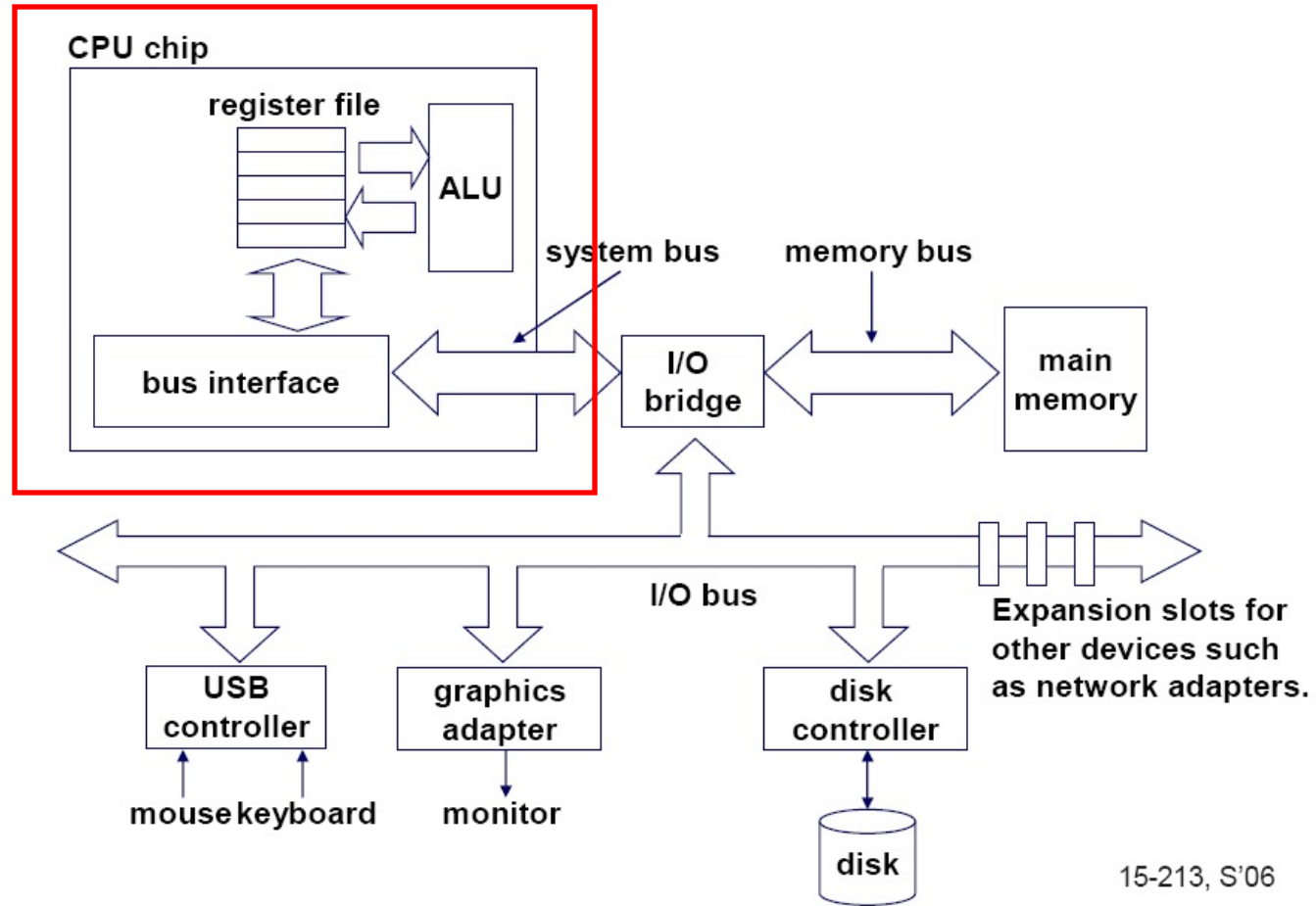


Intel Core i3, Core i5, core i7 & Core i9 Processors

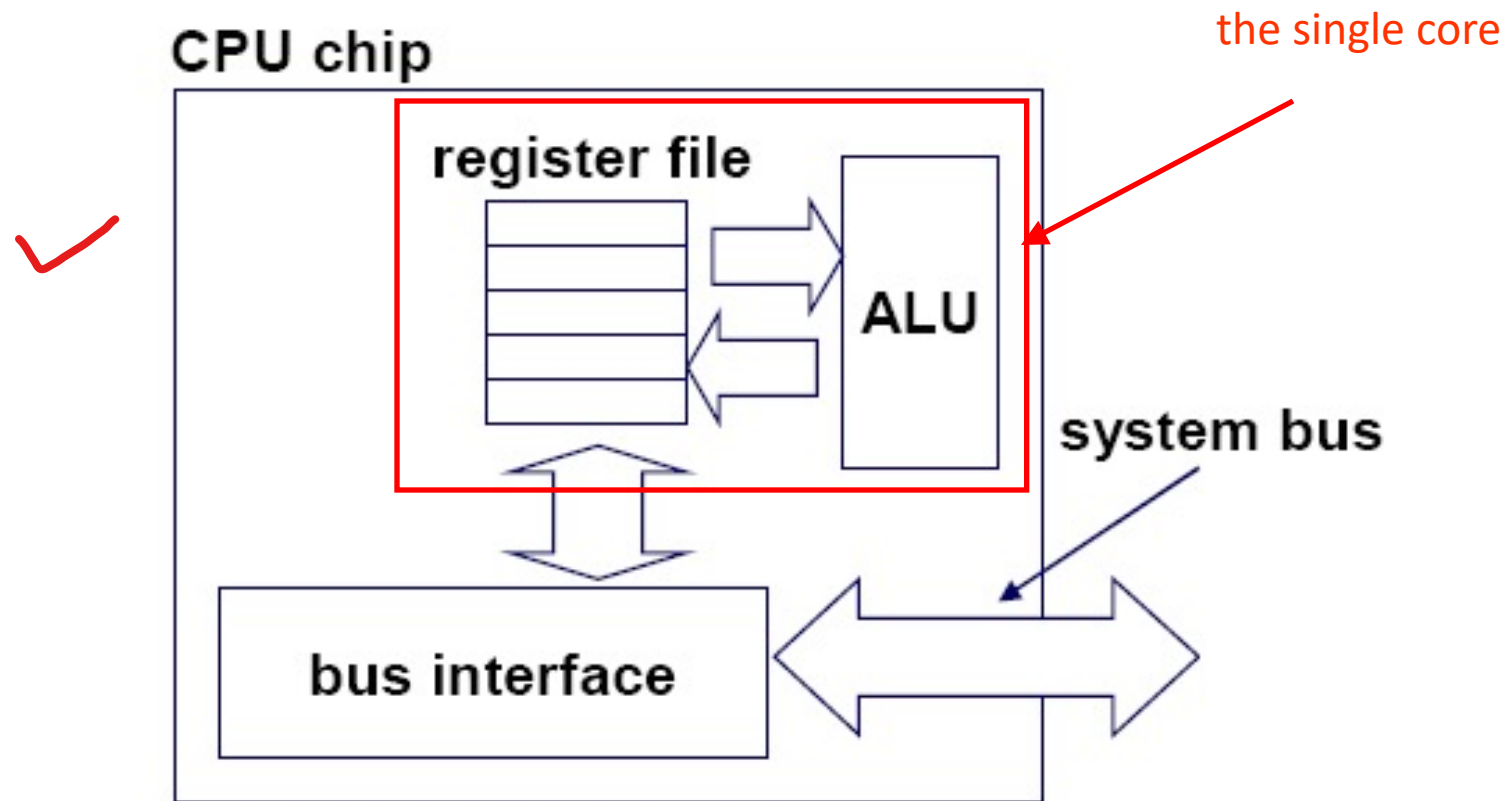
**Presented by
Dr. Md. Abir Hossain
Dept. of ICT
MBSTU**

