

# Computer Science E-1

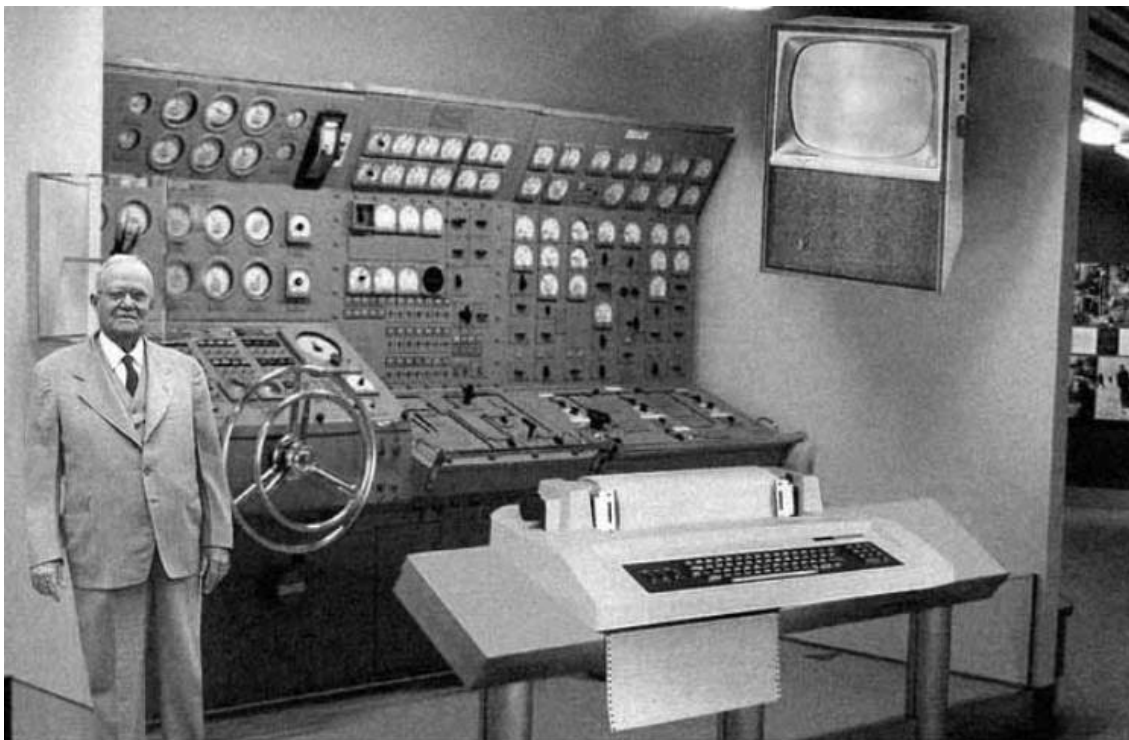
## Understanding Computers and the Internet

### Lecture 1: Hardware

Thursday, 22 September 2005

David J. Malan  
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*Scientists from the RAND Corporation have created this model to illustrate how a "home computer" could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, but 50 years from now scientific progress is expected to solve these problems. With teletype interface and the Fortran language, the computer will be easy to use.*

Excerpted from an issue of Popular Mechanics, 1954.

