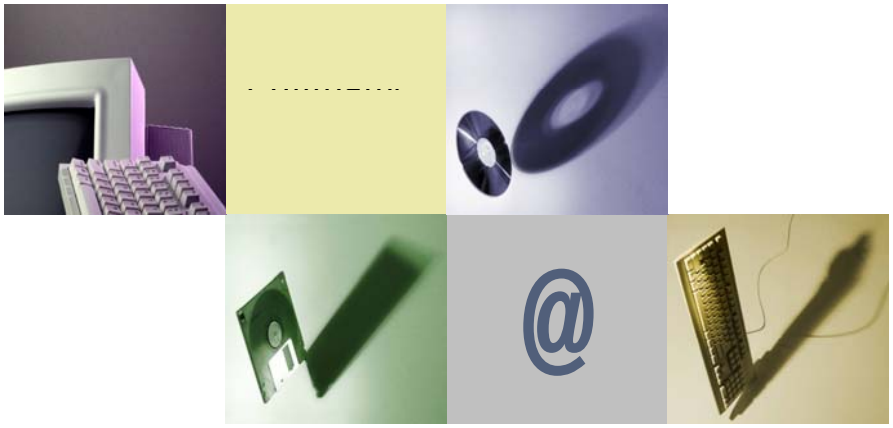
Computer Software



Digital Computer Concept and Practice

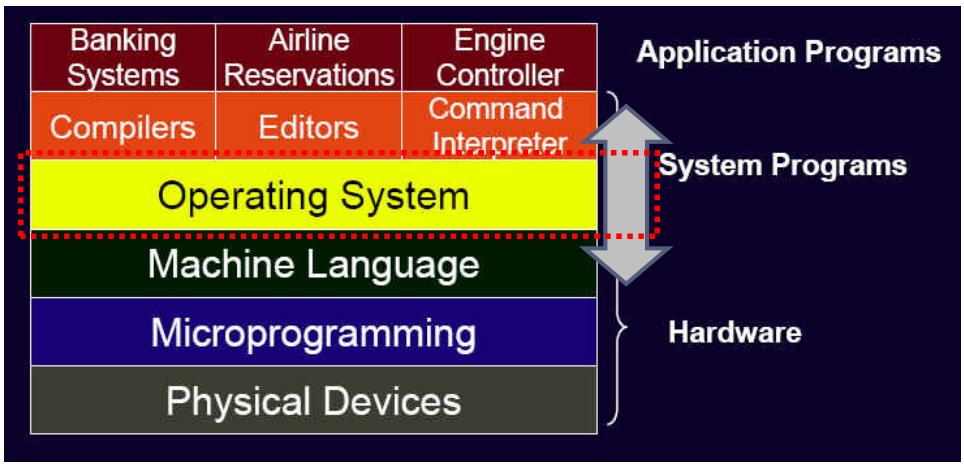
Contents

- Operating System (OS)
  - What is OS?
  - OS Types
  - Commercial OS
- Internal Representation of Data and Instructions

Computer Software

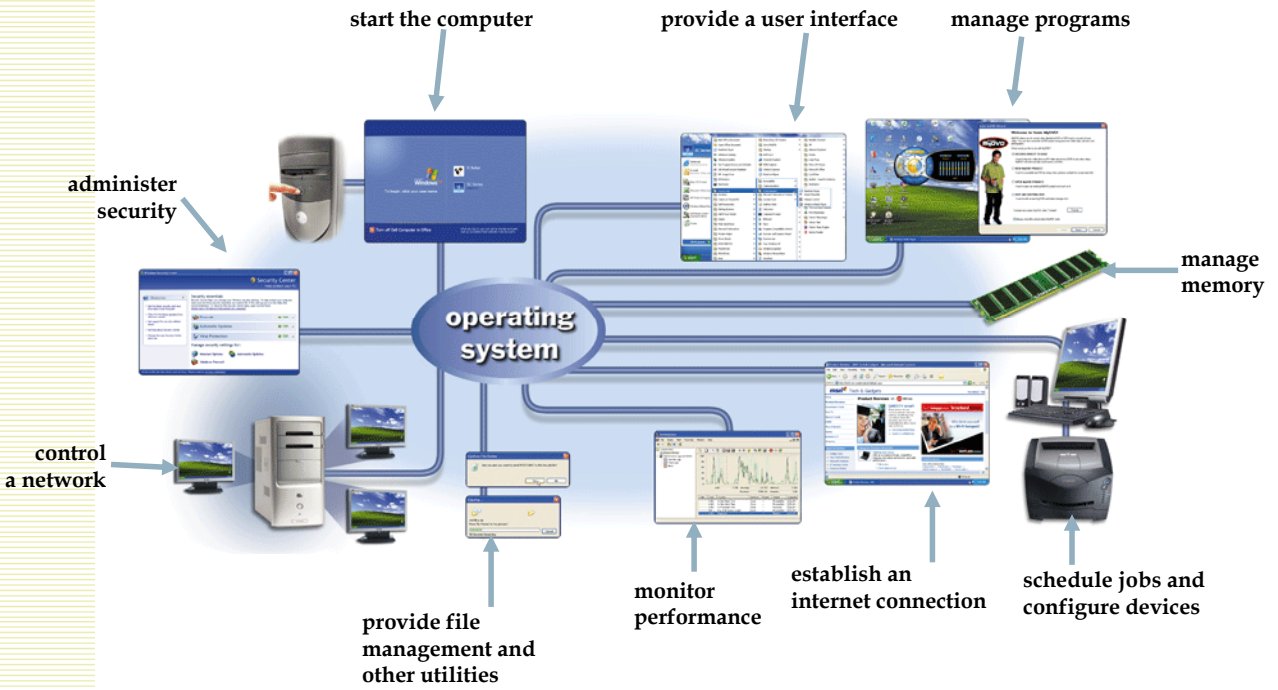
- System software: manages and controls computer hardware so that application software can perform a task
  - Operating systems
  - Device drivers
  - Programming tools, etc.
- Application software
  - Word processors: used to create and print documents.
  - Spreadsheets: allow users to perform various calculations on rows and columns of numbers.
  - Graphics, etc.

