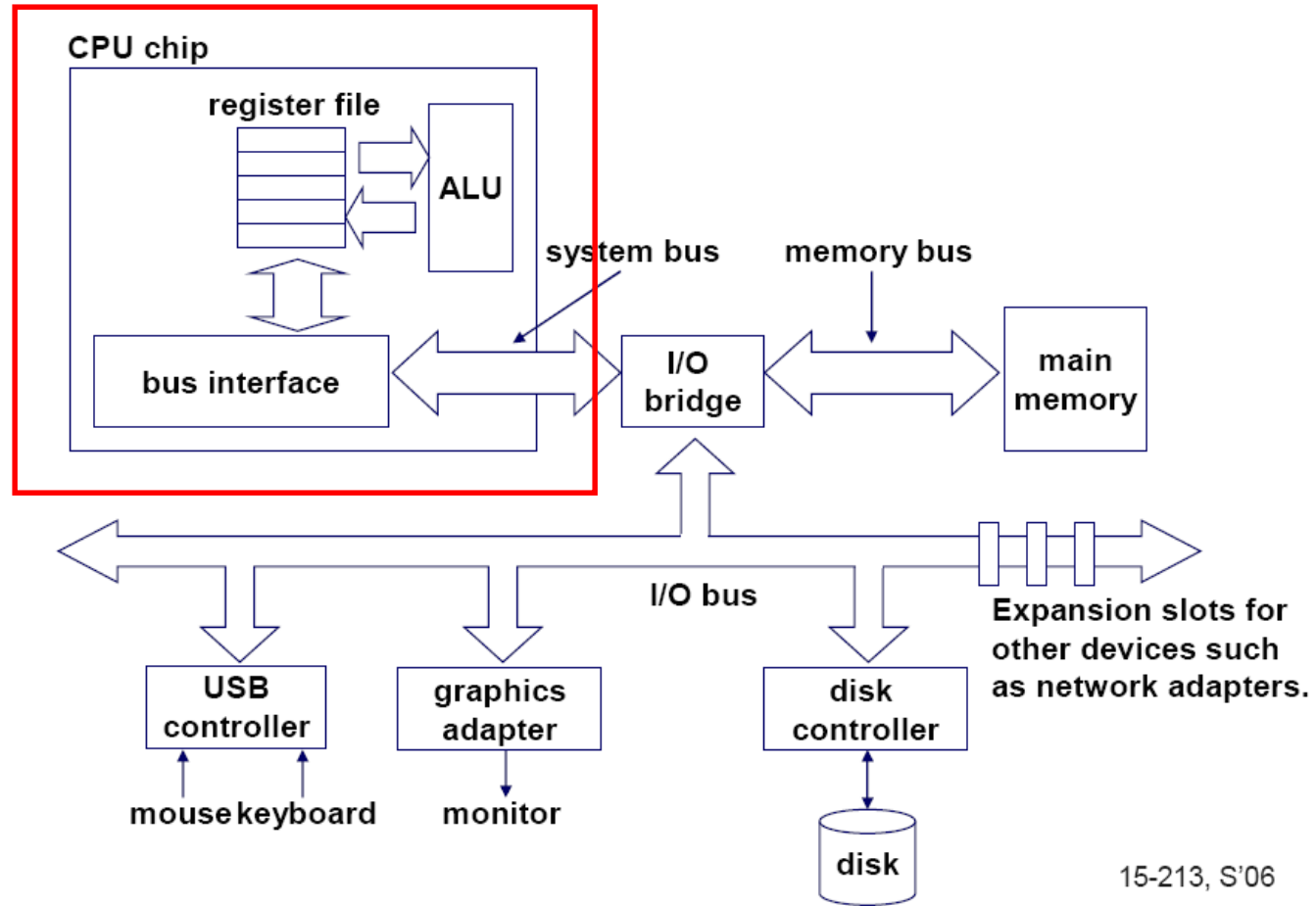


Intel Core i3, Core i5, core i7 & Core i9 Processors

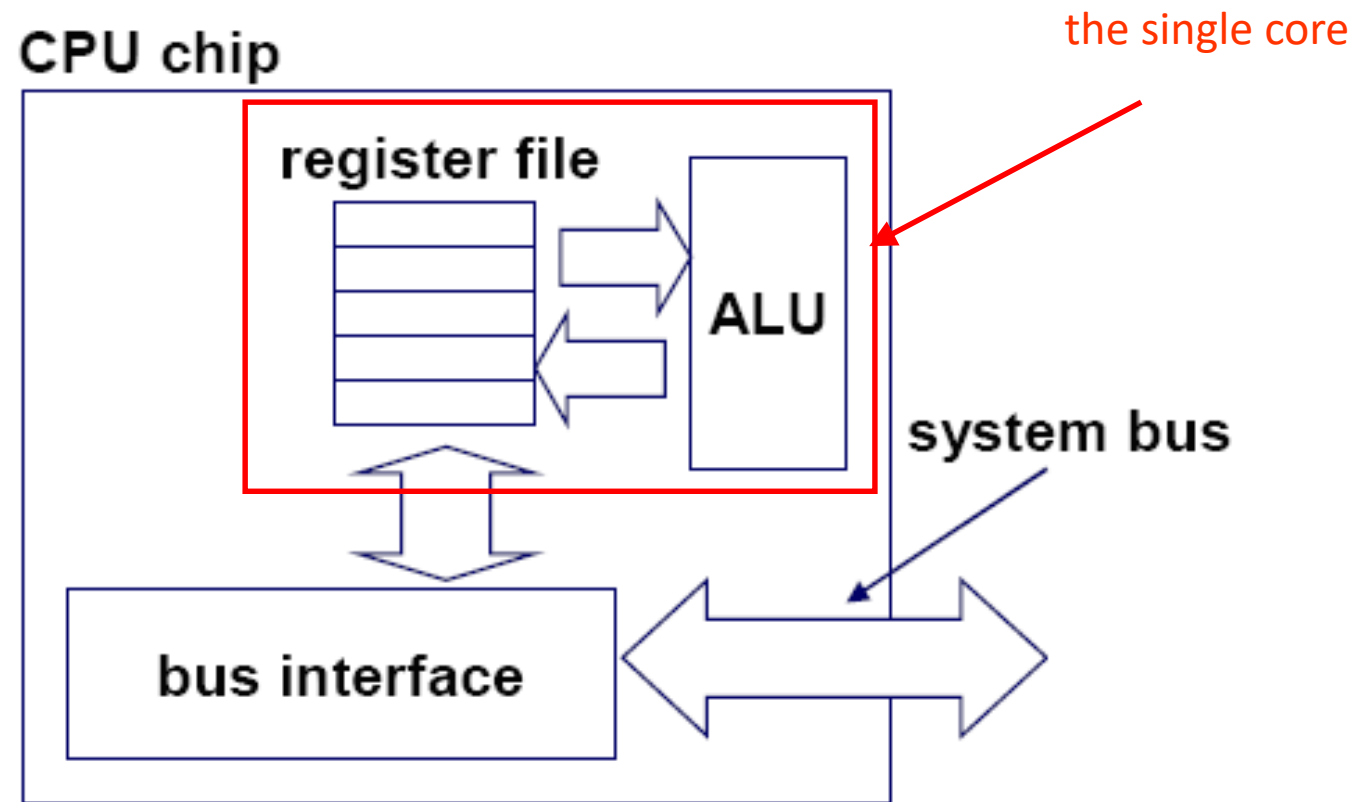
**Presented by
Dr. Md. Abir Hossain
