

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

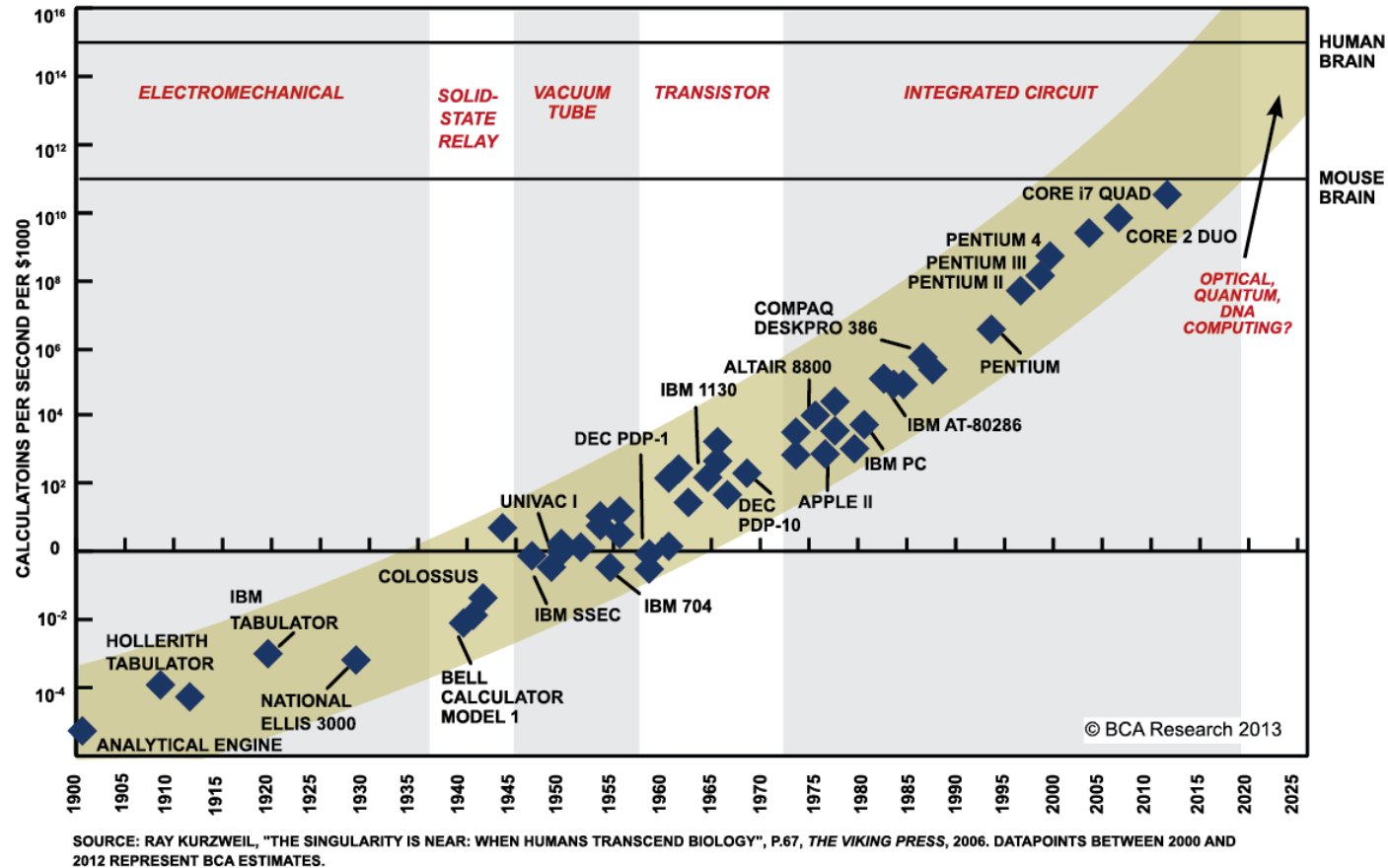
Computers: Hardware & Software

- 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

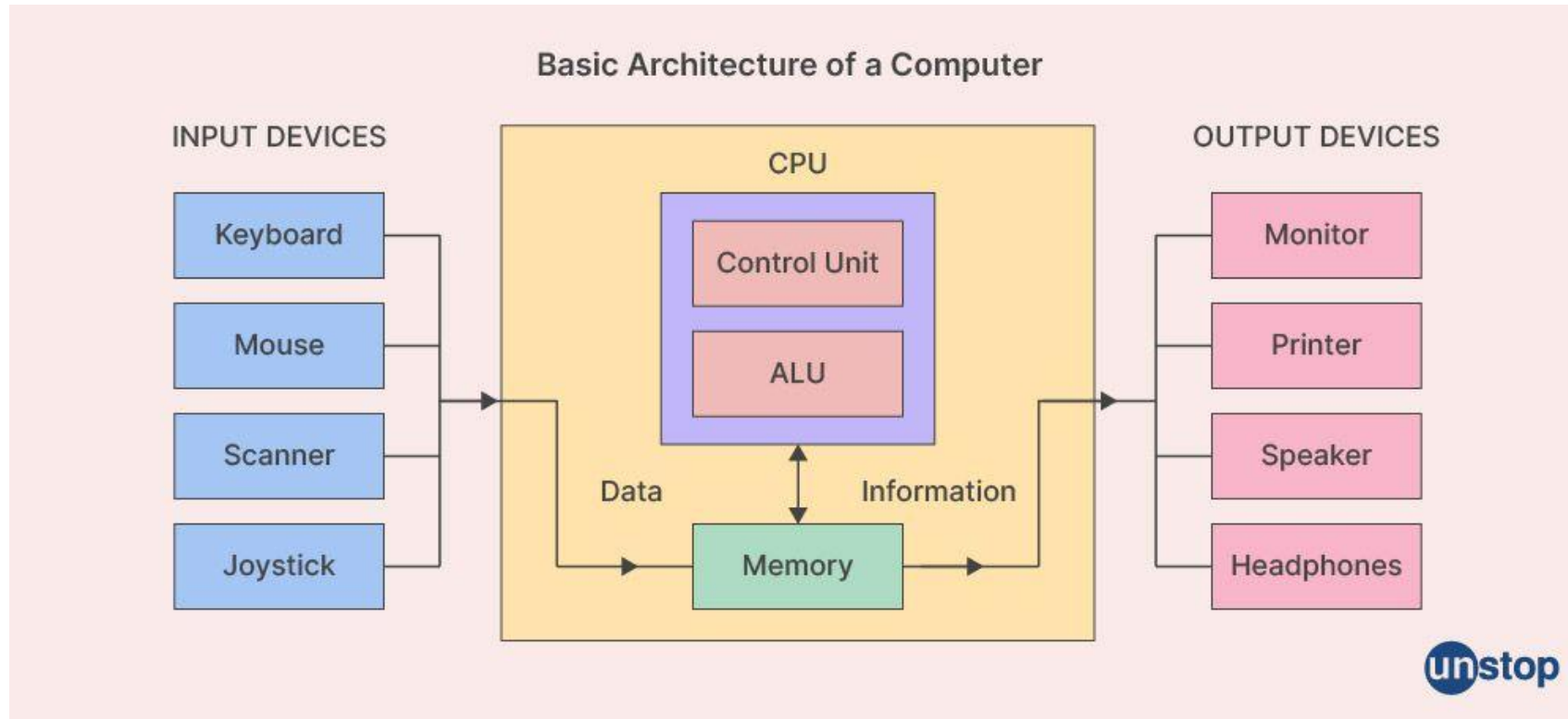
- Computers process data under the control of sequences of instructions called **computer programs**
- A computer consists of various **physical devices** referred to as hardware
- These programs guide the computer through ordered actions specified by people called computer **programmers**.
- The programs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

