, the lower the hit rate; (D) The smaller the TLB, the slower it operates..
22. In PA4, to force `setjmp(env)` to always return 0, `longjmp(env,t)` should be called with parameter `t` set to (A) -1; (B) 0; (C) 1; (D) none of the above..
23. The advantage of public key over secret key encryption is (A) efficiency of execution; (B) ease of key distribution; (C) inability to support digital signatures; (D) the sender and receiver have to know the same key.
24. The Banker's Algorithm keeps track of (A) free resources for all processes; (B) allocated resources per process; (C) total resources; (D) all of the above.
25. The Segment Table Base Register exists so that (which of) the following can determine where the segment table is located in physical memory: (A) the kernel; (B) the memory translation hardware; (C) the currently running process; (D) the CPU..
26. Multi-level Feedback-Queue Scheduling approximates which of the following scheduling policies: (A) FIFO; (B) Priority; (C) Round Robin; (D) Shortest Remaining Time.
27. In the Banker's Algorithm, which of the following scenarios can occur: (A) state is safe, a resource request is granted, state becomes unsafe; (B) state is safe, a resource request is granted, state remains safe; (C) state is unsafe, a resource request is granted, state becomes safe; (D) state is unsafe, a resource request is granted, state remains unsafe.

28. In PA3, which function is needed to implement Wait: (A) Block; (B) Unblock; (C) DoSched; (D) MyYieldThread.
29. The most important factor in determining the page size is (A) internal fragmentation; (B) external fragmentation; (C) the size of page tables; (D) the TLB hit rate.
30. If a set of periodic processes can be scheduled to meet all deadlines using Earliest Deadline First, can all deadlines also be met using Rate Monotonic Scheduling? (A) yes; (B) no; (C) depends on utilizations; (D) none of the above.
31. Given a semaphore Z, there is no way for a process to determine that (A) it blocked another process immediately after it called Wait (Z); (B) it blocked another process immediately after it called Signal (Z); (C) it will block itself if it calls Wait (Z); (D) it will block itself if it calls Signal (Z).
32. The UNIX owner/group/world protection scheme is (A) a simple form of access control lists; (B) a complex form of access control lists; (C) a simple form of capability lists; (D) a complex form of capability lists.
33. Consider a file system which is to be used for videos: once a video is saved, it is never modified or deleted, but may be read many times. Which disk space allocation method would you choose: (A) contiguous; (B) extent-based; (C) random; (D) all are equally good.
34. In UNIX, file names are kept in the file system's data block area rather than file metadata area for reasons of (A) access speed; (B) efficiency of storage usage; (C) reliability; (D) security.
35. Longjmp is most similar to which (A) a goto instruction; (B) receiving a message; (C) TSET instruction; (D) wait on a semaphore.
36. In PA4, MyCreateThread returns (A) 1 to indicate success; (B) nothing; (C) the ID of the created thread; (D) the ID of the calling thread.
37. End-to-end error control would be done in which of the following network layers: (A) physical; (B) link; (C) network; (D) transport?
38. If a web server has (on average) 6 requests it is handling, and every second 2 new requests come in, the average time it takes to complete a request is (A) 3; (B) 6; (C) 9; (D) 12.
39. The event ordering algorithm relies on the availability of: (A) local clocks; (B) a global clock; (C) shared memory; (D) a centralized server.
40. Comparing PA1 to PA4, SaveContext is most like (A) setjmp; (B) longjmp; (C) MyGetThread; (D) MyYieldThread.

Solutions

1. (B)
2. (B)
3. (D)
4. (B)
5. (D)
6. (A)
7. (D)
8. (A)
9. (A)
10. (A)
11. (B)
12. (C)
13. (A)
14. (C)
15. (B)
16. (A)
17. (A)
18. (D)
19. (B)
20. (A)
21. (A)
22. (D)
23. (B)
24. (D)
25. (B)
26. (D)
27. (B)
28. (A)
29. (D)
30. (C)
31. (C)
32. (A)
33. (A)
34. (B)
35. (A)
36. (C)
37. (D)
38. (A)
39. (A)
40. (A)

