Why take CS 240?

• Learn about computer hardware, interfaces.
• Programmers who understand basics of hardware are better programmers.
  – Representation
  – Translation
  – Implementation
  – …

int ≠ integer
float ≠ real

\[ x^2 \geq 0? \]
\[ 40000 \times 40000 = 1600000000 \]
\[ 50000 \times 50000 = -1794967296 \]

\[(x + y) + z \equiv x + (y + z)?\]
\[ (-2.7e23 + 2.7e23) + 1.0 \equiv 1.0 \]
\[ -2.7e23 + (2.7e23 + 1.0) \equiv 0.0 \]

Arithmetic Performance

1023*x 1024*x

Memory Performance

void copyji(int src[2048][2048], int dst[2048][2048])
{
    int i,j;
    for (i = 0; i < 2048; i++)
        for (j = 0; j < 2048; j++)
            dst[i][j] = src[i][j];
}

void copyij(int src[2048][2048], int dst[2048][2048])
{
    int i,j;
    for (i = 0; i < 2048; i++)
        for (j = 0; j < 2048; j++)
            dst[i][j] = src[i][j];
}

21 times slower
(Pentium 4)
Modern Digital Computer Organization

Processor

Memory

Bus

Disks

Net

USB

Etc.

Hardware: Physical View

USB...

Bus connections

IPG Atmel sticks

1 POE & RJ-11, 2 POE & RJ-45 POE

Processor

I/O controller

Storage connections

Memory

ENIAC

iPhone 5

Year

1946

2012

Weight

30 tons

4 oz

Volume

2,400 ft³

3.4 in³

Cost

56,000,000 (today)

$600

Speed

Few 1000 ops/sec

2,500,000,000 ops/sec

Memory

~100 bytes, ~500 added later

1,073,741,824 bytes (1 GB)

Power

150,000 W

<5W

Input/Output

Switches, punchcards

Touchscreen, audio, camera, wifi, cell, ...

Production

1

5,000,000 sold first 3 days

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