Lecture 1: Course Introduction and Overview

Prof. Randy H. Katz
Computer Science 252
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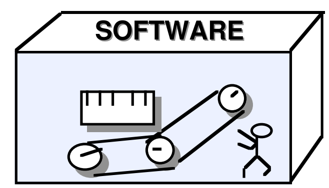
Computer Architecture Is …

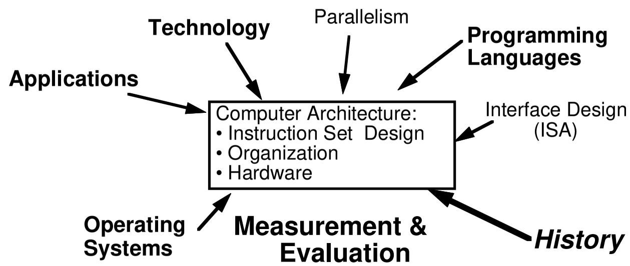
the attributes of a [computing] system as seen by the programmer, i.e., the conceptual structure and functional behavior, as distinct from the organization of the data flows and controls the logic design, and the physical implementation.

Amdahl, Blaaw, and Brooks, 1964

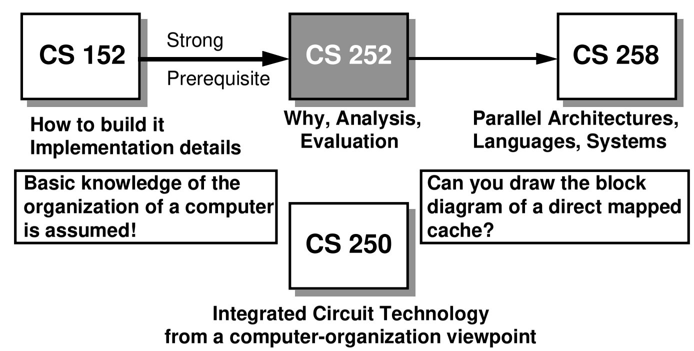


CS 252 Course Focus

Understanding the design techniques, machine structures, technology factors, evaluation methods that will determine the form of computers in 21st Century



Related Courses



Grading

- 30% Homeworks (work in pairs)
- 30% Examinations (2 Midterms + Final)
- 30% Research Project (work in pairs)
- 10% Class Participation

Topic Coverage

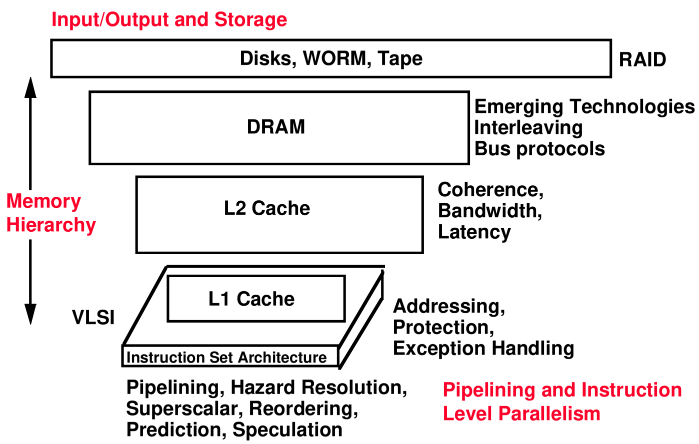
Textbook: Hennessy and Patterson, *Computer Architecture: A Quantitative Approach*, 2nd Ed., 1995.

- Fundamentals of Computer Architecture (Chapter 1)
- Instruction Set Architecture (Chapter 2)
- Pipelining and Instructional Level Parallelism (Chapter 3, 4)

- Memory Hierarchy (Chapter 5)
- Input/Output and Storage (Chapter 6)
- Networks and Interconnection Technology (Chapter 7)

- Multiprocessors (Chapter 8)
- Portable Systems
- Computer Arithmetic (Appendix A)

Computer Architecture Topics



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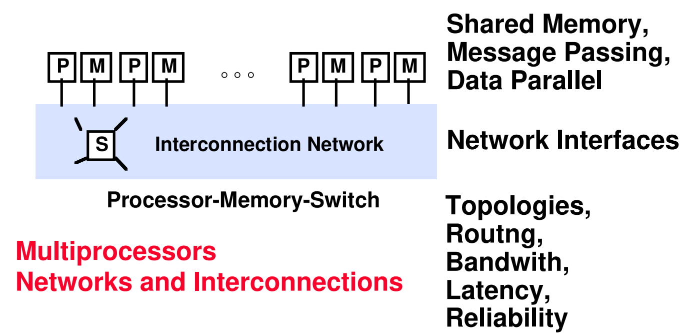
Computer Architecture Topics