Answers

1. The two with the black hats can see that the other has a black hat. After the first questioning, neither can respond (because each doesn't know what color hat they personally have). After the second question, each can respond yes, because had only one had a black hat, that one would have been able to respond after the first question; but since they didn't, there must be two black hats (seeing a red hat tells them there can't be three).
2. A variable declared static (local or global) will exist for the entirety of the process, so it must go in the data segment.
3. Signal will never cause a process to block, but if there are waiting processes, it will wake one up.
4. Semaphores only provide synchronization, whereas monitors provide both synchronization and data transfer. You can implement semaphores with monitors, but you can't implement monitors with semaphores, which is a good way of comparing their relative power.
5. If all resources are ordered, there can be no cycles.
6. 11 bit segment implies 2^{11} (2048) segments. With an 11 bit offset, that leaves 10 bits for page number, which implies 2^{10} (1024) pages.
7. Since the page was both referenced and modified, all three bits are set.
8. Segments can be sized exactly, so no internal space needs to be wasted.
9. A directory's name corresponds to the branch of a file's name, and to access a file, its inode is needed, identified by the inode number.
10. Since bytes 2500-2503 are within the third block, only one access is needed. (Not required as an answer, but as a study note: Had the file control block, i.e., inode, not been in memory, more accesses would be required to obtain it by parsing the file name.)
11. If the same block is not accessed within a short period of time, i.e., exhibits locality in time, the block cache would not help.
12. A hash table is what allows quick determination of whether a block is in the cache or not.
13. A resource's access control list lists the domains that allow access to that resource; access is easily revoked by removing the domain from the list.
14. SETUID changes the current domain to that of the owner of the file being executed, effecting a domain switch.
15. A device driver is built specifically for the device it controls, thus having device-specific functions.
16. One reason for the standard I/O library is to provide a temporary place to store I/O to avoid excessive kernel interactions; this is achieved with buffering.
17. An interrupt handler is activated when an I/O completes; the process that was waiting can now be made ready to run.
18. Only a cache keeps data for future reuse, not a buffer.
19. Anything involving buffering – buffered I/O, use of standard I/O library (which involves buffering at user level), use of the buffer cache for a block device – will involve copying of data into an intermediate place, i.e., a buffer, before copying it again to its ultimate destination, and so these will involve more memory accesses than unbuffered I/O.
20. The bitmap indicating which blocks are free is information about the entire file system, hence it is in the File System Metadata.
21. The TLB works because of locality of reference; without it, the TLB is useless. The other answers don't make sense (TLB is hardware, not software; larger TLB means higher hit rate; smaller TLB means faster operation).
22. Setjmp returns 0 when called directly the first time (rather than indirectly via longjmp). Thus, a return value of 0 is special, and longjmp can't force setjmp to return 0. Look up the man page for setjmp and longjmp.
23. Public keys, because they are public, can be distributed without regard for privacy, making key distribution easy.
24. The Banker's Algorithm uses Claims, Allocation, and Availability matrices, the latter two of which determine allocated, free, and total resources.
25. While the kernel loads the Segment Table Base Register, it is the hardware that makes use of it, telling it where to find the segment table to translate logical to physical addresses.
26. Since processes are effectively sorted by how much time they take, MLFQ approximates Shortest Remaining Time.
27. The bankers algorithm will avoid the system ever being in an unsafe state, or going into an unsafe state.
28. If a process calls Wait, it may have to block, which is implemented by calling Block.
29. While many factors go into determining the page size, since reducing access time is more important than saving space, the page size's affect on the TLB is most important.
30. If the sum of the utilizations is below a certain threshold, RMS can meet all deadlines.
31. A process that calls Wait can only block itself, but it cannot know before the call whether this will happen.
32. The scheme lists, for a particular resource (i.e., a file), which domains allow access to the resource, and what the permissions are.
33. Since the space of the video file will never change, the flexibility provided by extent-based or random are not needed, and furthermore, since reading videos requires high throughput, the efficiency provided by contiguous allocation is best.
34. Since filenames are variable and can be very large, and since the file metadata area must be preallocated, efficiency of storage dictates placing filenames in the data block area.
35. The effect of longjmp is to jump to a location that may be across procedure calls. This is why it is sometimes called a "non-local goto".
36. MyCreateThread creates a new thread and returns the id of the created thread so that the calling thread may learn its value.

37. The transport layer operates only at the end points of network communication, whereas the others (physical, link, network) also operate at intermediate points, e.g., routers.
38. This is an application of Little Law, $N = \lambda W$, where N is the average number of processes in the system, λ is the average arrival rate, and W is the average time in the system.
39. Event ordering only relies on the local clock of each participating machine; it does not require any centralized entity (global clock, shared memory, central server), which is why it is considered a distributed algorithm.
40. SaveContext is most like setjmp, as SaveContext saves the context of the currently running process, and setjmp saves the state of the currently running thread.