



American University of Beirut

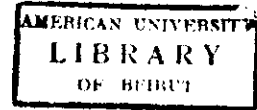
الجامعة الأمريكية في بيروت



Faculty of Arts & Sciences

Department of Mathematics

CMPS 272-Operating Systems
Final - Fall 2001-2002
Time: 2 Hours
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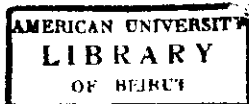
Instructor Name

Signature

Question	Max	Grade
A. General	20	
B. Unix	20	
C. Job Scheduling	20	
D. Process Coordination	20	
E. Deadlock	12	
F. Virtual Memory	26	
Total	118	



Good Work & Good Luck



General Remarks

Make sure of the followings:

1. Answers to multiple choice questions MUST be put in the tables provided at the end of each section. You MUST not put any marks on the questions nor on your choices.
2. Fill in the survey form after you finish your exam

A. General

1. One of the more common instances of client-server architectures is that of a file server serving files to client stations. The file server typically has a lot of storage whereas client stations have a much smaller disk. The client stations access the files through the network. This setup also allows a user to access his/her files from any station. Examples of such environments are Unix using NFS and PCs using a Windows 2000 file server.

In such an environment, when a user executes a program, which CPU executes the instructions of the program?

- (a) The CPU of the client machine.
- (b) The CPU of the server machine.
- (c) The CPUs of both the server and client machines.
- (d) None of the above.

2. What is the role of the other CPU if only one CPU executes the instructions of the program? Explain your answer in the space provided for it on Page 4.

2. If the dirty bit is set to one then

- (a) The page has to be written to the backstore.
- (b) The page has not been modified.
- (c) The page has to be swapped out.
- (d) The page is not in memory.

3. In scheduling, the technique of *aging* is best described as:

- (a) Gradual decrease of priority to prevent indefinite blocking.
- (b) Gradual decrease of priority to prevent deadlock.
- (c) Gradual increase of priority to prevent starvation.
- (d) Gradual increase of priority to prevent deadlock.

4. Throughput is:

- (a) The time between submission of a process until the first response is received.
- (b) The time before a process is preempted.
- (c) The number of processes in the ready queue.
- (d) None of the above.

5. Which of the following is NOT true regarding multiprogramming:
- (a) It makes efficient use of CPU by overlapping the the demands of the CPU and its I/O devices. ✓
 - (b) It always attempts to have something ready for the CPU to execute. ✓
 - (c) The degree of multiprogramming is the number of jobs ready to be run, e.g. *in the ready state*.
 - (d) All of the above.
6. In virtual memory, Belady's anomaly says:
- (a) The page-fault rate may decrease as the number of frames increases.
 - (b) The page-fault rate may decrease as the number of frames decreases.
 - (c) The page-fault rate may increase as the number of frames decreases.
 - (d) The page-fault rate may increase as the number of frames increases.
7. In multiprocessing, graceful degradation is best described as:
- (a) The ability to reduce the computation by distributing it among different processes.
 - (b) The ability to continue computation in the presence of failing processes. ✓
 - (c) The ability to reduce the reliability of the system doing the computation.
 - (d) None of the above.
8. Busy waiting is best described when:
- (a) A process is waiting for an event to occur and it does so by executing instructions.
 - (b) A process is waiting for an event to occur in some queues without having the CPU assigned.
 - (c) A process is in a waiting state.
 - (d) A process is executing a wait operation on a semaphore.
9. Which of the following is not a condition needed before a deadlock can occur?
- (a) At least one more resource must be held in a non-sharable mode.
 - (b) A process holding at least one resource is waiting for more resources held by other processes.
 - (c) Resources can be preempted.
 - (d) There must be circular waiting.
10. Which of the following is not a major activity of an OS with regard to memory management:
- (a) Keep track of which parts of memory are currently being used.
 - (b) Decide which processes are to be loaded into memory when available.
 - (c) Allocate and deallocate memory space as needed.
 - (d) Managing the free-space of the system.

