Operating Systems Comprehensive Exam

Spring 2006

Student ID # _____

3/16/2006

You must complete all of part I (60%)

You must complete two of the three sections in part II (20% each)

In Part I, circle or select only one answer for each question, unless notified otherwise.

Part I: You `must` complete `all` of this section.

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

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

2. 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**

3. Which of the following disk scheduling algorithms can, in some cases, delay requests for an indefinite amount of time (i.e., starvation can occur)?

   FIFO **SSTF** **LOOK** **SCAN** **none of these is correct**

4. Memory compaction can not reduce fragmentation when _____ is used.

   paging **segmentation** **contiguous allocation**

5. If a system is in an unsafe state, it is guaranteed that a deadlock will occur.

   True **False**

Matching: choose the best answer for each question from the list below:

6. _____ is commonly used to implement virtual memory.

7. The working set model for paging is based upon the assumption of _____.

8. If a page's _____ is set, the page must be written to disk before it is replaced.

9. _____ is used with the base register to determine if a memory access is out of bounds.

```
A.  invalid bit              B.  static linking
C.  page fault               D.  limit register
E.  demand paging            F.  fragmentation
G.  segment register         H.  deadlock
I.  locality                 K.  dirty bit
L.  program counter          M.  compaction
```

Matching: choose the best answer for each question from the list below:

10. The term _____ refers to a software-generated interrupt.

11. _____, and _____ are two of the three conditions that must be satisfied to create a valid solution (algorithm) for the critical section problem.

12. _____ provide a programming interface to the services provided by the OS.

13. _____ processes can affect or be affected by the execution of another process.

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

15. The _____ module gives control of the CPU to the process selected by the short-term scheduler.

A. mutex	**B. job scheduler**	**C. cooperating**
D. progress	**E. kernel mode**	**F. privileged instructions**
G. blocking	**H. atomic**	**J. dispatcher**
K. system calls	**L. mutual exclusion**	**M. independent**
N. bounded waiting	**O. asynchronous**	**P. trap**

16. Does the following pair of operations correctly implement a Semaphore?

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

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

Yes **No** If not, briefly explain the error:

Assuming that the Semaphore code is correct (or has been corrected), briefly describe two disadvantages of this type of Semaphore:

17. Internal fragmentation can occur when using (circle all that apply):

linked file allocation **contiguous memory allocation** **memory paging**

memory segmentation **contiguous file allocation** **indexed file allocation**

18. External fragmentation can occur when using (circle all that apply):

linked file allocation **contiguous memory allocation** **memory paging**

memory segmentation **contiguous file allocation** **indexed file allocation**

19. Clearly explain the difference between deadlock prevention and deadlock avoidance.

20. Answer the following questions based on a system that uses 24-bit memory addressing, a single-level page table and `2k` (i.e., `2048`) byte pages:

a) what is the maximum number of memory pages for this system? _____

b) how many bits in the address are used for the page offset? _____

c) what is the size of a memory frame (in bytes)? _____

d) how many total bytes of memory are available in the system? _____

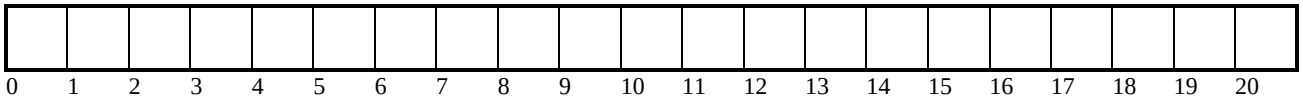
II. You must complete `two` of the following three sections. If you complete more than two sections, clearly indicate which two sections that you want graded. Otherwise, the first two sections will be graded and the third ignored.

A. 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	4	0
2	2	1
3	6	2
4	3	4

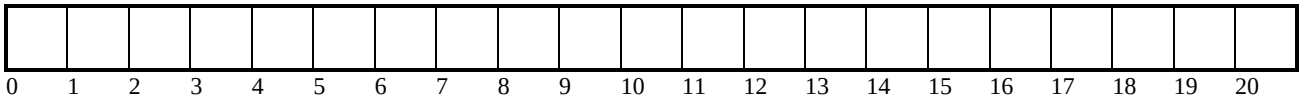
Fill in the following Gantt charts as specified and answer the questions associated with each part. Write the process number of the executing process in the cell for each time unit.

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



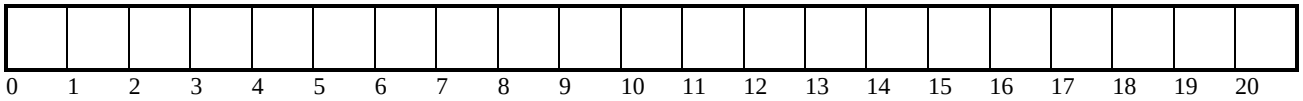
Average waiting time = **Which process had the longest response time _____**

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



Average waiting time = **What was the turnaround time for process 1 _____**

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



Average waiting time = **What was the turnaround time for process 3 _____**

B. Assume that processes 1 and 2 are dispatched concurrently and that A, B, C, D, E, F, G and H represent blocks of code and that the Semaphores S1, S2 and S3 were initialized to 0;

Process 1

```
…
A;
signal(S2);
B;
wait(S1);
C;
wait(S3)
D;
```

Process 2

```
…
E;
signal(S1);
F;
wait(S2);
G;
signal(S3);
H;
```

For the statements below, enter **T** if the statement is always TRUE, **F** if it is always FALSE and **U** if an answer can not be determined from the information given.

_____ B completes before F begins.

_____ D completes before G begins.

_____ C completes before H begins.

_____ A completes before G begins.

_____ G completes before C begins.

_____ C completes before E begins.

_____ F completes before D begins.

_____ G completes before D begins.

_____ E completes before C begins.

_____ F completes before A begins.

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

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

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	
Optimal with 3 frames	