Single-core computer



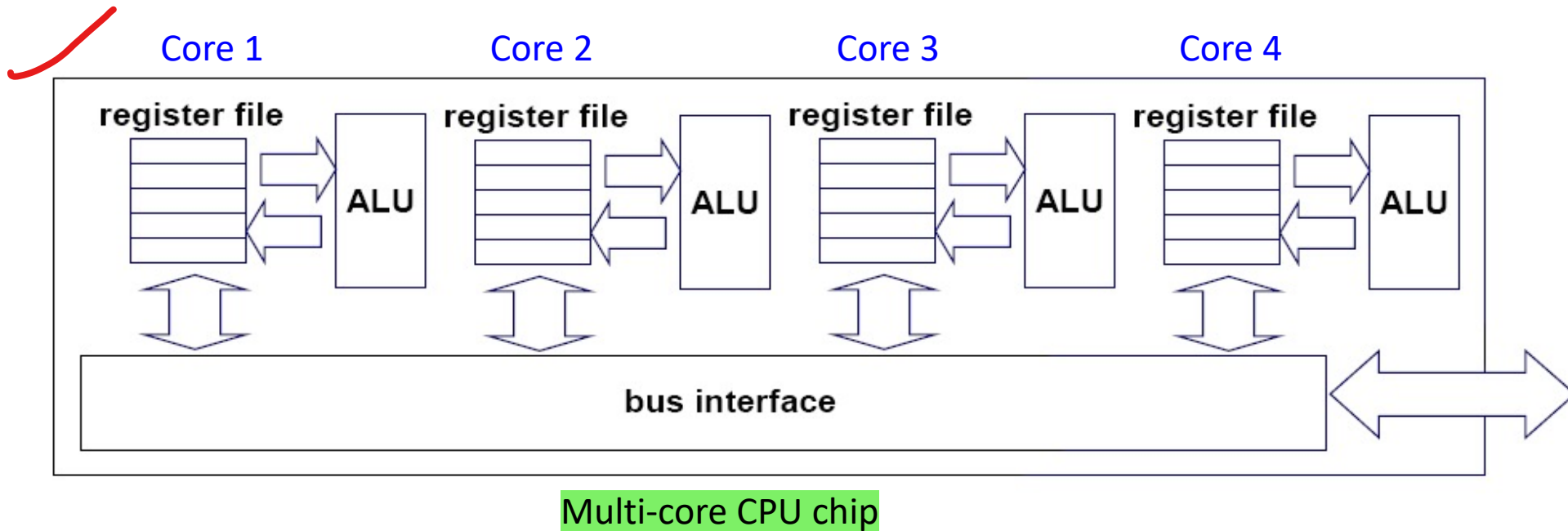
15-213, S'06

✓ Single-core CPU chip



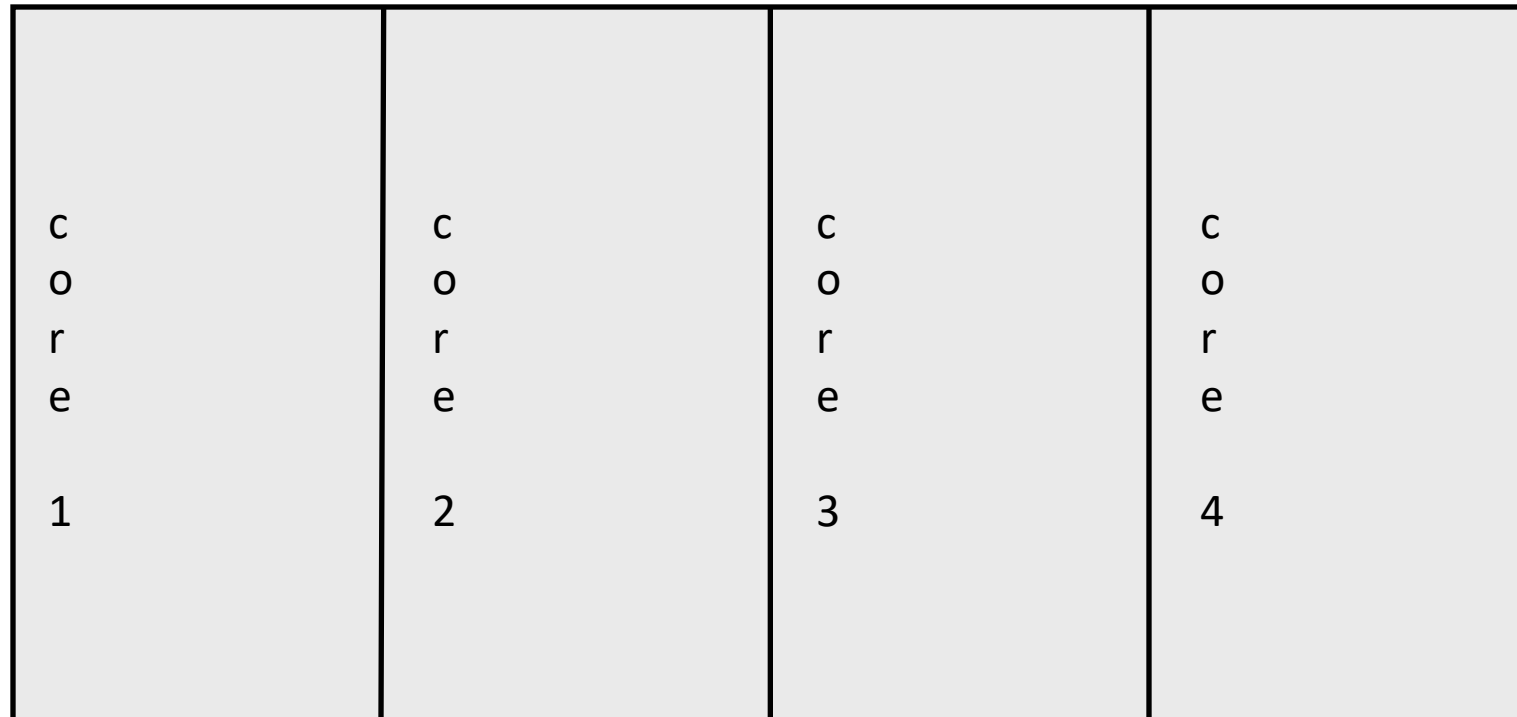
Multi-core architectures

- This lecture is about a new trend in computer architecture:
Replicate multiple processor cores on a single die.

