

Themes

- Abstractions, interfaces, implementations
- Representation: 0s and 1s
- Translation

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*x >= 0?

40000 * 40000 == 1600000000
50000 * 50000 == -1794967296

(x + y) + z == x + (y + z)?

(-2.7e23 + 2.7e23) + 1.0 == 1.0
-2.7e23 + (2.7e23 + 1.0) == 0.0

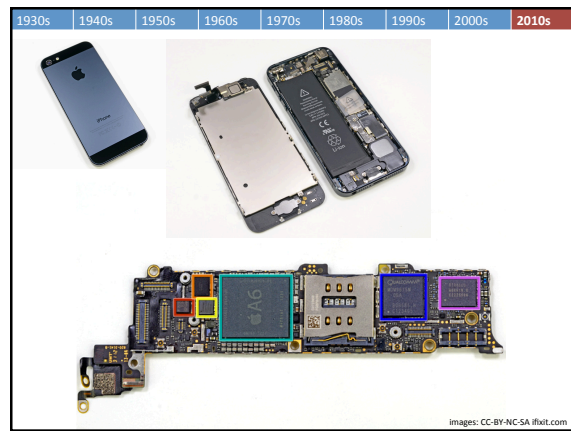
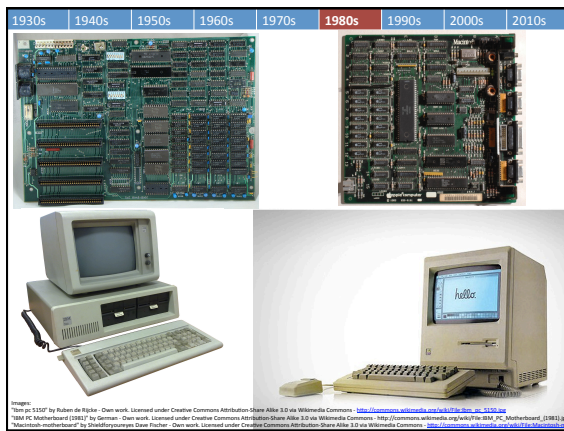
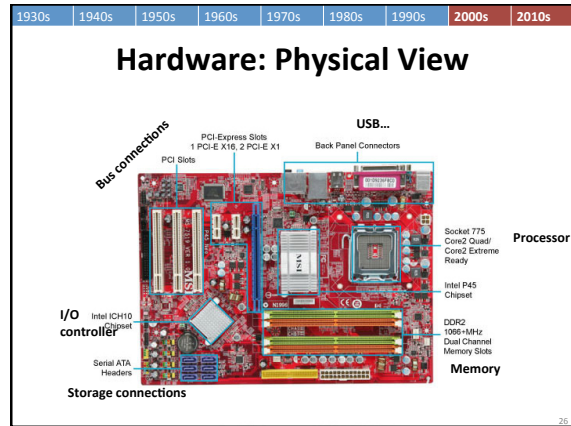
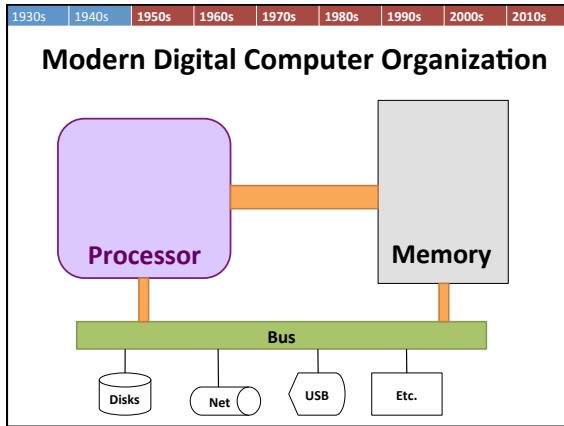
Arithmetic Performance



1023*x 1024*x

Memory Performance

<pre>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]; }</pre>	<pre>void copyji(int src[2048][2048], int dst[2048][2048]) { int i,j; for (j = 0; j < 2048; j++) for (i = 0; i < 2048; i++) dst[i][j] = src[i][j]; }</pre>
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21 times slower (Pentium 4)



Year	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s	2010s
ENIAC									
iPhone 5									
Year	1946	2012							
Weight	30 tons	4 oz							
Volume	2,400 ft ³	3.4 in ³							
Cost	\$6,000,000 (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							

ENIAC image: public domain; iPhone image: CC-BY-NC-SA ifixit.com