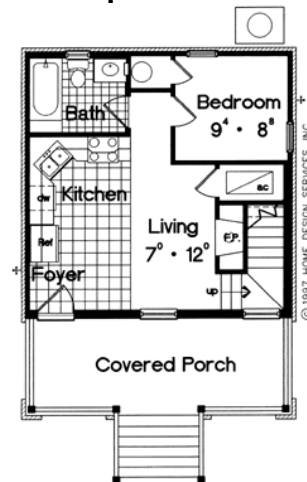


COMP375

Computer Architecture and Organization

Introduction

What is Computer Architecture?



Hardware

- This is a course about what's inside the box.
- How does the hardware run the software?
- How do hardware design features impact software execution?
- How does the software interface with the hardware?

Architecture and Organization

- **Architecture** is the design of the system visible to the assembly level programmer.
 - What instructions
 - How many registers
 - Memory addressing scheme
- **Organization** is how the architecture is implemented.
 - How much cache memory
 - Microcode or direct hardware
 - Implementation technology

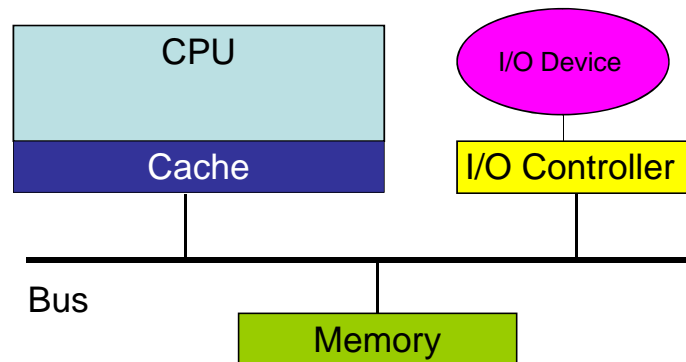
Same Architecture Different Organization

- Almost every program that can run on an original Pentium (or 8086) can run on a Pentium 4.
- All computers in the Intel Pentium series have the same architecture.
- Each version of the Pentium has a different organization or implementation.

Same Architecture Different Organization

- The IBM 360 computer was released in several different models.
- All had the same architecture. A program compiled on one IBM 360 would run on all models.
- The different models had different implementations, speed and price.

Basic Computer Components



Central Processing Unit

- Contains the control logic that initiates most activities in the computer.
- The Arithmetic Logic Units perform the math and logic calculations.
- Registers contain temporary data values.
- Program Counter contains the address of the next instruction to execute.

Registers

- The CPU has registers to temporarily hold data being acted upon.
- Different architectures have different number of registers.
- Some registers are available for the user programs to use directly.
- Some registers are used indirectly (such as the program counter).
- Some registers are used only by the operating system (i.e. program status reg)

Bus

- The bus is a set of parallel wires that connect the CPU, memory and I/O controllers.
- It has logic (the chipset) to determine who can use the bus at any given instant.
- The width of the bus determines the maximum memory configuration.

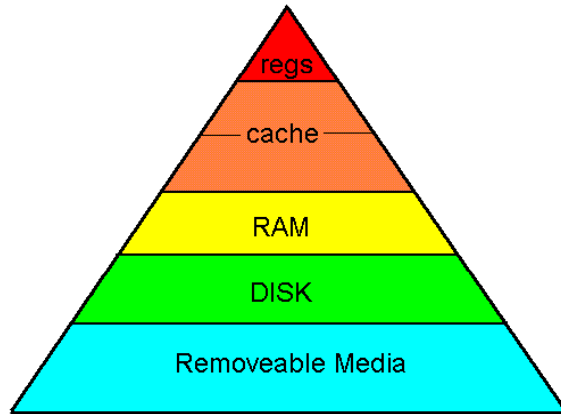
I/O Controllers

- Direct the flow of data to and from I/O devices.
- CPU sends a request to the I/O controller to initiate I/O.
- I/O controllers run independently and in parallel with the CPU.
- I/O controllers may interrupt the CPU upon completion of request or error.

Memory

- The internal memory is Random Access Memory (RAM).
- Both data and program instructions are kept in RAM.
- Instructions must be in RAM to be executed.

Memory Hierarchy



Instruction Cycle

- Fetch the instruction from memory
- Execute the instruction

Instruction Cycle *(more detail)*

- Fetch the instruction from the memory address in the Program Counter register
- Increment the Program Counter
- Decode the type of instruction
- Fetch the operands
- Execute the instruction
- Store the results

Simple Model of Execution

- Instruction sequence is determined by a simple conceptual control point.
- Each instruction is completed before the next instruction starts.
- One instruction is executed at a time.

Layers

You can consider computer operation at many different levels.

- Applications
- Middleware
- High level languages
- **Machine Language**
- **Microcode**
- **Logic circuits**
- Gates
- Transistors
- Silicon structures

First Assignment

- Complete the online quiz on metric prefixes by 9:30am on Friday, August 20
- Available on the class website assignments page
- Solutions available on the class website