Answers for Section A

1	2	3	4	5	6	7	8	9	10

Explanation for A.1

B. Unix

1. Assume that the directory *Silly* contains two subdirectories *Silly1* and *Silly2* and that the current working directory is *Silly2*. Which of the following command copies all files with extension *.dat* in *Silly2* to the subdirectory *Silly1*:

(a) % cp ../Silly1/*.dat Silly2

(b) % cp /Silly1/*.dat Silly2

(c) % cp *.dat ../Silly1 ✓

(d) % cp *.dat ./Silly1

2. The following command: "% chmod 664 temp"

(a) Removes the write access privilege for all users. ✓

(b) Removes the read access privilege for all users. ✓

(c) Removes the read access privilege for other users. ✓

(d) Removes the write access privilege for other users. ✓

3. Assuming that the file *cars* contains information about cars in the following format:

Type	Model	year	Quantity	Price
------	-------	------	----------	-------

such as:

honda	accord	81	30	6000
-------	--------	----	----	------

Which commands will display all cars priced under 3000:

(a) % awk '\$5 <= 3000' > cars

(b) % awk '\$5 <= 3000' < cars

(c) % cat cars | awk '\$5 <= 3000'

(d) % cat cars > awk '\$5 <= 3000'

4. Which of the following executes the command "Mystery" using the contents of the file "Godknows" as input?

(a) % Mystery | Godknows

(b) % Mystery > Godknows

(c) % Mystery >> Godknows

(d) % Mystery < Godknows ✓

5. Assuming that the output of the "ps" command is the following:

1062	ttyq0	0:01	jot
1102	ttyq0	0:01	jot
1067	ttyq0	0:00	jotxgizmo
1103	ttyq0	0:00	jotxgizmo
1133	ttyq0	0:00	ps
1035	ttyq0	0:10	tcsh

The following command will sort the output of "ps" in alphabetical order with respect to the last field and save the results in a file called "PSDetail.info":

- (a) % ps | sort +3 > PSDetail.info
- (b) % ps > sort -3 > PSDetail.info
- (c) % ps > sort +3 | PSDetail.info
- (d) None of the above.

6. Suppose your current working directory contains the following 20 files: File0, File1, ..., File19. Which command will concatenate the File0 to File10, File1 to File 11, File2 File 12, and so on up to File9 to File19.

- (a) % cat File* >> File1*
- (b) % cat File? >> File1?
- (c) % cat File[0-9] >> File1[0-9]
- (d) None of the above.

7. The output of the command "cat sillyawk" is:

```
{ if ($1 ~ /^[tm]) $2 = "nice"
  print}
```

Which best describes the role of the command "awk -f sillyawk data":

- (a) Will replace by *nice* the second field of each line that starts with the letter *t* ONLY.
- (b) Will replace by *nice* the second field of each line that starts with *tm* ONLY.
- (c) Will replace by *nice* the second field of each line with the first field containing the letter *t* or *m*.
- (d) Will replace by *nice* the second field of each line that starts with *t* or *m*.

8. Which of the following commands print the name of the owner of the current directory?

- (a) % ls -ld | awk {print \$1}
- (b) % ls -ld | awk '{print \$3}'
- (c) % ls -ld < awk '{print \$NF}'
- (d) % awk '{ print "ls -ld"}'

9. Suppose in your current directory you have a number of C files: Silly1.c, silly2.c, Silly3.c. Which of the command below will output all the lines of these files that start with *int* (the name of the file that contains each line must NOT be output):

- (a) % grep -n 'int' *.c
- (b) % grep -h 'int' *.c
- (c) % grep -h '^int' *.c

10. Assuming that you current working directory is *MyDir* issue the command *SillyX* at the prompt command to which it replies "command not found". Which of the following could not be the problem?

- (a) SillyX is not an executable file.
- (b) Your path variable does not include your current working directory.
- (c) Your path variable include the path of SillyX but SillyX is not in MyDir.
- (d) Your path variable does not include the path of the SillyX and SillyX is in MyDir.
- (e) None of the above.

Answers to Unix Question

1	2	3	4	5	6	7	8	9	10

C. Job Scheduling

1. A CPU scheduling algorithm determines an order for the execution of its scheduled processes. Given n processes to be scheduled on one processor, how many possible different schedules are there? Give a formula in terms of n . (Assume that the scheduling algorithm is non-preemptive.)

$n!$

2. Five jobs are waiting to be run. Their expected run times are 9, 6, 3, 5, and X . In what order should they be run to minimize average response time? (Your answer will depend on X .)

