I. True and False (2 points each) 24

1. (T / F) Divide by zero fault is handled by user-level exception handlers.
2. (T / F) TLB entries can be configured by user-level processes.
3. (T / F) System calls trigger mode switching.
4. (T / F) System call parameters are passed using registers.
5. (T / F) Interrupts occur synchronously to the user-level process.
6. (T / F) UNIX was implemented in Modula 3.
7. (T / F) In UNIX-like systems, exec() is a system call to start a new program.
8. (T / F) Up to N threads can be in the ready state in a system with N processors.
9. (T / F) Threads in the same process share page tables.
10. (T / F) Preemptive scheduling is always better than non-preemptive scheduling.
11. (T / F) Non-preemptive scheduling cannot make scheduling decisions until the currently running process voluntarily releases the CPU.
12. (T / F) Multi-level feedback queue (MLFQ) can use a different scheduling algorithm for each queue.
13. (T / F) In MLFQ, each process is statically assigned to each queue and cannot move to another at runtime.
14. (T / F) One of the disadvantages of partitioned scheduling (a.k.a. multiple queue multiprocessor scheduling) is the task migration overhead.

24. Which of the following does NOT apply to the Exokernel? (CEP)

A. Library OS can directly execute privileged instructions for efficiency.
B. Downloading code can improve performance by eliminating kernel crossings.
C. Visible resource revocation could be inefficient when revocations happen frequently.
D. Abort protocol is used for uncooperative library OSes.
E. All apply to Exokernel

25. Exokernel paper: below figure shows the round-trip latency of network messaging in a library OS (ExOS) with and without ASHs (application-specific handlers). Which of the following best explains this result?

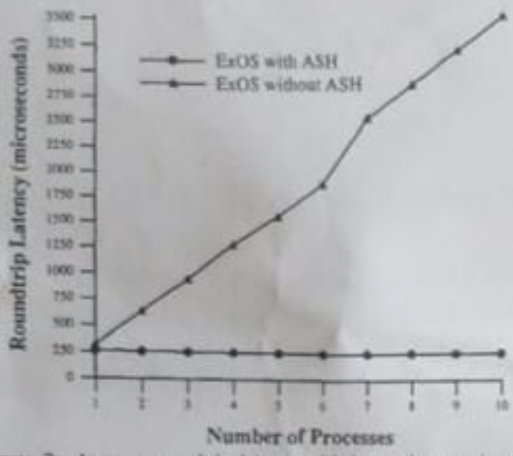


Figure 2: Average roundtrip latency with increasing number of active processes on receiver.

A. The performance benefit of ASHs comes from Modula-3.
B. Without ASHs, ExOS suffers from garbage collection of packet data.
C. Without ASHs, each border crossing time increases with the number of processes.
D. ASHs reduce the overhead of guard conditions in network message handlers.
E. ASHs allow network responses to be sent before ExOS is scheduled.

26. Choose a correct statement about priority-based scheduling.

A. Once assigned, the priority of each thread cannot be changed at runtime.
B. Starvation may happen regardless of whether preemption is enabled or not.
C. Priority inversion does not occur in multiprocessor systems.
D. Priority-based scheduling is inferior to fair-share scheduling.
E. None of the above

20. What OS structure will result in the least border crossings?

A. DOS-like structure
B. Monolithic kernel
C. Microkernel
D. All the same

III. Single choice/short answer (4 points each) 24 26

21. Consider a system using 24-bit address space, 1KB page size. Page table entry (PTE) is 4 bytes each. If single-level paging is used, what is the size of the page table per process?

A. 8192 bytes (= 2^13)
B. 16384 bytes (= 2^14)
C. 32768 bytes (= 2^15)
D. 65536 bytes (= 2^16)
E. 131072 bytes (= 2^17)

$2^{24} * 2^{-10} * 2^{2}$

22. Consider the same system as in the previous question (24 bit address space, 1KB page size, 4 bytes PTE). If this system uses two-level paging with 8 address bits for level 1 and 6 bits for level 2, what is the maximum total size of page tables one process can have? (short answer)

(steps on scratch paper)

Ans : 2^{22} bytes.

