

CS 4348.501 Operating Systems
Exam # 1, Feb 21st, 2018
Duration: 75 minutes

Name:

This exam is closed notes, and closed books. Cellphones and laptop must be turned off. No calculators allowed.

Cheers and Best wishes.

Question 1: State True/False.

(20 points)

1. A modern OS virtualizes CPU by time sharing.
2. A process is identical to a program.
3. A process is identical to thread.
4. The address space of a process is part of its state.
5. Executing a system call involves changing from user mode to kernel mode.
6. SJF scheduler uses the past to predict the future burst time.
7. The goal of SRTF scheduler is to minimize the response time
8. RR scheduler tends to decrease average response time as time quantum is decreased
9. A very small time quantum value reduces CPU utilization (context switching overhead).
10. In RR scheduling the response time for a process depends on the burst times of other processes that arrived earlier.
11. The OS provides illusion to each process that it has its own address space.
12. The size of the virtual page is always equal to the size of physical frame.
13. Paging suffers from external fragmentation.
14. The number of virtual pages is always equal to the number of physical frames.
15. If physical frame address is 24 bits and physical frame size is 4KB, then the 10 most significant bits exactly contain the frame number.
16. Threads within the same process share the stack.
17. Threads within the same process share the static data.
18. Concurrency leads to race condition.
19. Mutual exclusion can be achieved using locks.
20. Use of locks in a solution for critical section problem automatically guarantees progress.

Question 2 (10 points)

Assume that you have 3 processes A, B, and C in a system with a single CPU. Assume a non-preemptive priority scheduler that prioritizes based on the lexicographic order. Given the following sequence of steps, determine the state of processes after each step. The valid states are the 5 states discussed in the class.

Step 1: A and C are executed at the same time from the shell command prompt.

- 21. Process A is in which state?
- 22. Process C is in which state?

Step 2: Running process forks process B and immediately executes wait(NULL) system call.

- 23. Process A is in which state?
- 24. Process B is in which state?
- 25. Process C is in which state?

Step 3: The running process terminates.

- 26. Process A is in which state?
- 27. Process B is in which state?
- 28. Process C is in which state?

Step 4: The running process issues an i/o system call.

- 29. Process A is in which state?
- 30. Process B is in which state?
- 31. Process C is in which state?

Question 3 (10 points)

Assume three jobs (A, B, and C) arrive roughly at the same time. Only when you need to break the tie, assume Job A arrives slightly before Job B, and Job B arrives slightly before job C. Job A requires 2 sec of CPU, Job B is 8 secs, and Job C is 7 secs. Assume a time-slice of 1 sec.

32. Given a FIFO scheduler, what is the turnaround time of job B?
- a. 0 seconds
 - b. 2 seconds
 - c. 8 seconds
 - d. 10 seconds
 - e. None of the above
33. Given a FIFO scheduler, what is the average response time of the three jobs?
- a. 1 second
 - b. 2 seconds
 - c. 4 seconds
 - d. 9.67 seconds
 - e. None of the above
34. Given a RR scheduler, what is the turnaround time of job B?
- a. 1 second
 - b. 4 seconds
 - c. 16 seconds
 - d. 17 seconds
 - e. None of the above
35. Given a RR scheduler, what is the average response time of the three jobs?
- a. 1 second
 - b. 2 seconds
 - c. 3 seconds
 - d. 12.33 seconds
 - e. None of the above
36. Given a SJF scheduler, what is the turnaround time of job B?
- a. 2 seconds
 - b. 9 seconds
 - c. 16 seconds
 - d. 17 seconds
 - e. None of the above

Question 4 (10 points)

Assume demand paging with three frames. Consider the following page reference string:

7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1

37. If FIFO replacement is used, the number of page faults will be

- a. 8
- b. 9
- c. 10
- d. 11
- e. None of the above

38. If OPT replacement is used, the number of page faults will be

- a. 8
- b. 9
- c. 10
- d. 7
- e. None of the above

39. If LRU replacement is used, the number of page fault will be

- a. 8
- b. 9
- c. 10
- d. 11
- e. None of the above

Question 5 (10 points)

Consider the program below.

```
int tally, lock; // Global variables
void total(int thread_id){
    test_and_set(&lock)
    tally++;
    tally++;
    printf("value of tally is %d in thread %d", tally, thread_id);
    flush(stdout); //flushes the content in the buffer for stdout
    lock = 0;
}
void main(){
    tally = lock = 0;
    create_thread (total(1), total(2), total(3));
    join_threads();
    printf("value of tally after completion of threads = %d", tally);
}
```

In the above code, `create_thread` function creates three new threads, each concurrently executing function `total()`. Function `join_threads()` waits for the all the threads to terminate.

40. Which thread, as indicated by the thread id below, executes function `total()` first?
 - a. 1
 - b. 2
 - c. 3
 - d. Can't determine
41. What is the value of `tally` printed by the first thread that executes `total()`?
 - a. 0
 - b. 2
 - c. 4
 - d. 6
42. What is the value of `tally` printed by the second thread that executes `total()`?
 - a. 2
 - b. 4
 - c. 6
 - d. Can't determine
43. What is the value of `tally` printed by the third thread that executes `total()`?
 - a. 2
 - b. 4
 - c. 6
 - d. Can't determine
44. What is the value of `tally` printed in the `main()`?
 - a. 2
 - b. 4
 - c. 6
 - d. Can't determine