

Session 3: Devices Part 2

Tech Skills 101: Driver's Ed for the Digital World

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OLLI Fall 2025

Review of Session 1: Devices Part 1

“The Brain”

- Processors
 - Central Processing Unit
 - Graphics Processing Unit
- Memory
 - Random Access Memory
- Storage
 - Hard Disk Drive
 - Solid State Disk Driver Drive

Connectivity

- Ports & Cables
 - USB
 - Ethernet
 - HDMI
 - Power
- Wireless
 - WiFi
 - Cellular
 - Bluetooth
 - Near-Field Communication (NFC)

Interactivity *Input / Output*

- Keyboard
- Mouse / Touchpad
- Screen / Touchscreen
- Speakers
- Microphone
- Camera

General Purpose



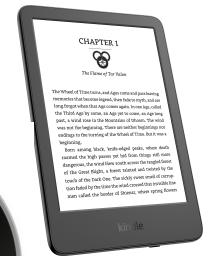
Single User / Mobile / Touch



Limited Purpose



Specific Purpose



This session

- More on the Processor (primarily CPU), Memory, and Storage
 - What each does
 - How they interact with each other
- Data: what data “looks like”...
 - ...to the processor
 - ...in memory
 - ...when stored “*on disk*” (i.e., to the drive; “when saved”)
- How the **size** of processors, memory, and storage is described

Example: when data in memory vs on disk

Using Pages app

- **Open/start/launch** the app and create a new **document**
*The app is now **running**; i.e., the app is using the processor and (some) memory*
- Type a sentence: “The quick blue fox jumps over the lazy dog.”
*Data that represents the sentence is now **in memory***
- Save
A copy of the data the app has in memory is now on my drive
- Change the sentence: “The quick **brown** fox jumps over the lazy dog.”
*The change I made to the text is now **in memory** but not on my drive*
- Save
The change I made to the text is now on my drive as well as in memory
- Quit
*The data the app has in memory is erased (a.k.a. “deleted”) from memory
The app “let’s go of” the processor and the memory it has been using*



Complete 8086 instruction set

Quick reference:

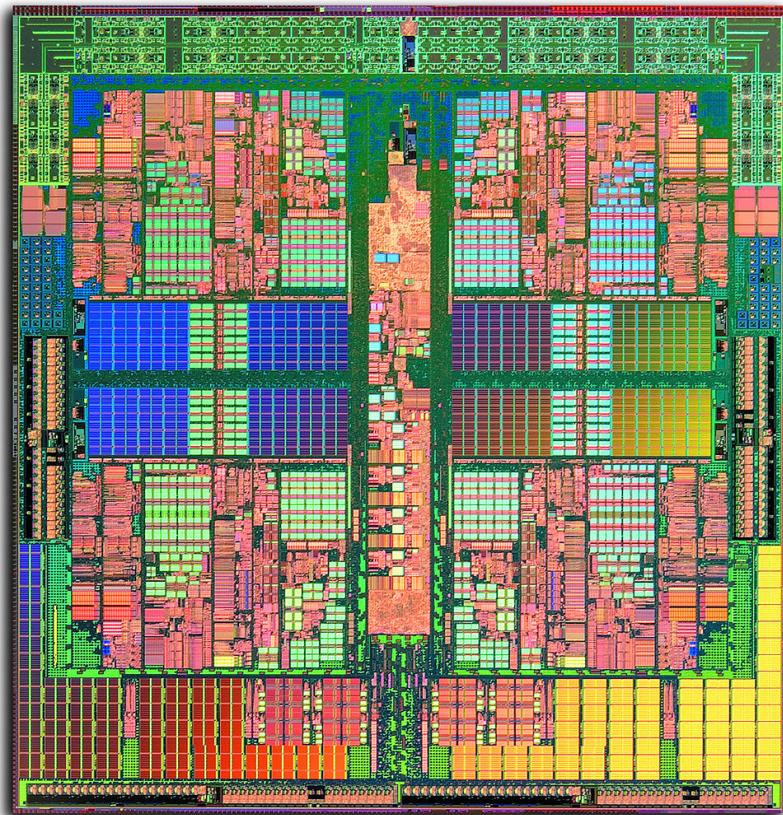
Math	AAA	CMPSB	AAD	CMPSW	CWD	JAE	JB	JNC	JNBE	JS	JPO	MOV	MOVSB	RCR	SCASB
Boolean Operators	AAM	DAA	AAS	DAS	DEC	JC	JBE	JNE	JNG	JZ	LAHF	MUL	REP	SCASW	SHL
Control of flow	ADC	DIV	ADD	HLT	IDIV	DEC	JCXZ	JGE	JNL	JNO	LEA	NEG	REPE	SHR	STC
Memory	AND	IMUL	CALL	IN	IMUL	CBW	IN	JG	JGE	JNL	LES	NOP	REPNE	STD	STI
	CALL	INT	CLI	INC	INTO	CLC	INT	JL	JGE	JNO	LODSB	NOT	REPZ	RET	STOSB
	CMP	IRET	CLD	INC	INTO	CLD	INT	JLE	JGE	JNO	LODSW	OR	RET	STOSW	SUB
		JA	CLI	INC	INTO	CMC	INT	JNA	JNAE	JNE	LOOP	POPA	ROL	TEST	XCHG
			CLD	INC	INTO	CMC	INT	JNA	JNAE	JNE	LOOPE	POPF	ROR	SAL	XLATB
				INC	INTO	CMP	INTO	JNB	JNAE	JNE	LOOPNE	PUSH	SAR	SBB	XOR
					IRET	CMP	INTO	JNB	JNAE	JNE	LOOPNZ	PUSHA	SAHF	SCL	
						JA		JNB	JNAE	JNE	LOOPZ	PUSHF	SBB	SCL	

