CS140 Help Session
Homework 2
UserProg

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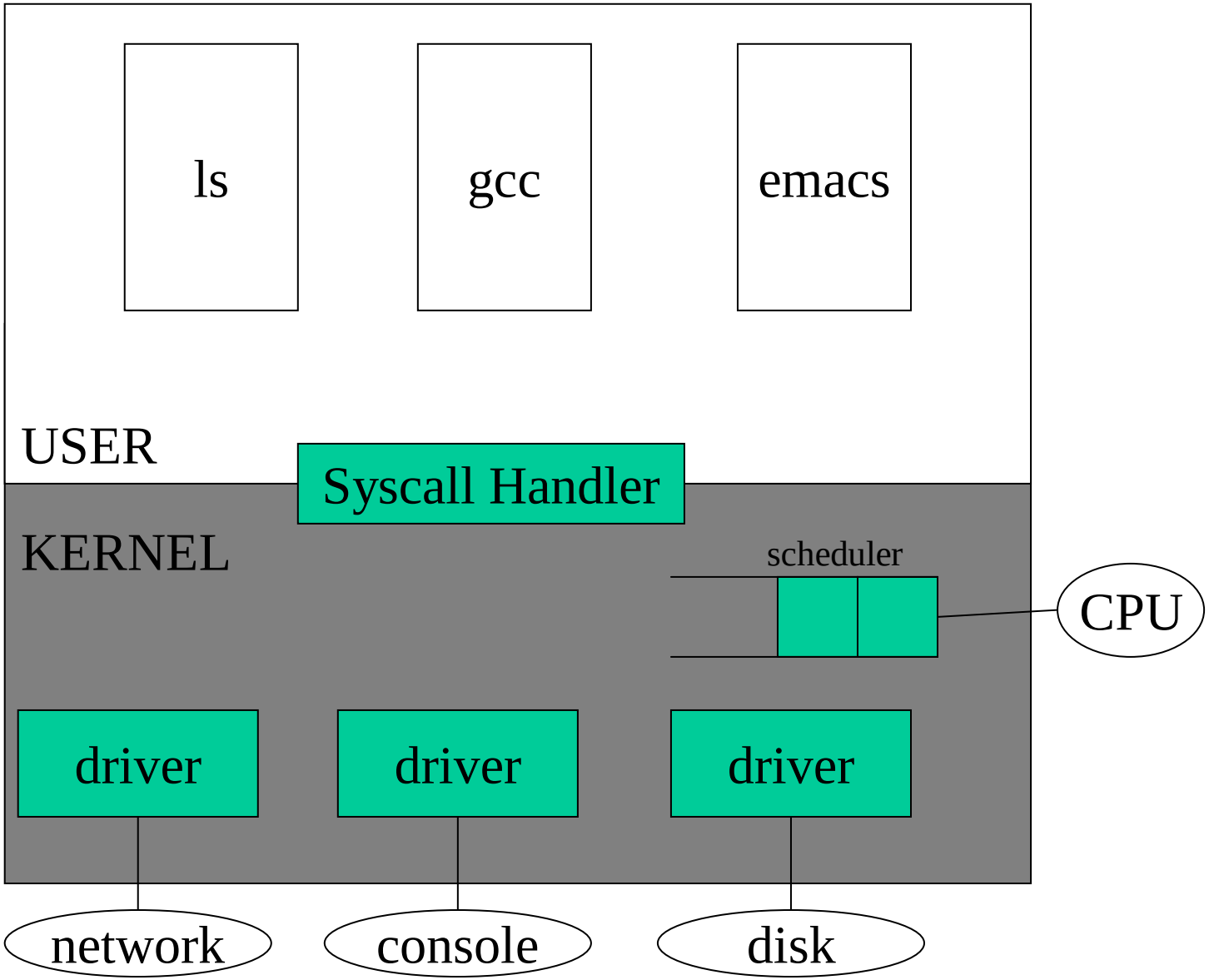
ls
gcc
emacs
USER
Syscall Handler
KERNEL
scheduler
CPU
driver
