Project 1

…because we want to do more than count system calls and spawned processes

Administrivia

- Project 0 due tomorrow, September 17, 11:59 PM
- Homework 3 due September 24
- Office Hour change
  - Project TAs will be holding office hours MW 1:00 PM – 2:00 PM

Overview

- After completing project 1, GeekOS will be able to:
  - Spawn background processes
  - Kill processes
    - Asynchronously
    - From another process
  - Provide status of active processes
    - Similar to the **ps** unix command

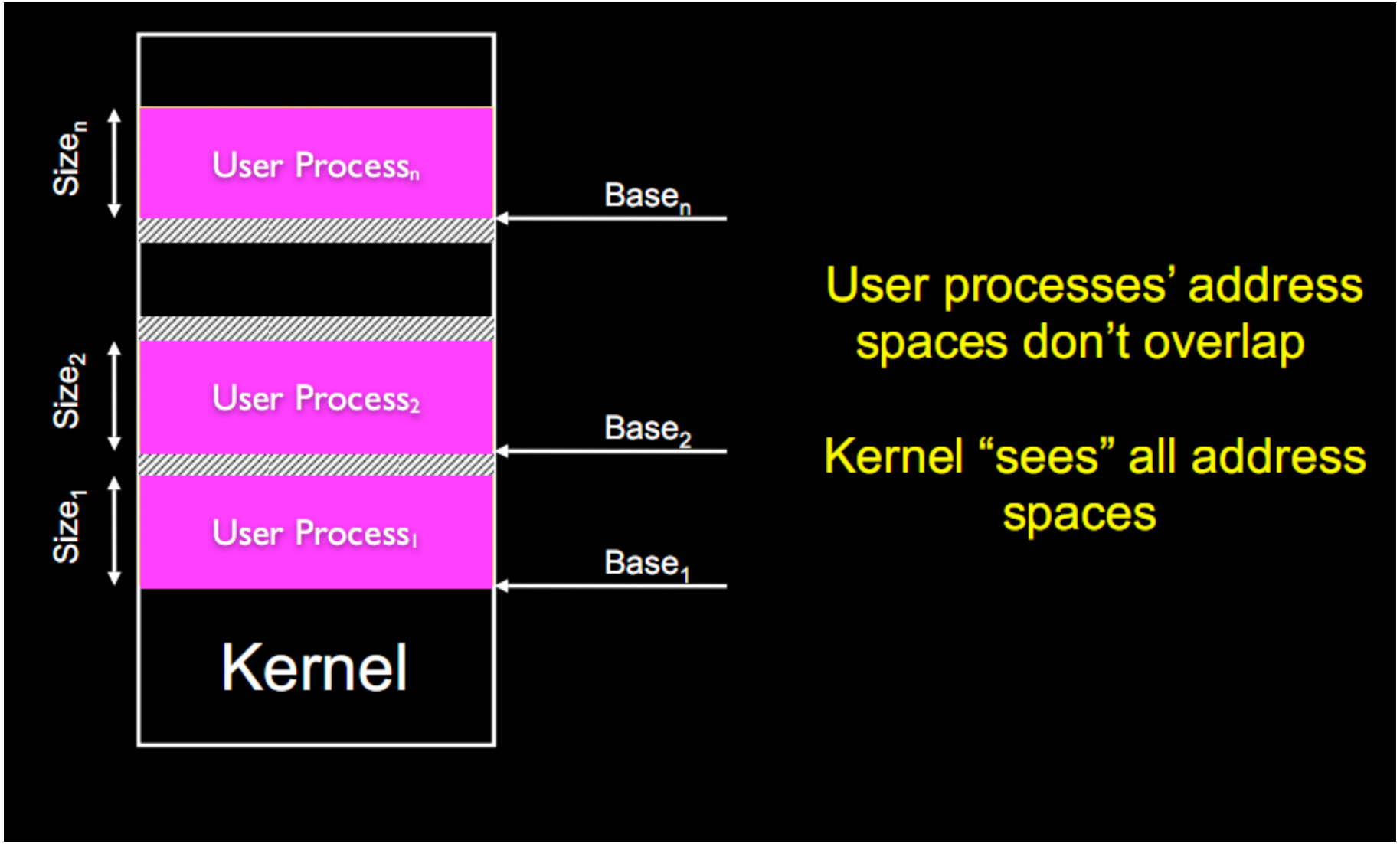
But First… Some Questions

- How are processes implemented in GeekOS?
- How do processes use system calls to request kernel services?