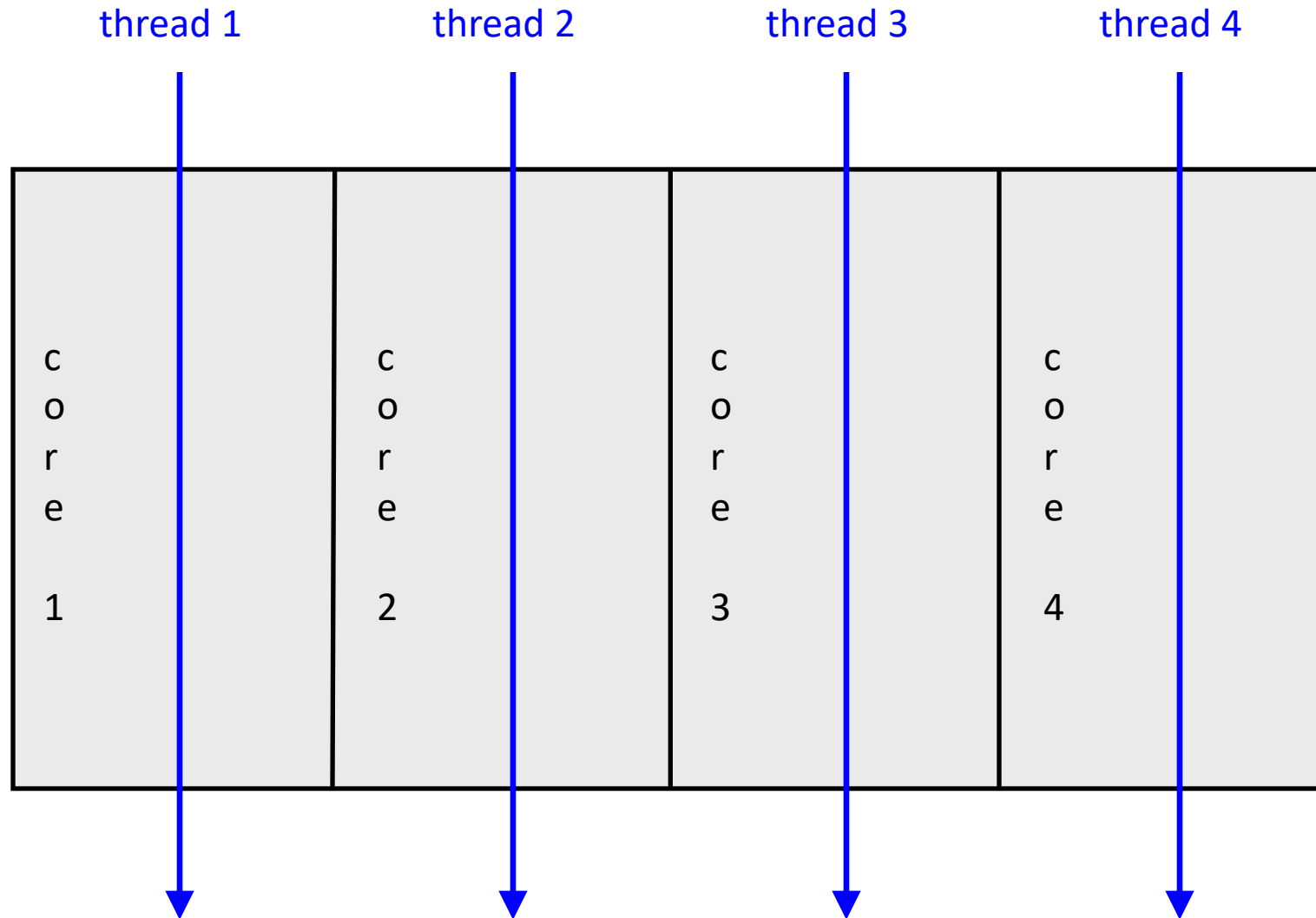


Multi-core CPU chip

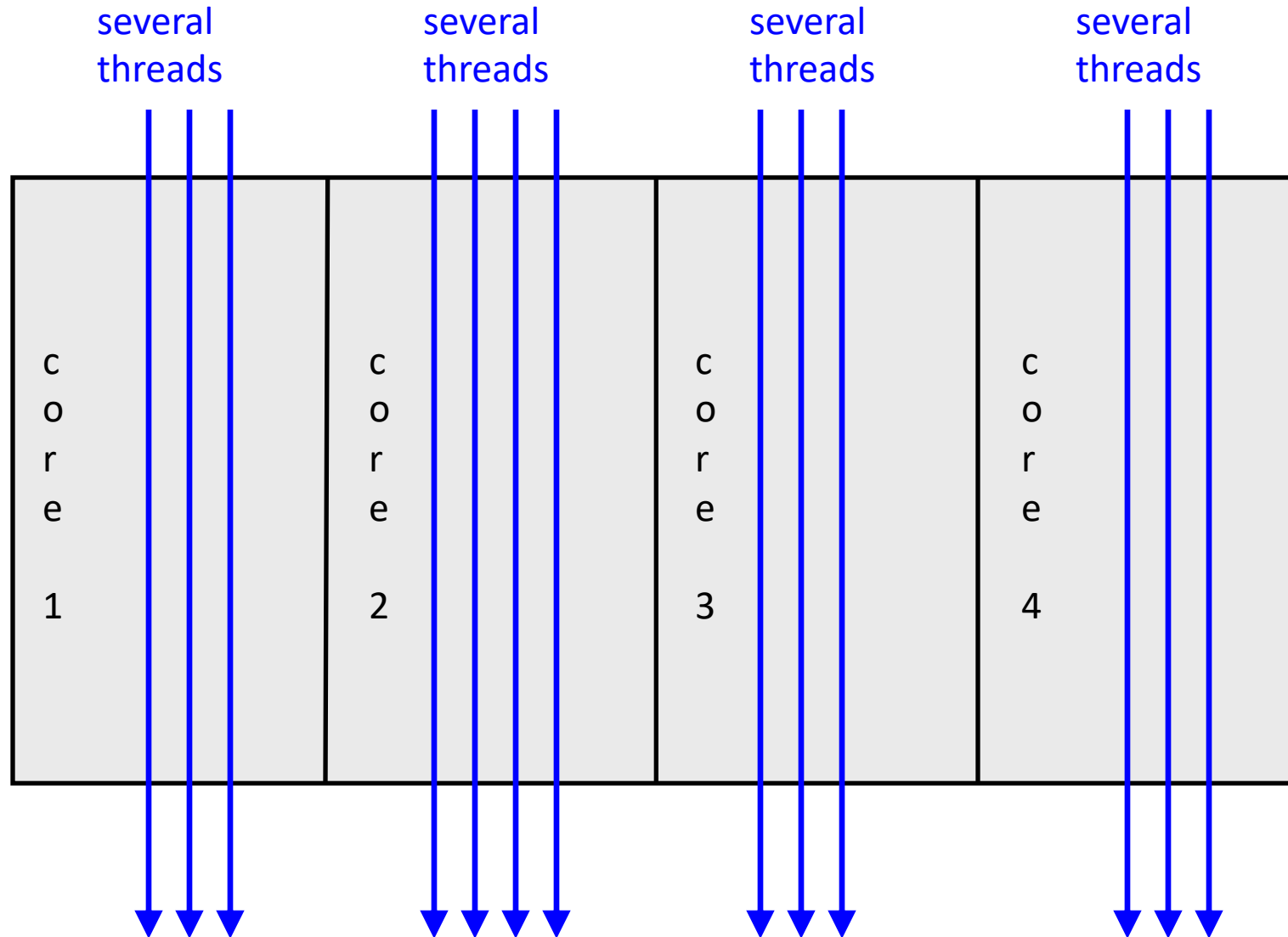
- The cores fit on a single processor socket
- Also called CMP (Chip Multi-Processor)



The cores run in parallel



Within each core, threads are time-sliced (just like on a uniprocessor)



✓ Processor

- A processor is an integrated electronic circuit that performs the calculations that run a computer. A processor performs arithmetical, logical, input/output (I/O) and other basic instructions that are passed from an operating system (OS).

- **Functions of processor**

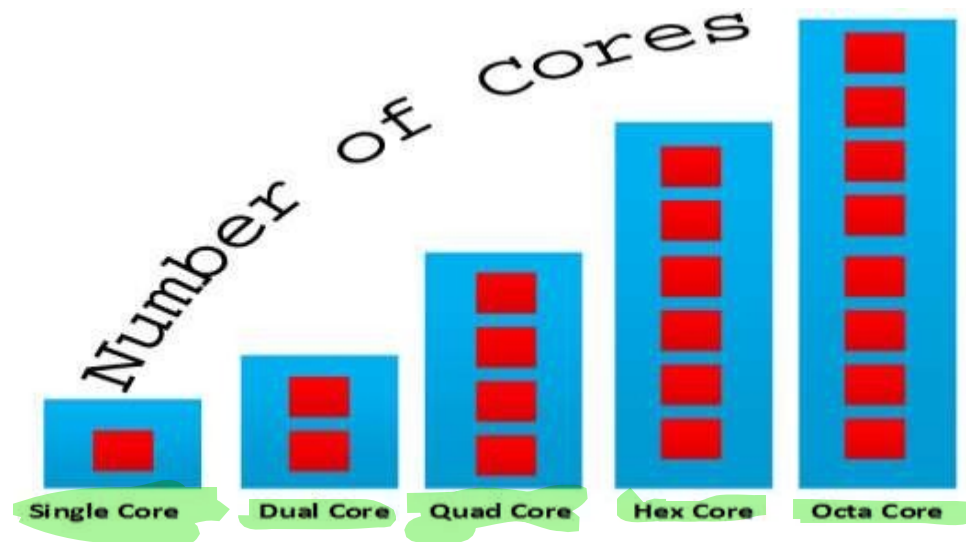
The four primary functions of a processor are **fetch, decode, execute and write back.**

- **Basic elements of a processor**

- **The arithmetic logic unit (ALU)** carries out arithmetic and logic operations.
- **The floating point unit (FPU)** known as numeric coprocessor, a specialized coprocessor that manipulates numbers more quickly.
- **Registers** supply data to the ALU and store the results of operations.
- **cache memory** in the CPU saves time to fetch instruction from (RAM).
- **Internal Buses** used to connect the components
- **Logic Gates** used to control the flow of information

✓ Core ??

- Core is part of a CPU that receives instructions and performs calculations or actions.
- A set of instructions can allow a software program perform a specific function. There are different types of cores .



Types Of Processors