Dept. of ICT
MBSTU**

Single-core computer



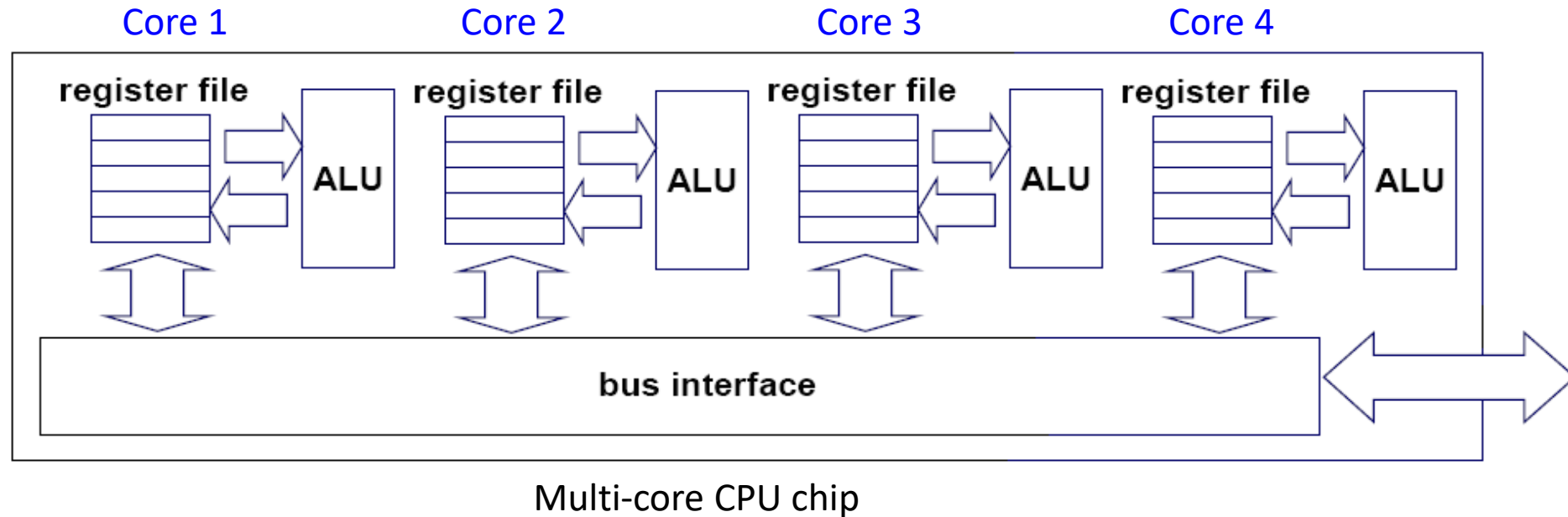
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Single-core CPU chip



