ECE 391 Discussion Week 4

Announcements & Reminders

- PS2 has been posted
  - Work in groups of at least 4
  - Due next Tuesday (Sept 21) 5:59 pm
- MP2 will be posted, git will be updated this week
  - Start early!!!!
  - Read the documentation carefully

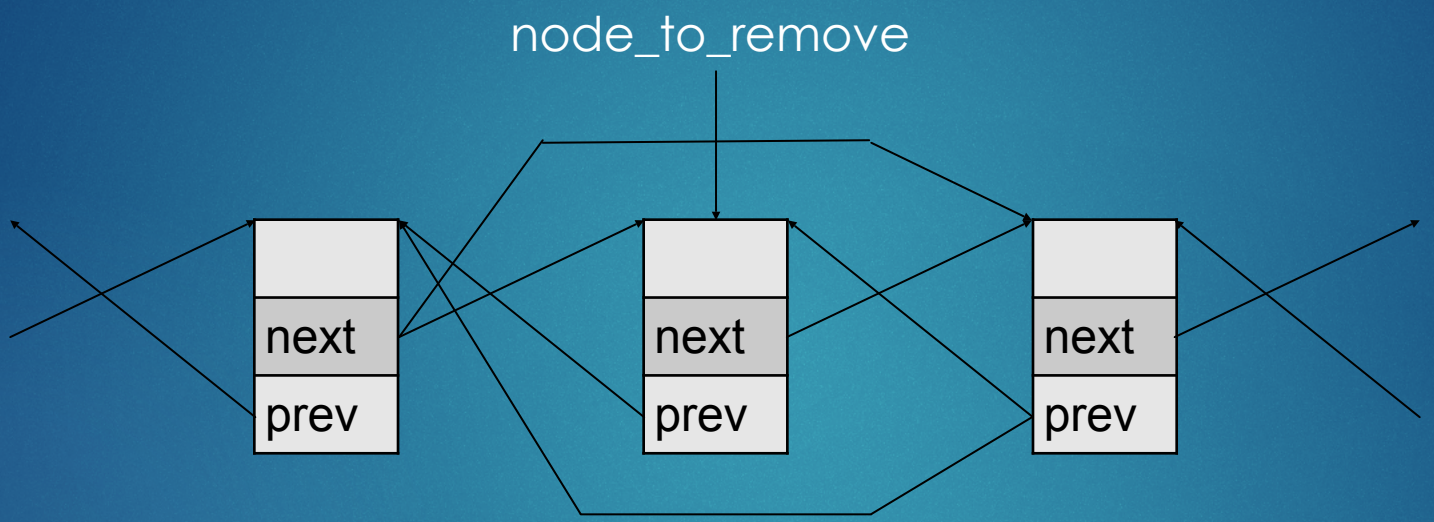
Problem Set 2

- Put everyone's name and NetID on one copy
- Don't be lazy, reading documentation will help you with your MP2
  - The website for VGA is related to checkpoint 1
  - The MTCP header file is related to checkpoint 2
- Don't over think in problem 3
  - Write code in the file provided
  - Test if it works before submission

Linked List

- Given a doubly linked list
  - Process 1 tries to traverse it (interrupt)
  - Process 2 tries to remove a node from it
  - Race condition

Linked List




```
CLI();
item_to_remove->prev->next = item_to_remove->next;
item_to_remove->next->prev = item_to_remove->prev;
STI();
```

But CLI/STI is only good for one processor

Synchronization (Atomic Instructions)

```
broken_lock:
        movl    4(%esp), %eax
        loop:
                movl (%eax), %edx
                jnz loop
                movl    $1, (%eax)
                ret
```

```
broken_lock:
        movl    4(%esp), %eax
        loop:
                movl    (%eax), %edx
                jnz             loop
                movl    $1, %ecx
                xchgl   %ecx, (%eax)
                ret
```

Spin Lock Implementation

```
typedef uint32_t spinlock_t;
void spin_lock(spinlock_t *lock);
```

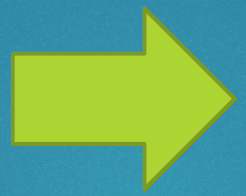
```
spin_lock:
        movl    4(%esp), %eax
        loop:
                movl    $1, %ecx
                xchgl   %ecx, (%eax)
                cmpl    $1, %ecx
                je              loop
                ret
```

```
void spin_unlock(spinlock_t *lock);
```

```
spin_unlock:
        movl    4(%esp), %eax
        movl    $0, (%eax)
        ret
```

Linked List Revisit

```
CLI();
/* critical section code */
STI();
```



```
CLI();
spin_lock(spinlock_t *lock);
/* critical section code */
spin_unlock(spinlock_t *lock);
STI();
```

When Using Locks

- Do not protect regions of memory from modification
- Do not mark certain data structures as locked
- Adding a lock to a struct does not magically protect that struct
- Does not matter if lock is in the struct or not
- It is up to the programmer to protect against race conditions

Synchronization Practice

- Ben Bitdiddle has a nasty problem with eating/drinking. In fact, he will eat anything placed in front of him immediately. Luckily for poor Ben, we ECE391 students have a tool to help him. This tool is called a lock. Ben is fed by a machine. The machine can dispense food and drink. To protect Ben, the machine must follow these rules:
- • Ben can only consume one item at a time (i.e. one drink or one food).
- • If food and drink are both ready for Ben, he must finish the drink first.
- • The machine can only hold up to 10 drinks at a time. It returns -1 if it fails to produce new drinks, returns 0 otherwise.
- • The machine can hold infinite amount of food (i.e. it will keep producing food no matter what).
- • Ben isn't too picky about food. That means if food (a) and (b) are ready at the same time, he will happily eat either (priority of food does not need to be enforced).
- • Ben isn't too picky about drinks. That means if drink (a) and (b) are ready at the same time, he will happily drink either (priority of drink does not need to be enforced).

Synchronization Practice

- Note: The only type of synchronization primitive you may use is spinlock t.
  There is no limit to the amount of food the machine can hold, however there may be a restriction from your code. Please state this restriction in plain text.
- /* you may add up to 3 elements to this struct */
- typedef struct food_drink_lock {
  } fd_lock_t;
- void produce_food(fd_lock_t* fd) { }
- void consume_food(fd_lock_t* fd) { }