Moore's Law



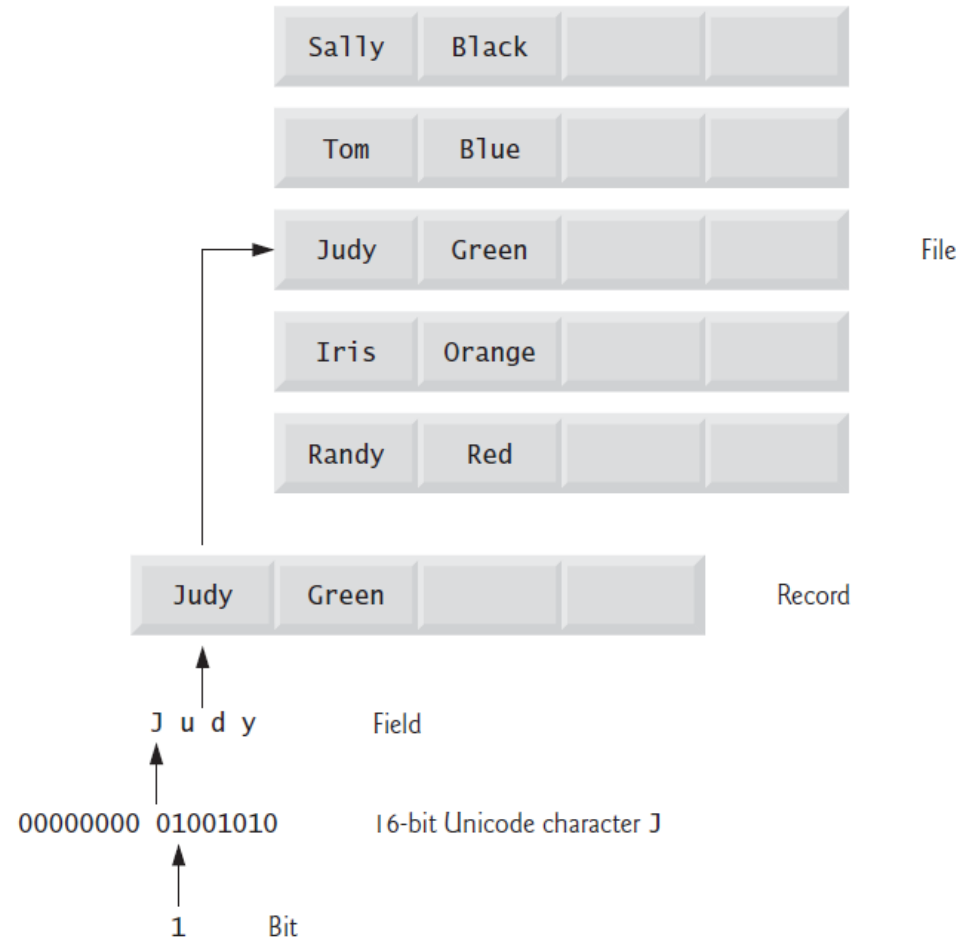
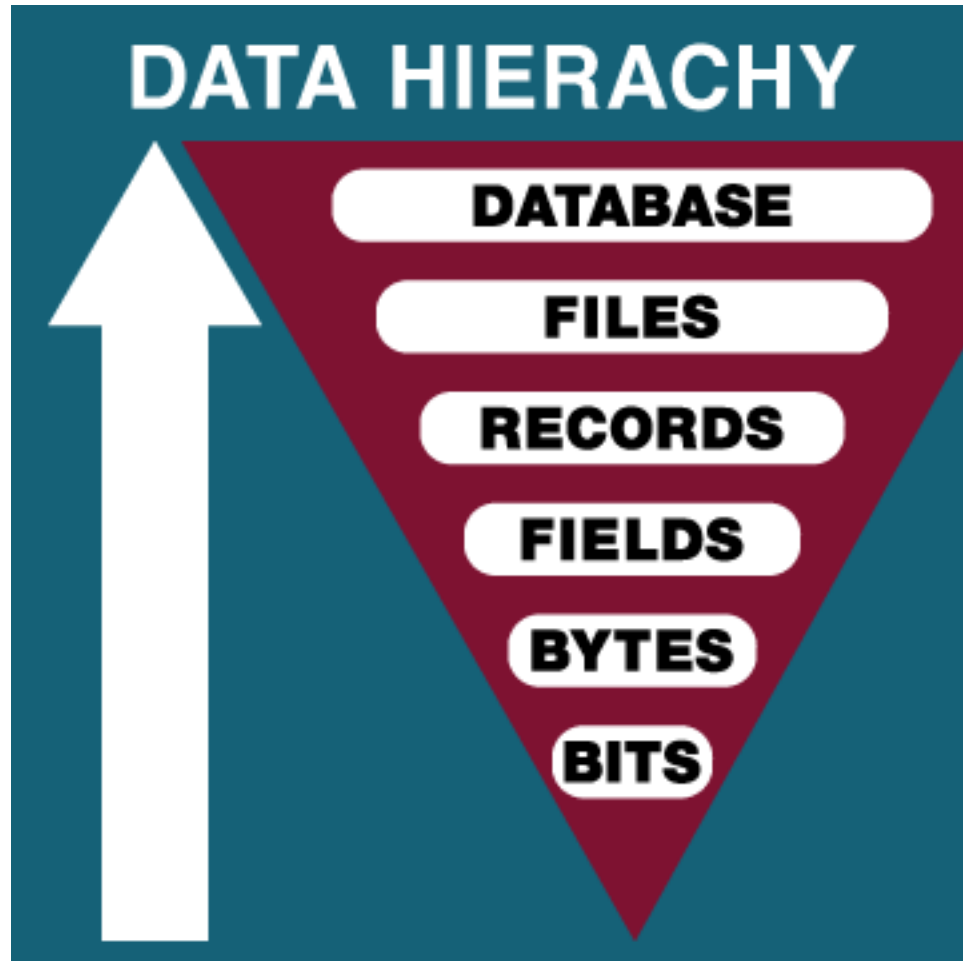
Definition: number of transistors in an integrated (IC) doubles every two years