References:

- [Table](#)
- [Wikipedia: x86 instructions listing](#)

Digital devices *multi-task*

Processors perform multiple tasks *in parallel*



- Examples
 - I receive a text message notification on my iPhone when I am using the News app
 - I watch a YouTube video using my browser while I clean out my email inbox
 - In my car, I can listen to music at the same time my GPS tells me how to get to my destination
- Processors have multiple **cores**
 - Each core implements the same set of operations
 - Data is shared between cores using a **cache** (high speed memory on the CPU)

www.intel.com/content/www/us/en/products/details/processors/core.html

DCSL Trackers Blogs Geekery Duo F h

Browse Intel Core Processors

See all Intel Core Processors SKUs

34 Products COMPARE ALL

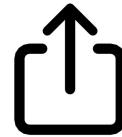
Product Name	Launch Date	Total Cores	Max Turbo Frequency	Cache	GPU Name
<input type="checkbox"/> Intel® Core™ 3 Processor 201TE (12M Cache, up to 4.60 GHz)	Q1'25	4	4.6 GHz	12 MB	Intel® UHD Graphics 770
<input type="checkbox"/> Intel® Core™ 3 Processor 201EF (12M Cache, up to 4.80 GHz)	Q1'25	4	4.8 GHz	12 MB	
<input type="checkbox"/> Intel® Core™ 3 Processor 201E (12M Cache, up to 4.80 GHz)	Q1'25	4	4.8 GHz	12 MB	Intel® UHD Graphics 770
<input type="checkbox"/> Intel® Core™ i5-110 Processor (12M Cache, up to 4.30 GHz)	Q3'25	6	4.3 GHz	12 MB Intel® Smart Cache	Intel® UHD Graphics 630
<input type="checkbox"/> Intel® Core™ 5 Processor 120F (18M Cache, up to 4.50 GHz)	Q3'25	6	4.5 GHz	18 MB Intel® Smart Cache	
<input type="checkbox"/> Intel® Core™ 5 Processor 120 (18M Cache, up to 4.50 GHz)	Q3'25	6	4.5 GHz	18 MB Intel® Smart Cache	Intel® UHD Graphics 730
<input type="checkbox"/> Intel® Core™ 3 processor 100UL (10M Cache, up to 4.50 GHz)	Q2'24	6	4.5 GHz	10 MB	Intel® Graphics
<input type="checkbox"/> Intel® Core™ 3 processor 100U (10M Cache, up to 4.70 GHz)	Q1'24	6	4.7 GHz	10 MB Intel® Smart Cache	Intel® Graphics
<input type="checkbox"/> Intel® Core™ 3 processor 100U (10M Cache, up to 4.70 GHz, with IPU)	Q1'24	6	4.7 GHz	10 MB Intel® Smart Cache	Intel® Graphics