5, 3, 6, 9, X

3

$X < 3 = 6$
5, 3, 6, 9, X

3. Consider the following set of processes, with the length of the CPU-burst time given in msecs:

Process	Burst Time	Priority
P_1	10	3
P_2	6	5
P_3	2	2
P_4	4	1
P_5	8	4

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5 , all at time 0.

- (a) Draw three charts illustrating the execution of these processes using FCFS, SJF, and RR (quantum = 1) scheduling.

- (b) What is the turnaround time of each process for each of the scheduling algorithms in part a.

Process	FCFS	SJF	RR
P_1			
P_2			
P_3			
P_4			
P_5			

- (c) What is the waiting time of each process for each of the scheduling algorithms in part a.

Process	FCFS	SJF	RR
P_1			
P_2			
P_3			
P_4			
P_5			

- (d) What is the turnaround time of each process for each of the scheduling algorithms in part a.

Process	FCFS	SJF	RR
P_1			
P_2			
P_3			
P_4			
P_5			

- (e) Which of the schedules in part a results in the minimal average waiting time (over all processes)?

D. Process Coordination

1. The following is an implementation of the critical-region construct *region x when B do S*:

```

wait(mutex);
while not B do
begin
  first_count := first_count + 1;
  if second_count > 0
  then
    Signal(second_delay)
  else
    Signal(mutex);
  Wait(first_delay);
  first_count := first_count - 1;
  second_count := second_count + 1;
  if first_count > 0
  then
    Signal(first_delay);
  else
    Signal(second_delay);
  Wait(second_delay);
  second_count := second_count - 1;
end;
S;
if first_count > 0
then
  Signal(first_delay)
else if second_count > 0
then signal(second_delay)
else
  signal(mutex);

```

The following actions occurred in the order presented:

- Process P_0 arrives with False B
- Process P_1 arrives after P_0 with False B
- Process P_2 arrives after P_1 with False B

- (a) What is the value of each of the variables in the present state of the region?

case	FirstDelay	FistCount	SecondDelay	SecondCount	mutex
(a)					

- (b) Assume now that P_3 has arrived with a True B and the B condition becomes true for P_1 but not for P_0 nor for P_2 . Which process will signal mutex and what are the values just after P_1 leaves the region?

case	FirstDelay	FistCount	SecondDelay	SecondCount	mutex
(b)					

2. Three concurrent processes need to coordinate their actions in order to achieve their task. Each process generates an event. However, it is critical that these events occur in one of two repeating sequences: (1) E1 E2 E3 E3 or (2) E2 E1 E3 E3.

P_1	P_2	P_3
...
...
...
...
...
repeat	repeat	repeat
...
...
...
...
...
E1	E2	E3 E3
...
...
...
...
...
until false	until false	until false

Define semaphores and use the wait & signal primitives so the events always occur in the specified order.

Semaphore	Initial value

E. Deadlocks

1. Consider the following snapshot of a system:

	Allocation				Max				Available				Need			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	0	1	2	0	0	2	4	1	7	4	0				
P_1	1	0	0	0	2	7	5	0								
P_2	1	3	5	4	3	6	10	10								
P_3	0	6	3	2	0	12	8	4								
P_4	0	0	1	4	0	6	6	8								

Answer the following questions using the banker's algorithm:

(a) Fill the contents of the matrix *Need* in the table above.

(b) Is the system in a safe state? Justify your answer.

(c) If a request from process P_3 arrives for $(0, 4, 2, 0)$, can the request be granted immediately?

(d) If a request from process P_0 arrives for $(2, 2, 0, 0)$, can the request be granted immediately?

F. Virtual Memory

1. In a system with swapping has the following free holes: 100k, 500k, 200k, 300k, and 600k (in that order). It needs to load processes with the following sizes: 212k, 417k, 112k, and 426k (in that order) into memory:

(a) How would the *First-Fit* algorithm place the processes?

Hole	Process(es)
100k	
500k	
200k	
300k	
600k	

(b) How would the *Best-Fit* algorithm place the processes?

Hole	Process(es)
100k	
500k	
200k	
300k	
600k	

(c) How would the *Worst-Fit* algorithm place the processes?

Hole	Process(es)
100k	
500k	
200k	
300k	
600k	

2. Consider a system with 4 frames and the following page reference string:

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

(a) Fill the following table using the FIFO replacement algorithm?

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

Number of page faults is :

(b) Fill the following table using the LRU replacement algorithm?

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

Number of page faults is :