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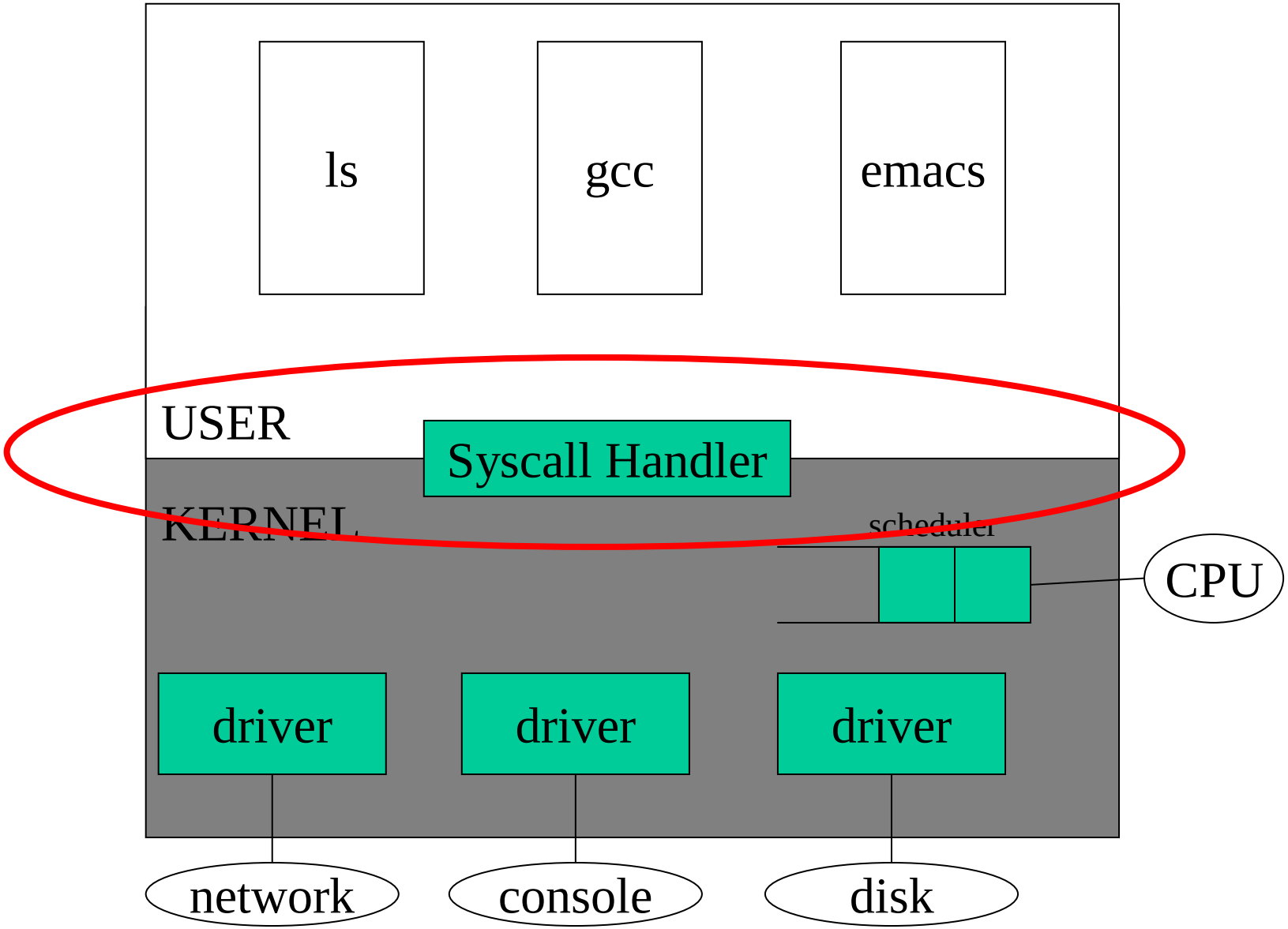
driver
network
console
disk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User vs. Kernel Code

