ECE 486/586
Computer Architecture

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Review

- Contemporary computing categories
  - Desktop/laptop, Servers, Embedded, Personal Mobile Devices, Warehouse Scale Computing/Clusters
- Energy and power
- Fabrication and test economics
  - Die area, defect density, yield
- Reliability
- Instruction set architecture
  - Operations, Operands, Addressing modes
  - Instruction encoding
  - Quantitative methods
    - Instruction mix, addressing modes, displacement values
  - MIPS
- Performance measurement/analysis, benchmarking

Review

- Quantitative methods
  - Amdahl's Law
  - Speedup, Execution Time = IC x CC x (average) CPI
  - Average CPI
- Procedure call conventions
  - Call/return, parameter passing, return values
  - Memory map, storage classes
- Number representation, computer arithmetic
  - Unsigned, signed representations, floating point
  - Simple integer multiplication/division

Review

- MIPS Data Path
  - Basic data path, control logic
  - Bypassing/forwarding
  - Pipeline execution diagrams
  - Multicycle execution units
- Data dependence and hazards
  - True dependence, output dependence, anti-dependence
  - RAW, WAW, WAR hazards
- Scoreboard and Tomasulo's algorithm
- Branch prediction
  - Branch outcome, branch target, tournament predictors
- Thread level parallelism

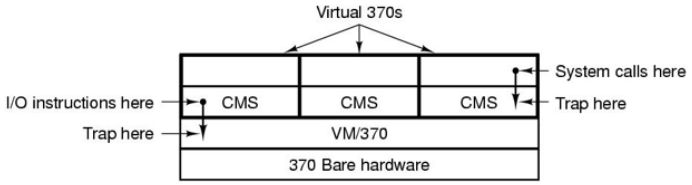
Future

- ECE 587/588 Advanced Computer Architecture I, II
- ECE 540 System on Chip Design with FPGAs
- ECE 544 Embedded System Design with FPGAs
- ECE 510 Topics: Pre-Silicon Verification
- ECE 510 Topics: SystemVerilog

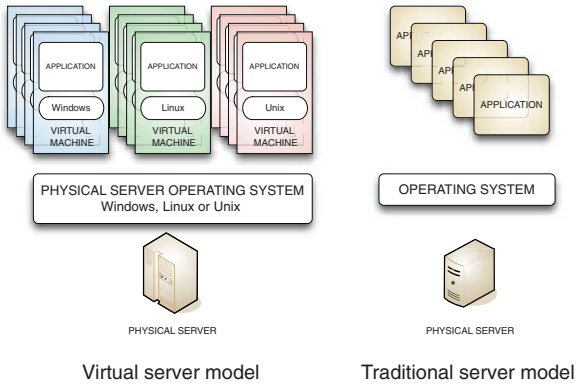
- Warehouse scale computing
  - Reliability, communications/networking, energy, cost
  - Algorithm development (Map/Reduce)
  - Computing as utility (Amazon Web Services)
- Parallel computing
  - Multicore, multi-thread, GPUs
  - Particularly programming
  - OpenMP (C library), MPI, Cuda (Nvidia GPUs)

Future

- Virtualization
  - Origins in 1960s (IBM VM)



  - VirtualBox, Parallels, VMWare Fusion, Xen, others
  - Provide an abstraction of the hardware to OS/application
  - Uses
    - Servers
      - Run multiple application/server/OS combinations on single server
      - Better utilization over separate (underutilized) server for each
      - Lower administration costs
      - Extend to different versions as well
    - Desktop
      - Run Windows on your Mac
      - Linux on your Windows PC
    - Secure platforms
      - Isolate application to OS instance
      - Protect underlying machine, resources
      - OS debugging and instrumentation



Virtual server model

Traditional server model