Operating System (OS)



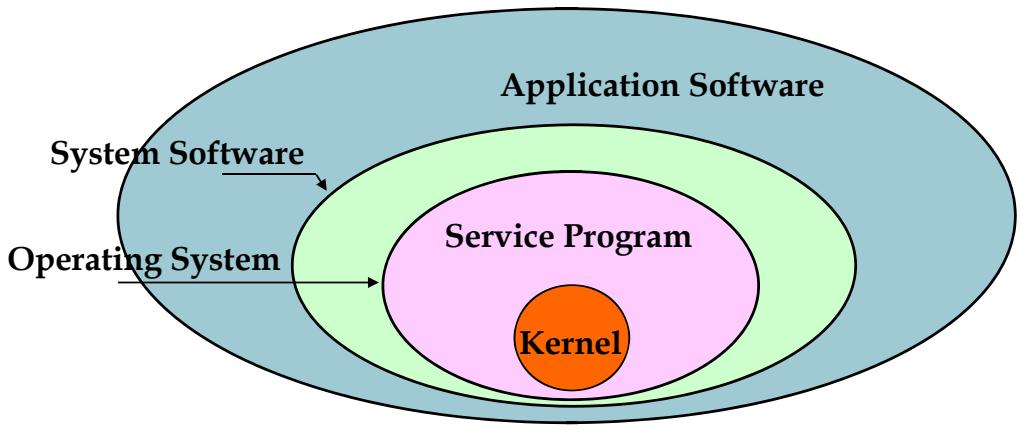
- Goals
  - Execute user programs
  - Use the computer hardware in an efficient manner
  - Make the computer system convenient to use

OS Tasks



OS Architecture

- OS = Kernel + Service Programs



Operating System Architecture

- Kernel
  - Core component (OS of a narrow sense)
  - When an OS boots, a kernel loads first and remains in main memory.
  - Provides all the essential services
    - CPU scheduling, managing system resources, I/O functions, etc.
- Service programs
  - Provide convenience services
    - Notepad, calculator, disk defragmenter, etc.

Types of Operating Systems

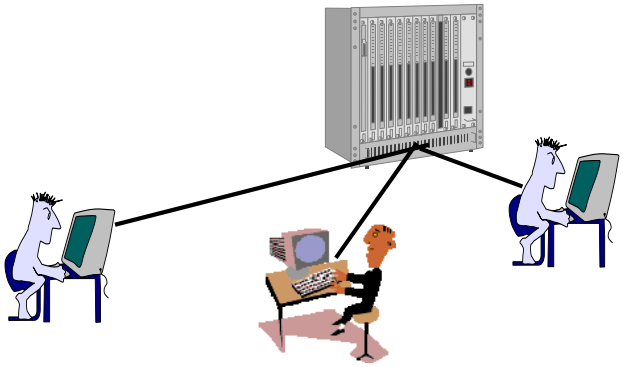
- **Job Processes ➔ Single Tasking, Multitasking**
- **Users ➔ Single User, Multi-user**
- **System Processes ➔ Batch Processing, Time-Sharing**

