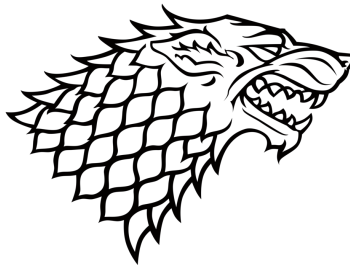Final Exam

CSE 3320

Spring 2019

Name: _____

UTA ID:_____

House Stark

"I certify that the following work is my work alone and I will follow the highest
standards of integrity and uphold the spirit of the Honor Code"

Signature:_____

Directions: This is a closed book, closed notes exam. You may use a hand written 3x5 index card with notes. Please answer the questions briefly but completely. Write your answers legibly. Unreadable answers will be counted wrong. You may write on back if needed. There is a powers of two tables on the last page.

1. 5pts Consider a type 1 hypervisor that can support up to n virtual machines at the same time. PCs can have a maximum of four disk primary partitions. Can n be larger than 4? If so, where can the data be stored?

2. 6pts Describe locality of reference.

Process ID	Arrival Time	Runtime (seconds)	Priority
1	0	6	3
2	1	4	4
3	3	4	1
4	6	2	4
5	10	2	1
6	13	6	2
7	14	2	1

3. 8pts You are tasked with implementing the preemptive job scheduler for new touch screen tablet for artists. Due to the tactile nature of the consumer use cases a responsive GUI is your key characteristic. Given a representative set of tasks in the table above, determine what the optimal scheduling algorithm is for your device. Quantify your choice with Gannt charts and other calculations.

Extra Space If Needed

4. 4pts Suppose you had a computer that supported virtual memory and had 64-bit virtual addresses and 4 KB pages. If a process actually uses 2048 pages of its virtual address space, how much space would be occupied by the page table for that process if a single-level page table was used?

5. 4pts You are given an index allocated file system with disk blocks that are 8 KB in size and a pointer to a disk block is 64 bit. This file system's index nodes have 10 direct disk blocks, as well as 5 indirect disk blocks, 4 double indirect blocks and 3 triple indirect blocks. What is the largest file that can be held using this inode layout?

Block size = 8 KB = 8192 bytes
Pointer size = 64 bit = 8 bytes
Pointers per block = 8192 / 8 = 1024

Total data blocks:
- Direct: 10
- Indirect: 5×1024
- Double indirect: 4×1024^2
- Triple indirect: 3×1024^3

$$10 + 5 \cdot 1024 + 4 \cdot 1024^2 + 3 \cdot 1024^3 = 3{,}225{,}424{,}906 \text{ blocks}$$

Largest file size:
$$3{,}225{,}424{,}906 \times 8192 \text{ bytes} \approx 2.64 \times 10^{13} \text{ bytes} \approx 24 \text{ TB}$$

6. 4pts Consider a reference string 1,2,3,4,2,5,6,2,3,2,1,6,7; and a system with only 3 frames, pure demand paging, and all frames initially empty.

(a) How many page faults would occur with an Optimal replacement scheme? What are the identities of pages in the frames when the reference string has completed?

(b) How many page faults would occur with a FIFO replacement scheme? What are the identities of pages in the frames when the reference string has completed?

(c) Would increasing the number of frames always decrease the number of page faults for a particular reference string for LRU? for Optimal? Why or why not? You need not provide "proof", just an explanation.

Extra Space If Needed

7. 4pts. Which of the following instructions should be allowed only in kernel mode?

(a) Disable all interrupts

(b) Read the time-of-day clock.

(c) Set the time-of-day clock.

(d) Change the memory map.

8. 4pts Given the following request queue -- 2, 27, 8, 76, 42, 20 84, 31, 92, 97 with the disk head initially at the track 35 initially moving in the positive direction (towards 100). The beginning of the disk is at 0 and the end of the disk is at 100. Calculate the travel distance for the C-LOOK algorithm. Assume all reads are made in the positive direction if applicable.

9. 4pts You are given the following data about a virtual paged memory system:

(a)The parallel TLB can hold 1024 entries and can be accessed in 1 clock cycle (1 nsec).

(b) A page table entry can be found in 100 clock cycles or 100 nsec.

(c) The average page replacement time is 6 msec.

If page references are handled by the TLB 99% of the time, and only 0.01% lead to a page fault, what is the effective address-translation time (EAT + page replacement)

10. 4pts In a system with threads, is there one stack per thread or one stack per process when user-level threads are used? What about when kernel-level threads are used? Explain.

11.   4pts Describe the SCAN (elevator) disk scheduling algorithm. What is the advantage of the SCAN (elevator) algorithm over the shortest-seek-first algorithm?

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12. 4pts A disk rotates at 7200 RPM. It has 1000 sectors of 512 bytes each round the outer cylinder. Given a seek time of 3 ms, calculate the average data rate and maximum data rate in bytes/sec for the disk.

13 . 7pts List the 7 layers of the OSI network model and give an example of each if one exists.

14. 6pts Alice and Bob have previously exchanged public keys. Now Alice wants to send a confidential message to Bob. What should Alice do? Fill in each blank with one of the following words: decrypts, signs, digests, encrypts, Alice, Bob, public, private.

Alice _____the message with _____'s   _____ key

then Bob _____ the result with _____ 's   _____ key.

15. 3pts Describe the effects of a corrupted data block for a given file for:

(a) contiguous,

(b) linked

(c) indexed

16. 10pts Describe demand based paging. You should consider addresses spaces, pages, frames, page tables, and Memory Management Units in your answer. What are the benefits?

17. 2pt Contiguous allocation of files leads to disk fragmentation be- cause some space in the last disk block will be wasted in files whose length is not an integral number of blocks. Is this internal fragmentation or external fragmentation?

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18. 8pts How long does it take to load a 64-KB program from a disk whose average seek time is 5 msec, whose rotation time is 5 msec, and whose tracks hold 1 MB

(a) for a 2-KB page size?
(b) for a 4-KB page size?

The pages are spread randomly around the disk and the number of cylinders is so large that the chance of two pages being on the same cylinder is negligible.

n	2^n	n	2^n	n	2^n
0	1	11	2,048	22	4,194,304
1	2	12	4,096	23	8,388,608
2	4	13	8,192	24	16,777,216
3	8	14	16,384	25	33,554,432
4	16	15	32,768	26	67,108,864
5	32	16	65,536	27	134,217,728
6	64	17	131,072	28	268,435,456
7	128	18	262,144	29	536,870,912
8	256	19	524,288	30	1,073,741,824
9	512	20	1,048,576	31	2,147,483,648
10	1,024	21	2,097,152	32	4,254,967,296