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# Computation

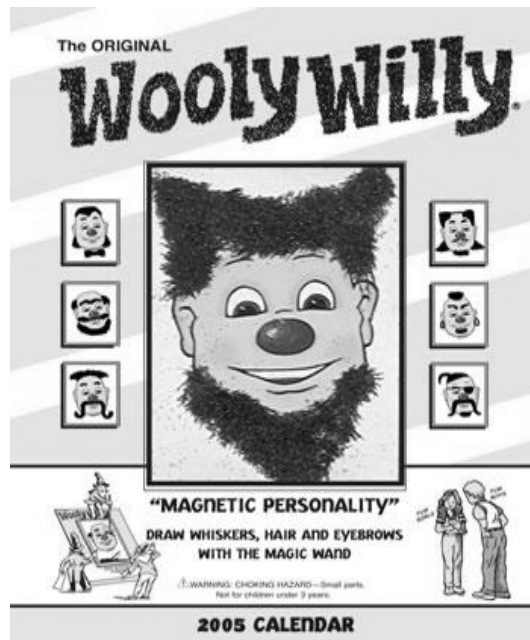


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3

# Computation



4

# Computation

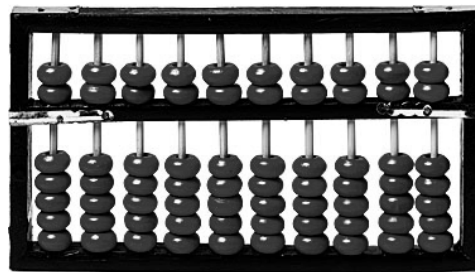


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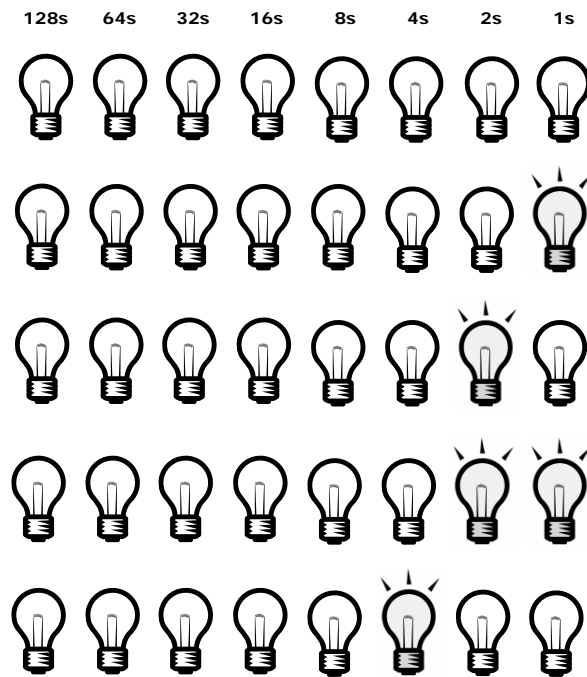
# Computation



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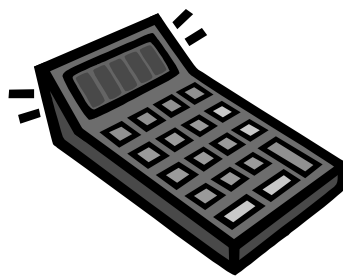
6

