Operating Systems Comprehensive Exam

Spring 2013

Student ID # _____

3/20/2013

You must complete all of Section I

You must complete two of the problems in Section II

If you need more space to answer a question, use the back of a page and indicate which question is being answered.

Section I: You must complete all problems in this section.

1. Allows I/O devices to transfer data directly into main memory without passing it through the CPU.

base registers **page table** **DMA** **threads** **none of these**

2. Memory compaction can be used to minimize the effects of _____ fragmentation.

internal **external** **both** **none of these**

3. Given a time-sharing operating system, which of the following would be an advantage of increasing the length of the time quantum? (circle the **best** answer)

shorter response time **lower context switching overhead**

longer turnaround time **none of these is an advantage**

4. Belady's anomaly can affect the performance of the _____ page replacement algorithm.

FIFO **LRU** **optimal** **none of these**

5. _____ is commonly used to implement virtual memory.

static linking **limit register** **demand paging** **compaction**

6. A process that does not affect, and is not affected by, another process is referred to as:

static **independent** **cooperating** **dynamic** **unbounded**

7. **Explain** the difference between deadlock avoidance and deadlock prevention:

8. A UNIX process calls `fork()` to create a child process as shown: `pid = fork();`

a) What value will be assigned to `pid` in the parent process by the call to `fork()`?

the parent's process id **the child's process id** **zero** **none of these**

b) What value will be assigned to `pid` in the child process by the call to `fork()`?

the parent's process id **the child's process id** **zero** **none of these**

9. Is there an **error** in the following pair of *Semaphore* operations (assume that S is initially 0)?

```
wait(S)  {
   while(S > 0);
   S--;
}
```

```
signal(S)  {
   S++;
}
```

Yes **No** If your answer is **yes**, briefly **explain** the error and **describe** how it can be corrected:

10. **Compare** the advantages and disadvantages of a kernel-level thread scheduler vs. a user-level thread scheduler, include **one advantage** and **one disadvantage** of each.

Matching: for questions 11, 12 & 13, choose the best answer for each question from the list below:

11. _____ This describes the situation when a process spends more time paging than executing.

12. When a process uses a _____ **`send`** to deliver a message, it must wait until the receiving process gets the message.

13. _____ This occurs when attempting to access a memory page that is not currently in memory.

A. atomic	**B. blocking**	**C. busy waiting**
D. mutex	**E. page fault**	**F. thrashing**

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14. A file handle (or file descriptor) is a pointer into the _____.

open file table **file control block** **directory** **file allocation table**

15. What specific term refers to the set of machine instructions that can only be executed while in the system (i.e. supervisor) mode?

bounded code **privileged instructions** **monitor instructions** **static link**

16. Which of the following file allocation methods can result in external fragmentation?

linked allocation **indexed allocation** **contiguous allocation**

17. Regarding memory allocation, **explain** the difference between *paging* and *segmentation*. **Include** the advantages and disadvantages of each approach and specifically **mention** the types of fragmentation that can occur with each approach.

Section II: You must complete **two** of the following **three** problems **(A, B, or C).**
If you complete more than two problems, clearly **indicate which two** problems you want graded. Otherwise, **only the first two** attempted problems will be graded**.**

A. Consider the following list of disk access requests, in arrival order. For each disk scheduling algorithm, **calculate** the number of tracks that the read/write head crosses without stopping. The disk drive has 200 tracks, from 0 to 199, and the read/write head has a starting location of track **100**.

Show your work to receive partial credit, otherwise an incorrect answer will get zero points.

45, 65, 128, 136, 87, 84, 126, 47, 23

(a) First-Come, First-Served _____

(b) Shortest Seek Time First _____

(c) Given the following segment table:

Calculate the correct physical addresses for the following logical addresses [segment, offset], **indicate** any addressing errors that occur.

Segment	Base	Length
0	600	190
1	220	320
2	950	150
3	480	80

a) [2, 110] physical address? _____

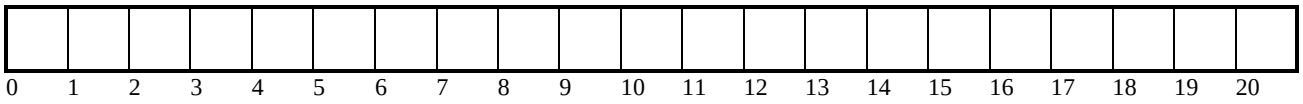
b) [0, 225] physical address? _____

B. Given the following set of processes, answer the questions below. Assume that each new process arrives after the interrupted process has been returned to the ready queue. If two processes arrive at the same time, or have the same remaining burst time, schedule them in process number order.

Process Id	Burst Time	Arrival Time
1	6	0
2	3	1
3	2	3
4	5	4

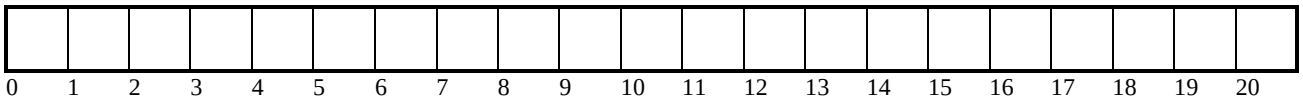
Fill in the following Gantt charts as specified and **answer the questions** associated with each part. Write the process number of the executing process in the cell for each time unit.

1) **First-Come-First-Served** (non-preemptive):



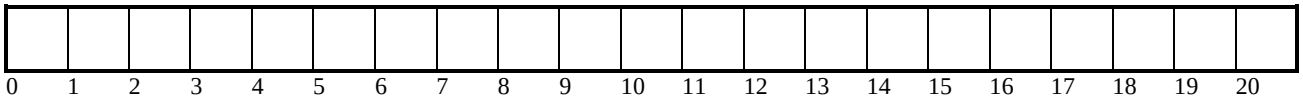
Average waiting time = **What was the turnaround time for process 2 _____**

2) **Shortest-job-first** (preemptive):



Average waiting time = **Which process had the longest response time _____**

3) **Round Robin** (time slice (quantum) is 1 time unit):



Average waiting time = **What was the turnaround time for process 2 _____**

C. Given the following list of page references, in execution order:

```
1, 2, 3, 4, 5, 1, 3, 2, 4, 2, 3, 4, 5
```

Given the number of available frames shown in the table below, **how many page faults will occur** for each of the following page replacement algorithms? (All pages are initially empty.)

You must **show your work** to receive partial credit, otherwise only your answers will count.

Algorithm	**# of page faults**
FIFO with 4 frames	
LRU with 3 frames	
LRU with 4 frames	