

Introduction to Computer Organization



MM PG College Fatehabad

Class BA 1st Year

What is a System?

- According to dictionary.com:

A group of interacting, interrelated, or interdependent elements forming a complex whole.

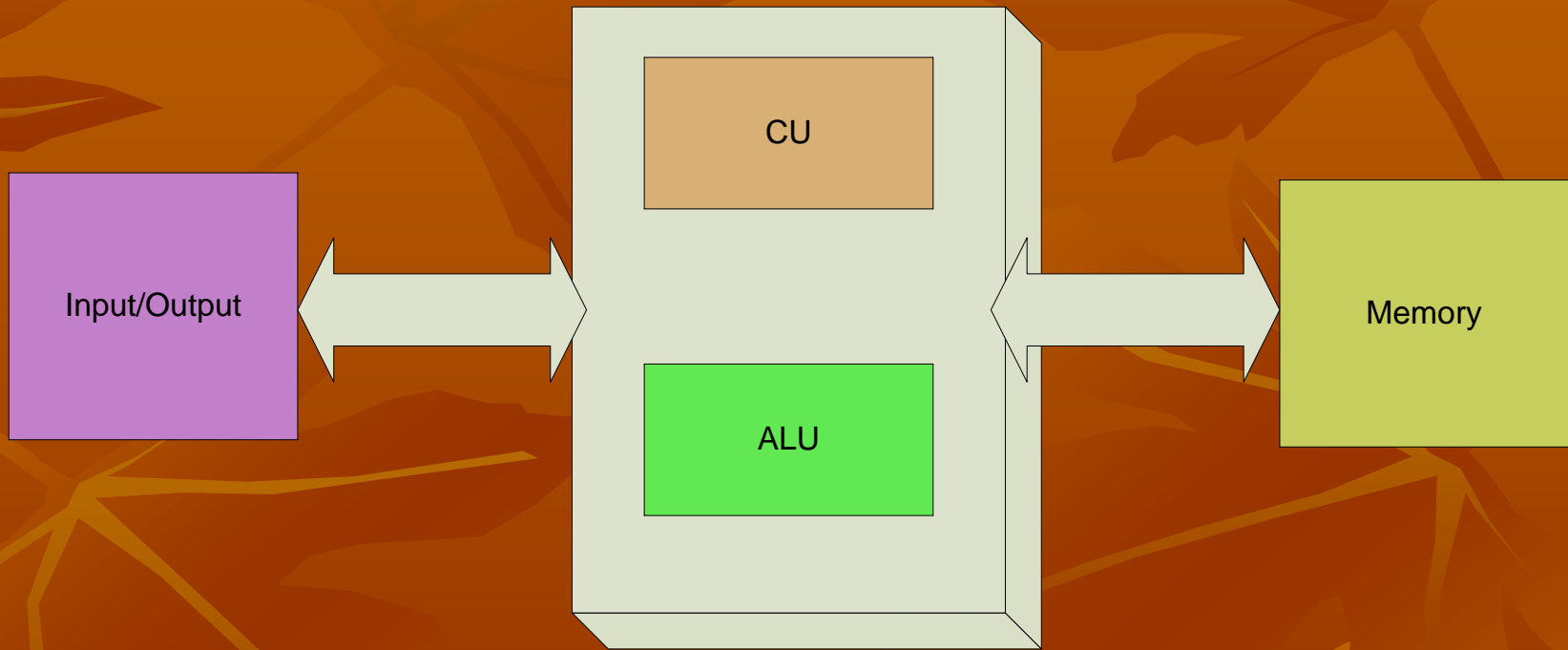
"system." *The American Heritage® Dictionary of the English Language, Fourth Edition.* Houghton Mifflin Company, 2004. 07 Nov. 2006. <Dictionary.com

<http://dictionary.reference.com/browse/system>>

Computer Systems

- A computer system is a particular type of system that its primary purpose is that of performing computations. Before the time of the electronic computers, a computer was a person that performed computations.
- A computer system is composed of a Central Processing Unit (Control Unit and Arithmetic & Logic Unit), Memory and Input/Output subsystems.

