LECTURE - 01

Computer Architecture

- "Architecture"
  - The art and science of designing and constructing buildings
  - A style and method of design and construction
  - Design, the way components fit together
- Computer Architecture
  - The overall design or structure of a computer system, including the hardware and the software required to run it, especially the internal structure of the microprocessor

CS422 Prerequisites

- Computer organization (CS220)
  - Digital logic
  - Memory chips, number representation
  - Computer arithmetic, adders, ripple-carry...
  - I/O organization
  - Peripherals
  - Pipelining, RISC

CS422 Course Contents

- Performance and CPI, benchmarks, Amdahl's law

- Pipelining, hazards

- Instruction Level Parallelism: Scoreboarding, Tomasulo's algorithm

- Dynamic branch prediction, VLIW, software pipelining

CS422 Course Contents (continued)

- Cache and memory systems

- I/O systems, RAID, benchmarks

- Multiprocessors, cache consistency protocols

- Processor networks

- Vector processors

Course Evaluation

- Scribe notes: 5%

- Homework assignment(s): 20%

- Mid-sems: 30%

- End-sem: 45%

    – May give part of it as take-home

Course References

- **"Computer Architecture: A Quantitative Approach"**, 2nd edition, David A. Patterson and John L. Hennessy, Morgan Kaufmann Publishers.

- CS252, Graduate Computer Architecture, U.C.Berkeley

Computer Architecture

- Design aspects:
  - Instruction set
  - Cache and memory hierarchy
  - I/O, storage, disk
  - Multi-processors, networked-systems
- Criteria: performance, cost, end-applications, complexity

Technology Trends

- Since 1970s: Microprocessor-based

- Several PCs/Workstations put together can buy more cycles for the same cost

  - The Berkeley NOW project

- Transistor density: 50% per year

- DRAM density: 60% per year

- Magnetic disk density: 50% per year

Technology Trends (continued)

- Software:
  - More memory usage
  - High-level language

- Growth rate in CPU speed: 50% per year
  - Architectural ideas: pipelining, caching, out-of-order execution, sophisticated compilers

- Trends are important:
  - Product cycle is 4 years!
  - Also beware of technology thresholds

Cost Trends

- Cost depends on various factors:
  - Time, volume, competition
- Cost of IC:
  - Cost of die + Testing + Packaging
- Cost of die: Wafer-cost/Dies-per-wafer
- Yield is an important factor
- Cost proportional to Die-area^4

Upcoming Topics

- Performance metrics, CPI
- Amdahl's law