## Memory & OS Review

COSC 208, Introduction to Computer Systems, 2022-05-05

## Outline

- Memory hierarchy
- Caching
- Processes
- Scheduling
- Threads

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Thermory filerations
Q1: What is the <b>fastest volatile</b> memory?
Q2: What is the <b>fastest non-volatile</b> memory?
Q3: Why is a hard disk drive (HDD) slower than a solid state drive (SSD)?
Q4: Why is accessing main memory (i.e., Random Access Memory (RAM)) slower than accessing a cache?
Q5: Why do solid state drives (SSDs) cost less per unit of capacity than main memory (i.e., Random Access Memory (RAM))?

## Caching

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Q6: Assume the cache size is 3 and the <b>optimal</b> cache replacement algorithm is used. Indicate what happens with the cache on each data access.
<ul> <li>Access 2</li> <li>Access 4</li> <li>Access 1</li> <li>Access 2</li> <li>Access 3</li> <li>Access 2</li> <li>Access 4</li> <li>Access 1</li> <li>Access 1</li> <li>Access 2</li> <li>Access 2</li> <li>Access 1</li> <li>Access 2</li> <li>Access 4</li> <li>Access 1</li> </ul>
Q7: Assume the cache size is 3 and the <b>least recently used (LRU)</b> cache replacement algorithm is used. Indicate what happens with the cache on each data access.
<ul> <li>Access 2</li> <li>Access 4</li> <li>Access 2</li> <li>Access 4</li> <li>Access 3</li> <li>Access 2</li> <li>Access 4</li> <li>Access 1</li> <li>Access 1</li> <li>Access 2</li> <li>Access 2</li> <li>Access 1</li> <li>Access 2</li> <li>Access 4</li> <li>Access 1</li> </ul>
Q8: Write a program that creates a new process. The child process should print "I am a child"; the parent process should print "I am a parent; my child is CPID" (replacing CPID with the child's PID).

A   20   0	Process Duration Arrival Time A 20 0 B 15 0 C 25 5 D 5 10 10: Draw the schedule when a First In First Out (FIFO) scheduling algorithm is used.  11: Compute the turnaround and wait time for each process based on the above schedule.  Process Turnaround Wait A B C D							
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A B C D	A B C D	10: <i>Draw ti</i>			t Out (FIFO) scheduling a	lgorithm is used		
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		11: <i>Compu</i> <b>Process</b> A	he schedule v	when a First In Fir				
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	(12: Draw the schedule when a Shortest Job First (SJF) scheduling algorithm is used.	Q11: Compu Process A B	he schedule v	when a First In Fir				
		Process A B C	te the turnard	ound and wait tim	e for each process based	on the above sc	hedule.	
		Process A B C	te the turnard	ound and wait tim	e for each process based	on the above sc	hedule.	
		Process A B C	te the turnard	ound and wait tim	e for each process based	on the above sc	hedule.	

มา3: _Comp <b>Process</b>	ute the turnaroui  Turnaround	nd and wait tin <b>Wait</b>	for each process based on the	above schedule
A				
В				
С				
D				
Q14: Draw tı	he schedule whe	n a Shortest T	e to Completion First (STCF) sc	cheduling algorithm is used.
Q15: Compu	ite the turnaroun	d and wait tim	for each process based on the a	above schedule.
Process	Turnaround	Wait 		
Α				
В				
С				
D				
Q16: <i>Draw ti</i>	he schedule whe	n a Round Rou	d (RR) scheduling algorithm is u	used with a time quantum of 10.
Q17: Compu	ite the turnaroun	d and wait tim	or each process based on the a	above schedule.
Process	Turnaround	Wait		
Α				
В				

## **Threads**

A program contains the following functions:

```
void *dec(void *arg) {
    int *t = (int *)arg;
    *t--;
    return NULL:
}

void *inc(void *arg) {
    int *t = (int *)arg;
    *t++;
    return NULL;
}

void *zero(void *arg) {
    int *t = (int *)arg;
    *t = 0;
    return NULL;
}
```

For each of the following main methods, list **all possible outputs** the program could produce. Assume threads are only preempted if they become blocked waiting for other threads.

Q18:

```
int main() {
    int *total = malloc(sizeof(int));
    *total = 2;
    pthread_t thrA, thrB;
    pthread_create(&thrA, NULL, &inc, total);
    pthread_create(&thrB, NULL, &inc, total);
    pthread_join(&thrA);
    pthread_join(&thrA);
    pthread_join(&thrB);
    printf("%d\n", *total);
}
```

Q19:

```
int main() {
    int *total = malloc(sizeof(int));
    *total = 2;
    pthread_t thrA, thrB;
    pthread_create(&thrA, NULL, &dec, total);
    pthread_create(&thrB, NULL, &zero, total);
    pthread_join(&thrA);
    pthread_join(&thrA);
    pthread_join(&thrB);
    printf("%d\n", *total);
}
```

Q20:

```
int main() {
    int *total = malloc(sizeof(int));
    *total = 2;
    pthread_t thrA, thrB;
    pthread_create(&thrA, NULL, &zero, total);
    pthread_join(&thrA);
    pthread_join(&thrB, NULL, &inc, total);
    pthread_join(&thrB);
    printf("%d\n", *total);
}
```