

CS1100 – Introduction to Programming

- Programming your "friend".
- Brief history of computing and computers (slides)

} Lecture 1

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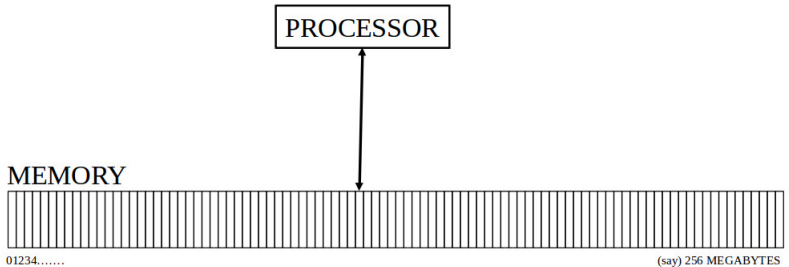
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Lecture 1

- Representation of Numbers.
- Programs reside in memory !.
- Compilation/Execution of Programs.
- Introduction to C-programming.

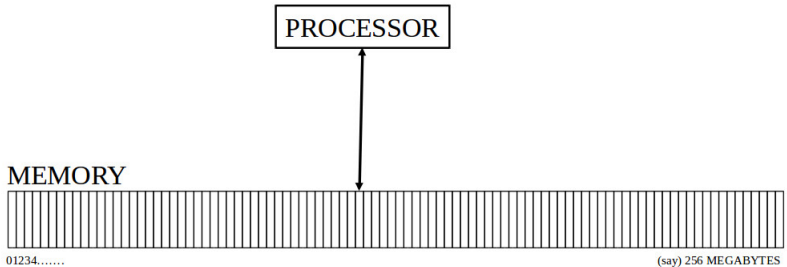
Lectures 2
and 3

The Computing Machine



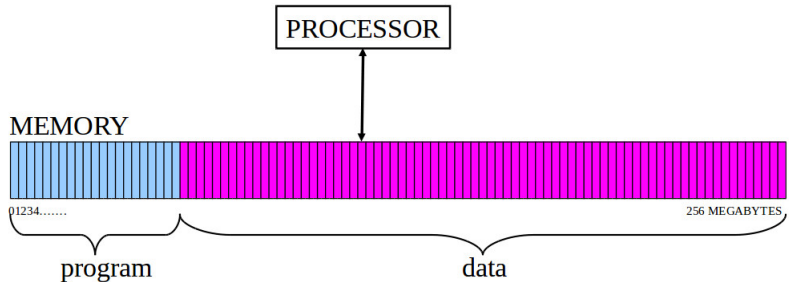
- The computer is made up of a processor and a memory.

The Computing Machine



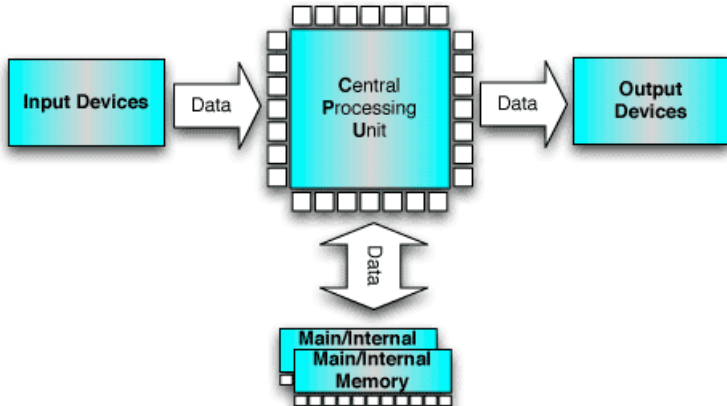
- The computer is made up of a processor and a memory.
- The memory can be thought of as a series of locations to store information.

The Computing Machine



- A program is a sequence of instructions assembled for some given task.
- Most instructions operate on data.
- Some instructions control the flow of the operations.

The Computing Machine : von Neuman Architecture



How does the computer represent data?

- To store : Numbers, text, graphics and images, video, audio, program instructions.

