CS560 Final Exam, May 4, 2009

Answer all questions

Question 1

State the four necessary conditions for deadlock, and then give two example solutions to the Dining Philosopher's problem that we went over in class that solve the deadlock problem by eliminating different conditions. Just give description (not code) and how it eliminates the condition.

Question 2

Explain how Unix inodes work, and how they provide a nice blend of properties for a variety of files.

Question 3

Describe RAID-4 or RAID-5 (single fault-tolerance) disk arrays: describe their motivation, their properties, how they tolerate failures, and the way in which disks fail that renders them inadequate in many of today's disk arrays.

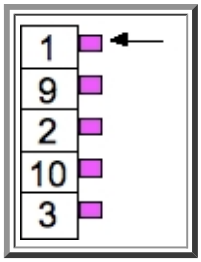
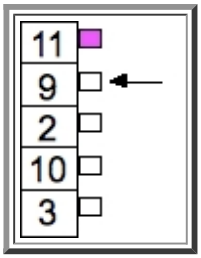
Question 4

Suppose you are allocating five pages to a user's process. The user's program generates the following page trace:

1, 9, 1, 2, 10, 3, 9, 11, 1, 2, 1, 10, 11, 10, 9, 1, 2, 1, 4, 10, 11, 8, 10, 1, 8, 10, 11, 4

On the next page are 24 sequences of page faults. For each of the four page replacement algorithms listed, say which sequence of page faults would be generated by that algorithm.

- Optimal
- LRU
- FIFO
- Clock (second chance)

For the clock algorithm, just so we're on the same page, after the first five references, the state of memory, plus the reference bits and algorithm pointer are as pictured to the right (magenta means that the reference bit is set):	
The reference to page 11 will cause a page fault, and after the page replacement, the state of the system is:	

Note, I have work sheets for you that should help.

The answers for question 4 -- note, the correct answers are here. If your answer isn't here, then your answer is not correct. However, if you are sure about your answer, give it instead of the one here. If you're right and I'm wrong, you'll get some extra points. If you give me a sequence that is listed here, instead of the letter of the sequence, I will be irritated. Perhaps you don't care about my irritation.

The sequences are sorted numerically.

a. 1, 9, 2, 10, 3, 11, 1, 2, 1, 11, 1, 2, 4, 10, 8, 1, 8, 4
b. 1, 9, 2, 10, 3, 11, 1, 2, 10, 4, 11, 8
c. 1, 9, 2, 10, 3, 11, 1, 2, 11, 10, 4, 11, 8
d. 1, 9, 2, 10, 3, 11, 1, 9, 1, 4, 10, 8, 10, 1, 10, 11
e. 1, 9, 2, 10, 3, 11, 1, 9, 2, 4, 10, 11, 8, 1
f. 1, 9, 2, 10, 3, 11, 1, 9, 4, 10, 11, 8, 1
g. 1, 9, 2, 10, 3, 11, 1, 9, 4, 11, 8, 1
h. 1, 9, 2, 10, 3, 11, 1, 10, 1, 2, 1, 4, 10, 8, 11
i. 1, 9, 2, 10, 3, 11, 1, 11, 10, 4, 8
j. 1, 9, 2, 10, 3, 11, 2, 4, 8, 10
k. 1, 9, 2, 10, 3, 11, 2, 9, 2, 4, 11, 8, 1
l. 1, 9, 2, 10, 3, 11, 2, 10, 9, 1, 4, 8, 11
m. 1, 9, 2, 10, 3, 11, 4, 8
n. 1, 9, 2, 10, 3, 11, 4, 8, 1
o. 1, 9, 2, 10, 3, 11, 4, 8, 1, 8, 11, 4
p. 1, 9, 2, 10, 3, 11, 4, 8, 10
q. 1, 9, 2, 10, 3, 11, 4, 11, 8, 11, 4
r. 1, 9, 2, 10, 3, 11, 9, 1, 2, 4, 10, 11, 8, 1
s. 1, 9, 2, 10, 3, 11, 9, 1, 4, 8, 10, 11
t. 1, 9, 2, 10, 3, 11, 9, 2, 4, 10, 11, 8, 1
u. 1, 9, 2, 10, 3, 11, 9, 4
v. 1, 9, 2, 10, 3, 11, 9, 4, 8
w. 1, 9, 2, 10, 3, 11, 9, 4, 10, 8
x. 1, 9, 2, 10, 3, 11, 9, 4, 10, 11, 8

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NOTE: For question 5, save the last four parts to be
the last questions that you answer.  If you don't
know how to do them, don't waste time on them.  Instead
spend your time making the other answers on the exam
tight.
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Question 5

S0BR	2
S0LR	2
S1BR	5
S1LR	4

On Easter Island, out in the remote South Pacific, the development of microprocessors and silicon has not been as rapid as it has been here. They've just released their second generation of machines, the Ear-Lobe-2. They have the following features:

- Pages are 64 bytes. Note, 64 is equal to 2^6.
- Pointers are 24 bits. Pointers reference bytes.
- The amount of main memory allocated for users is 128 KB and starts at physical address 0x0. Note, 128 K is equal to 2^{17}.
- Page tables are stored in the same memory that is allocated for the user, in contiguous pages.
- Page table entries are 2 bytes, and reference pages by page number. They also contain a valid bit. The first page is numbered zero.
- There is no backing store.

0x0	0
0x410	1
0x222	1
0x3cc	1
...	
0x200	1
0x240	1
0x111	1
0x113	1
...	
0x0	0
0x404	1
0x401	1
0x460	1
...	
0x201	1
0x342	1
0x402	1
0x202	0
...	
0x120	1
0x140	1
0x108	1
0x1c0	1
...	
0x2c0	1
0xcc	1
0x322	1
0x88	1
...	
0x10c	1
0x300	1
0x480	0
0x7c	0
...	
0x2c0	0
0x100	0
0x20c	0
0xff	0
...	
0xcf0	1
0x333	1
0x411	1
0x233	1
...	

The paging scheme is paged segmentation. There are two segment base registers and two segment length registers. They are indexed by the highest bit in a pointer. Each points to a single-level page table for the respective segment. The length register holds the number of pages that compose the page table for that segment.

Part 1: How many pages are in main memory?

Part 2: Draw for me what a pointer looks like, in terms of segment, page and offset. Make sure you tell me how the bits of the pointer are partitioned.

Part 3: Is it possible to use address 0x7fffff? Why or why not? Be specific.

Part 4: What would be the problem if you set the segment 0 base register (S0BR) to 2047 and the segment 0 length register (S0LR) to 2? Be specific.

For Parts 5-8, Suppose the first nine pages of memory and segment registers are as pictured to the right. Only the first eight bytes of each page are pictured. Translate each of the virtual addresses to physical addresses. Use hex. If the translation results in a segmentation violation, tell me where the violation occurs and why.

Part 5: 0x08.
Part 6: 0x80000c.
Part 7: 0x6c.
Part 8: 0x800825.

Extra Credit

Suppose instead of identifying pages, the page trace of question five indexed the first line of a famous song's lyrics. The trace would then be:

"Who's, Machine, Who's, The, To, Black, Machine, All, Who's, The, Who's, To, All, To, Machine, Who's, The, Who's, Private, To, All, Sex, To, Who's, Sex, To, All, Private."

Identify the song: title and artist.