

Programming for Engineers

Lecture 1A: Introduction to Computers and C Programming

Course ID: EE057IU

Lecture Outline

- Introduction to Computers
- Introduction to C Programming Language
- Setting up Development Environment
- Algorithm: Basic Syntax and Semantics

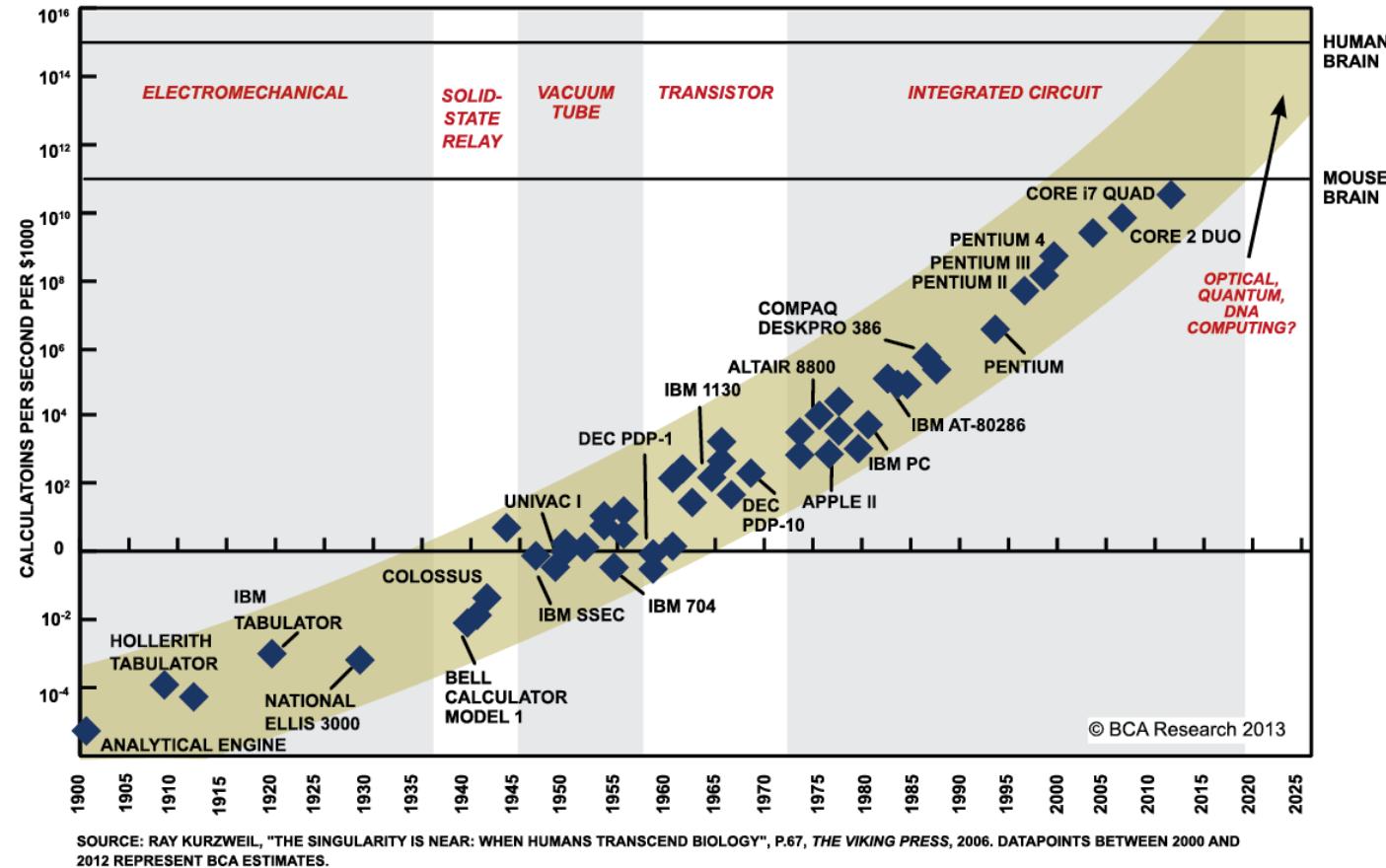
Computers: Hardware & Software

- In use today:
 - **Computers and smartphones:** perform billions of calculations in one sec
 - **Supercomputers:** Frontier (USA, Aug 2022)
Aurora (USA, Jun 2023)
Eagle (USA, Aug 2023)
Fugaku (Japan, Jun 2020)
 - **Graphic Processing Unit (GPU)** Nvidia H100, Nvidia H200 (Hopper 2024)
Nvidia B100, Nvidia B200 (Blackwell 2025)
Intel Gaudi 3
AMD MI300X
 - **Quantum Computer**