Single core processors

- Oldest Type of Processor used in 1970's
- Only One Core
- Not good for Multi-tasking
- Another operation will perform after finishing the activated operation.

Dual core processors

- Workload is divided into Two Core
- CPU can handle Multi-tasking
- SMT(Simultaneously Multithreading) Support
- faster than single core

Quad core processors

- Workload is Divided into Four Cores
- Each Core has its own Cache
- Greater Multi-tasking
- Much Faster than Single Core and Dual Core

✓ Overview of core i3,i5,i7,i9

- **core i3 processor** is a **dual-core** computer processor, available for use in both desktop and laptop computers. The Core i3 processor is available in multiple speeds, ranging from **1.30 GHz up to 3.50 GHz**, and **support 3 MB or 4 MB** of cache. Released on January 2010 to April 2018.
- **core i5 processor** is dual-core or quad-core. The Core i5 processor is available in multiple speeds, ranging from **1.90 GHz up to 3.80 GHz**, and it support **3 MB, 4 MB or 6 MB** of cache. Released on January 2010 to April 2018
- **core i7 processor** is dual-core, quad-core and hex-core processor architectures. An Intel Corei7 is the fastest version of the Intel processor **for consumer-end computers and devices**. Released on September 2009 to April 2018 .
- **core i9 processor** became the top model in the Core "i" series .Designed for high-performance computing and **gaming**. Released on April 2018.