Address Space Protection

- Protects against processes accessing:
  - Another processes memory
  - Kernel memory
- Logical addresses used
  - Kernel controls what memory a process can access
  - An interrupt is issued if the process attempts to access memory outside of its logical address space

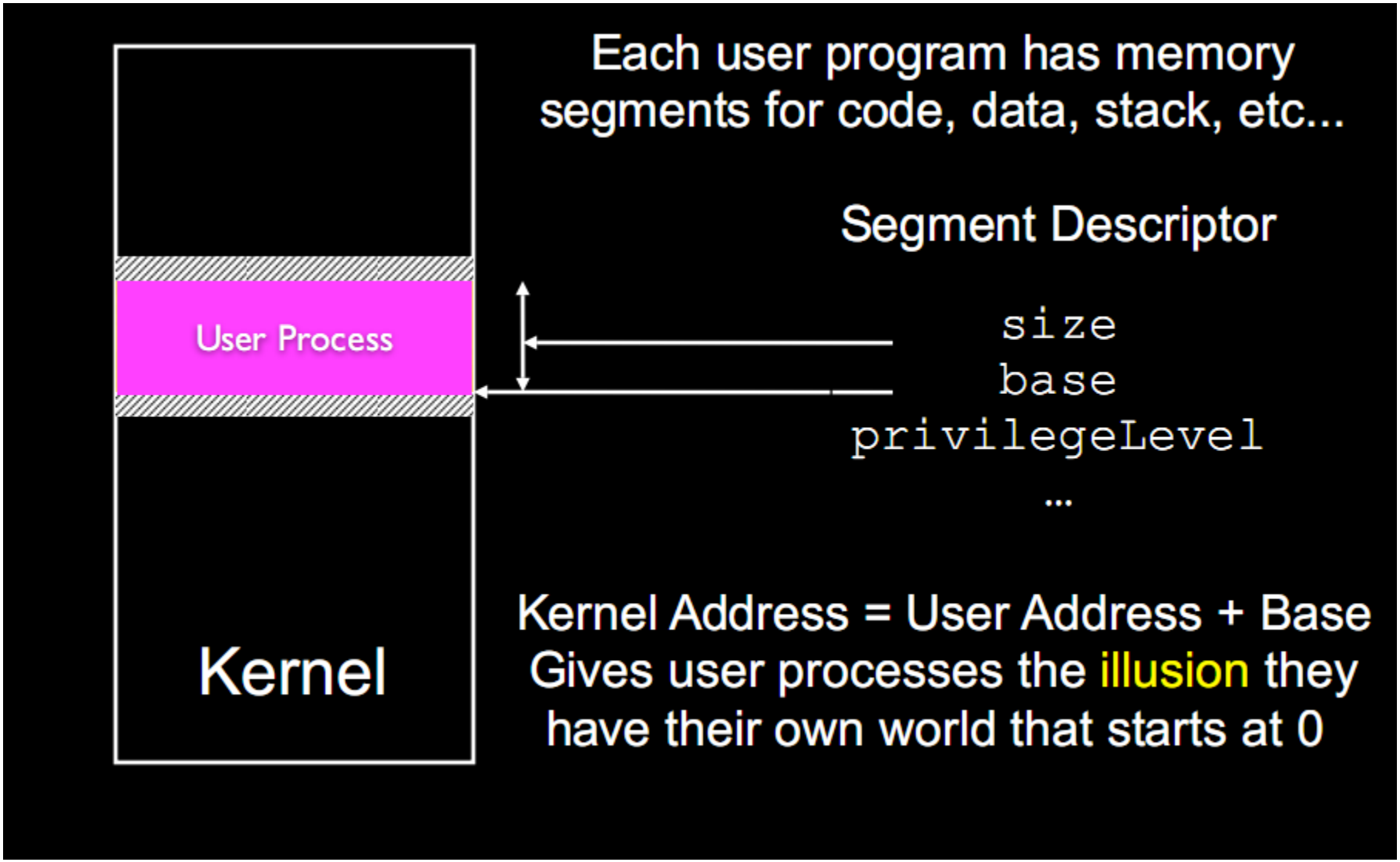
Address Space Protection in GeekOS



Address Space Protection in GeekOS

- Allow for the use of **relative** memory references
  - Relative to the base of the current memory segment
  - Linker must know where parts of the program will be with regards to the start of the executable in memory