- Tests in src/userprog/ are now user code
- More user programs to play with are in src/examples
- You can write and compile your own, with some limitations
- You don’t NEED to write any user code

User vs. Kernel Code

- OLD: `run_test` ran code directly in the main thread
- NEW:

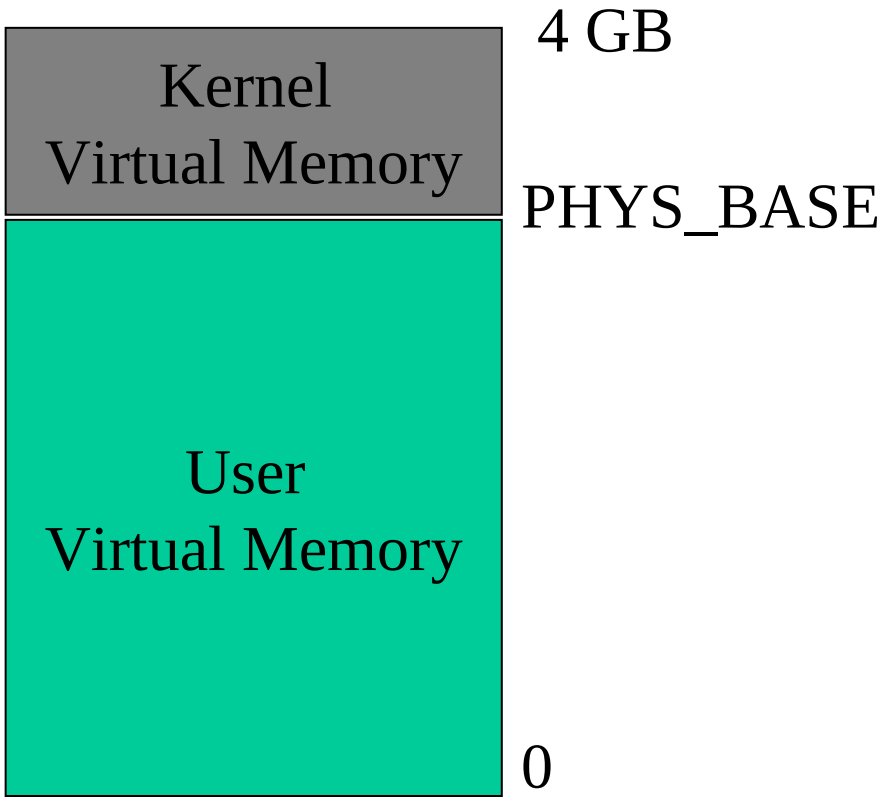
`process_execute("cp -r pintos .")`

calls `create_thread(...)`

calls `execute_thread(...)`

Runs `"cp"` in user space.