Computers: Terminology

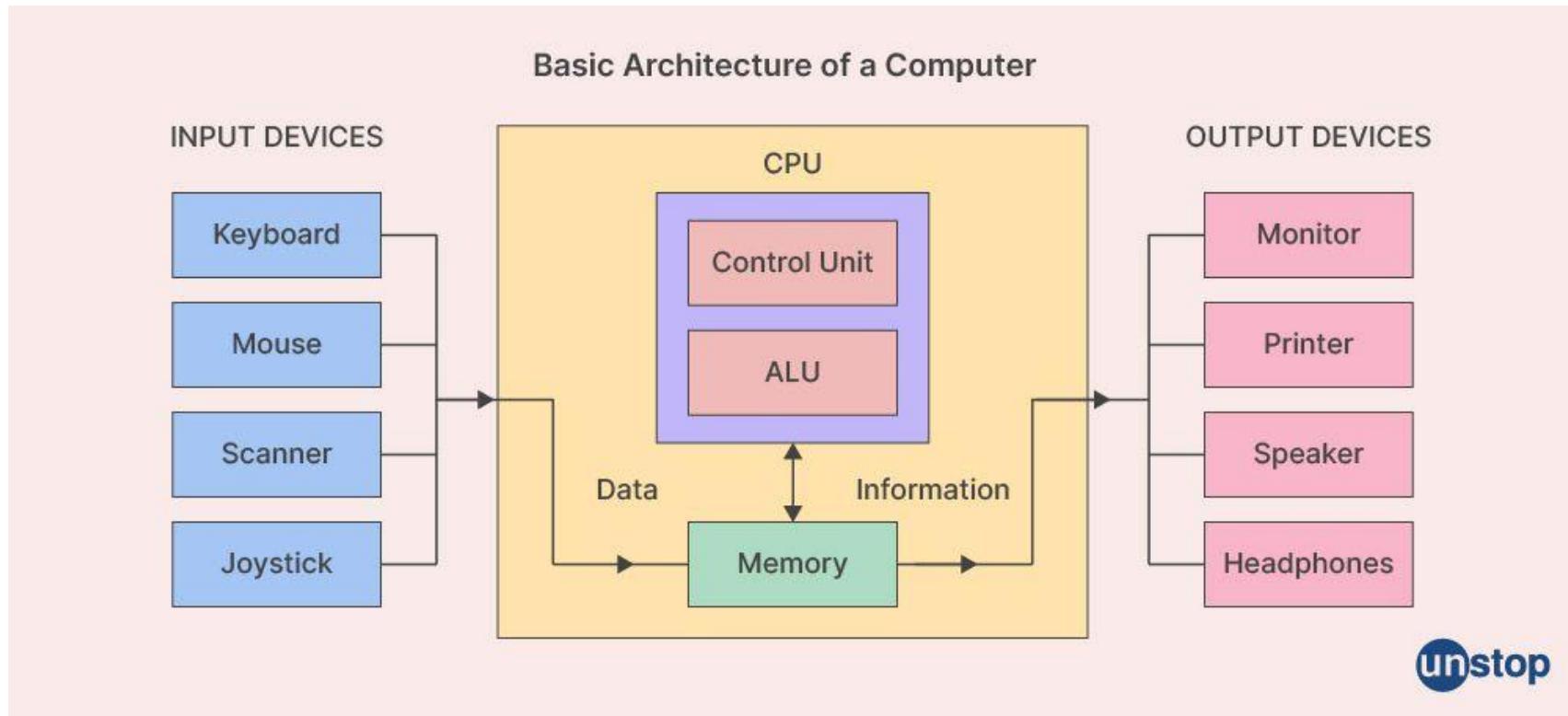
- Computers process data under the control of sequences of instructions called **computer programs**
- A computer consists of various **physical devices** referred to as hardware
- These programs guide the computer through ordered actions specified by people called computer **programmers**.
- The programs that run on a computer are referred to as **software**