Segmentation Principles



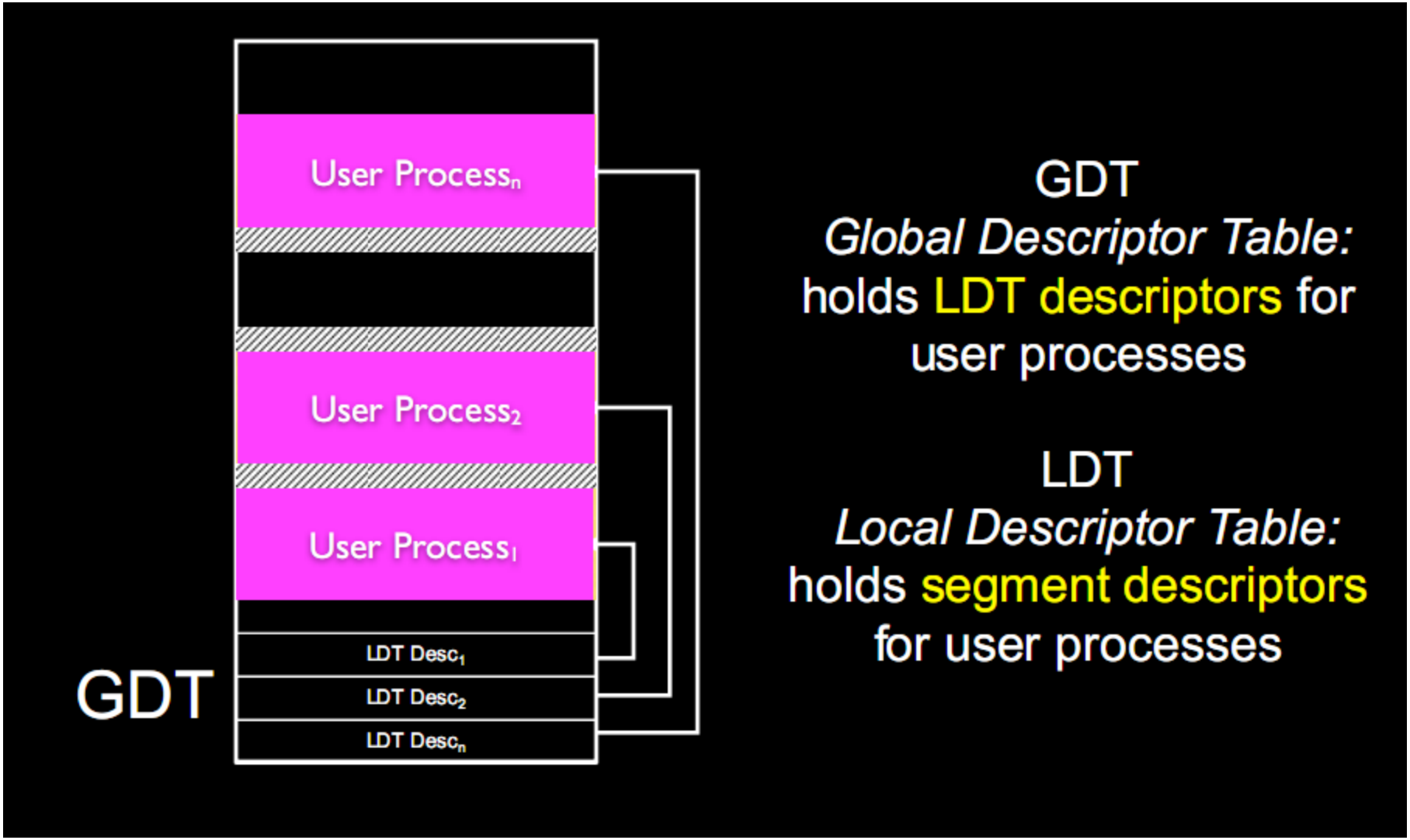
x86 Segmentation in GeekOS

- Segment Descriptor
  - Base address
  - Limit address
  - Privilege level
- Descriptors are stored in descriptor tables
- Two types of descriptor tables