✓ Core i3

- 64-bit processor architecture
- Dual Core
- Supports Hyper threading
- 3MB or 4 MB Smart Cache
- 1.400 billion Transistors (vary from version and generation)
- Frequency Range: 1.30 GHz up to 3.50 GHz
- Max Memory Size (dependent on memory type) of 16.38 GB
- Memory Type DDR3 1066 MHz or 1333 MHz

Westmere MicroArchitecture (1st Generation)

- Contains 45 nm "Ironlake" [GPU](#).
- Transistors: 382 million
- Smart Cache

Model Number	Frequency	Cores	Release date	Memory	Release Price
Core i3- 530	2.93	2	January 2010	DDR3	\$113
Core i3-550	3.2 GHz	2	May 2010	DDR3	\$138

Sandy Bridge MicroArchitecture (2nd Generation)

- Transistors: 624 million

Model Number	Frequency	Cores	Release date	Memory	Release Price
Core i3- 2100	3.1 GHz	2	Februrary 2011	DDR3	\$117
Core i3-2125	3.3 GHz	2	September2011	DDR3	\$134

✓ Advantages

- Cheap
- Hyper Threading
- Processors have improved Pentium base.
- Better performance with more reliable outputs
- New architecture with more integrations and high speed performance structure.

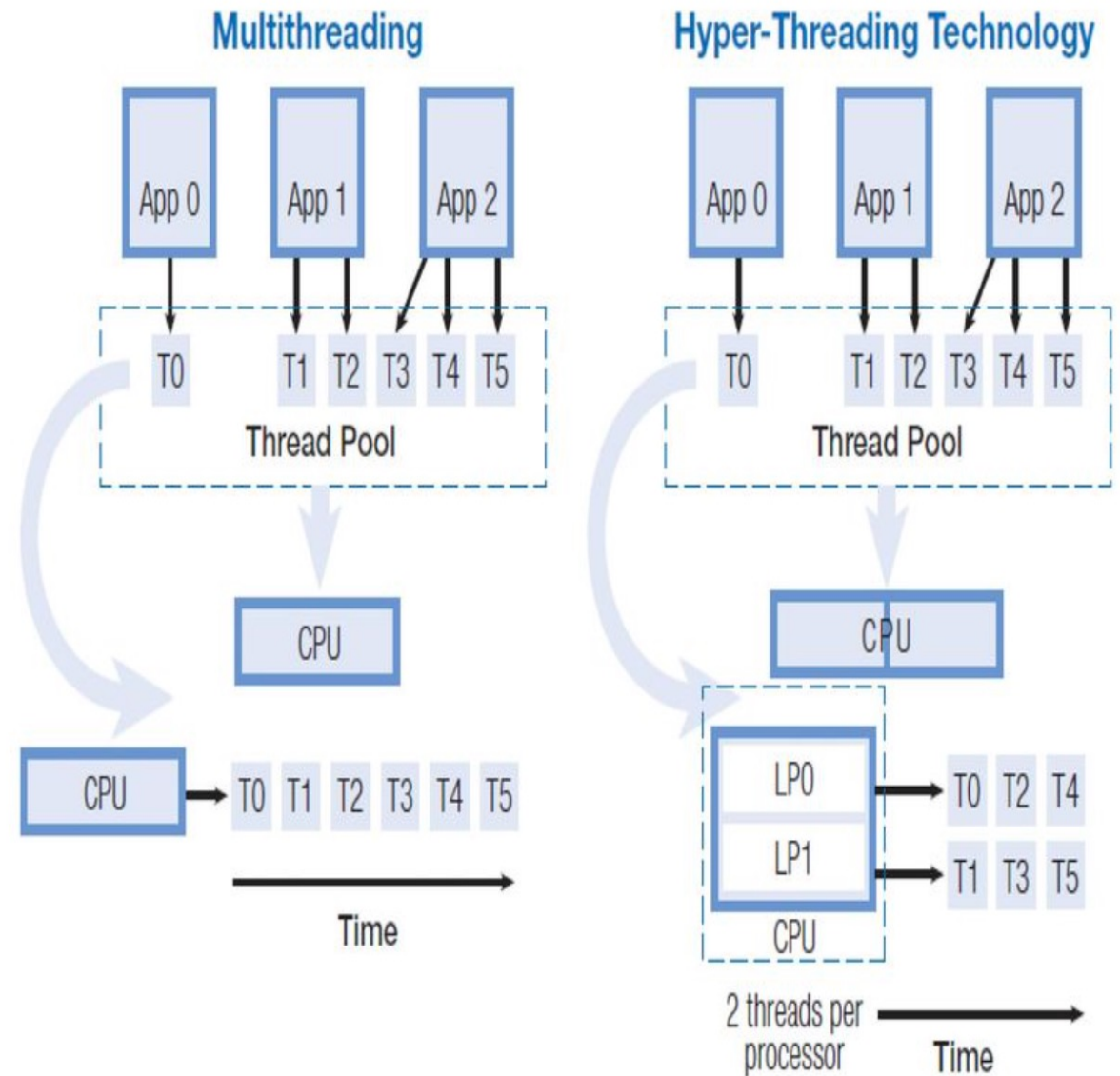
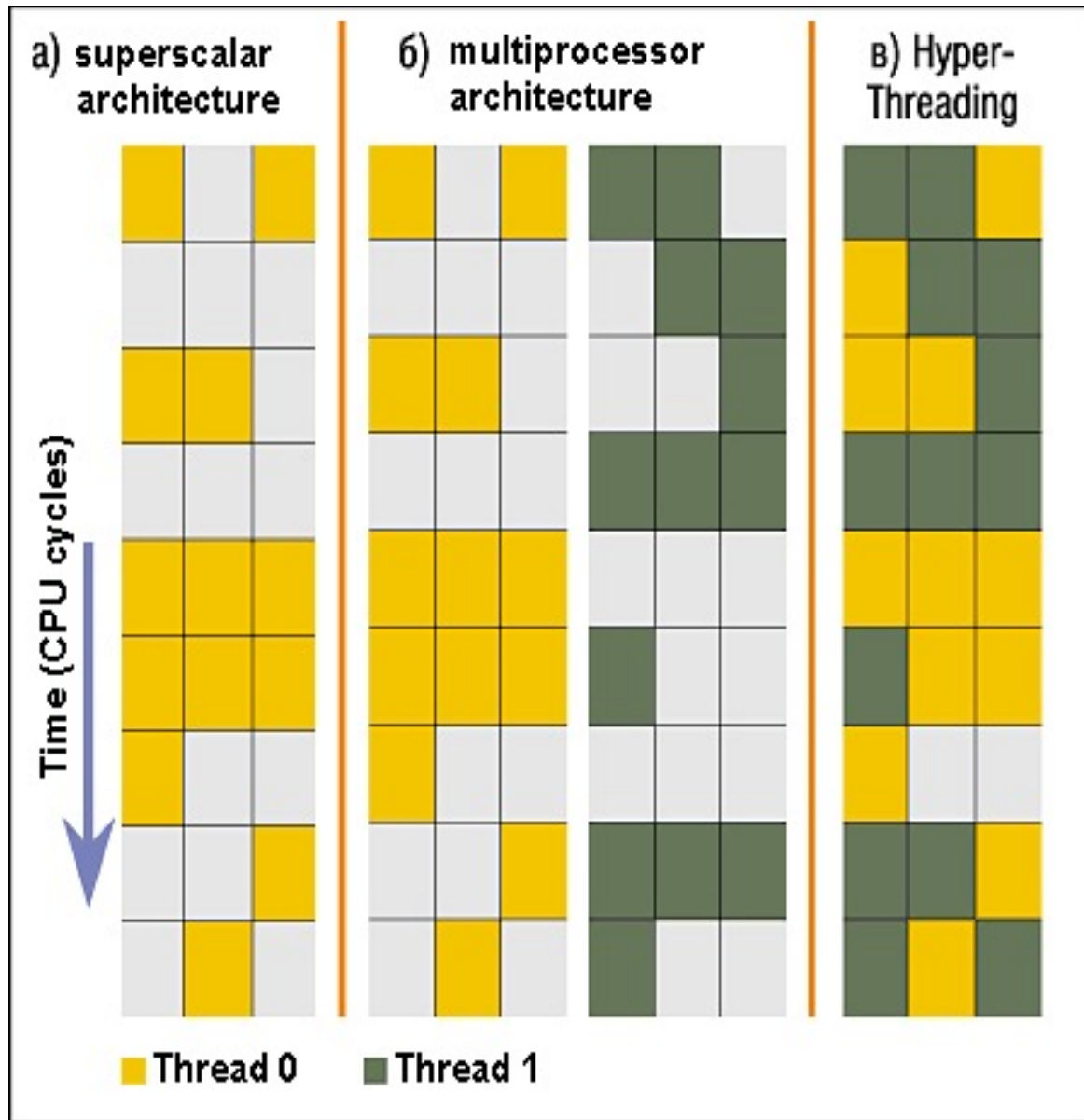
Disadvantages