Moore's Law



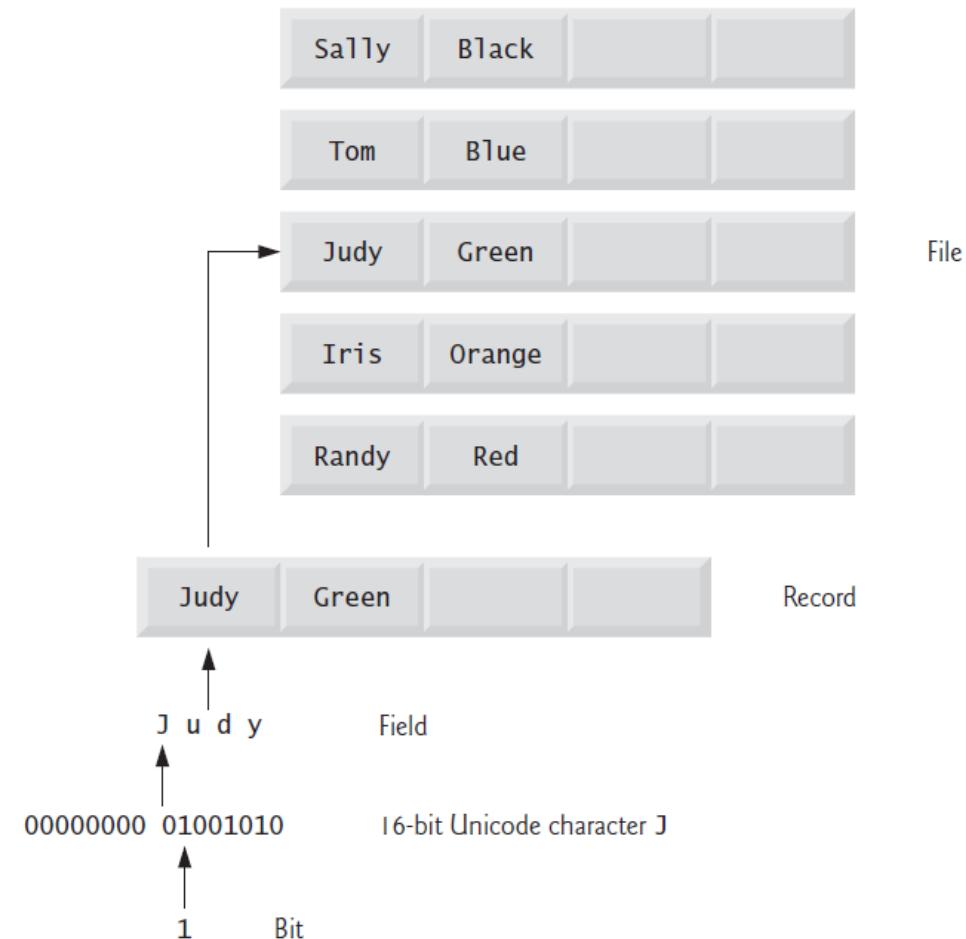
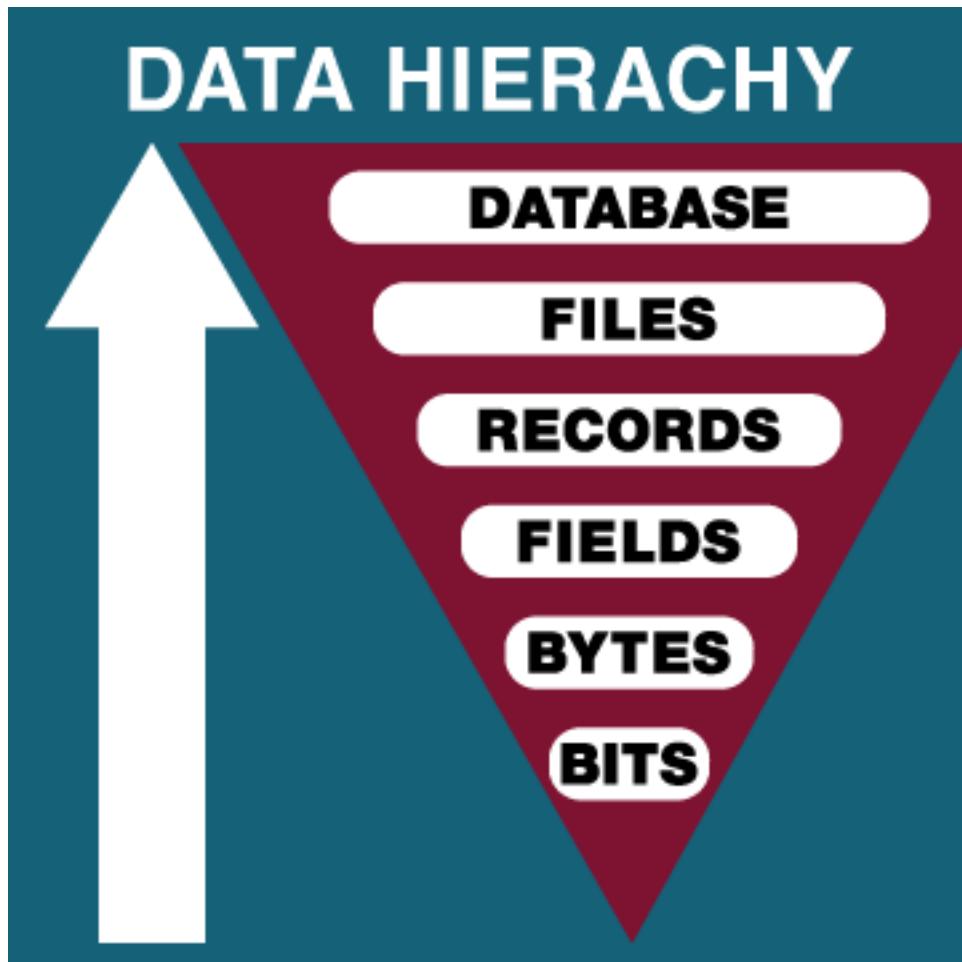
Definition: number of transistors in an integrated (IC) doubles every two years