Feedback

Chip	 Apple M4 chip	 Apple M4 Pro chip	 Apple M4 Pro chip	 Apple M4 Max chip
Apple M4 chip	10-core CPU with 4 performance cores and 6 efficiency cores	12-core CPU with 8 performance cores and 4 efficiency cores	14-core CPU with 10 performance cores and 4 efficiency cores	14-core CPU with 10 performance cores and 4 efficiency cores
10-core GPU	16-core GPU	20-core GPU	32-core GPU	
Hardware-accelerated ray tracing	Hardware-accelerated ray tracing	Hardware-accelerated ray tracing	Hardware-accelerated ray tracing	
16-core Neural Engine	16-core Neural Engine	16-core Neural Engine	16-core Neural Engine	
120GB/s memory bandwidth	273GB/s memory bandwidth	273GB/s memory bandwidth	410GB/s memory bandwidth	
Media Engine	Media Engine	Media Engine	Media Engine	Media Engine
Hardware-accelerated H.264, HEVC, ProRes, and ProRes RAW	Hardware-accelerated H.264, HEVC, ProRes, and ProRes RAW	Hardware-accelerated H.264, HEVC, ProRes, and ProRes RAW	Hardware-accelerated H.264, HEVC, ProRes, and ProRes RAW	Hardware-accelerated H.264, HEVC, ProRes, and ProRes RAW
Video decode engine	Video decode engine	Video decode engine	Video decode engine	Video decode engine
Video encode engine	Video encode engine	Video encode engine	Video encode engine	Two video encode engines
ProRes encode and decode engine	ProRes encode and decode engine	ProRes encode and decode engine	ProRes encode and decode engine	Two ProRes encode and decode engines
AV1 decode	AV1 decode	AV1 decode	AV1 decode	AV1 decode
—	Configurable to:	Configurable to:	Configurable to:	

Information ≈ Data

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A screenshot of a web browser window displaying a Wikipedia page titled "2011_Groundhog_Day_bizzard". The page discusses the first district-wide cancellation of classes since the Blizzard of 1999. It includes several images of snow-covered streets and vehicles, and a video player showing an amateur video of cars stuck on Lake Shore Drive.

which marked the first district-wide cancellation of classes since the [Blizzard of 1999](#).
[62] Heavy snow and high winds, reaching up to 60 miles per hour (80 km/h), caused rail switches to fail at the [Wrigley Field](#).
[63][64] Northwestern University and the [University of Chicago](#) canceled classes Wednesday for the first time since 1979.
State workers were ordered not to leave their homes during the blizzard in 1979.
[65][66] Over 39,000 people were stranded in Chicago, the largest figure since a blizzard in 1979.
[67] Mail service was suspended.
[68] Amtrak train service out of Chicago was delayed.

The [Blizzard of 1999](#) was a strong winter snowstorm which struck the Midwestern United States and portions of central and eastern Canada, hitting hardest in Iowa, Wisconsin, Illinois, Indiana, Michigan, Ohio, southern Ontario, and southern Quebec. The storm began on January 27, 1999, and continued through January 30. In the central part of the state, numerous residents rushed to the stores to stock up on supplies. On Tuesday, several school districts announced they would be closed for the day. About 1.5 inches (3.8 cm) of snow fell in the Chicago area. Sustained winds reached up to 60 miles per hour (80 km/h). Local government officials encouraged citizens to stay home and prepare for the worst. In the city, residents braced for the storm by preparing living and sleeping areas for emergency personnel. In the suburbs, flights were canceled, and local officials repeatedly urged residents not to travel, since because of the whiteout conditions, snow plows had been taken off the roads.
[75][76] Interstate 80 was closed Tuesday night between Morris and Princeton. On Wednesday, I-290 and Illinois Route 53 were shut down from Lake Cook Road in Arlington Heights to St. Charles Road in Elmhurst. Forty vehicles were abandoned on Route 53. Parts of Interstate 57 were also shut down. The state police described most expressways as "impassable".
[67][77] 50 motorists stranded on Illinois Route 47 south of Huntley received assistance from a snowmobile club, while dozens of motorists had to be rescued on Illinois Route 72, west of Hampshire.
[68] During the storm's peak on Tuesday night, more than 100,000 customers were without electricity across the state, including 79,000 ComEd customers across Northern Illinois and 35,800 Ameren customers in Central Illinois.
[78] Several charities set up shelters for the homeless and those stranded by the blizzard,
[79] and Governor Pat Quinn mobilized 500 Illinois National Guard troops to help rescue stranded motorists.
[80] Hundreds of motorists had been rescued off Interstates 290, 55, 57, and 80. In addition, over 80 traffic accidents were reported.
[67]

