

Course Description:

Computer Systems discusses computers as an integrated whole, including: **hardware resources** (e.g., CPU cores, CPU cache, memory management unit (MMU), RAM); and **systems languages** (assembly language, C (the low-level high-level language), POSIX threads, the shell (the original UNIX scripting language), and Python (the de facto scripting language of today)). Tying all of this together is the **operating system**, which provides software abstractions (aka programmer's models) for the hardware resources.

At the heart of an operating system is a process table. It provides an abstraction for a process running on a CPU core. A process can be thought of as a running program: code plus data. The CPU core supports code. The CPU cache, MMU and RAM support data. Assembly language, C, the UNIX shell, and Python represent progressively higher levels of abstraction for manipulating these hardware resources.

Today's CPUs contain many cores. This motivates the **POSIX threads** programmer's model, which allows one program to manipulate many CPU cores.

Faculty Information:

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Office Hours: Wed.: 10:30 - 11:30; Fri: 10:30 - 11:30; and by appointment.

Textbook:

Computer Organization and Design: The Hardware/Software Interface
(5th edition), 2013, ISBN 978-0-12-407726-3,
by Patterson and Hennessy, Elsevier Morgan Kaufmann Publishers

ONLINE RESOURCES:

Operating Systems: Three Easy Pieces: <http://www.ostep.org> (version 0.80)
UNIX/XV6 SOURCE CODE: <http://pdos.csail.mit.edu/6.828/2012/xv6/xv6-rev7.pdf>

Exams and Grades:

There will be approximately seven homework assignments over the semester, plus a midterm and a final. They will be weighted 40% for the final, 30% for the midterm, and 30% for the homework. All homework assignments will be weighted equally.

Syllabus:

| <i>Week</i> | <i>Topics</i> | <i>Chapter</i> |
|-------------|---|--|
| Sept. 7, 15 | Introduction, Assembly | Ch. 1, Ch. 2.1-2.8 |
| Sept. 22 | Assembly/Machine Language | Ch. 2.1-2.8, Appendix A.6, A.9, A.10 and green card |
| Sept. 29 | Assembly/Machine Language (cont.) | (cont.) |
| Oct. 6 | C ptrs. | class lectures |
| Oct. 13 | UNIX syscalls; UNIX shell, fork/exec/wait | class lectures, ostep.org: Ch. 4-5 |
| Oct. 20 | Cache (direct, set assoc., fully assoc.) | Ch. 5.3-5.4 |
| Oct. 27 | Virtual Memory & MMU/TLB | Ch. 5.7; ostep.org: Ch. 15, 18, 19 |
| Nov. 3 | Mid-Term; file descriptors | ostep.org: Ch. 5 |
| Nov. 10 | Filesystems; UNIX Shell revisited; Python | class lectures |
| Nov. 17 | UNIX Process Table; virt. mem. page tables | xv6: proc.h, proc.c, vm.c |
| Nov. 24 | Thanksgiving holiday | |
| Dec. 1 | Threads, Proc. synch, Locks (mutex, semaphore) | ostep.org: Ch. 26, 27.1-27.3, 28, 31 |
| Dec. 8 | Review; Optional: monitors; TBB, OpenMP | class lectures, ostep.org: Ch. 30 |
| Dec. 10-18 | Reading Day and Week of Final Exams (see MYNEU) | |