# Computation



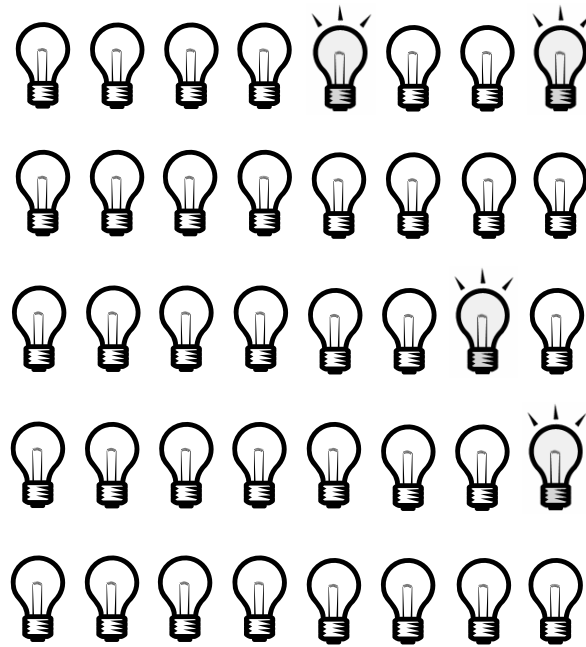
7

# Computation



8

# Computation



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# Computation

0	0	0	0	1	0	0	1
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0

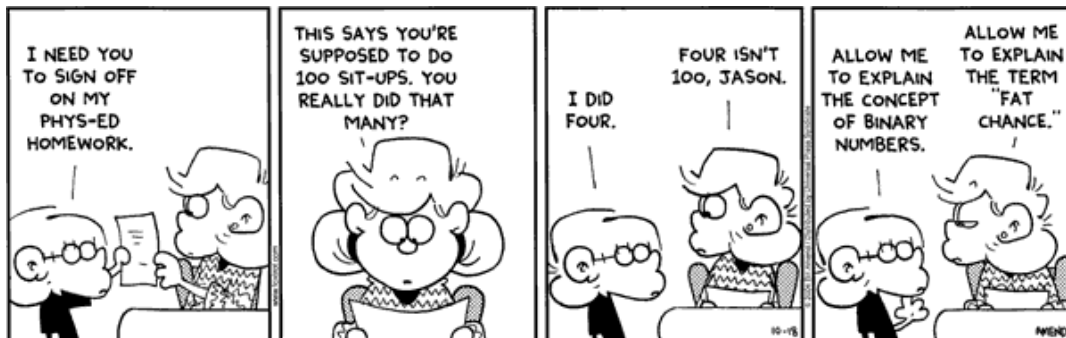
10

# Computation

Base-10	Base-2
0	
1	
2	
3	
4	
5	
6	
7	
...	
15	
...	
255	
256	

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# Computation



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# Bits and Bytes

Unit	Abbreviation	Definition
bit	b	0 or 1
byte	B	8 b
		1,024 B
		1,048,576 B
		1,073,741,824 B
		1,099,511,627,776 B

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## ASCII

Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL (null)	32	20	040	##32;	Space	64	40	100	##64;	@	96	60	140	##96;	`
1	1	001	SOH (start of heading)	33	21	041	##33;	!	65	41	101	##65;	A	97	61	141	##97;	a
2	2	002	STX (start of text)	34	22	042	##34;	"	66	42	102	##66;	B	98	62	142	##98;	b
3	3	003	ETX (end of text)	35	23	043	##35;	#	67	43	103	##67;	C	99	63	143	##99;	c
4	4	004	EOT (end of transmission)	36	24	044	##36;	\$	68	44	104	##68;	D	100	64	144	##100;	d
5	5	005	ENQ (enquiry)	37	25	045	##37;	%	69	45	105	##69;	E	101	65	145	##101;	e
6	6	006	ACK (acknowledge)	38	26	046	##38;	&	70	46	106	##70;	F	102	66	146	##102;	f
7	7	007	BEL (bell)	39	27	047	##39;	'	71	47	107	##71;	G	103	67	147	##103;	g
8	8	010	BS (backspace)	40	28	050	##40;	(	72	48	110	##72;	H	104	68	150	##104;	h
9	9	011	TAB (horizontal tab)	41	29	051	##41;	)	73	49	111	##73;	I	105	69	151	##105;	i
10	A	012	LF (NL line feed, new line)	42	2A	052	##42;	*	74	4A	112	##74;	J	106	6A	152	##106;	j
11	B	013	VT (vertical tab)	43	2B	053	##43;	+	75	4B	113	##75;	K	107	6B	153	##107;	k
12	C	014	FF (NP form feed, new page)	44	2C	054	##44;	,	76	4C	114	##76;	L	108	6C	154	##108;	l
13	D	015	CR (carriage return)	45	2D	055	##45;	-	77	4D	115	##77;	M	109	6D	155	##109;	m
14	E	016	SO (shift out)	46	2E	056	##46;	.	78	4E	116	##78;	N	110	6E	156	##110;	n
15	F	017	SI (shift in)	47	2F	057	##47;	/	79	4F	117	##79;	O	111	6F	157	##111;	o
16	10	020	DLE (data link escape)	48	30	060	##48;	0	80	50	120	##80;	P	112	70	160	##112;	p
17	11	021	DC1 (device control 1)	49	31	061	##49;	1	81	51	121	##81;	Q	113	71	161	##113;	q
18	12	022	DC2 (device control 2)	50	32	062	##50;	2	82	52	122	##82;	R	114	72	162	##114;	r
19	13	023	DC3 (device control 3)	51	33	063	##51;	3	83	53	123	##83;	S	115	73	163	##115;	s
20	14	024	DC4 (device control 4)	52	34	064	##52;	4	84	54	124	##84;	T	116	74	164	##116;	t
21	15	025	NAK (negative acknowledge)	53	35	065	##53;	5	85	55	125	##85;	U	117	75	165	##117;	u
22	16	026	SYN (synchronous idle)	54	36	066	##54;	6	86	56	126	##86;	V	118	76	166	##118;	v
23	17	027	ETB (end of trans. block)	55	37	067	##55;	7	87	57	127	##87;	W	119	77	167	##119;	w
24	18	030	CAN (cancel)	56	38	070	##56;	8	88	58	130	##88;	X	120	78	170	##120;	x
25	19	031	EM (end of medium)	57	39	071	##57;	9	89	59	131	##89;	Y	121	79	171	##121;	y
26	1A	032	SUB (substitute)	58	3A	072	##58;	:	90	5A	132	##90;	Z	122	7A	172	##122;	z
27	1B	033	ESC (escape)	59	3B	073	##59;	;	91	5B	133	##91;	[	123	7B	173	##123;	{
28	1C	034	FS (file separator)	60	3C	074	##60;	<	92	5C	134	##92;	\	124	7C	174	##124;	
29	1D	035	GS (group separator)	61	3D	075	##61;	=	93	5D	135	##93;	]	125	7D	175	##125;	}
30	1E	036	RS (record separator)	62	3E	076	##62;	>	94	5E	136	##94;	^	126	7E	176	##126;	~
31	1F	037	US (unit separator)	63	3F	077	##63;	?	95	5F	137	##95;	_	127	7F	177	##127;	DEL

