Midterm Review

Computer Systems Programming, Spring 2023

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- Which topic do you want to cover for the review?

Upcoming Due Dates

- HW2 (Threads) Due TONIGHT @ 11:59 pm
  - Released

- Midterm
  - Take-home style on Wednesday 3/1 @ Noon till Friday 3/3 @ noon
  - Logistics released on Course Website

Collaboration Policy

- You are to write up and work on the midterm on your own. We want the work you submit to be a representation of your own thoughts.

- However, we acknowledge that your peers are often one of the best resources for understanding concepts; therefore, we are allowing the "Gilligan's Island Rule."

Gilligan's Island Rule

- **The Gilligan's Island Rule:** You are free to meet with fellow students and discuss assignments with them. Writing on a board or shared piece of paper during the meeting is acceptable; however, **you should not take any written (electronic or otherwise) record away from the meeting.** Everything that you derive from the collaboration should be in your head.
- After the meeting, engage in at least a half-hour of mind-numbing activity (like watching an episode of Gilligan's Island), before starting to work on the assignment.

Review Topics

- C strings & output params
- C++ Class
- Concurrency
- Scheduling
- VM
- Caching (LRU)

C Strings & Output Params

- Complete the following function (on Codio)

```
// given a string, allocates and creates a new duplicate
// of it and returns it through the output parameter "out".
// Returns false on error, returns true otherwise

void str_duplicate(char* str, char** out) {




}
```

C Strings & Output Params

- Complete the main function

```
// given a string, duplicates it and returns it through
// the output parameter "out". Returns false on error
// returns true otherwise
void str_duplicate(char* str, char** out);

// duplicates a string literal,
// prints the duplicate, and runs without errors
int main(int argc, char** argv) {
  char* sample = "Hello World!";




}
```

C++ Class

- Complete the IntList class which represents a linkedlist of integers (on Codio)

- In particular, complete the `remove_all(int)` function

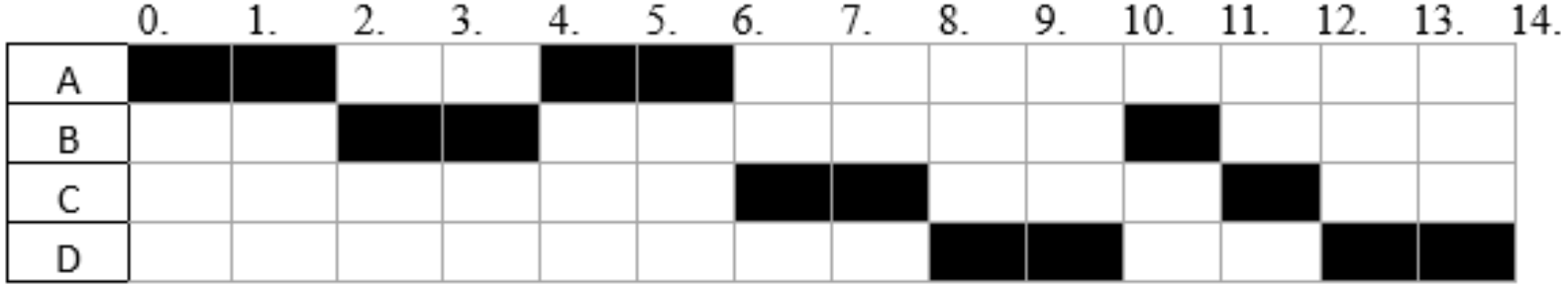
Concurrency

- There are at least 4 bad practices/mistakes done with locks in the following code. Find them.
  - Assume `g_lock` and `k_lock` have been initialized and will be cleaned up.
  - Assume that these functions will be called by multi-threaded code.

```
pthread_mutex_t g_lock, k_lock;
int g = 0, k = 0;

void fun1() {
  pthread_mutex_lock(&g_lock);
  g += 3;
  pthread_mutex_unlock(&g_lock);
  k++;
}

void fun2(int a, int b) {
  pthread_mutex_lock(&g_lock);
  g += a;
  pthread_mutex_unlock(&g_lock);
  pthread_mutex_lock(&k_lock);
  a += b;
  pthread_mutex_unlock(&k_lock);
}

void fun3() {
  int c;
  pthread_mutex_lock(&g_lock);
  cin >> c;  // have the user enter an int
  k += c;
  pthread_mutex_unlock(&g_lock);
}
```

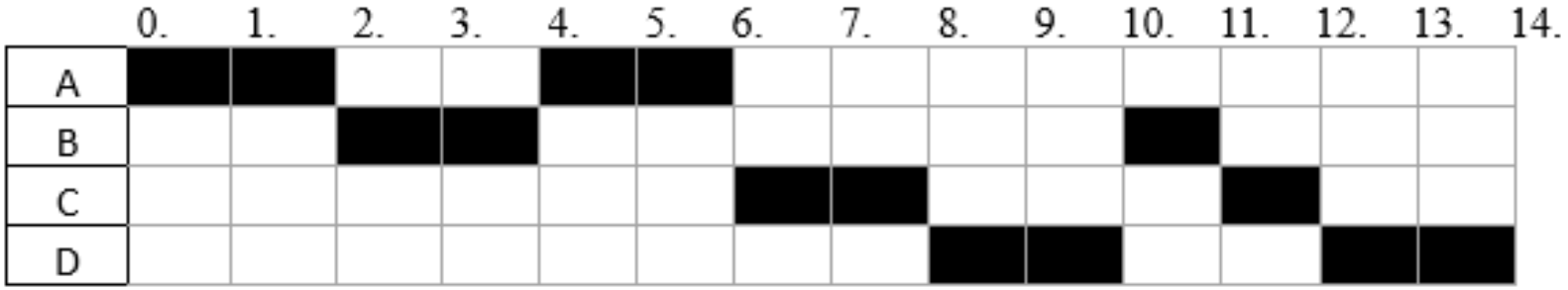
Scheduling

- Four processes are executing on one CPU following round robin scheduling:



- You can assume:
  - All processes do not block for I/O or any resource.
  - Context switching and running the Scheduler are instantaneous.
  - If a process arrives at the same time as the running process' time slice finishes, the one that just arrived goes into the ready queue before the one that just finished its time slice.

Scheduling



- All processes do not block for I/O or any resource.
- Context switching and running the Scheduler are instantaneous.
- If a process arrives at the same time as the running process' time slice finishes, the one that just arrived goes into the ready queue before the one that just finished its time slice.

- What is the earliest time that process C could have arrived?
- Which processes are in the ready queue at time 9?
- If this algorithm used a quantum of 3 instead of 2, how many fewer context switches would there be?

Virtual Memory

- Consider a system with the following configuration:
  - 32-bit address space
  - 2GB physical memory size
  - 16-bit addressability (2 bytes per address)
  - 32KB page size

- How many entries are there in each process's page table? Express your answer as a power of 2.

- How many frames are there of physical memory?

Caching (LRU)

- Consider that we have physical memory that can hold 4 pages of memory and uses LRU for replacement. Come up with an example scenario where having this policy hurts performance.