Descriptor Tables

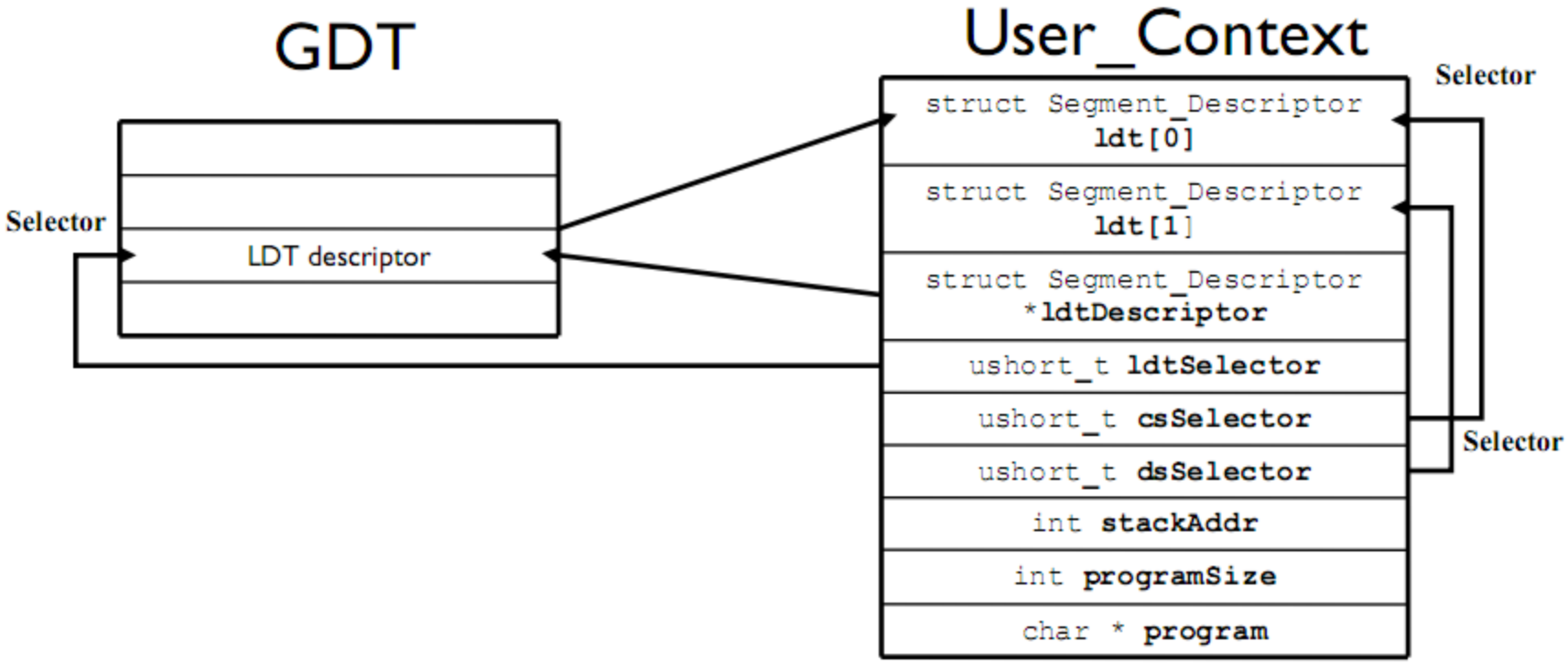
- Local Descriptor Table (LDT)
  - Stores the segment descriptors for each user process
  - One per process
- Global Descriptor Table (GDT)
  - Stores information for all of the processes
  - Contains a LDT segment descriptor for each user process

