Classes of Computing Applications

- Desktop
  - Personal computer
- Servers
  - Web server
  - Supercomputer
- Embedded computers
  - Washing machine
  - Cell phone

Different design requirements, uses HW in different ways

Understanding Program Performance

Hardware and Software Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Affects Performance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithm</td>
<td># source-level statements, # I/O ops</td>
</tr>
<tr>
<td>Prog. Lang., compiler, architecture</td>
<td># machine insts</td>
</tr>
<tr>
<td>Processor, memory system</td>
<td>How fast can insts be executed?</td>
</tr>
<tr>
<td>I/O system (HW + OS)</td>
<td>How fast can I/O ops execute?</td>
</tr>
</tbody>
</table>

Terminology

- Systems software
  - Operating system
    - Interfaces between user program and hardware
  - Compiler
    - Translates program in high-level language to assembly language
  - Assembler
    - Translates assembly language program to machine language

Computer Basics

- Functions
  - Inputting data
  - Outputting data
  - Processing data
  - Storing data
- Components
  - Input
  - Output
  - Memory
  - Datapath (ALU)
  - Control
Components

- Instruction set architecture

Brief History of Technology

- 1951 – Vacuum tube
- 1965 – Transistor
- 1975 – Integrated circuit
- 1995 – Very large scale integrated circuit
- 2005 – Ultra large scale integrated circuit

Vacuum Tubes – 1946-59

- ENIAC (WWII)
  - Eckhart and Mauchly (UPenn)
  - 18,000 vacuum tubes, 1500 electronic relays
  - hardwired programs
- Stored program concept
  - Von Neumann
- EDSAC
  - First operational stored program computer

Transistors 1959-64

- 1/10 size of vacuum tube
- Lower operating temperature → longer life

Integrated Circuits – 1964-1975

- Kilby of Texas Instruments
  - Idea to build entire circuits on semiconducting material
  - 10 – 10,000 components per chip
  - Computers became smaller

VLSI and Ultra VLSI

- Millions to billions of transistors on a chip
Basic Definitions and Conventions

- Decimal
- Binary
- Hexadecimal

Problem 1.1

- PowerPC 601 processor addresses $2^{32}$ bytes of memory. What is the maximum number of 64-bit words that can be stored in this memory?

Problem 1.2

- A certain IBM 970 processor has a system clock frequency of 1.2 GHz, what is the clock period?

Problem 1.4

- How many 500 MB tapes will be required to back up a 120 GB hard drive? How long will the backup process take if one tape can be filled in 5 minutes?