

CS 544 Exam 1 (19%) - Spring 2025

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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 5 and fill in bubble 5.** 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. 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 2750
2. Use `-L localhost:4155:localhost:3625` to establish the SSH tunnel
3. Use `-p ????:2750` in the `docker run ...` command
4. Enter `http://localhost:4155/` in the browser

What should `???` be in step 2?

- (A) 2750 (B) 4155 (C) 8888 (D) 5000 (E) 3625

Q2. What will be printed?

Two threads are running concurrently on a single core, with the following lines of code, respectively:

```
# thread 1
if y > 0:
    print("apple")
print("sauce")

# thread 2
x = 1
y = 2
z = 3
```

Context switches happen so that the interleaving starts like this:

```
thread 1:      thread 2:
            x = 1
if y > 0:
            y = 2
# the rest is hidden...
```

- (A) apple (B) sauce (C) apple sauce

Q3. You are running a VM on a cloud that is using a NAT. What should you bind to?

`python3 -m http.server --bind=???`

The internal IP is 10.128.0.6, the external IP is 35.226.202.103, and the loopback IP is 127.0.0.1. You want Internet users to be able to visit your site.

- (A) 10.128.0.6 (B) 35.226.202.103 (C) 127.0.0.1

Q4. The prefix of an address identifies the NIC's manufacturer. What kind of address is it?

- (A) IP address (B) MAC address (C) port number (D) host name

Q5. How many cache hits are there for the following workload?

C, A, A, B, B, B, C, A

Assume FIFO eviction and cache size 3.

- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

Q6. Which is an example of a pseudo file system?

- (A) NFS (B) procfs (C) tmpfs (D) ext4

Q7. Is the below data layout column oriented or row oriented?

Table:

2,1,6
5,4,3

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

- (A) column oriented (B) row oriented

Q8. If you build an image from a Dockerfile, change the Dockerfile, then build again, what change will usually result in a SLOWER rebuild?

- (A) changing a line near the beginning (B) changing a line near the end

Q9. You start a container `bright-spark` in detached mode, so you cannot immediately see what the process started by `CMD` is printing. How can you see that output?

- (A) `docker ps bright-spark`
(B) `docker logs bright-spark`
(C) `docker exec -it bright-spark`
(D) `docker exec bright-spark stdout`

Q10. The following code is about to run in a container on a VM. The VM has 4 GB of RAM currently available, the container was launched with `-m 2g`, and `big.file` is 3 GB.

```
import mmap
with open("big.file", "rb") as f:
    mm = mmap.mmap(f.fileno(), 0, access=mmap.ACCESS_READ)
```

Will memory constraints PREVENT the code from running?

- (A) yes (B) no

Q11. What letters could possibly be printed, and in what order?

Two threads are running concurrently on a single core, with the following lines of code, respectively:

```
# thread 1
with lock:
    print("X")

# thread 2
lock.acquire()
print("Y")
lock.release()
```

- (A) definitely X, then Y
- (B) definitely Y, then X
- (C) either X then Y, or Y then X
- (D) either X or Y, but not both

Q12. What does the "which" command print out?

- (A) the PATH variable
- (B) a path to a program
- (C) the Linux distro version
- (D) the shell being used

Q13. Is deadlock possible when these two threads run concurrently?

```
# thread 1
with lockA:
    with lockB:
        print(A+B)

# thread 2
with lockB:
    with lockA:
        print(A-B)
```

- (A) yes
- (B) no

Q14. With gRPC, what generated code does a client use to make calls?

- (A) servicer code
- (B) stub code

Q15. How many cache hits are there for the following workload?

B, A, C, F, A, B, C, A

Assume LRU eviction and cache size 2.

- (A) 0
- (B) 1
- (C) 2
- (D) 3
- (E) 4

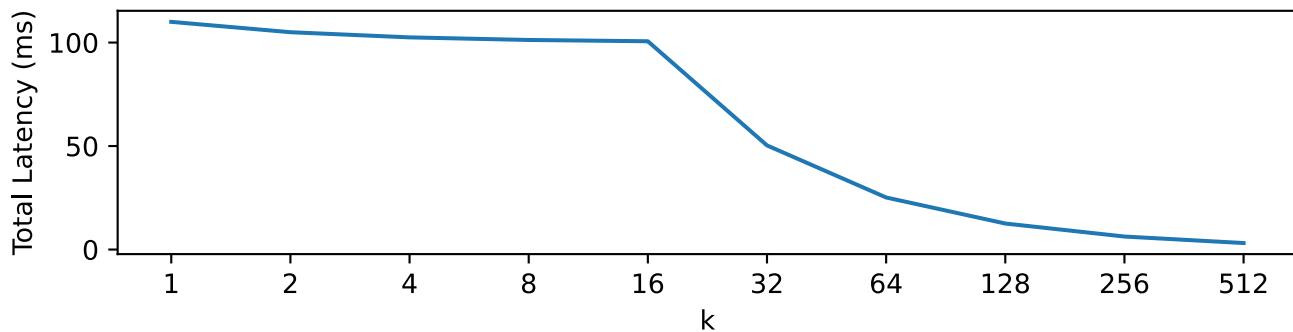
Q16. Which one is an example of a throughput measurement?

- (A) 6 MB
- (B) 2 seconds
- (C) 3 MB/s

Q17. What does the cacheline size appear to be?

An array `arr` contains int32 entries. The plot shows the total time to run this loop:

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



- (A) 16 (B) 32 (C) 64 (D) 128 (E) 256

Q18. What is something that is shared between all threads in a process?

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

Q19. What value(s) could possibly be printed?

```
x = 10
def task():
    global x
    x += 3
t = threading.Thread(target=task)
t.start()
t.join()
print(x)
```

- (A) only 10 (B) only 13 (C) 10 or 3 (D) 10 or 13 (E) only 3

Q20. Which I/O pattern is most challenging for SSDs?

- (A) random reads (B) random writes (C) sequential reads (D) sequential writes