x86 Segmentation in GeekOS



x86 Segmentation in GeekOS

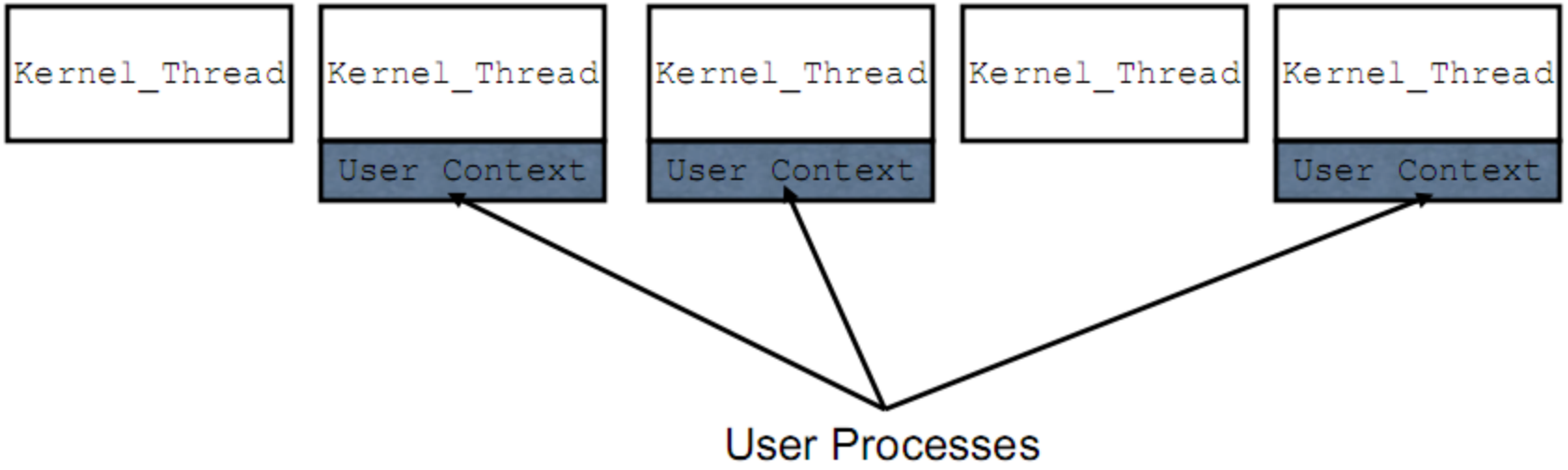
(implementation)



x86 Segmentation

- Intel docs, fig. 3-1 and 3-5
- Yes, you should download a copy
- http://www.intel.com/products/processor/manuals

User Processes in GeekOS



Lifetime of an User Process

- Shell spawns user processes using `Spawn_With_Path` (see `src/user/shell.c`)
- User process termination
  - **Normally** – via `Exit`, called automatically when `main()` finishes
  - **Killed** – via `Sys_Kill` which you will implement
- Parent processes can wait for their children using `Wait`

System Calls Review

- Processes may need to access protected system resources
  - E.g., for I/O, may need to access video memory outside of the processes' segment
- OS provides a series of System Calls
  - Routines that carry out some operation for the user process that calls it
  - Execute in ring 0 – kernel mode (as opposed to ring 3, user mode)

System Calls Review

- In GeekOS, int 0x90
- int 0x90
  - Put arguments in registers on user side
  - Recover the arguments on kernel side
  - Call Sys_xxx accordingly (`Sys_Null`, `Sys_Exit`) (`src/geekos/syscall.c`)
  - Return result or error code
- Use `g_currentThread` to get information about the current thread

Background Processes

- Changes to the shell (`src/user/shell.c`)
  - Modify code to handle forking processes
    - Parse commands and scan for &
  - If & detected, spawn in background, don't `Wait()`
  - If & not detected, spawn normally, do `Wait()`
- Sys_Spawn() (`src/geekos/syscall.c`)
  - Need to consider 'spawn in background argument'
- Input
  - Background process and any child of a background process cannot receive input from the keyboard

Killing Background Processes

- Kernel: Sys_Kill() (`src/geekos/syscall.c`)
  - Get the PID of the victim process
  - Lookup the victim's Kernel_Thread (see `Lookup_Thread` in `src/geekos/kthread.c`)
  - Dequeue thread from all queues and 'kill' it
    - Run queue, join queues, device queues, ect.
  - The currently running thread can kill itself
  - Handle killing zombies, FG processes, BG processes, Wait()ing processes, processes spawned by background processes, ect.

Killing Background Processes

- User
  - Add **`src/user/kill.c`** for testing
  - Add **`kill.c`** to USER_C_SRCS in **`build/Makefile.common`** to create an user program

Printing the Process Table

- Kernel: Sys_PS() (`sys/geekos/syscall.c`)
  - Return information about current processes
  - Prepare a `struct Process_Info` array in kernel space
  - Examine all threads: `s_allThreadList` in `src/geekos/kthread.c`, and fill out the above array
  - Copy array into user space: `Copy_To_User()`

Printing the Process Table

- User
  - Add the ‘ps’ user program: **`src/user/ps.c`**
  - Run ‘ps’, ‘man ps’ in Linux to get an idea of what we are looking for