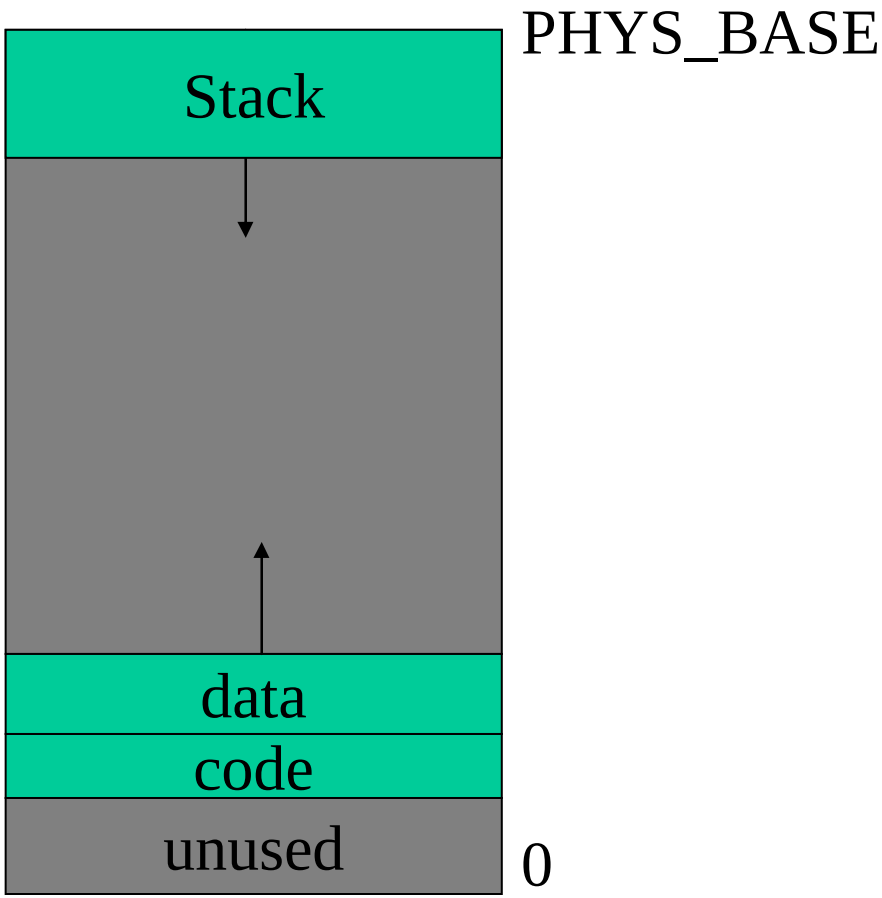
User vs. Kernel Memory



User code can not access addresses above PHYS_BASE.

The user can only access mapped addresses

User Virtual Memory



If the user tries to access an unmapped address, it will page fault

Even in kernel mode you can page fault if you try to access an unmapped user address

Enabling User Code

1. Start it running
   - Set up the stack

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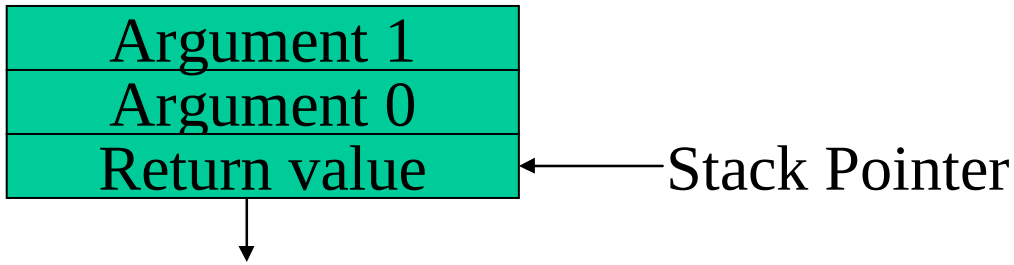
Enabling User Code

1. Start it running
   - Set up the stack
2. Allow it to do things
   - Interact with the file system
   - Interact with the user
   - Communicate with other processes
3. Don’t let it crash the kernel!
   - Check all user pointers

Setting Up the Stack

```
void
_start (int argc, char *argv[])
{
exit (main (argc, argv));
}
```

Your code must set up the “main” function call by hand.



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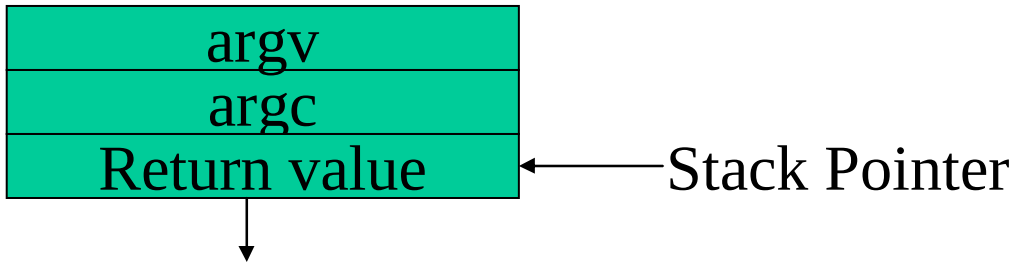