Computer System Overview



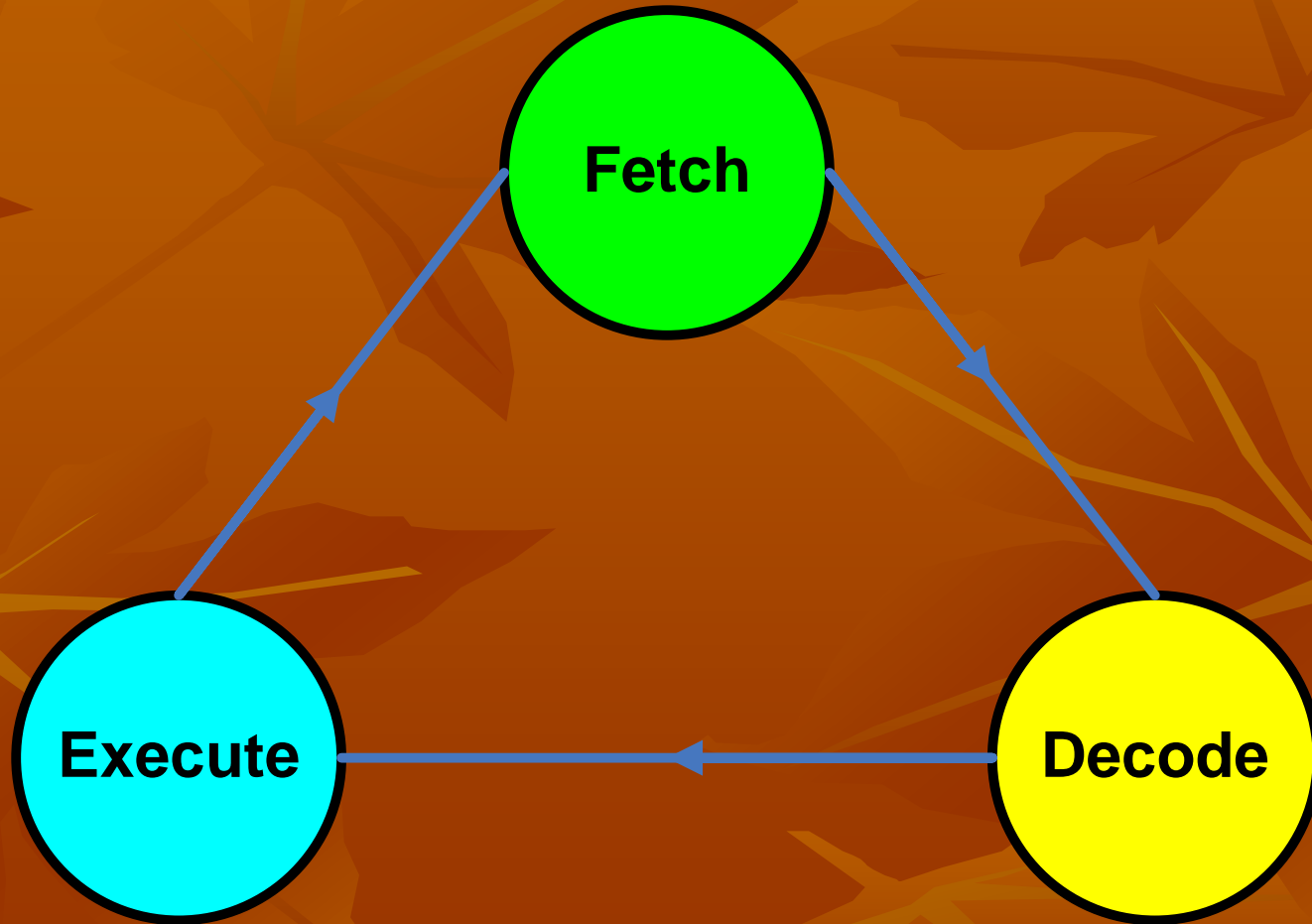
Central Processing Unit (CPU)

- The Central Processing Unit is composed of a Control Unit and an Arithmetic & Logic Unit.
- The Control Unit *controls* the different components of the system and it is responsible for fetching, decoding and executing the instructions of a program.
- The Arithmetic & Logic Unit is performs arithmetic and logical operations such as addition, division, comparison, etc.