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# ASCII

128	Ç	144	É	160	á	176	☐	193	⊥	209	ƒ	225	ß	241	±
129	ù	145	æ	161	í	177	☐	194	⌈	210	π	226	Γ	242	≥
130	é	146	Æ	162	ó	178	☐	195	⌋	211	ℓ	227	π	243	≤
131	â	147	ô	163	ú	179		196	—	212	ℓ	228	Σ	244	∫
132	ä	148	ö	164	ñ	180	†	197	+	213	ƒ	229	σ	245	∫
133	à	149	ò	165	Ñ	181	‡	198	‡	214	ƒ	230	μ	246	+
134	â	150	û	166	ª	182	‡	199	‡	215	‡	231	τ	247	≈
135	ç	151	ù	167	º	183	π	200	ℓ	216	‡	232	Φ	248	°
136	ê	152	—	168	¿	184	π	201	ƒ	217	∫	233	⊕	249	·
137	ë	153	Ö	169	—	185	‡	202	ℓ	218	ƒ	234	Ω	250	·
138	è	154	Û	170	¬	186	‡	203	ƒ	219	■	235	δ	251	√
139	í	156	£	171	½	187	π	204	‡	220	■	236	∞	252	—
140	î	157	¥	172	¼	188	∫	205	=	221	■	237	φ	253	²
141	ï	158	—	173	¡	189	∫	206	‡	222	■	238	ε	254	■
142	Ä	159	ƒ	174	«	190	∫	207	⊥	223	■	239	∩	255	
143	Å	192	Ł	175	»	191	∫	208	ℓ	224	α	240	≡		

Source: [www.asciitable.com](http://www.asciitable.com)

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## Agenda

- Computation
- Overview
- Bits and Bytes
- ASCII
- Processors
- Motherboards
  - Connectors, Ports, Slots, Sockets
  - System Bus
- Memory
  - ROM
    - BIOS
    - CMOS
    - POST
  - RAM
    - SIMMs, DIMMs, RIMMs
    - EDO, SDRAM, RDRAM
  - Level-1 and Level-2 Cache
  - Secondary Storage
  - Virtual Memory

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# Overview

## Expectations

You are expected to attend or watch all lectures,  
complete nine problem sets, take two exams,  
and produce a final project.

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# Overview

## Lectures

Hardware  
Software  
The Internet  
Multimedia  
Security  
Website Development  
Programming  
Dotcoms  
Computer Science  
...

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# Overview

## Books

### Set One: for True Beginners

*Computers Are Your Future 2006*, Complete Edition  
*How the Internet Works*, Seventh Edition  
*How to Use HTML and XHTML*  
*Teach Yourself VISUALLY Computers*, Fourth Edition

### Set Two: for Students More Savvy

*Computers Are Your Future 2006*, Complete Edition  
*How Computers Work*, Seventh Edition  
*How the Internet Works*, Seventh Edition  
*HTML for the World Wide Web with XHTML and CSS: Visual QuickStart Guide*, Fifth Edition

### Supplementary

*DHTML and CSS for the World Wide Web: Visual QuickStart Guide*, Third Edition  
*How the Mac® Works*, Millennium Edition

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# Overview

## Sections

Dissecting a PC  
Upgrading a PC  
Exploring the Internet  
Treasure Hunting  
Building and Configuring a (W)LAN  
Designing GIFs, JPEGs, and PNGs  
Disinfecting a PC  
Building Websites with XHTML  
Enhancing Websites with CSS and SSI  
Programming in JavaScript

...