Setting Up the Stack

```
cp -r pintos .
```

argc = 4

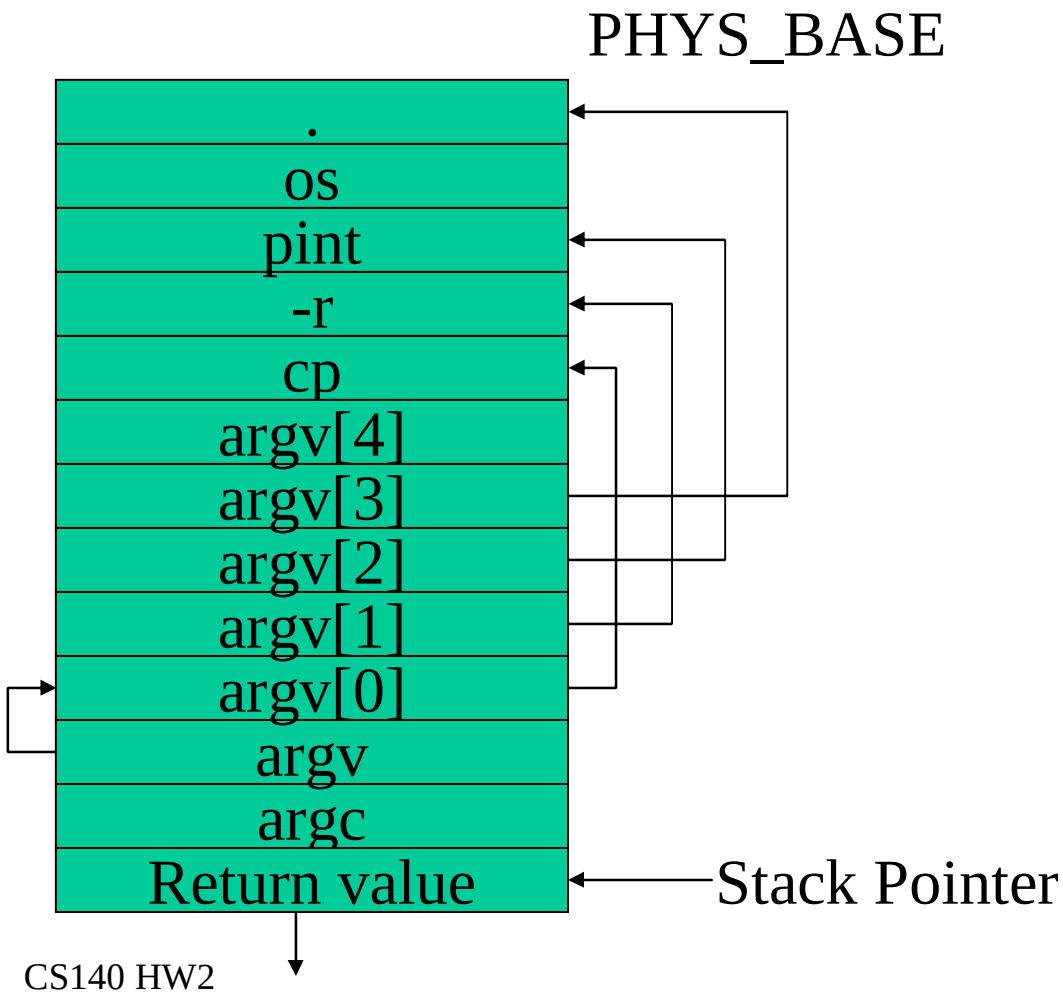
argv[0] = “cp”

argv[1] = “-r”

argv[2] = “pintos”

argv[3] = “.”