- Slower than latest version (Core i5,i7 & i9) processor.
- Get over-heated.
- Graphics quality is low than latest version.

✓ Hyper Threading Technology

- Hyper-threading is Intel's term also called simultaneous multithreading or SMT.
- Hyper-threading is a process by which a CPU divides up its physical cores into virtual cores that are treated as if they are actually physical cores by the operating system.
- Hyper-threading works by allowing each core in your CPU to do two actions at the same time.
- Hyper-threading working better performance in
 - Video editing
 - Rendering in 3D
 - CPU-stress minimizing in multi-tasking

Hyper Threading Technology



✓ Core i5

- Design to perform better for daily usage of computer, and processing.
- Core i5 is available in dual core and quad core processor architecture
- No. of cores
 - 4 cores (Desktop)
 - 2 cores (Mobile)
- Supports Hyper threading **Cache Memory**
 - A 32-KB instruction and 32-KB data first-level cache (L1) for each core
 - A 256-KB shared instruction / data second-level cache (L2) for each core
 - Up to 8-MB shared instruction / data third-level cache (L3), shared among all cores.
- **1.750 billion Transistors (vary)**
- **Frequency Range** 1.90 GHz up to 3.80 GHz
- **Memory Type** DDR3 1600 MHz or 1333 MHz (at initial stage)
- Support **Turbo Boost Technology**

Advantages

- High speed performing rate so they are able to perform at the maximum CPU rate of 3.6 GHz
- Turbo technology is present in the device that boost up the working speed of the computational systems
- It provides the 64 bit architecture for the users for the reliable working.

Disadvantages:

- More expensive than core i3
- Less data visualization technology to users to view high quality images and video graphics.

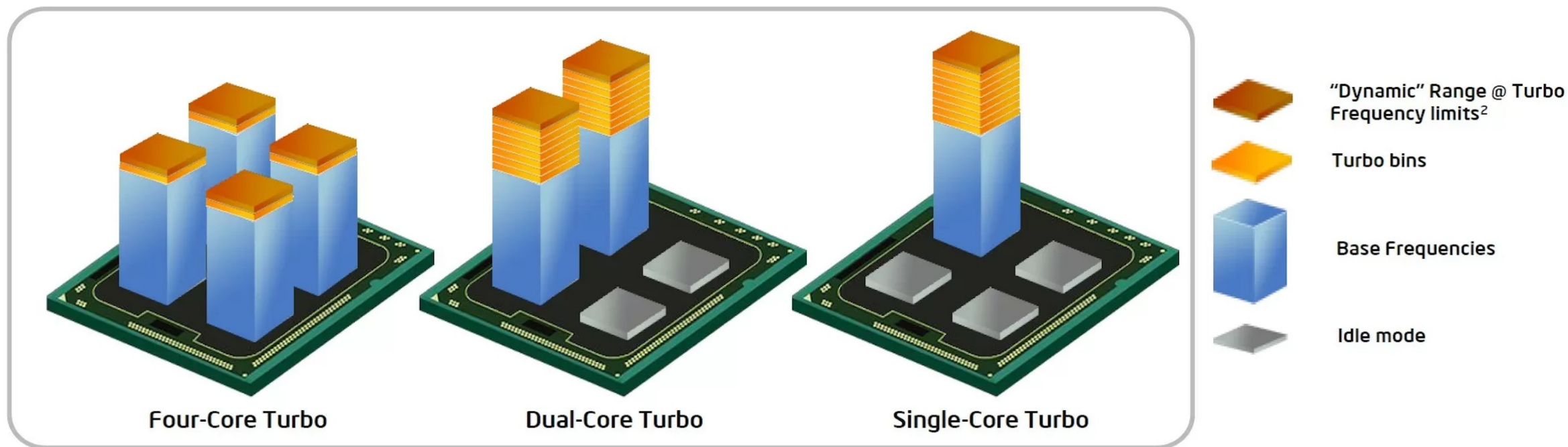
✓ Turbo Boost Technology

- Intel® Turbo Boost Technology can potentially increase CPU speeds up to the Max Turbo Frequency while staying within safe temperature and power limits.
- It is sometimes called "Algorithmic Overclocking"
- Intel Turbo Boost Technology is activated when the operating system requests the highest performance state of the processor.
- Maximum turbo frequency indicates the highest possible frequency achievable when conditions allow the processor to enter turbo mode.
- This can increase performance in both single-threaded and multithreaded applications.
- Intel Turbo Boost Technology frequency varies depending on
 - Workload
 - Hardware
 - Software and
 - Overall system configuration.

