COP 4600 – Summer 2014

Introduction To Operating Systems

Final Exam Review

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Material Covered On Exam

- Material from exam #1 and exam #2. Review the exams.

- New material from:

  - Distributed process management

  - Device Management (homework #4)

  - File Management

  - Embedded Systems

- Makeup of the exam will be similar to exam 1 and 2, with a mixture of multiple choice and true/false questions comprising about 60% of the total points with the remainder of the points allocated to work type problems.

Sample Questions:

1. Given the reference string shown below, determine the number of page faults that occur for this reference string when a FIFO page replacement policy is used with both a three and a four frame allocation.

    ref. string = 1, 3, 5, 4, 3, 2, 5, 6, 5, 4, 3, 4, 2, 3, 4, 5, 6, 2, 3, 4

2. Given the reference string shown below, determine the number of page faults that occur for this reference string when a LRU page replacement policy is used with both a three and a four frame allocation.

    ref. string = 1, 3, 5, 4, 3, 2, 5, 6, 5, 4, 3, 4, 2, 3, 4, 5, 6, 2, 3, 4

3. Given the reference string shown below, determine the number of page faults that occur for this reference string when the Optimal page replacement policy is used with both a three and a four frame allocation.

    ref. string = 1, 3, 5, 4, 3, 2, 5, 6, 5, 4, 3, 4, 2, 3, 4, 5, 6, 2, 3, 4

Sample Questions:

4.
- A process has associated with it the following table.
- For each logical address shown indicate if the address is legal.
- If it is, compute the physical address.
- Addresses are in the form <p, d>.
- Assume each page/frame is 1000 bytes in size.

Page #	Frame #
0	32
1	18
2	3
3	45

Logical Address < 0, 321 >   Is it legal? _____   Physical Address _____

Logical Address < 1, 3100 >   Is it legal? _____   Physical Address _____

Logical Address < 4, 754 >   Is it legal? _____   Physical Address _____

Logical Address < 2, 208 >   Is it legal? _____   Physical Address _____

Logical Address < 3, 0 >   Is it legal? _____   Physical Address _____

Sample Questions:

5. Given the following table of processes, their arrival times, processing times, and priority, construct Gantt charts for each of the following processor scheduling protocols and determine for each protocol, the average turnaround time, average normalized turnaround time, and the average waiting time.   Do this for the protocols: (a) FCFS, (b) SPN, (c) RR with time quantum = 1, (d) non-preemptive priority, and (e) preemptive priority.

Process	Arrival Time	Processing Time	Priority
A	0	10	4
B	2	3	2
C	4	2	3
D	6	4	3
E	8	5	1

Sample Questions:

6. Given the following sequence of disk track requests, and assuming that the read/write head is current positioned on track 50 (tracks numbered 0-199) and moving toward larger track numbers (toward the center of the disk), determine the total number of tracks traversed in accommodating all of the requests using the (a) the SSTF disk scheduling algorithm and (b) the C-SCAN disk scheduling algorithm.

20, 44, 116, 98, 178, 35, 99, 122, 156

Sample Questions: ANSWERS

Question 1

FIFO

Ref. String	1	3	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3	4	
frame 1	1	1	1	3	3	5	5	4	2	6	5	5	4	4	4	3	2	2	5	6	
frame 2		3	3	5	5	4	4	2	6	5	4	4	3	3	3	2	5	5	6	3	
frame 3			5	4	4	2	2	6	5	4	3	3	2	2	2	5	6	6	3	4	total faults
page fault	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	14

FIFO

Ref. String	1	3	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	6	3	4	
frame 1	1	1	1	1	1	3	3	5	5	5	4	4	4	4	4	2	2	2	2	6	
frame 2		3	3	3	3	5	5	4	4	4	2	2	2	2	2	6	6	6	6	3	
frame 3			5	5	5	4	4	2	2	2	6	6	6	6	6	3	3	3	3	5	
frame 4				4	4	2	2	6	6	6	3	3	3	3	3	5	5	5	5	4	total faults
page fault	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	N	N	N	N	Y	N	N	N	Y	9

Sample Questions: ANSWERS

Question 2

LRU																				
Ref. String	1	3	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3	4
frame 1	1	1	1	3	5	4	3	2	2	6	5	5	3	4	2	3	4	5	6	2
frame 2		3	3	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3
frame 3			5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3	4
page fault	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y

total faults: 15

LRU																				
Ref. String	1	3	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3	4
frame 1	1	1	1	1	1	5	4	3	3	2	6	6	5	5	5	2	3	4	5	6
frame 2		3	3	3	5	4	3	2	2	6	5	5	3	4	2	3	4	5	6	2
frame 3			5	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3
frame 4				4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3	4
page fault	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	N	N	Y	Y	Y	Y

total faults: 14

Sample Questions: ANSWERS

Question 3

Optimal

Ref. String	1	3	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3	4	
frame 1	1	1	1	4	4	4	4	4	4	4	4	4	4	4	4	4	6	6	6	4	
frame 2		3	3	3	3	2	2	6	6	6	3	3	3	3	3	3	3	3	3	3	
frame 3			5	5	5	5	5	5	5	5	5	5	2	2	2	2	2	2	2	2	total faults
page fault	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	N	Y	N	N	Y	Y	N	N	Y	11