Computer Organization



- Input Unit
- Output Unit
- Memory Unit
- Arithmetic and Logic Unit (ALU)
- Central Processing Unit(CPU)
- Secondary Storage Unit

Data Hierarchy



Data Hierarchy: Example

- American Standard Code for Information Interchange (ASCII)

Dec	Hex	Oct	Chr	Dec	Hex	Oct	HTML	Chr	Dec	Hex	Oct	HTML	Chr	Dec	Hex	Oct	HTML	Chr
0 0	000	NULL		32 20	040	 	Space	64 40	100	@	@	96 60	140	`	'			
1 1	001	Start of Header		33 21	041	!	!	65 41	101	A	A	97 61	141	a	a			
2 2	002	Start of Text		34 22	042	"	"	66 42	102	B	B	98 62	142	b	b			
3 3	003	End of Text		35 23	043	#	#	67 43	103	C	C	99 63	143	c	c			
4 4	004	End of Transmission		36 24	044	$	\$	68 44	104	D	D	100 64	144	d	d			
5 5	005	Enquiry		37 25	045	%	%	69 45	105	E	E	101 65	145	e	e			
6 6	006	Acknowledgment		38 26	046	&	&	70 46	106	F	F	102 66	146	f	f			
7 7	007	Bell		39 27	047	'	'	71 47	107	G	G	103 67	147	g	g			
8 8	010	Backspace		40 28	050	((72 48	110	H	H	104 68	150	h	h			
9 9	011	Horizontal Tab		41 29	051))	73 49	111	I	I	105 69	151	i	i			
10 A	012	Line feed		42 2A	052	*	*	74 4A	112	J	J	106 6A	152	j	j			
11 B	013	Vertical Tab		43 2B	053	+	+	75 4B	113	K	K	107 6B	153	k	k			
12 C	014	Form feed		44 2C	054	,	,	76 4C	114	L	L	108 6C	154	l	l			
13 D	015	Carriage return		45 2D	055	-	-	77 4D	115	M	M	109 6D	155	m	m			
14 E	016	Shift Out		46 2E	056	.	.	78 4E	116	N	N	110 6E	156	n	n			
15 F	017	Shift In		47 2F	057	/	/	79 4F	117	O	O	111 6F	157	o	o			
16 10	020	Data Link Escape		48 30	060	0	0	80 50	120	P	P	112 70	160	p	p			
17 11	021	Device Control 1		49 31	061	1	1	81 51	121	Q	Q	113 71	161	q	q			
18 12	022	Device Control 2		50 32	062	2	2	82 52	122	R	R	114 72	162	r	r			
19 13	023	Device Control 3		51 33	063	3	3	83 53	123	S	S	115 73	163	s	s			
20 14	024	Device Control 4		52 34	064	4	4	84 54	124	T	T	116 74	164	t	t			
21 15	025	Negative Ack.		53 35	065	5	5	85 55	125	U	U	117 75	165	u	u			
22 16	026	Synchronous idle		54 36	066	6	6	86 56	126	V	V	118 76	166	v	v			
23 17	027	End of Trans. Block		55 37	067	7	7	87 57	127	W	W	119 77	167	w	w			
24 18	030	Cancel		56 38	070	8	8	88 58	130	X	X	120 78	170	x	x			
25 19	031	End of Medium		57 39	071	9	9	89 59	131	Y	Y	121 79	171	y	y			
26 1A	032	Substitute		58 3A	072	:	:	90 5A	132	Z	Z	122 7A	172	z	z			
27 1B	033	Escape		59 3B	073	;	;	91 5B	133	[[123 7B	173	{	{			
28 1C	034	File Separator		60 3C	074	<	<	92 5C	134	\	\	124 7C	174	|				
29 1D	035	Group Separator		61 3D	075	=	=	93 5D	135]]	125 7D	175	}	}			
30 1E	036	Record Separator		62 3E	076	>	>	94 5E	136	^	^	126 7E	176	~	~			
31 1F	037	Unit Separator		63 3F	077	?	?	95 5F	137	_	_	127 7F	177		Del			