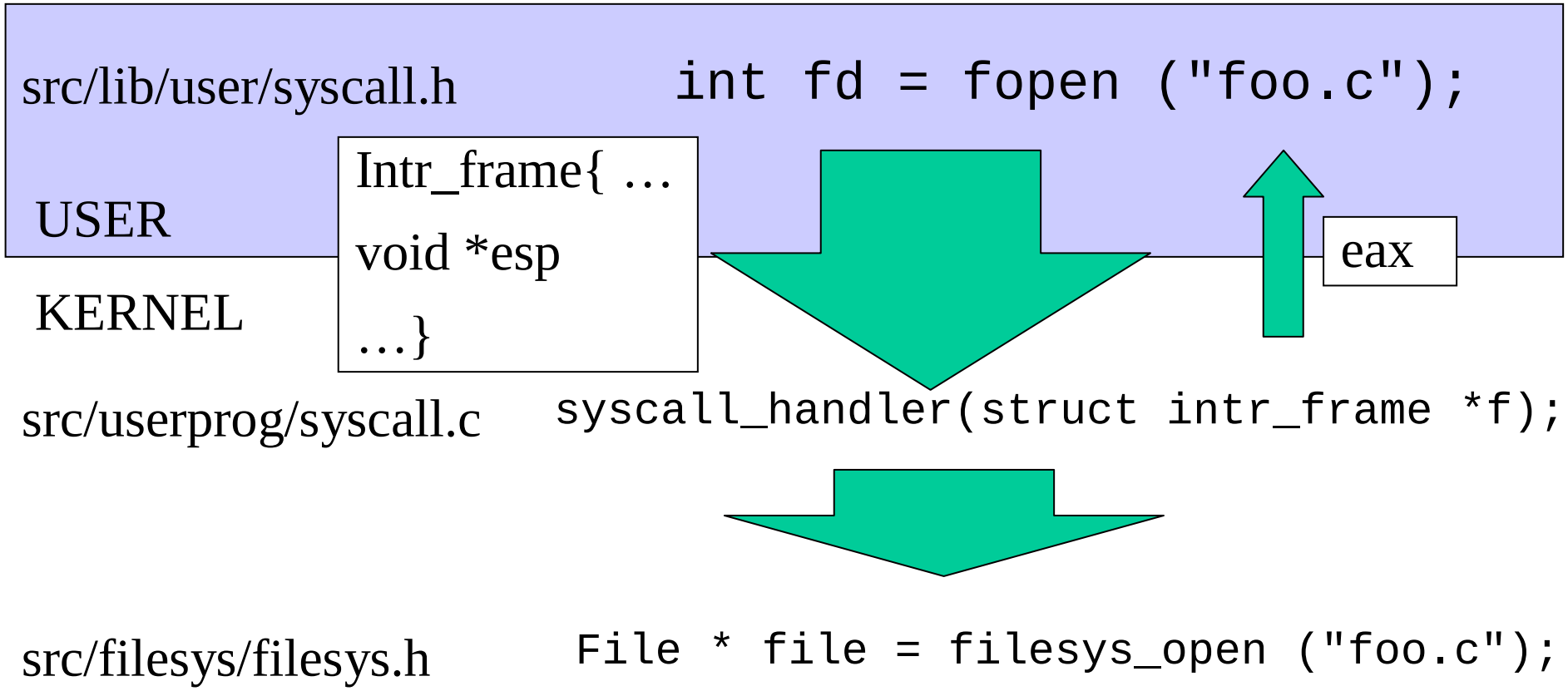
argv[4] = 0



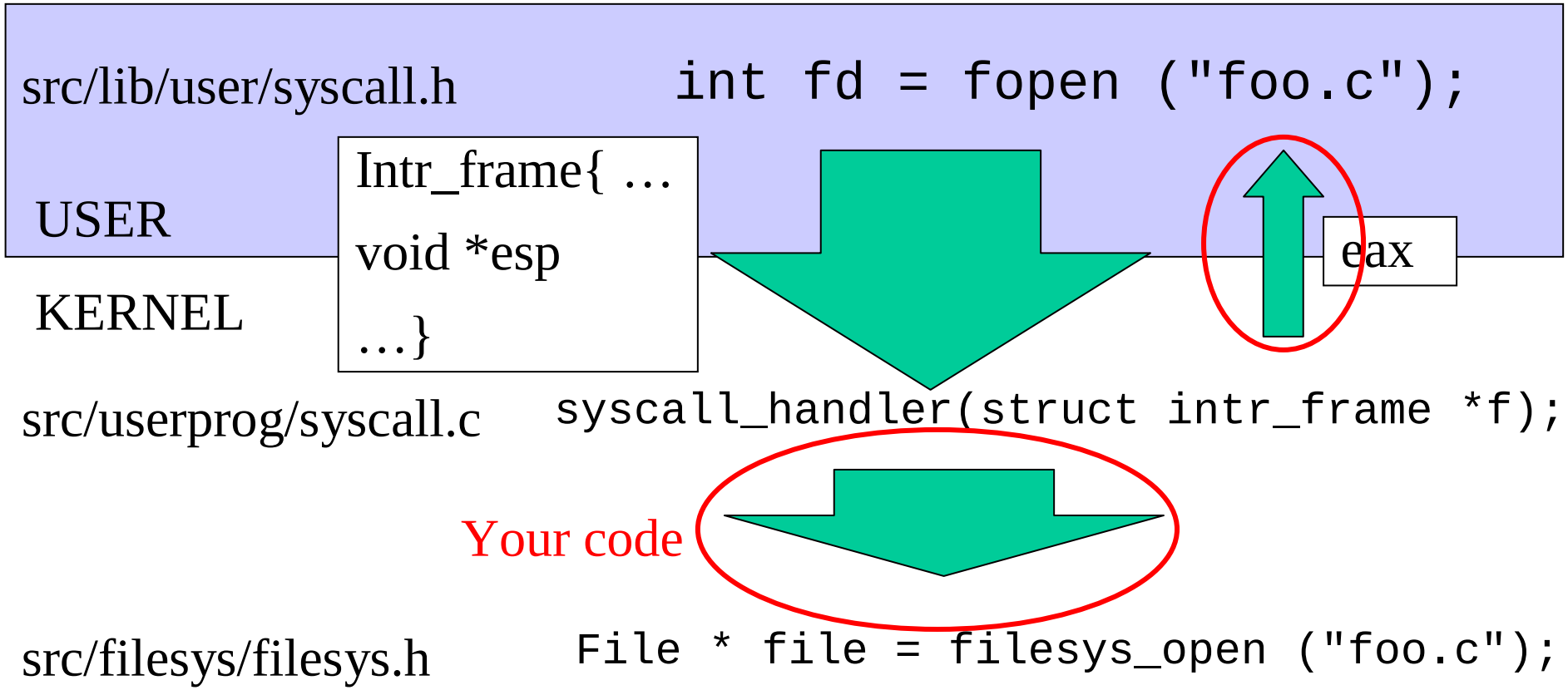
System Calls

- File System Related
- Process Related
- more to come in HW 3

System Calls



System Calls



System Calls - File System

- You do NOT need to change the file system for this project
- Users deal with `file descriptors` (`ints`). The file system uses `struct file *`. You need to enforce a mapping.
- The file system is not thread-safe (yet!) so use coarse synchronization to protect it.

System Calls - File System

- Reading from the keyboard and writing to the console are special cases
  - fd STDOUT_FILENO
    - Can use `putbuf(…)` or `putchar(…)`
    - In src/lib/kernel/console.c
  - fd STDIN_FILENO
    - Can use `input_getc (…)`
    - In src/devices/input.h

System Calls - Processes

- int **wait** (pid_t *pid*)
  - Parent must block until the child process pid **exit**s
  - Must return the status value of the child
  - Must work if child has already exited
  - Must fail if it has already been called on the child.
- void **exit** (int *status*)
  - Exit w/ the specified status & free resources
  - Required: print out the exit status
  - Need synchronization with **wait** so the parent can retrieve your status if desired.

System Calls - Processes

- pid_t **exec** (const char **cmd_line*)
  - Create a new child process
  - This **MUST** not return until the new process has successfully been created (or has failed)

Design these three well! They are the most time-consuming.

System Calls - Paranoia