Control Unit (CU)

- The Control Unit is the part of the CPU that fetches (reads) instructions from memory.
- Each instruction is decoded to determine what exactly it is supposed to do.
- Once decoded, each instruction is executed.
- The cycle continues until the system is powered down.

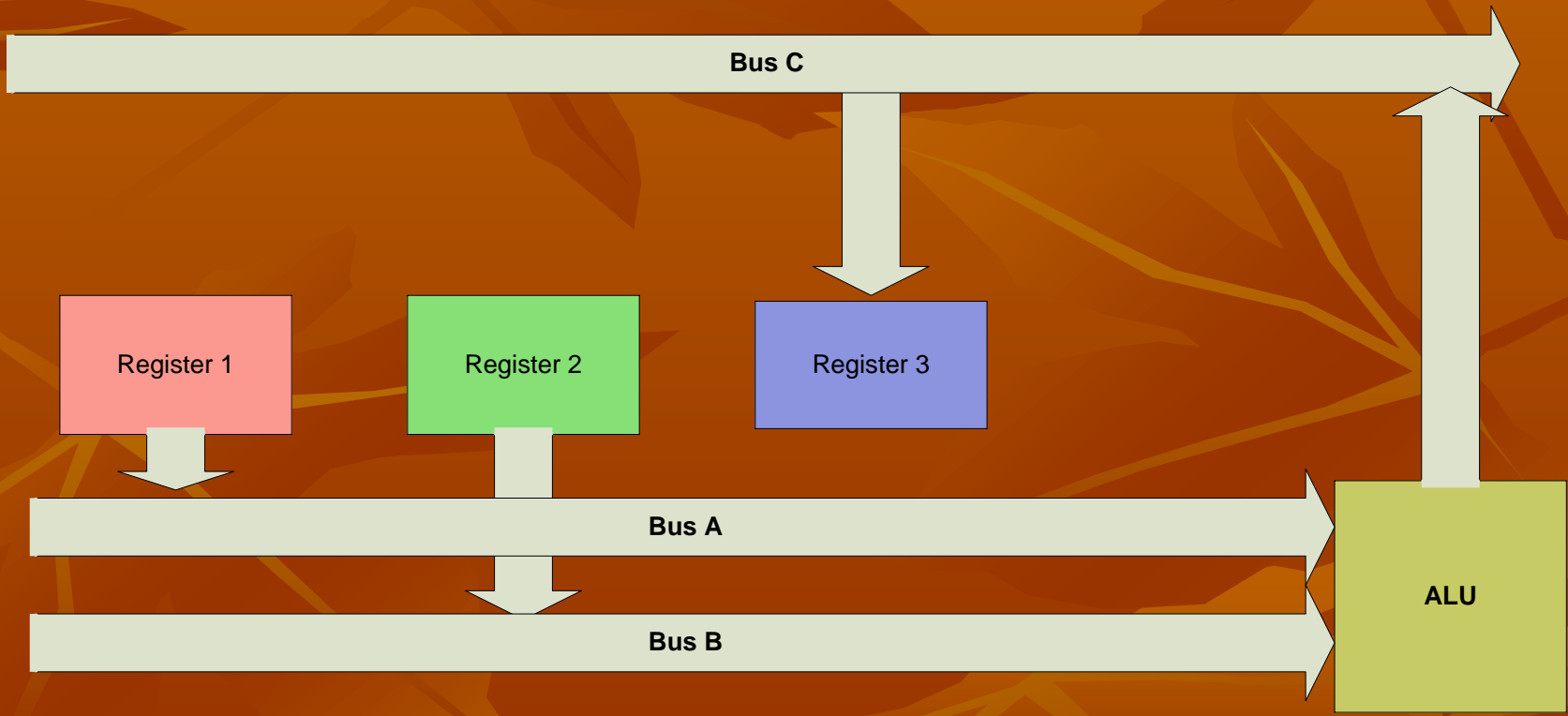
Fetch, Decode, and Execute Cycle



Arithmetic & Logic Unit (ALU)

