

Computer Science

*What a physical scientist should know about
computer science*

Craig Rasmussen (Research Support Services, University of Oregon)

How do these things work?



What courses do I need to take for a computer science minor (32 credits)

- Required courses (24 credits)

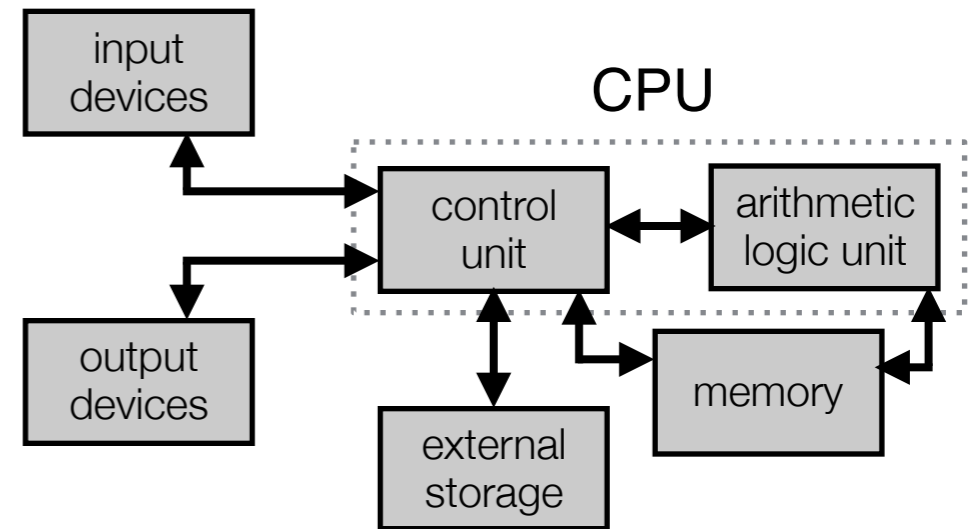
- Introduction to Computer Science I-II-III
- ~~Elements of Discrete Mathematics I-II~~
- Introduction to Data Structures

- Upper-division courses (8 credits)

- ~~Computer Architecture~~
- Introduction to Algorithms
- ~~C/C++ and Unix~~
- ~~Operating Systems~~
- Automata Theory
- ~~Software Methodology I-II~~
- ~~Introduction to Compilers~~
- Computational Science
- Bioinformatics
- Data Mining
- Introduction to Artificial Intelligence
- Machine Learning

Computer Architecture Basics

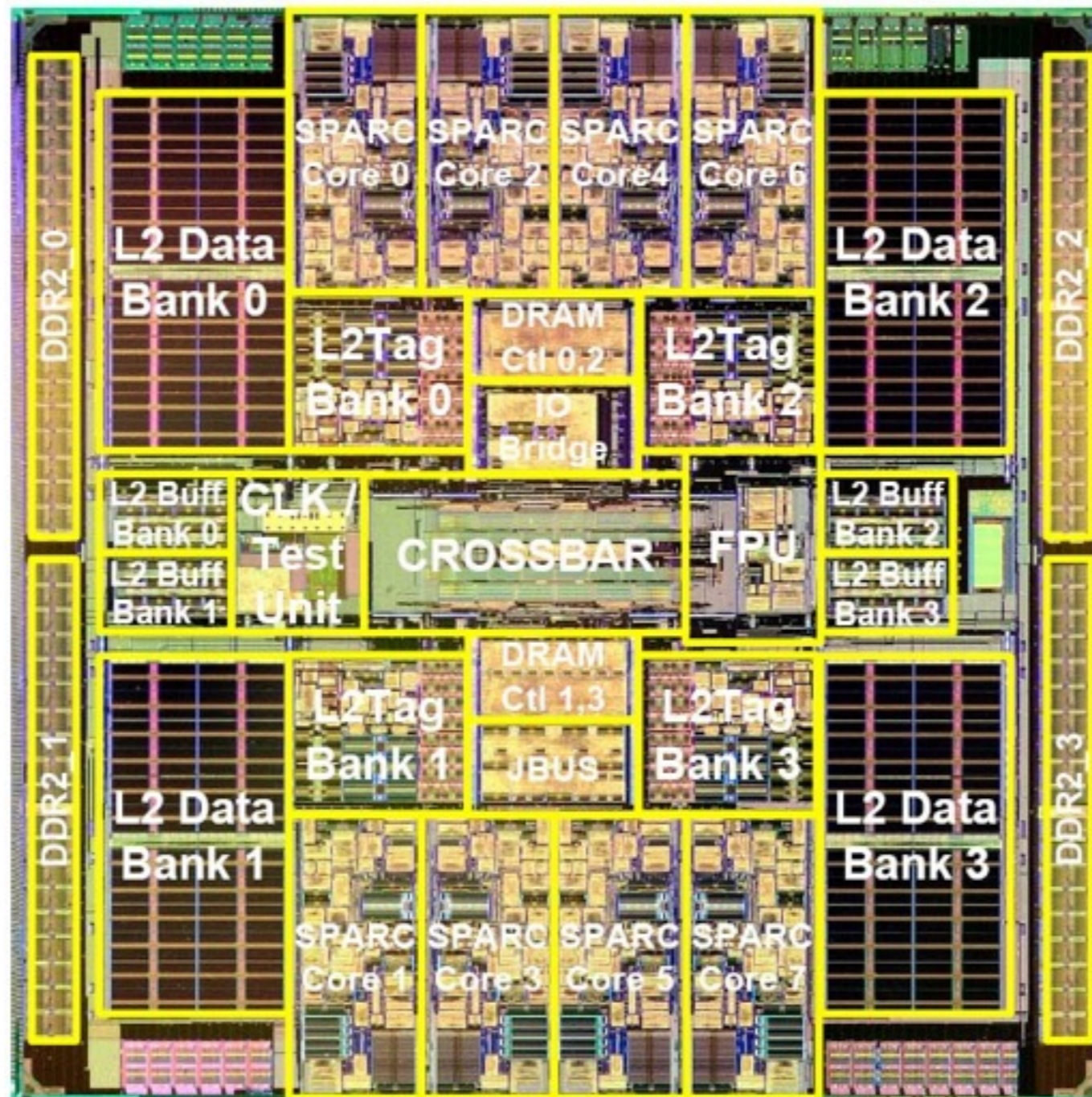
- A computation
 - input, compute, output
- Control unit
 - operates on instructions (load, add, store)
- Arithmetic logic unit
 - performs calculations (register1 + register2; result stored in register3)
- A bus connects CPU to **memory**
 - load memory into a register
 - store from a register into memory