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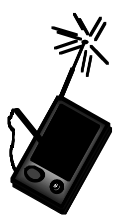
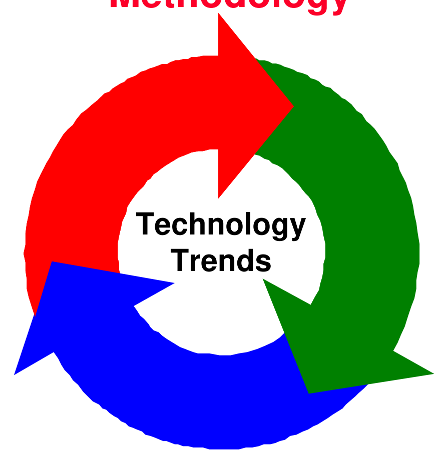
Computer Architecture Topics

- **Portable Systems**

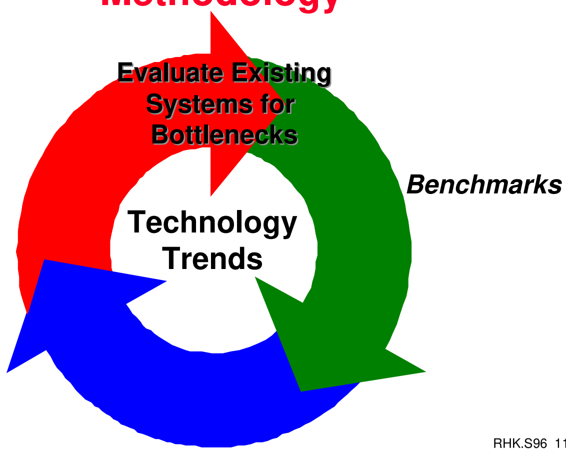


Computers vs. Intelligent Communicators
High Performance vs. Low Power
LCD Technologies
Real-time Input/Output (e.g., Pen Input)
Portable Storage Devices (PCMCIA)
Intelligent Batteries

Computer Engineering Methodology



Computer Engineering Methodology



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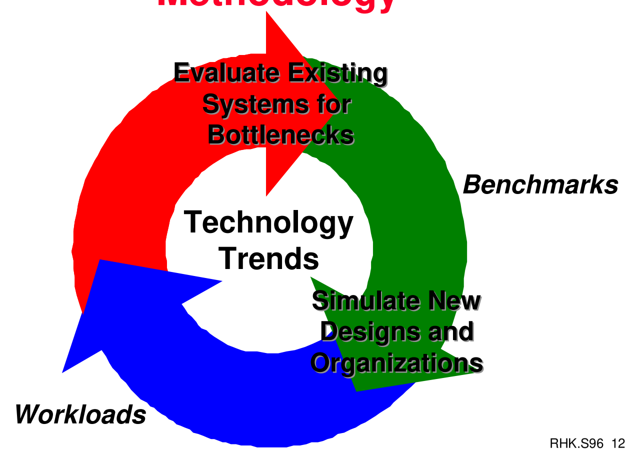
Computer Engineering Methodology



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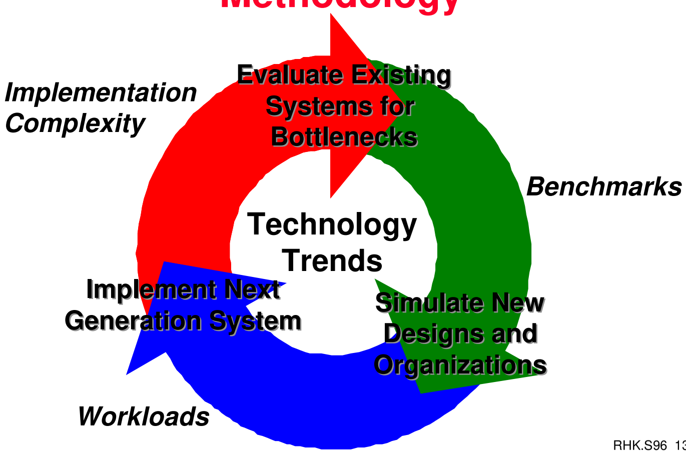
Computer Engineering Methodology