Job Processes

- Single tasking
  - One task at one time
  - MS-DOS (Microsoft Disk Operating System)
    - Developed in early 1980s for personal computers
    - Used command-line interface when first developed
    - Hardly used today because it does not offer GUI
- Multitasking
  - More than one task at one time
  - Allows more than one program to run concurrently
    - Foreground contains a program you are using
    - Background contains programs that are running but are not in use

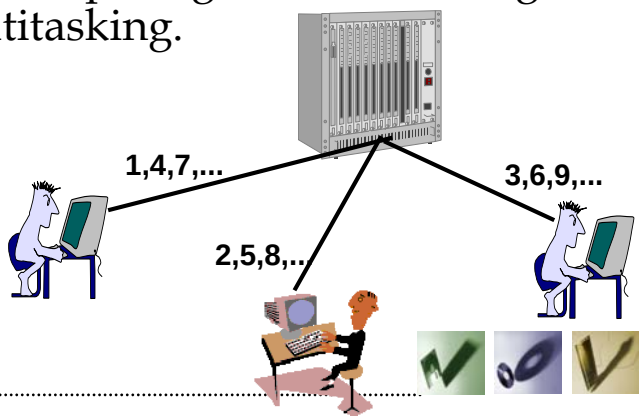
User

- Single user
  - MS-DOS, Windows 95
- Multi-user
  - Allows two or more users to run programs at one time
  - UNIX (LINUX), Windows XP, Windows Vista



System Processes

- Batch processing (early OS)
  - Processing of several jobs by a computer, one after the other
  - Programs are grouped, and processed at a later time
- Time-sharing
  - Refers to sharing a computing resource among many users by multitasking.
  - Faster responses
  - UNIX



Examples of Operating System

- **MS Windows**
- **UNIX (LINUX)**
- **Mac OS**

MS Windows

- MS Windows versions
  - Windows 3.x
    - Not OS
    - Offering multitasking and GUI
  - Windows 95
    - Plug and Play
    - OLE (Object Linking and Embedding)

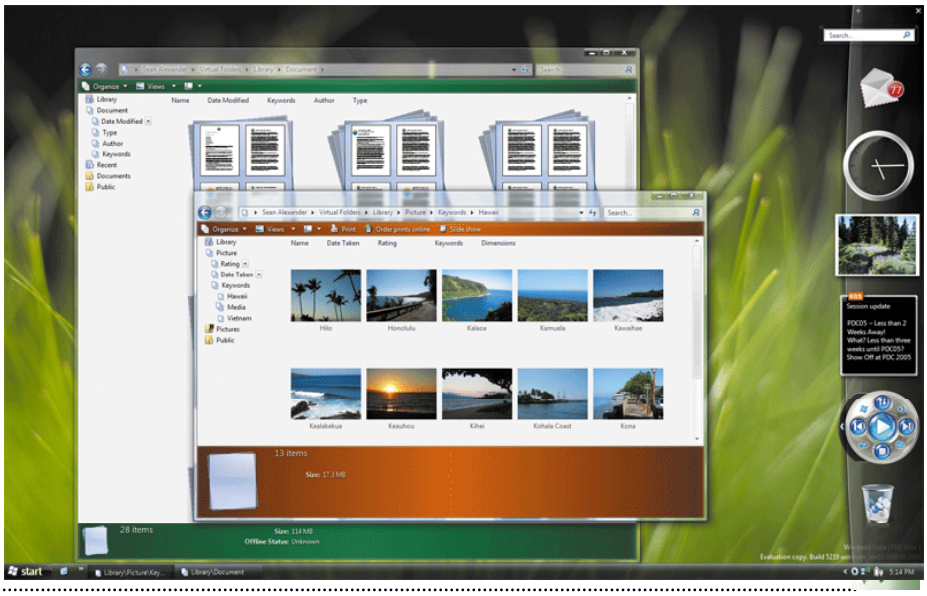
Windows Version	Year Released
Windows 3.x	1990
Windows NT 3.1	1993
Windows 95	1995
Windows NT Workstation 4.0	1996
Windows 98	1998
Windows Millennium Edition	2000
Windows 2000 Professional	2000
Windows XP	2001
Windows XP SP2	2004
Windows Vista	2006

MS Windows

- Windows XP
  - Fast, reliable(?) Windows operating system
  - Available in five editions: Home Edition, Professional Edition, Tablet PC Edition, Media Center Edition, and 64-bit Edition