asciicharstable.com

Programming Languages

- **High-level languages**

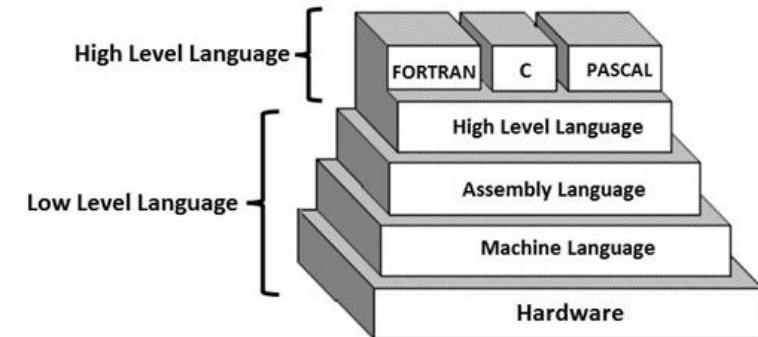
- Single statement can do substantial tasks
- Translator program from high-level languages to machine is called “**Compilers**”

- **Assembly language**

- English-like abbreviations
- Translator program from assembly to machine is called “**Assemblers**”

- **Machine Language**

- Consists of strings of numbers (1s and 0s)
- Elementary operations one at a time



Computer Language and its Types

e.g., add *overtime* to *base pay* and store result in *gross pay*

LOAD	BASEPAY
ADD	OVERPAY
STORE	GROSSPAY

$$\text{grossPay} = \text{basePay} + \text{overtimePay}$$

Welcome to C Programming!

- C is one of the world's most enduring and popular programming languages.
- Book says Tiobe Index, C is the world's most popular language. (written in 2017)

However!

Aug 2024	Aug 2023	Change	Programming Language	Ratings	Change
1	1		 Python	18.04%	+4.71%
2	3	▲	 C++	10.04%	-0.59%
3	2	▼	 C	9.17%	-2.24%
4	4		 Java	9.16%	-1.16%
5	5		 C#	6.39%	-0.65%

Welcome to C Programming!

- **Powerful Tasks:** C allows you to write instructions (code) that control computers and devices.

- **Industry Use:**

- **Operating Systems:** Windows, macOS, Linux.
- **Applications:** Web browsers (e.g., Google Chrome, Mozilla Firefox), database systems (e.g., Microsoft SQL Server, Oracle, MySQL).



The C Programming Language

- **Origin and Development**

- **1972:** Dennis Ritchie develops C at Bell Labs
- **Influenced by:** Basic Combined Programming Language (**BCPL**) and **B** language
- **1978:** *The C Programming Language* (often called K&R after its authors Kernighan and Ritchie) published
- **1983:** American National Standards Institute (ANSI) C standardization process begins
- **2011:** standard added features like multi-threading support and improved Unicode handling.
- **2017:** C18 standard, primarily a bug fix release, with no major new features.