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# Overview

## Workshops

Using a PC and the Course's Website  
Navigating, Configuring, and Troubleshooting Windows  
Navigating, Configuring, and Troubleshooting Mac OS  
Inside the 'Net  
Building a PC  
Computer Games  
Digital Photography  
Tour of University Information Systems  
...

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# Overview

## Problem Sets

Hardware  
Software  
The Internet  
Hardware, Software, and the Internet  
Multimedia  
Security  
Website Development  
Programming  
Dotcoms

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# Overview

## Final Project

Option One: The Website  
Option Two: The Paper and Presentation

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# Overview

## Grades

Problem Sets	40%
Exam 1	20%
Exam 2	20%
Final Project	20%

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# Overview

## Website

`http://www.fas.harvard.edu/~csciel/`

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# Overview

## Staff

`csciel@fas.harvard.edu`

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# Overview

## Listserv

`csciel@lists.dce.harvard.edu`

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# Overview

## Staff's Picks



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# Overview

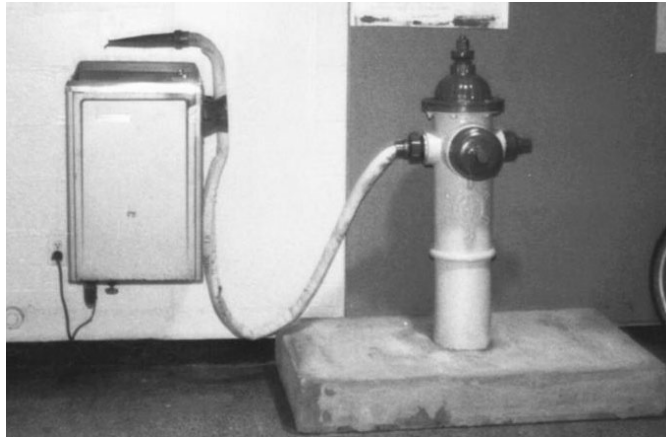
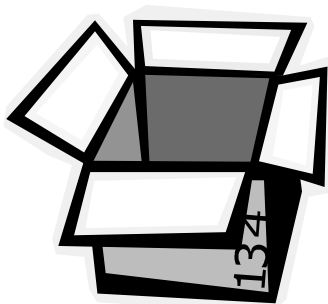


Image from [http://hacks.mit.edu/Hacks/by\\_year/1991/fire\\_hydrant/](http://hacks.mit.edu/Hacks/by_year/1991/fire_hydrant/).

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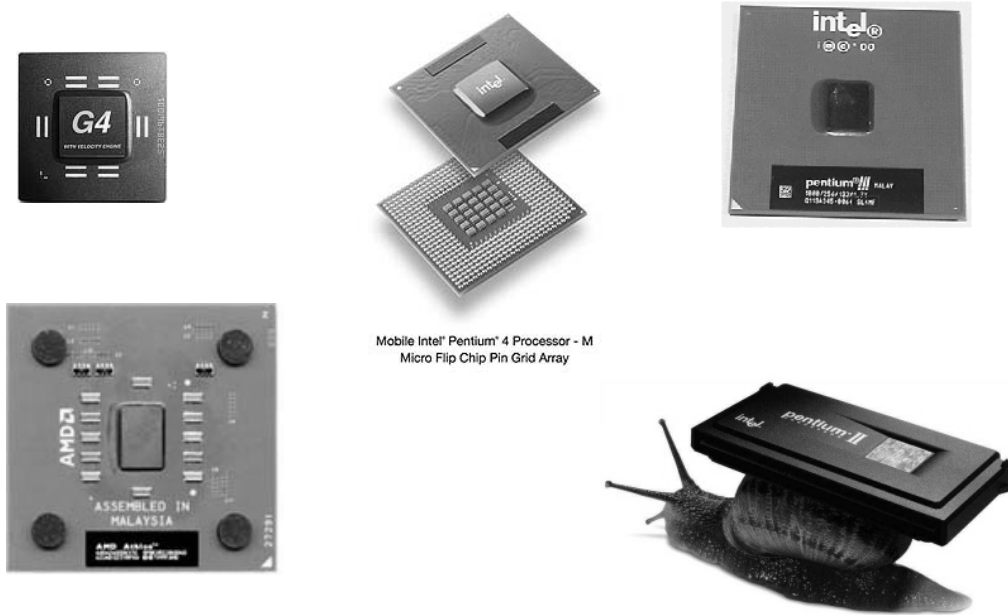
# Overview

