CS 544 Exam 1 (16%) - Fall 2024

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Fill in these fields (left to right) on the scantron form (use pencil):

1. LAST NAME (surname) and FIRST NAME (given name), fill in bubbles
2. IDENTIFICATION NUMBER is your Campus ID number, fill in bubbles
3. Under A of SPECIAL CODES, tell us about the nearest person (if any) to your left. 0=no person to the left in your row, 1=somebody you do not know is there, 2=somebody you do know is there.
4. Under B of SPECIAL CODES, do the same as B, but for the person to your right
5. **Under C of SPECIAL CODES, write 1 and fill in bubble 1**. This is very important!

Make sure you fill all the special codes above accurately in order to get graded.

You have 40 minutes to take the exam. Use a #2 pencil to mark all answers. When you're done, please hand in these sheets in addition to your filled-in scantron. You may not sit adjacent to your friends or other people you know in the class (having only one empty seat is considered "adjacent"). You may only reference your notesheet. You may not use books, your neighbors, calculators, or other electronic devices on this exam. Please turn off and put away portable electronics now.

If multiple answers are correct, choose the best answer.

Do not communicate with anybody besides the teaching team about questions or answers until exam grades have been posted.

(Blank Page for You to Do Scratch Work)

Q1. Assume multiple threads are concurrently running the following code:

```python
# lock is a global lock
if x + y < 100:
    with lock:
        x += y
```

Is the above code guaranteed to prevent x from exceeding 100 (assuming it was initially less that 0)?

(A) yes   (B) no

Q2. Using protocol buffers, you store value y in an intX type (X could be 32, 64, etc). What determines how many bytes the value will consume when serialized?

(A) how big y is   (B) how big X is

Q3. Where does tmpfs store data?

(A) in memory   (B) only on an HDD   (C) only on an SSD   (D) on any block device

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Q4. Is the below data layout column oriented or row oriented?

Table:

```
4,5,3
6,2,1
```

Disk layout: 4,5,3,6,2,1

(A) column oriented   (B) row oriented

Q5. What is something that is shared between all threads in a process?

(A) stack   (B) heap   (C) instruction pointer

Q6. 8 MB/s is equivalent to what?

(A) 1 Mbps   (B) 8 Mbps   (C) 64 Mbps   (D) 8000 Mbps   (E) 8192 Mbps

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Q7. For a very large sequential I/O to a hard drive, what will dominate the time?

(A) moving the head   (B) waiting for the platter to rotate   (C) transferring the data

Q8. The prints to standard out from the server are not immediately appearing in the log:

```
python3 server.py > log.txt
```

What should you do if you want to see thoses prints right away?
(A) pass "-u" to python3
(B) append "&" to the end
(C) use "2>" instead of ">"
(D) run the command with sudo

Q9. You have an LRU cache of size 4. How many hits will there be for the following workload?

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

(A) 0   (B) 1   (C) 2   (D) 3   (E) 7

Q10. You have a URL someprotocol://someaddr:someport/someresource. Which part will determine the specific running process that will receive the request?

(A) someprotocol   (B) someaddr   (C) someport   (D) someresource

Q11. True/False: when a thread is holding a lock during a critical section, the scheduler WILL NEVER context switch to another thread in the same process.

(A) True   (B) False

Q12. Say you have this workload on a cache of size 2: A,A,A,A,B,C. When C is accessed, what would each policy evict?

(A) both FIFO and LRU evict A
(B) FIFO evicts A; LRU evicts B
(C) FIFO evicts B; LRU evicts A

Q13. Which call allocates a new region of the virtual address space in Linux?

(A) expand   (B) fill   (C) mmap   (D) populate   (E) vainit

Q14. For which increase in K should we expect the biggest decrease in the time it takes the loop to execute?

Answer with respect to this loop we discussed during lecture:

```
for (int i = 0; i < arr.Length; i += K) arr[i] *= 3;
```

Assume `arr` contains 64-bit integers and the CPU has 64-byte cachelines. Increase K...

(A) from 1 to 2   (B) from 2 to 4   (C) from 8 to 16   (D) from 16 to 32

Q15. GET, POST, PUT, etc., are examples of _____ methods.

(A) Arrow   (B) gRPC   (C) HTTP   (D) IP   (E) protobuf

Q16. How do you pipe the output from program X to program Y?

(A) X > Y   (B) X -> Y   (C) X | Y   (D) X & Y   (E) X &> Y

Q17. What value(s) could possibly be printed?

```python
x = 8
def task():
    global x
    x += 4
t = threading.Thread(target=task)
t.start()
t.join()
print(x)
```

(A) only 12   (B) 8 or 4   (C) only 8   (D) only 4   (E) 8 or 12

Q18. What "docker _____" command should you use to list running containers?

(A) active   (B) exec   (C) list   (D) ps   (E) ss

Q19. Which of the following are byte addressable?

(A) only memory   (B) only disk   (C) both memory and disk

Q20. You want to connect from a browser on your laptop to Jupyter running in a container on your VM. You take the following steps:

1. Write a command in the Dockerfile to launch Jupyter on port 2017
2. Use `-p 3142:2017` in the `docker run ...` command
3. Use `-L localhost:4030:localhost:3142` when establishing the SSH tunnel
4. Enter `http://localhost:????/` in the browser

What should `????` be in step 4?
(A) 5000   (B) 8888   (C) 4030   (D) 2017   (E) 3142