Overview
- Midterm: Oct 21
- Final: Dec 16
- 4 Homeworks
- Reading Assignments due by class
- Very boring videos on the web if you miss a class.
- Late HW - lose 15% per day
- Due @ Midnight
- Allowed: 4 days late on 1 HW
- Urged to collaborate on HW, name collaborators in HW submission

What are we covering?
- How Computers Work
- All the messy details behind high level programs

What is an Operating System?
- Resource Manager
- Virtual Machine
- Hardware Initialization

HW - OS - PROGRAM

Basics (topics covering)
- Program Loading
- Context Switching
- Virtual Memory
- Hardware Virtualization
- File, IO, Disks, RAID
- Security

A Simple Computer (Display Hardware)

Registers

PC

Memory

Frame Buffer

0
1
2
3
4
5
6
7

SP
A Simple Computer (continued)

```
fbuf = F000
str bytes
'H'
'E'
'L'
'o'

begin: mov str, r1
        mov 5, r2
        mov fbuf, r3

loop:  mov *(r1++), r4
        mov r4, *(r3++)
        decr r2
        jnz  loop

done:  jmp done
```

Memory
---
| r1 | Hello |
| r2 | count |
| r3 | fbuf |

Program #2 (keyboard control)

```
begin:  mov  str, r1
        mov  5, r2
        mov  fbuf, r3

loop:   mov *(status), r4
        cmp  r4, 0
        jz   loop
        mov *(key), r4

        - wait for any key loop.
```

---

Keyboard Controller
- FB00
- FB01

Keyboard

Note: We'll insert this code into the program above so we have both input + output.
Program #3 (Adding Abstraction)

- Initialize R1, R2, R3

  loop: call getkey
  mov *(r1+4), r4
  push r4
  call putchar
  pop r4

Note: Assume getkey, pushkey are provided for us.

This shows the first signs of an operating system.

"Library OS"

Step #4 (Rearranging the Memory Map)

- Move the program to low memory.
- Allow use to use high memory for programs.

This allows us to clear memory & load a new program. We can have many programs on disk.

If we upgrade the OS, all memory locations of libraries change.

Step #5 (Create a Jump Table)

- Create a table of pointers so the we always know what address to access functions.

Now we can have a long lived OS interface.

LINUX & Windows use something similar.