## The Not-Dumb Question Box



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# CPUs



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# Motherboards

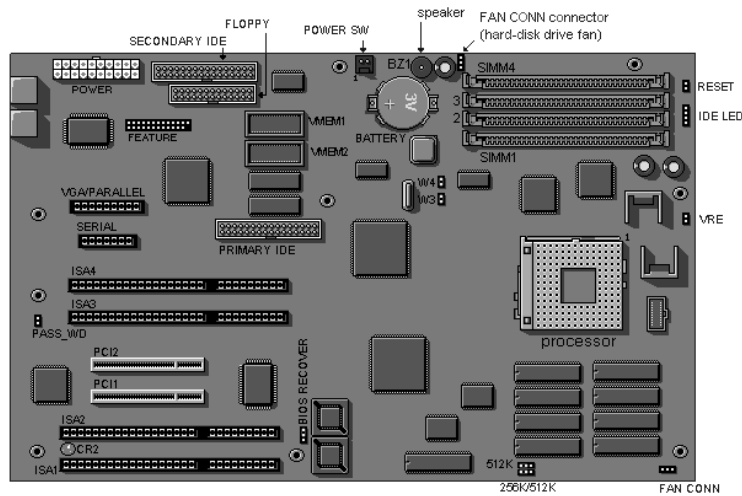


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# Motherboards

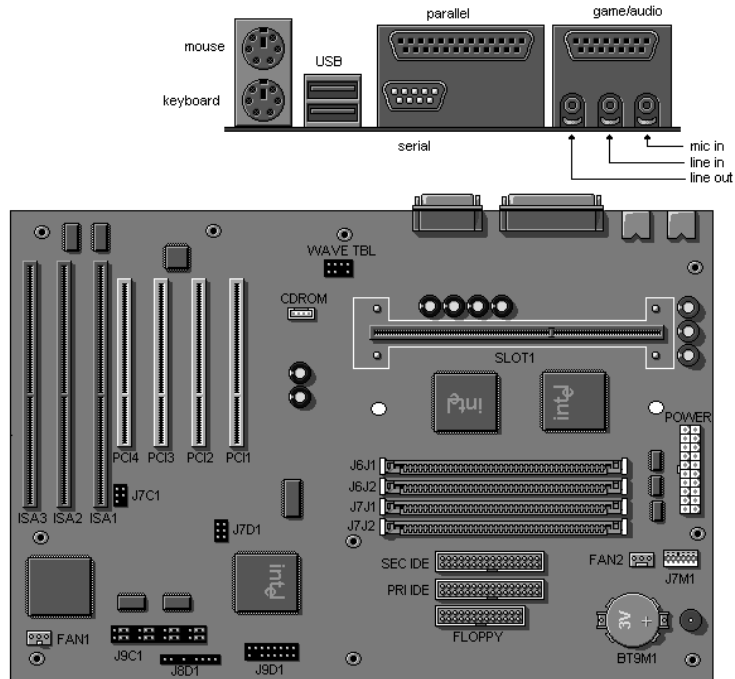


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# Memory

## ROM



Image from [http://www.kontron.com/support/bios\\_id.cfm](http://www.kontron.com/support/bios_id.cfm), copyright © Kontron.com.