- In a system call, the user will pass you all kinds of addresses (buffers, strings, stack pointers, etc).
- Trust no one. Check anything the user passes to you.
  - Is the passed-in address in user memory?
  - You can use pagedir_get_page(…) to check if the address is mapped for the user program.
- Kill the child if it passes an illegal address.
  - Free any locks and resources.

Utilities –Making Disks

- User code must be on a virtual hard drive

```
cd pintos/src/userprog
make
pintos-mkdisk fs.dsk 2                /*create a 2MB disk*/
pintos -f -q                          /*format the disk*/
pintos -p ../examples/echo -a echo -- -q  /*put a program on
                                            the disk and
                                            rename it*/
pintos -q run 'echo x'                /* run the program*/
```

Utilities –Making Disks

- Recommend making a backup disk w/ programs loaded in case your disk gets trashed

Getting Started

- Make a disk and add some simple programs
  - run `make` in src/examples
- Temporarily set up the stack to avoid page faulting immediately. `esp = esp - 12;`
- Enable reading from user memory addresses
- Handle `write()` syscall for STDOUT_FILENO
- Change `process_wait` to an infinite loop so that pintos doesn't power off

Utilities – Debugging User Code

- Start pintos-gdb as usual
- `add-symbol-file` *program*
- Set breakpoints, etc, in user code
  - Kernel names will take precedence over user code
  - Change this by doing `pintos-gdb` *userprog.o*, then `add-symbol-file kernel.o`