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- In some way, all information is digitized - broken down into pieces and represented as numbers.
- Example : Representing Text Digitally.
 - Every character is stored as a number, including spaces, digits, and punctuation.
 - Corresponding upper and lower case letters are separate characters.



The ASCII table

American Standard Code for Information Interchange (ASCII).

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

But, how does number get stored?

Number Systems.

- Decimal (base 10 - uses 10 symbols $\{0 \dots 9\}$. Eg : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

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Eg : 0, 1, ..., 9, A, B, C, D, E, F, 10, 11, ... 19, 1A, 1B, ...

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Quick Primer on Number System : Base n

Take every "digit" and multiply by increasing powers of n and add.

$$\begin{array}{ccc} & 329 & \\ / & | & \backslash \\ 10^2 & 10^1 & 10^0 \end{array}$$

$$3 \times 100 + 2 \times 10 + 9 \times 1 = 329$$

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$$\begin{array}{ccc} \text{most} & & \text{least} \\ \text{significant} & & \text{significant} \\ & 101 & \\ / & | & \backslash \\ 2^2 & 2^1 & 2^0 \end{array}$$

$$1 \times 4 + 0 \times 2 + 1 \times 1 = 5$$

Converting from Decimal to Binary

Convert the decimal number 39 to binary (base 2).

2		39	
2		19	+ Remainder 1
2		9	+ Remainder 1
2		4	+ Remainder 1
2		2	+ Remainder 0
2		1	+ Remainder 0
		0	+ Remainder 1

$$\begin{aligned} 39 &= 2 * 19 + 1 \\ &= 2 * (2 * 9 + 1) + 1 \\ &= 2^2 * 9 + 2^1 * 1 + 1 \\ &= 2^2 * (2 * 4 + 1) + 2^1 * 1 + 1 \\ &= 2^3 * 4 + 2^2 * 1 + 2^1 * 1 + 1 \\ &= 2^3 * (2 * 2 + 0) + 2^2 * 1 + 2^1 * 1 + 1 \\ &= 2^4 * 2 + 2^3 * 0 + 2^2 * 1 + 2^1 * 1 + 1 \\ &= 2^4 * (2 * 1 + 0) + \dots \\ &= 2^5 * 1 + 2^4 * 0 + 2^3 * 0 + 2^2 * 1 + 2^1 * 1 + 1 \end{aligned}$$

$$\begin{aligned} (100111)_2 &= (1 \times 2^0) + (1 \times 2^1) + (1 \times 2^2) + (0 \times 2^3) + (0 \times 2^4) + (1 \times 2^5) \\ &= (39)_{10} \end{aligned}$$

Which Number System? Binary !

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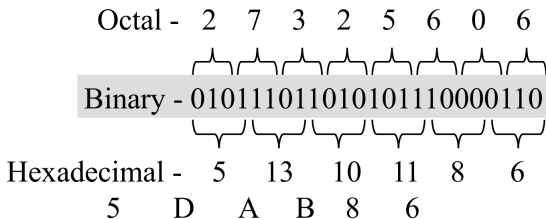
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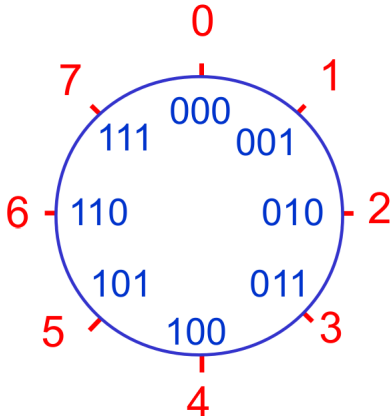


Representing values in Binary

If we have m bits, we can represent 2^m unique different values.

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A useful circle :



Representing negative numbers

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0 1 0	+2
0 1 1	+3
1 0 0	0
1 0 1	-1
1 1 0	-2
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- using n bits: $-(2^{n-1} - 1) \dots (2^{n-1} - 1)$.
- zero has two representations.

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Ones complement notation

- for a negative number n , represent the number by the bit complement of its binary rep. using k bits.

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- using n bits: $-(2^{n-1} - 1) \dots (2^{n-1} - 1)$.
- zero has two representations.
- not very widely used representation.