11 snow-related deaths had been reported in Illinois by February 3. The body of an individual was recovered from Lake Michigan by Chicago

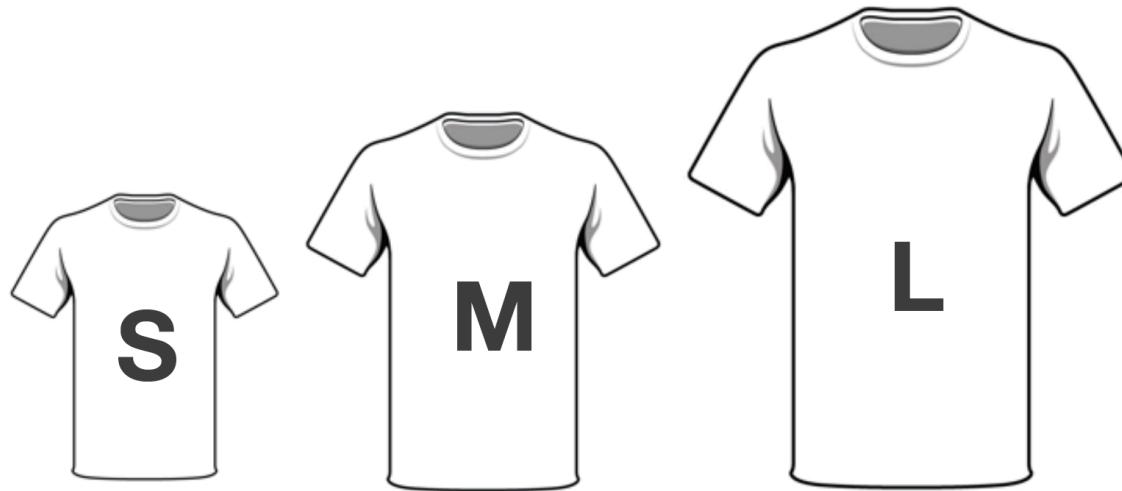
The size of data is measured in *bytes*

byte	<ul style="list-style-type: none">A byte is the smallest unit of dataOne byte...<ul style="list-style-type: none">can represent 256 valuesis made up of eight <i>bits</i>		
kilobyte	KB	1,000 bytes	one thousand bytes
megabyte	MB	1,000,000 bytes	one million bytes
gigabyte	GB	1,000,000,000 bytes	one billion bytes
terabyte	TB	1,000,000,000,000 bytes	one trillion bytes

Examples

- War and Peace*: 2MB
- Bible KJV: 2.2 MB
- Harry Potter series: 20MB
- 5 minutes of HD video: 1GB
- 5 minutes of 4K video: 3.4GB
- 5 minutes of 8K video: 6.7GB

Note: You may see the acronyms “Gbps” (*gigabits per second*) and “Mbps” (*megabits per second*) sometimes—often by Internet providers. E.g., “1000 Mbps”. These numbers describe the rate data moves between devices/components; the higher the number, the faster data moves.



		Small	Medium	Large
Processor	Apple	M4	M4 Pro	M4 Max
	Intel	Core 5	Core 7	Core 9
Memory	Apple	16GB	24GB	32GB
Storage	Apple	256GB	512GB	1TB

Software

Hardware