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

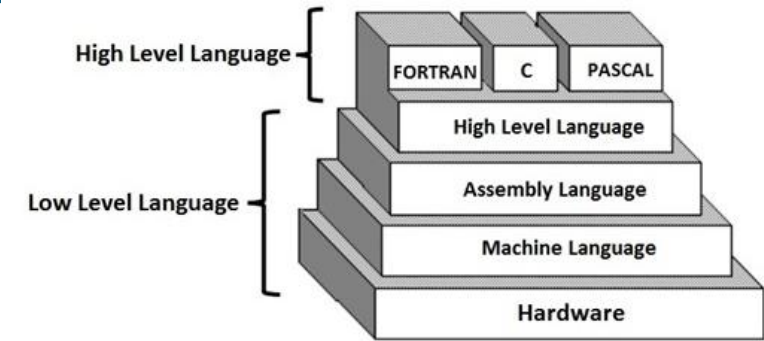
- American Standard Code for Information Interchange (ASCII)

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

grossPay = basePay + 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**

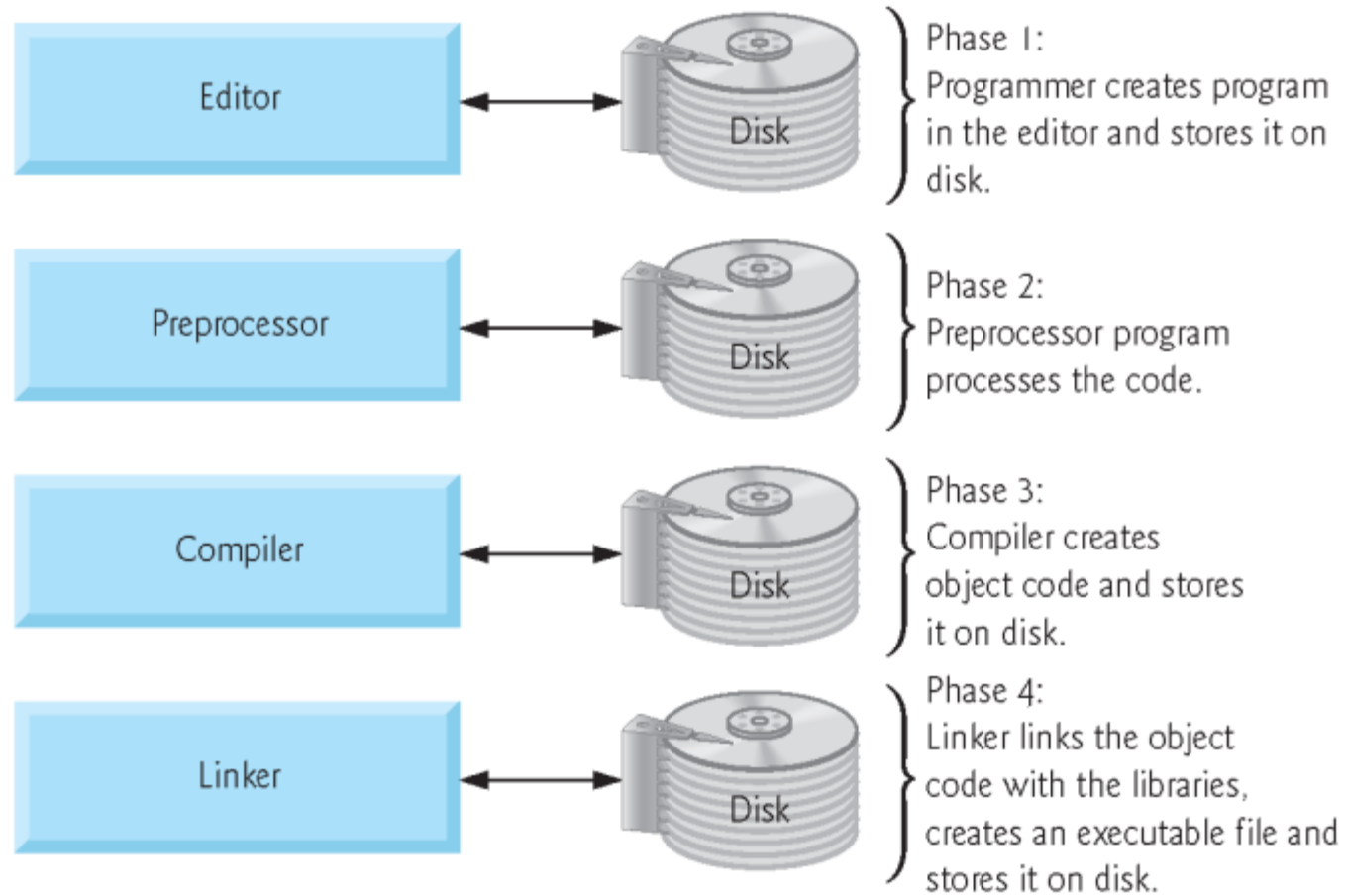