Optimal

Ref. String	1	3	5	4	3	2	5	6	5	4	3	4	2	3	4	5	6	2	3	4	
frame 1	1	1	1	1	1	2	2	6	6	6	6	6	2	2	2	2	2	2	2	2	
frame 2		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
frame 3			5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	
frame 4				4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	total faults
page fault	Y	Y	Y	Y	N	Y	N	Y	N	N	N	N	Y	N	N	N	Y	N	N	N	8

Sample Questions: ANSWERS

Question 4

- A process has associated with it the following table.
- For each logical address shown indicate if the address is legal.
- If it is, compute the physical address.
- Addresses are in the form <p, d>.
- Assume each page/frame is 1000 bytes in size.

Page #	Frame #
0	32
1	18
2	5
3	45

Logical Address < 0, 321 > Legal – physical address = (32 * 1000 + 321) = 32,321

Logical Address < 1, 3100 > Illegal - displacement of 3100 is larger than 1000 byte page size

Logical Address < 5, 754 > Illegal – process has no page 5 in the page table

Logical Address < 2, 208 > Legal – physical address = (5 * 1000 + 208) = 5208

Logical Address < 3, 0 > Legal – physical address = (45 * 1000 + 0) = 45,000

Sample Questions: ANSWERS

Question 5 - FCFS

FCFS																											T_R	T_R/T_S	wait time
Process																													
A																											10	1	0
B			w	w	w	w	w	w	w	w																	11	3.666667	8
C				w	w	w	w	w	w	w	w	w															11	5.5	9
D					w	w	w	w	w	w	w	w	w														13	3.25	9
E						w	w	w	w	w	w	w	w	w	w	w											16	3.2	11
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		average	12.2	3.323333	7.4

Sample Questions: ANSWERS

Question 5 - SPN

SPN																											T_R	T_R/T_S	wait time
Process																											T_R	T_R/T_S	wait time
A																											10	1	0
B		w	w	w	w	w	w	w	w	w	w																13	4.333333	10
C				w	w	w	w	w	w																		8	4	6
D					w	w	w	w	w	w	w	w	w														13	3.25	9
E							w	w	w	w	w	w	w	w	w	w	w										16	3.2	11
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		average	12	3.156667	7.2

Sample Questions: ANSWERS

Question 5 – RR, q = 1

RR, q =1																											T_R	T_R/T_S	wait time
Process																														
A			w		w		w		w		w	w	w		w	w	w		w	w		w					24	2.4	13
B				w	w	w	w	w	w	w		w	w	w													8	2.666667	10
C						w	w	w	w	w	w																7	3.5	6
D							w	w	w	w	w		w	w		w	w										12	3	9
E									w	w	w	w	w	w	w		w	w		w		w					13	2.6	11
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		average	12.8	2.833333	9.8

Sample Questions: ANSWERS

Question 5 – priority – non-preemptive

Priority - non-preemptive																											T_R	T_R / T_S	wait time
Process																												T_R	T_R / T_S	wait time
A																												10	1	0
B		w	w	w	w	w	w	w	w	w	w	w	w	w														16	5.333333	13
C				w	w	w	w	w	w	w	w	w	w	w	w	w												16	8	14
D						w	w	w	w	w	w	w	w	w	w	w	w	w										18	4.5	14
E									w	w																		7	1.4	2
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		average		13.4	4.046667	8.6

Sample Questions: ANSWERS

Question 5 – priority – preemptive

Priority - preemptive																										T_R	T_R/T_S	wait time
Process																												
A		A	A	w	w	w	w	w	w	w	w	w	w	w	w	w	w	A	A	A	A	A	A	A	A	24	2.4	14
B			B	B	B																					3	1	0
C					C(w)	C	C																			3	1.5	1
D							D(w)	D	D(w)	D(w)	D(w)	D(w)	D(w)	D	D	D									10	2.5	6
E									E	E	E	E	E												5	1	0
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	average	9	1.68	4.2

Sample Questions: ANSWERS

Question 6(a) - SSTF

SSTF	Next Track Accessed	Number of Tracks Traversed	Cummulative Tracks Traversed
	44	6	6
	35	9	15
	20	15	30
	98	78	108
	99	1	109
	116	17	126
	122	6	132
	156	34	166
	178	22	188
	Average Number of Tracks Traversed:		20.88888889

Sample Questions: ANSWERS

Question 6(b) – C-SCAN

C-SCAN			
	Next Track Accessed	Number of Tracks Traversed	Cummulative Tracks Traversed
	98	48	48
	99	1	49
	116	17	66
	122	6	72
	156	34	106
	178	22	128
	199	21	149
	0	200	349
	20	20	369
	35	15	384
	44	9	393
	Average Number of Tracks Traversed:		43.66666667