- The Arithmetic & Logic Unit (ALU) performs the arithmetic operations as well as the logical operations.
- The arithmetic operations include addition, subtraction, multiplication and division.
- The logical operations are commonly used to compare values and determine whether they are greater, lesser or equal to one another.
- These operations are normally carried out with registers that are part of the CPU.

ALU and Registers



Storage (Memory)

- The Storage subsystem is a unit that is capable of retrieving and saving instructions as well as data.
- There are two main types of storage: Primary Storage and Secondary Storage.
- Primary Storage is the memory that is immediately available to the CPU and it is normally fast (RAM or Random Access Memory).
- Secondary Storage is indirectly available to the CPU and it is typically slower. (Hard disks, tapes, etc.)

Input/Output (I/O)

- The I/O subsystem is critical since it is the one responsible for receiving and sending data to the outside world. The computer would be useless to us without this system.
- There are many devices that can be used for input and/or output. Typical input devices are keyboards, mice, and graphics tablets. Typical output devices are screens and force-feedback joysticks.

Number Systems

- Everything that the computer handles is stored in the form of numbers. The numbers are meaningless by themselves and we need to associate significance so that they can be useful.
- We associate symbols with the concept of a number and, for example, the number three is represented with the symbol 3. The symbol is not the number three but a placeholder for its concept.

Decimal Number System

- We use the decimal number system in our daily lives. It is called the decimal system because it uses 10 distinct symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.
- We can represent any number by combining these symbols. The number three million seven hundred forty eight thousand and three hundred twenty one can be represented with 3748321.

Decimal Numbers in Computers

- If we want a computer to use the decimal number system we need to have devices capable of storing, retrieving and manipulating ten values or primitive symbols.
- Although possible, this system would be subject to error and deterioration and would imply a short lifetime.

Binary Number System

- What is the simplest number system we could use?
- We could use the unary number system but it does not lend itself to simple and speedy manipulation in terms of arithmetic and other operations.
- We use the Binary Number System inside the computers. This system only has two symbols, 0 and 1.

Binary Number System in Computers

- Besides the physical (electronics) reasons for using binary there are also mathematical advantages.
- Boolean Algebra is an area of mathematics that studies the properties of the binary system. It provides us with an excellent foundation not only to design the electronic parts of a computer but also to develop algorithms to expedite computations.

Examples of Binary Numbers and Some Operations

- $34_{10} = 100010_2$
- $3_{10} = 11_2$
- $3748321_{10} = 1110010011000111100001_2$
- $23_{10} + 74_{10} = 97_{10}$
- $10111_2 + 1001010_2 = 1100001_2$
- $7480_{10} / 10_{10} = 748_{10}$
- $1000010110_2 / 10_2 = 100001011_2$

Coding Information

- We usually assign meaning to different symbols. As long as we agree on what symbol has what meaning we are able to communicate with each other using those symbols.
- We can use 0 and 1 in place of *no* and *yes*. They could also mean *closed* and *open*, *agree* and *disagree*, *bad* and *good*.

Coding Text

- One of the very useful coding schemes we used with computers is the coding of text characters.
- The ASCII code is widely used throughout the computing world. Every character has a binary code and we can represent text by using binary numbers and interpreting them as characters.
- ASCII is a subset of UNICODE which is used to encode international symbols.

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		DEL

Text, Images and Sound

- In the same way that we code text we can code virtually anything.
- An image is basically a rectangle of dots and each dot is of a certain color. The color of these dots can be represented by a number.
- Sound may be represented as a sequence of numbers indicating how to move a speaker.