Dennis Ritchie
1941-2011

C – Built for Performance

➤ **Operating Systems**

- Unix, Linux, Android, portions of Windows, OS-X built on Objective C

➤ **Embedded Systems**

- GPS, Intelligent Traffic Alert, Robots

➤ **Real-time Systems**

- Air traffic control, Industrial automation

➤ **Communication Systems**

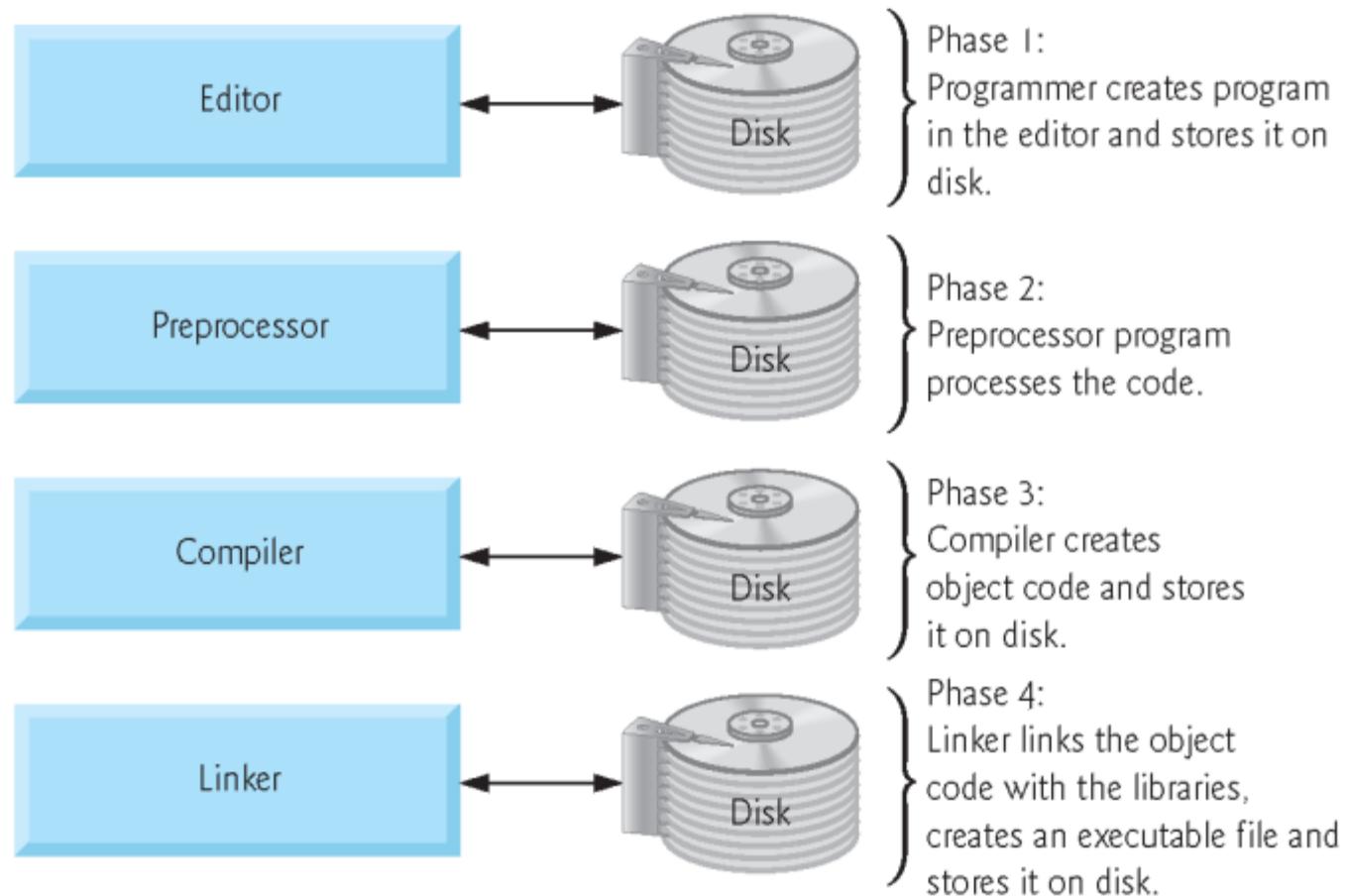
- Audio and video delivery

➤ **C-based programming languages:** *Object C, Java, Visual C#*

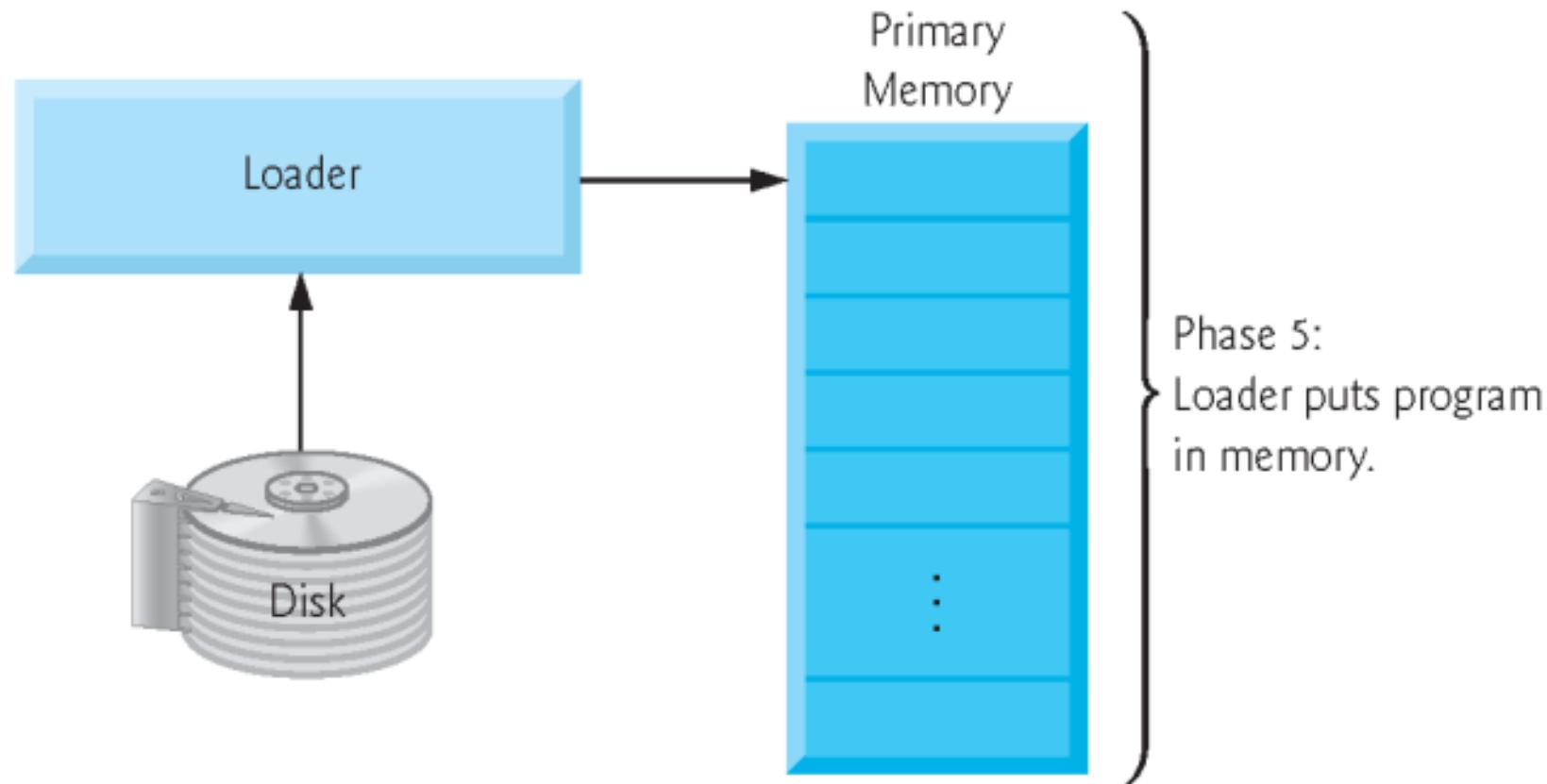
➤ **Other Popular programming languages**

- *BASIC, Python, JavaScript, Swift, R*

C Program Development



C Program Development



C Program Development