$2^{10} + 2^{16}$

23. Which of the following does NOT apply to the SPIN operating system? (**CEP**)

A. Capabilities are implemented directly through the use of pointers.
B. Each logical protection domain has a separate address space.
C. Dispatcher latency may increase linearly with the number of handlers and guards.
D. Garbage collection may occur at runtime.
E. All apply to SPIN

II. Single choice (3 points each) 15

15. Which of the following is true about XV6?

A. There is no separation between user and kernel space at runtime.
B. XV6 follows the monolithic kernel design.
C. XV6 does not support multi-core processors.
D. XV6 does not support multi-level paging.

16. We use the RISC-V version of XV6 for lab projects. What is the default page size in this version?

A. 1KB
B. 2KB
C. 4KB
D. 8KB

17. Which of the following is correct when implementing a parallel application using processes vs. threads?

A. Context switch overhead of processes is higher
B. Sharing data between processes is faster due to Inter-Process Communication.
C. Memory consumption of processes is higher
D. Processes cause fewer page faults.
E. A & B
F. A & C
G. B & D
H. A & C & D

18. Choose the one that best describes mode switching and context switching

A. Context switching is faster than mode switching
B. Interrupts cause context switching but not mode switching
C. System calls always lead to context switching
D. User processes can trigger mode switching by directly modifying the mode register
E. None of the above

19. Which of the following is NOT an advantage of virtual memory?

A. Makes the memory allocation of multiple processes easier
B. Solves the external fragmentation problem via paging
C. Reduces DRAM access latency
D. Enhances protection
E. None of the above

27. Which of the following is correct for the head-of-line blocking problem?

A. It is usually caused by I/O-bound processes blocking CPU-bound processes.
B. FCFS (First come first serve) scheduler can solve this problem.
C. It increases average turnaround time.
D. It increases overall throughput.
E. None of the above

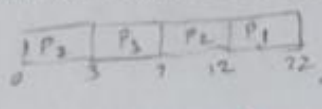
28. Consider a system running the following three processes:

Process	Burst Time	Arrival Time
P1	10	0
P2	8	0
P3	4	3

What is the average turnaround time under the non-preemptive Shortest Job First (SJF) scheduler? (Turnaround time = Completion time – Arrival time)

A. 22/3
B. 35/3
C. 39/3
D. 42/3
E. 48/3

29. For the processes P1, P2, and P3 of the previous question, what is the average turnaround time under the Preemptive-SJF (PSJF) scheduler? (short answer)



Ans: 41/3

38/3

30. Which of the following is correct about the lottery scheduler? **(CEP)**

A. Lottery scheduling is probabilistically fair
B. Average response time of a process is inversely proportional to its ticket allocation
C. Ticket transfer is conceptually similar to priority inheritance
D. Ticket inflation may cause starvation to other user/application groups
E. A & B
F. A & B & C
G. A & B & C & D

31. Which of the following is true about user-level threads and kernel-level threads?

A. System calls are generally faster in user-level threads than in kernel-level threads.
B. Faults in user-level threads do not trigger mode switching.
C. Both kernel-level and user-level threads maintain thread control blocks in the kernel space.
D. User-level threads of the same process share a single user-level stack.
E. None of the above

32. Which of the following is FALSE about scheduler activations?

A. Scheduler activation enables coordination between user and kernel schedulers
B. Kernel uses a scheduler activation to notify the user-level scheduler of relevant kernel events
C. One scheduler activation is assigned to each application
D. Application is free to implement any scheduling policy on top of the scheduler activation
E. None of the above

33. Consider a system with three processes:

Process	Arrival Time	Tickets
P1	0	2
P2	0	3
P3	0	5

What is the process scheduling order by stride scheduling?

A. P1 → P2 → P3 → P1 → P2 → P3 → P1 ...
B. P1 → P2 → P3 → P2 → P3 → P1 → P2 ...
C. P3 → P2 → P1 → P3 → P2 → P1 → P3 ...
D. P3 → P2 → P1 → P3 → P2 → P3 → P2 ...
E. P3 → P2 → P3 → P1 → P3 → P2 → P3 ...
F. P3 → P2 → P3 → P2 → P1 → P3 → P2 ...

[End of document. Good luck!