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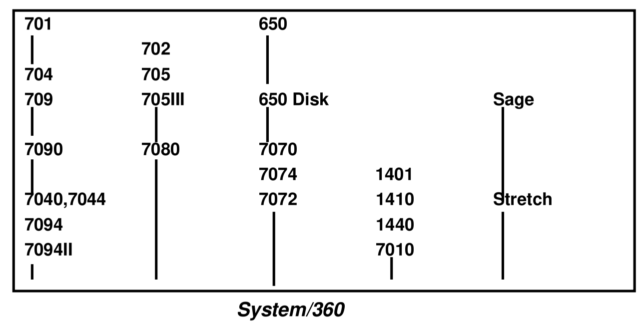
Early Commercial Computing



1954: IBM 701, Core Memory

1957: Moving Head Disk

1958: Transistor, FORTRAN, ALGOL

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Underlying Technologies

	Year	Logic	Storage	Prog. Lang.	O/S
	54	Tubes	core (8 ms)		
	58	Transistor (10µs)			Fortran
	60			Algol, Cobol	Batch
	64	Hybrid (1µs)	thin film (200ns)	Lisp, APL, Basic	
	66	IC (100ns)		PL1, Simula,C	
	67				Multiprog.
Generational	71	LSI (10ns)	1k DRAM	O.O.	V.M.
Evolutionary	73	(8-bit µP)			
	75	(16-bit µP)	4k DRAM		
	78	VLSI (10ns)	16k DRAM		Networks
	80		64k DRAM		
	84	(32-bit µP)	256k DRAM	ADA	
Parallelism	87	ULSI	1M DRAM		
	89	GAs	4M DRAM	C++	
	92	(64-bit µP)	16M DRAM	Fortran90	

Context for Designing New Architectures

- **Application Area**
  - **Special Purpose (e.g., DSP) / General Purpose**
  - **Scientific (FP intensive) / Commercial (Mainframe)**
- **Level of Software Compatibility**
  - **Object Code/Binary Compatible (cost HW vs. SW; IBM S/360)**
  - **Assembly Language (dream to be different from binary)**
  - **Programming Language; Why not?**

Context for Designing New Architectures

- **Operating System Requirements for General Purpose Applications**
  - Size of Address Space
  - Memory Management/Protection
  - Context Switch
  - Interrupts and Traps
- **Standards: Innovation vs. Competition**
  - IEEE 754 Floating Point
  - I/O Bus
  - Networks
  - Operating Systems / Programming Languages ...

Predictions for the Late 1990s

- **Technology**
  - Very large dynamic RAM: 64 MBits and beyond
  - Large fast Static RAM: 1 MB, 10ns
- **Complete systems on a chip**
  - 10+ Million Transistors
- **Parallelism**
  - Superscalar, Superpipeline, Vector, Multiprocessors
  - Processor Arrays

Predictions for the Late 1990s

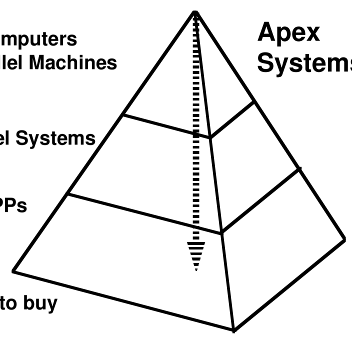
- Low Power
  - 50% of PCs portable by 1995
  - Performance per watt
- Parallel I/O
  - Many applications I/O limited, not computation
  - Computation scaling, but memory, I/O bandwidth not keeping pace
- Multimedia
  - New interface technologies
  - Video, speech, handwriting, virtual reality, …

Predications for the 1990s

- "Network-Integrated Computing"
  - Wide-area AND local-are integration of cluster-based computing, MPPs, and high performance networks
- Scalable Technologies for Computing, Networking, and Information Systems
  - Systems that scale DOWN as well as UP
  - High performance workstations
  - Clusters and distributed systems
  - Massively parallel I/O and compute servers
  - National Information Infrastructure

Traditional Technology
Trickle-Down

- High performance technologies trickle down



But who can afford to buy the Apex anymore?

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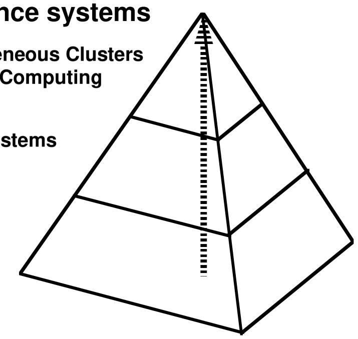
1990s Technology
Trickle-Up

- Communications technologies “trickle up” into high performance systems



You already own the Apex system!

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