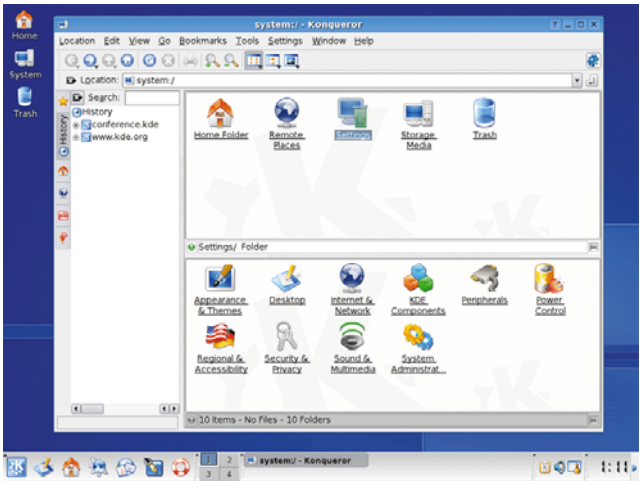
MS Windows

- Windows Vista
  - Successor to Windows XP, containing a new interface and new/enhanced features



UNIX

- UNIX (1969, Bell Lab.)
  - Portability, small size kernel, and open source codes (by C language)
  - Currently offers GUI
  - Many versions
    - System V
    - SunOS
    - Solaris
    - Linux (for PC)



Mac OS

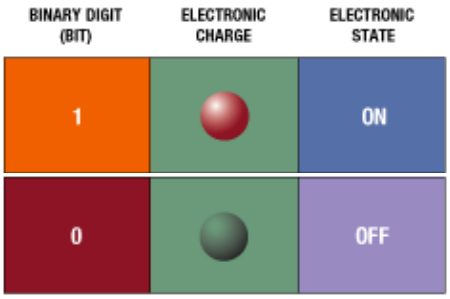
- Mac OS X
  - Available only for Apple computers
  - GUI environments

Storage Unit (Memory)

	Address	Storage values
	…	
Program	16	Store 3 in the variable X
	20	Store 1 in the variable Y
	24	Store X + Y in the variable Z
	…	
Data	32	X : 3
	36	Y : 1
	40	Z : 4

Data Representation

- How do computers represent data?
  - Digital
    - Recognize only two electronic states: on or off
    - Use a binary number system to recognize two states
      - 0 and 1, called bits (short for binary digits)
      - Word: data processing unit in the computer



Data Representation

- Byte
  - Eight bits grouped together as a unit
  - Provides enough different combinations of 0s and 1s to represent 256 individual characters
    - 8 bits = 1 byte → 2^8=256 information
  - Numbers, uppercase and lowercase letters, punctuation marks etc.

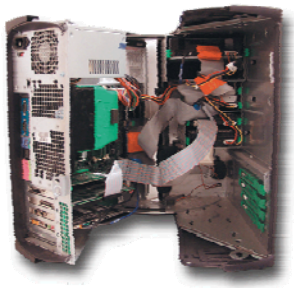
Data Representation

- Types of coding systems to represent data
  - ASCII – American Standard Code for Information Interchange
    - It provides for 256 characters
      - E.g.) 01000001 – A, 01000010 – B
  - EBCDIC – Extended Binary Coded Decimal Interchange Code
  - Unicode – coding scheme capable of representing all world's languages
    - UTF (Unicode Transformation Format) encodings
    - UCS (Universal Character Set) encodings

Data Representation Process

- How is a letter converted to a binary form and back?

Step 1.
The user presses the capital letter T on the keyboard.



Step 2.
An electronic signal for the capital letter T is sent to the system unit.

Step 3.
The signal for the capital letter T is converted to its ASCII binary code (01010100) and is stored in memory for processing.

Step 4.
After processing, the binary code for the capital letter T is converted to an image, and displayed on the output device.

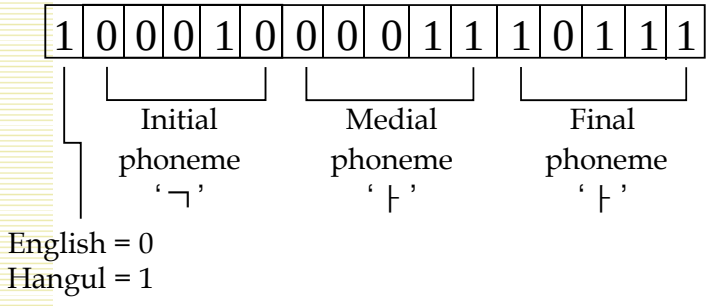
ASCII Table

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	&#127;	DEL

Source: www.LookupTables.com

Hangul Character Representation

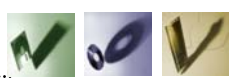
- Combination code (조합형)
  - The beginning consonant, a middle vowel and an optional ending consonant are represented by each 5 bit.