- Audio and video delivery

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

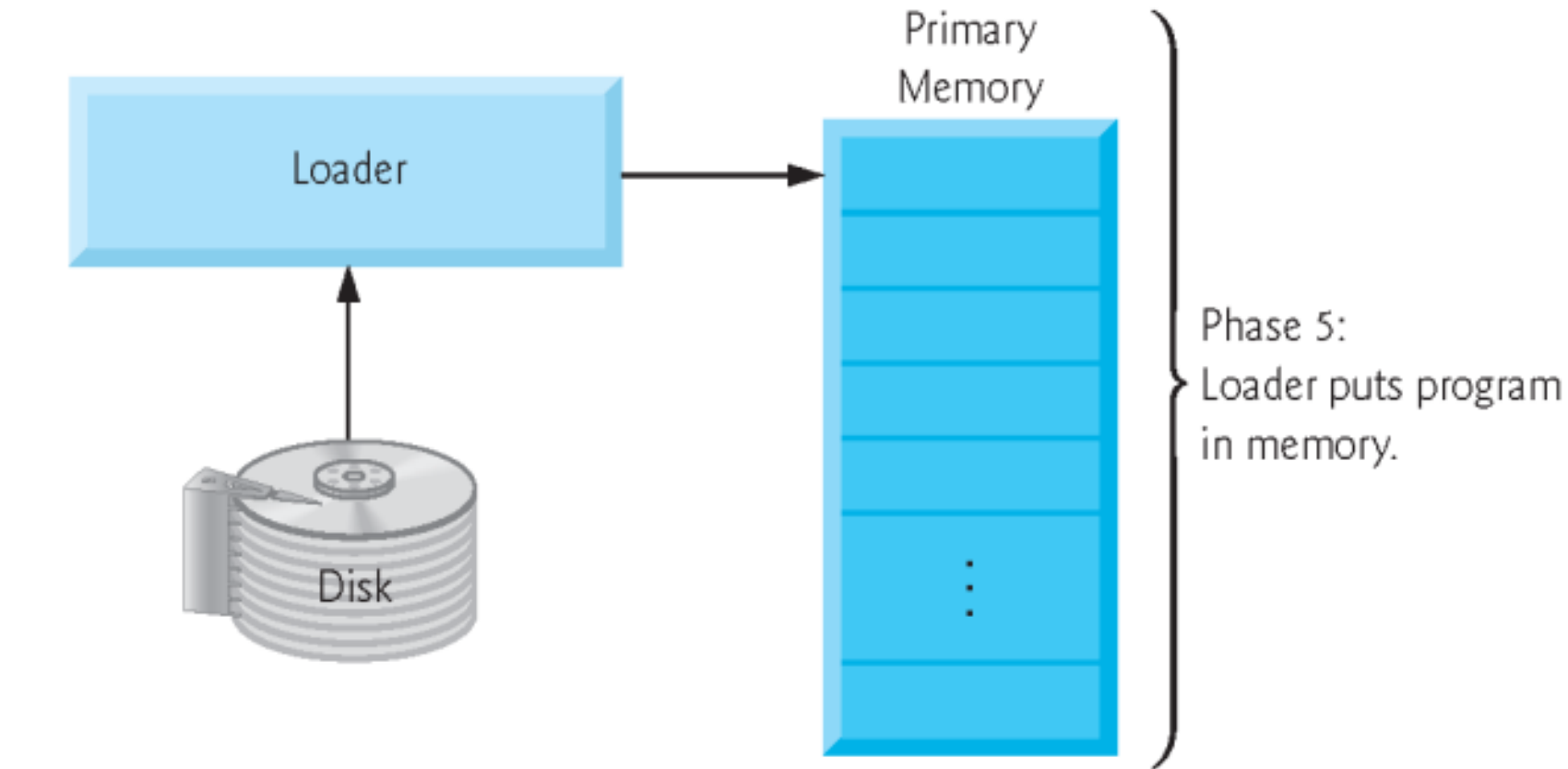
➤ **Other Popular programming languages**

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

C Program Development



C Program Development



C Program Development