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# Memory

## ROM

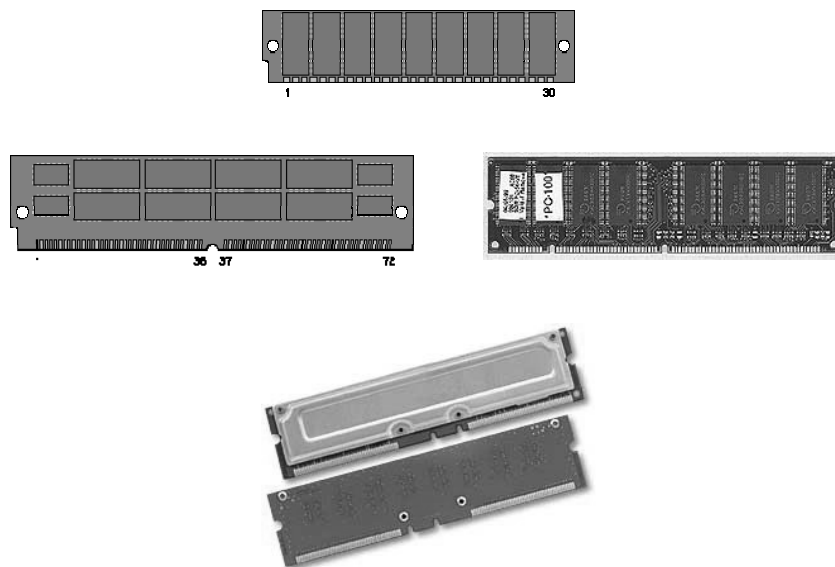


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# Memory

## RAM



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# Memory

## Level-1 and Level-2 Cache

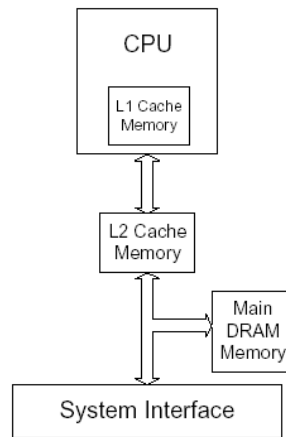


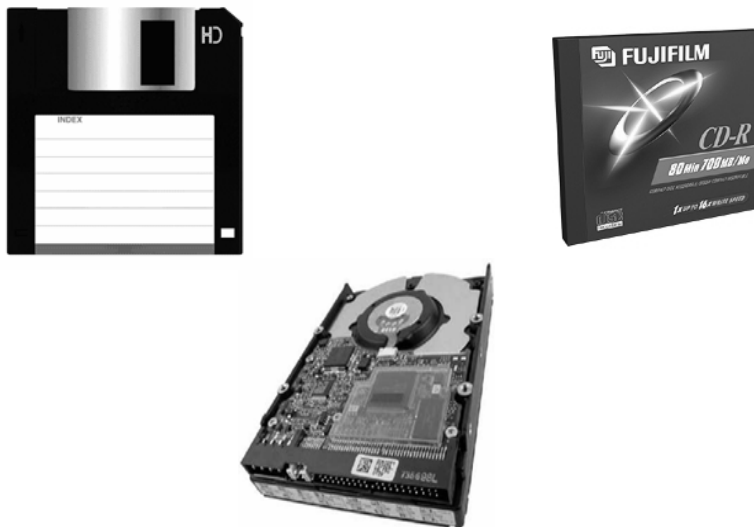
Figure 3-1 Pentium® Processor with L2 cache

Image from <http://www.intel.com/design/intarch/papers/cache6.pdf>, copyright © Intel Corporation.

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# Memory

## Secondary Storage



Images from <http://www.cts.com/crash/yin/images/>;  
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and [http://www.kids-online.net/learn/clickjr/details/3\\_5db.html](http://www.kids-online.net/learn/clickjr/details/3_5db.html).

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# Memory

## Virtual Memory

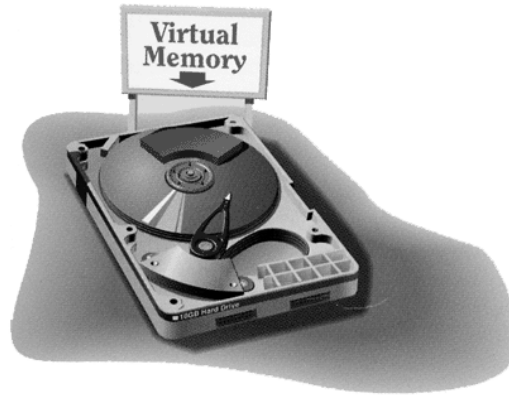


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## Understanding Computers and the Internet

### Lecture 1: Hardware

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