- Completion code (완성형)
  - A pre-defined set of Korean character codes, which maps pre-selected Hangul into two-byte coding space

Number (Hexadecimal)	Character
B0A1	가
B0A2	각
B0A3	간
…	…

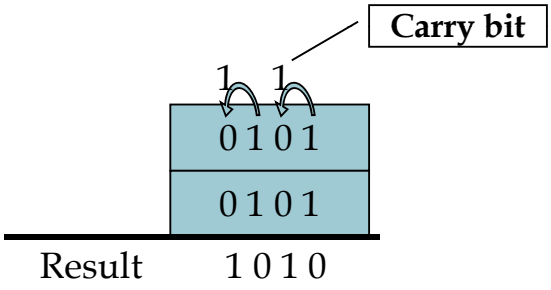
- Currently, Unicode is the standard



Number Representation

- The rules for binary arithmetic are:

0 + 0 = 0, carry = 0
1 + 0 = 1, carry = 0
0 + 1 = 1, carry = 0
1 + 1 = 0, carry = 1

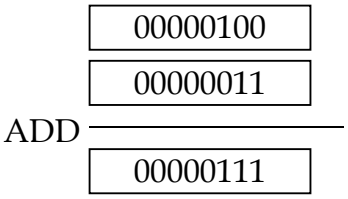


Binary Arithmetic Example

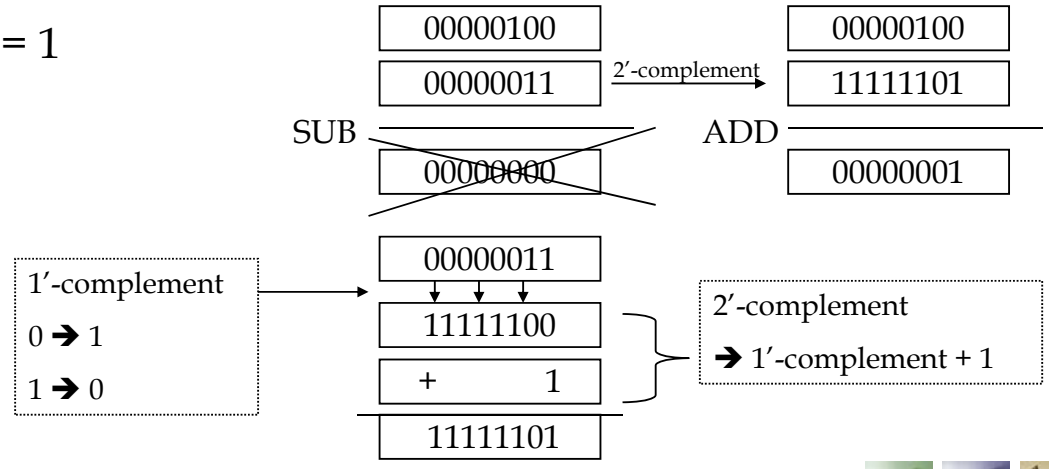
		00001000				00101011	
+		00000111		+		00000001	
	0	00001111			0	00101100	
		00001000				11000100	
+		11111111		+		01000001	
	1	00000111			1	00000101	

Handling Integers

- 4 + 3 = 7



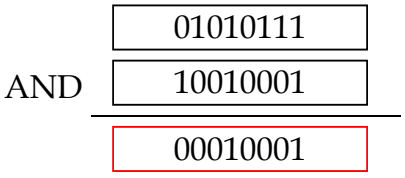
- 4 – 3 = 1



Logical Operation

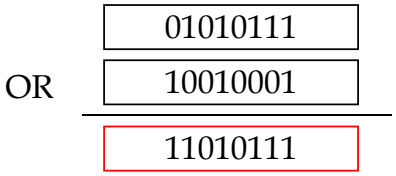
- AND

Input 1	input2	result
0	0	0
0	1	0
1	0	0
1	1	1



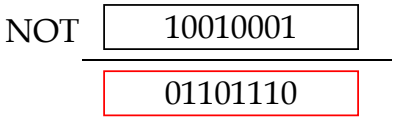
- OR

input1	input2	result
0	0	0
0	1	1
1	0	1
1	1	1



- NOT

input	result
0	1
1	0



- XOR

Instruction Representation

- Instructions are coded as a sequence of binary digits.
- Instruction: operation code + address
- e.g.) A1 ← A2 + A3
  - Load A2, 3: (hexadecimal) **05** 02 00 03
  - Load A3, 1: **05** 03 00 01
  - ADD A1, A2, A3: **70** 01 02 03