Computer Architecture is... ???

- Computer Architect (building architect)
  - high-level design
  - organization
  - functionality
  - performance

- Hardware Designer (builder, construction engineer)
  - materials
  - implementation details

- the first computer science discipline
- Eckert and Mauchly, the first computer scientists, were computer architects, as was John von Neumann and Maurice Wilkes

- That part of the machine that is visible to the user (programmer/compiler-writer/OS writer/user)
  - the software interface (Instruction Set Design)
  - performance (Computer Organization)
Computer Architecture is... ???

- Instruction Set Design
- Computer Organization

PERFORMANCE!!!!!
and power/energy/fault tolerance

Why do I care?

- You may actually do computer architecture someday
- You may actually care about software performance someday
  - The ability of application programs, compilers, operating systems, etc. to deliver performance depends critically on an understanding of the underlying computer organization.
  - That becomes more true every year.
  - Computer architectures become more difficult to understand every year.

The Forces on Computer Architecture

Computer Architecture:
- Instruction Set Design
- Hardware Organization
Administration

• Who are you?
• Who am I?
• syllabus, other details

What is Computer Architecture?

Computer Architecture = Machine Organization + Instruction Set Architecture

What the machine looks like

How you talk to the machine

The Instruction Set Architecture

• that part of the architecture that is visible to the programmer
  – opcodes (available instructions)
  – number and types of registers
  – instruction formats
  – storage access, addressing modes
  – exceptional conditions

Examples of ISAs

• Alpha AXP
• Intel 80x86/pentium*/IA32
• Intel IA64/Itanium
• VAX
• MIPS
• SPARC
• IBM 360
• PowerPC
• ARM
The Instruction Set Architecture

• ISA provides a level of abstraction for both the hardware and the software

Computer Organization

• Once you have decided on an ISA, you must decide how to design the hardware to execute those programs written in the ISA as fast as possible.
• This must be done every time a new implementation of the architecture is released, with typically very different technological constraints.

The Challenge of Computer Architecture

• This industry changes faster than any other.
• The ground rules change every year.
  – new problems
  – new opportunities
  – different tradeoffs
• It’s all about making programs run faster than the next guy’s machine.

Performance Trends

- A graph showing performance trends over the years for CPU and memory, indicating an increase in performance with time.
What you can expect to get out of this class

- to become conversant with computer architecture terms and concepts.
- to understand fundamental concepts in computer architecture and how they impact computer and application performance.
- to be able to read and evaluate architectural descriptions of even today's most complex processors.
- to learn experimental techniques used to evaluate advanced architectural ideas.

Key Points

- Computer Architecture defines the software-visible machine description (ISA) and the overall machine organization.
- High-performance software requires a deep understanding of the underlying machine organization.
- The instruction set architecture defines how software is allowed to use the processor. Multiple computers with vastly different organizations and performance can share an ISA.