Turbo Boost Technology(Con..)

- Intel® Turbo Boost Technology 2.0² follows the behaviour described above, and is available on most Intel® Core™ processors newer than 2nd Gen (Intel® Core™ i5, i7, i9 processors, and Intel® Xeon® processors).
- Intel® Turbo Boost Max Technology 3.0 is an enhanced version of 2.0 that boosts the speed of a CPU's fastest cores individually, while also directing critical workloads to those boosted cores. It can increase single-threaded performance up to 15%.
- Intel® Turbo Boost Technology 3.0 is available in Intel® Core™ X-series processors, including:
 - Intel® Core™ i7-69xx/68xx processors
 - Intel® Core™ i9-7900X/i9-7920X/i9-7940X/i9-7960X/i9-7980XE/i7-7820X/i7-9800X processors
 - Intel® Core™ i9-9820X/i9-99x0XE/i9-99x0X processors
 - Intel® Xeon® processor E5-1600 v4 product family (single-socket)

Intel® Turbo Boost Technology¹ 2.0



Efficient.

- ✓ Adapts by varying turbo frequency to conserve energy depending upon the type of instructions

Dynamic.

- ✓ Boosts power level to achieve performance gains for high intensity "dynamic" workloads

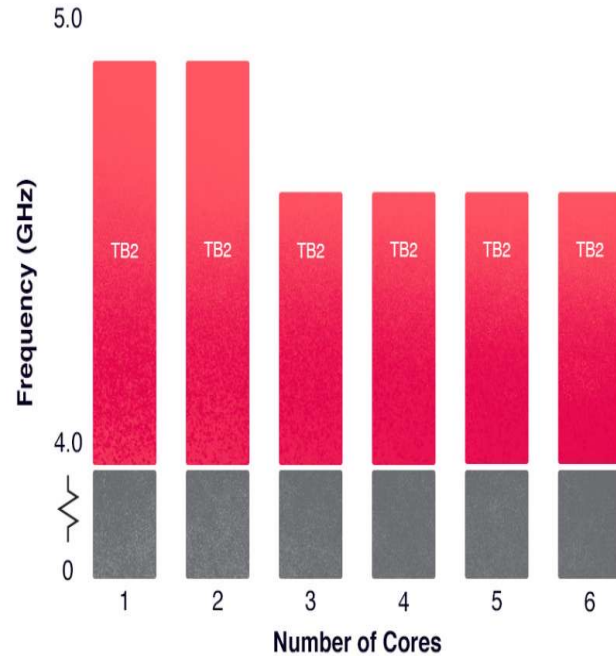
Intelligent.

- ✓ Power averaging algorithm manages power and thermal headroom to optimize performance

Intel® Turbo Boost Technology 2.0 delivers intelligent and energy efficient performance on demand

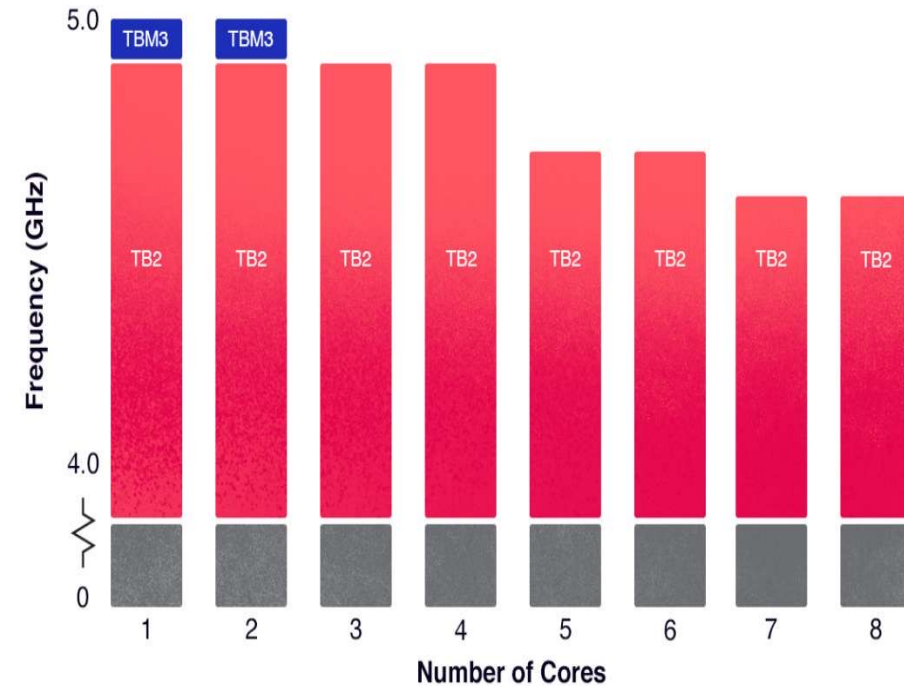
Turbo Boost Technology(Con..)

Intel® Core™ i5-11600K



Turbo Boost 2.0

Intel® Core™ i7-11700K



Turbo Boost 3.0

Core i7

- built based on the new Intel's micro architecture technology called **Nehalem**
- No. of cores
 - **4** cores / **6** cores (**Desktop**)
 - **2** cores / **4** cores (**Mobile**)
- **Transistors** (**9 billion**+ for intel i7-12700k)
- **Memory Type** **DDR3** , **DDR4** **1333** MHz or **1600** MHz
- **Frequency Range** **1.90** GHz up to **3.80** GHz
- **1MB** L2 and **8MB** L3 cache
- Support **Hyper-threading technology**
- Enhanced Intel **SpeedStep Technology**
- **Virtualization Technology**
- Streaming SIMD Instructions (MMX)
- **Over clocking capability**
- Supports Intel **Turbo Boost technology**

Advantages:

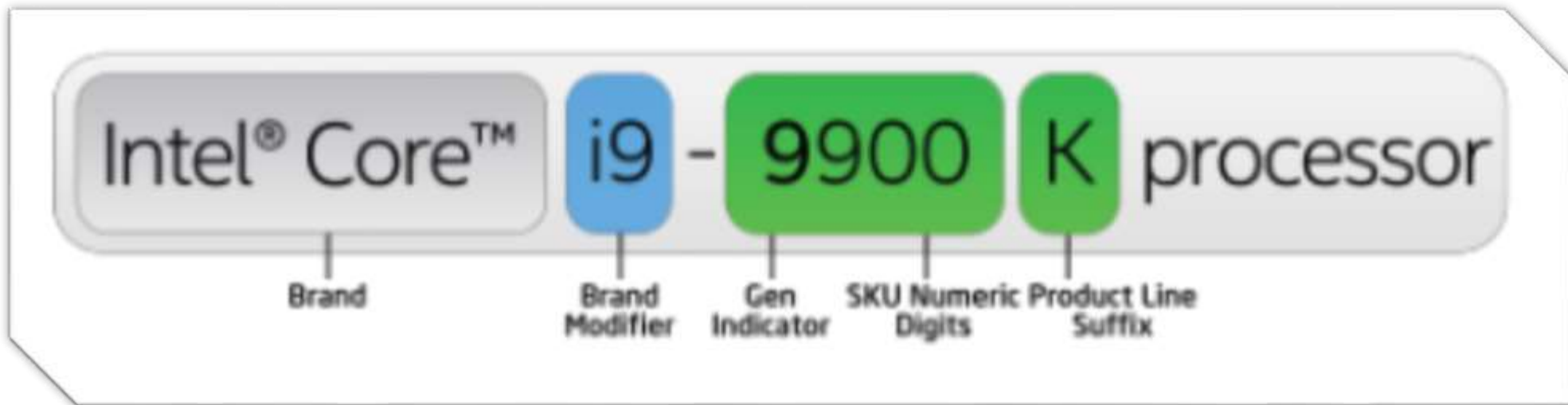
- Big cache size
- Very fast
- Better cooling system
- Provide High data visualization technology to users to view high quality images and video graphics.
- The i7 processor is marketed primarily to gaming enthusiasts, digital artists such as filmmakers and animators, multimedia editing, and specialized application.

Disadvantages

- Very Costly
- Power Consumption is relatively high from prior processors

Processor Family/Specifications	Intel Core i3 Processors	Intel Core i5 Processors	Intel Core i7 Processors
Core Number	2 Cores (Desktop/Mobile)	4 Cores (Desktop) 2 Cores (Mobile)	4 Cores / 6 Cores (Desktop) 2 Cores / 4 Cores (Mobile)
Processing Threads	4 Processing Threads (Desktop / Mobile)	8 Processing Threads (Desktop) 4 Processing Threads (Mobile)	8 / 12 Processing Threads (Desktop) 4 / 8 Processing Threads (Mobile)
Maximum Base Clocking Frequency	3.4 GHz	3.4 GHz	3.2 GHz
Maximum Turbo Boost Frequency	Not Applicable	3.8 GHz	3.8 GHz
Maximum Smart Cache Size	3 MB	6 MB	12 MB
Intel Turbo Boost 2.0	X	✓	✓
Intel Hyper-Threading	✓	✓ (Only Mobile Processors)	✓
Best Desktop Processor	Intel Core i3-2130 (3.40 GHz, 3 MB)	Intel Core i5-2550K (3.40 GHz, 6 MB)	Intel Core i7-3930K (3.2 GHz, 12 MB)
Best Mobile (Laptop) Processor	Intel Core i3-2370M (2.40 GHz, 3MB)	Intel Core i5-2540M (2.60 GHz, 3 MB)	Intel Core i7-2860QM (2.50 GHz, 8 MB)

Hidden secrets of Model number



Product Line Suffix

Suffix	Description	Example
Desktop		
K	Unlocked	8th Gen Intel® Core™ i7-8700K processor
T	Power-optimized lifestyle	6th Gen Intel® Core™ i7-6700T processor
Mobile/Laptop		
<u>U</u>	ultra-low power	
<u>H</u>	High Performance Graphics	7th Gen Intel® Core™ i3-7100H processor
<u>HQ</u>	High performance graphics, quad core,	7th Gen Intel® Core™ i7-7920HQ processor (Gaming Laptops)
<u>HK</u>	High performance graphics, unlocked	6th Gen Intel® Core™ i7- <small>1/10/2019</small> 6820HK processor

CORE i9

- One of the **most powerful Intel processors**
- Faster and smarter than existing CPUs because of its expanded multi-threading capacity and better power efficiency.
- Has different range of cores (**6~18**)
- Upto **16MB** Smart Cache
- **Transistors** (Intel Core i9-12900K chip counting 2.95B with 7nm processor area)
- **Base Frequency Range:** **2.8** GHz to **3.6** GHz
- **Turbo Freequency Range:** **4** GHz to **5.3** GHz
- **Max Memory Size:** **128 GB**, **64** GB (dependent on memory type)
- **Memory Type** Up to **DDR5** 5600 MT/s, Up to **DDR4** 3200 MT/s (13th generation laptop processor)
- Supports **Hyper threading**, **Turbo Boost Technology** 2.0, Intel **Turbo Max Technology** 3.0, **Intel SpeedStep Technology**, **Virtualization**, Software Guard (SGX), and Memory Protection (MPX),

Core i9

Processor Names	Processor Base Frequency	Max Turbo Frequency	Cores	Threads	Bus Speed	Recommended Price	Cache	Memory Type
I9-7800X	3.50 GHz	4.00 GHz	6	12	8 GT/s DMI3	\$383.00 - \$389.00	8.25 MB	DDR4-2400
i9-7960X	2.80 GHz	4.20 GHz	16	32	8 GT/s DMI3	\$1684.00 - \$1699.00	22 MB	DDR4-2666
i9-7940X	3.10 GHz	4.30 GHz	14	28	8 GT/s DMI3	\$1387.00 - \$1399.00	19.25 MB	DDR4-2666
i9-7920X	2.90 GHz	4.30 GHz	12	24	8 GT/s DMI3	\$1189.00 - \$1199.00	16.5 MB L3	DDR4-2666
i9-7900X	3.30 GHz	4.30 GHz	10	20	8 GT/s DMI3	\$989.00 - \$999.00	13.75 MB	DDR4-2666
i9-9980X	3.00 GHz	4.40 GHz	18	36	8 GT/s DMI3	\$1979.00 - \$1999.00	24.75 MB Smart Cache	DDR4-2666

Advantages:

- Powerful
- Fast
- Great choice for Workstations, power users, content creators. Although negligible improvement in gaming
- Improves the competition in CPU market, which in result benefits the customers.
- Offer significantly higher number of PCIe lanes than any other consumer CPU available in the market. Well, till Threadripper lands at least.
- Intensive multitasking such as video or gaming, or content creation.

Disadvantages:

- High cost
- Consumed Higher power
- Required expensive motherboards and supporting device to fit in.

Thank You !