Microprocessor Architectures: A chip



Microprocessor Architectures: 8 Core CPU Architecture (Sparc)

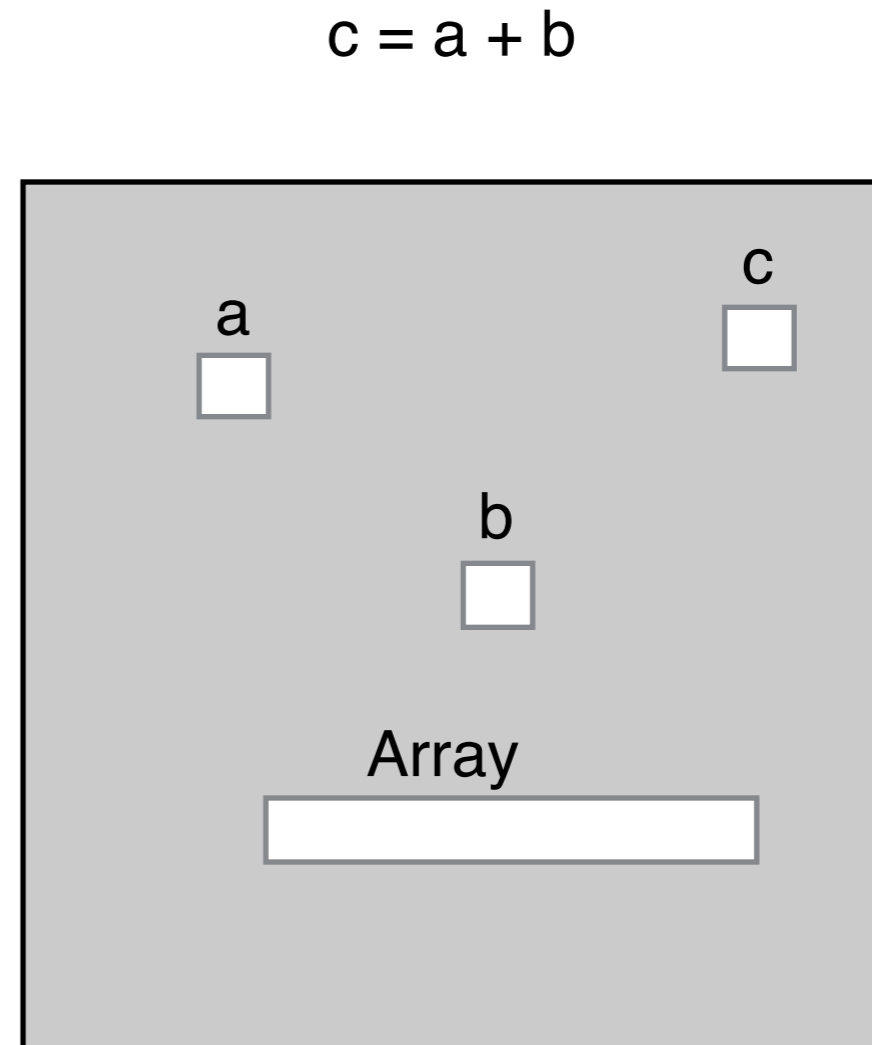


Microprocessor Architectures: GPU Architecture



Memory Basics

- Disk storage - slow
- Main memory - fast
- Caches (I, II, III) - faster
- Registers - fastest
- Variables are stored in main memory
 - located by an *address*
 - hexadecimal (0xa32b0fd)
 - random access



Operating System Basics

- Unix is an operating system
 - so is Windows
 - what is Mac OS X?
- Bash is a program (also Python)
 - called a shell (ls, pwd, cd, date, echo ...)
- A program is a set of instructions
- The operating system manages resources and handles events
 - keyboard input, memory, disk drives, network
- The operating system schedules execution of things (*fairly*)
 - processes and threads

What's the most important job of an operating system?

- It's the immune system
 - protects the system from idiot programmers
 - protects the system from evil hackers
 - viruses, malware, denial of service attacks (?)
- What is a virus anyway?
 - self replicating RNA (recall instructions)
- But can it protect the system from the CIA?
 - how about from China?
- Back to the fairness issue
 - core wars at Stanford

Software Engineering Basics

- Use git revision control
- Git commands
 - clone a repository
 - add files (not binaries) and commit changes
 - push changes back to master repository
 - pull changes someone else committed
- Everyone should get an account on github
 - store your class homework code there?
 - store your class projects there?
- Debuggers, memory leaks, performance tools

Compiler Basics

- Compilers parse input files and produce object code (instructions)

```
pure CONCURRENT subroutine convolve(Image, Filter)
  real, intent(in out), HALO(:, :) :: Image
  real, intent(in) :: Filter(-3:3, -3:3)

  Image(0,0) = sum(Filter * Image)
end subroutine convolve
```