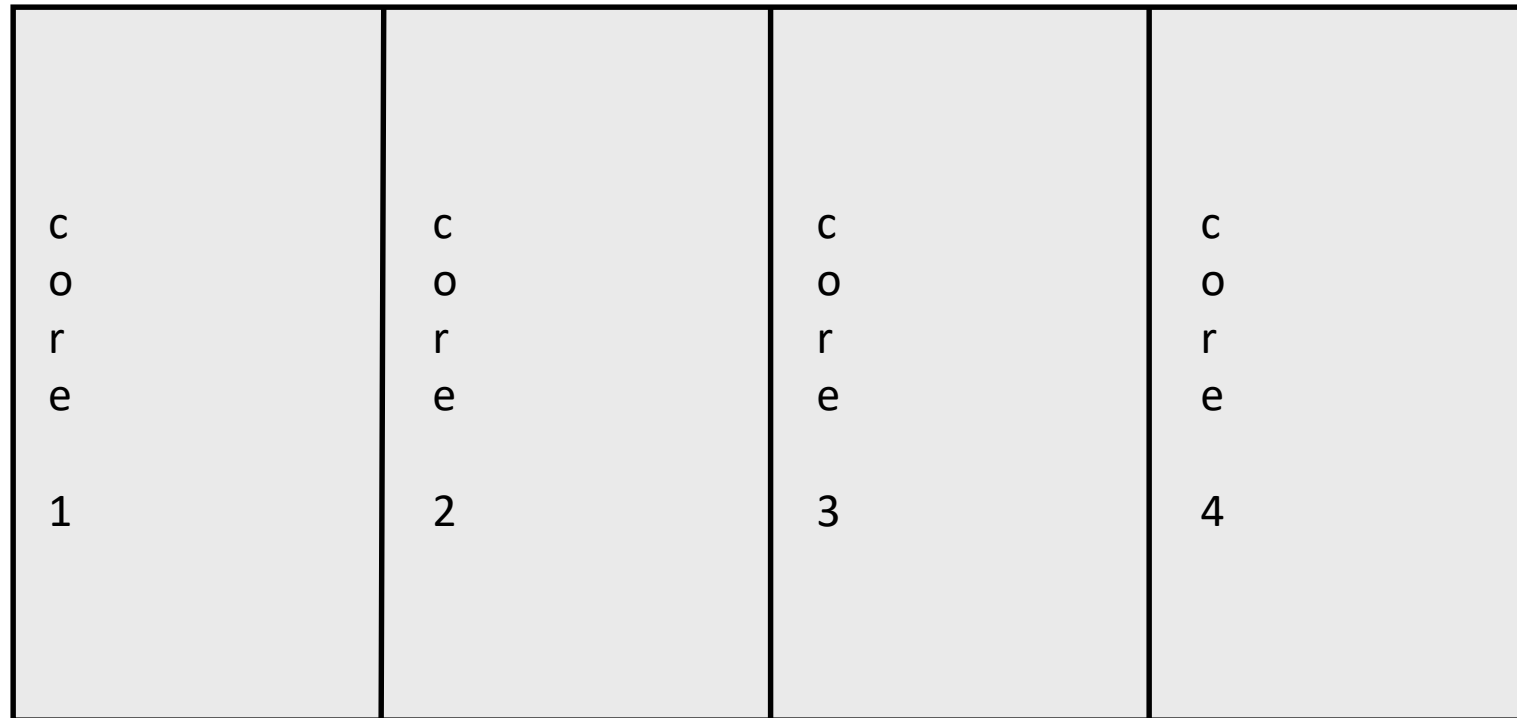
Multi-core architectures

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

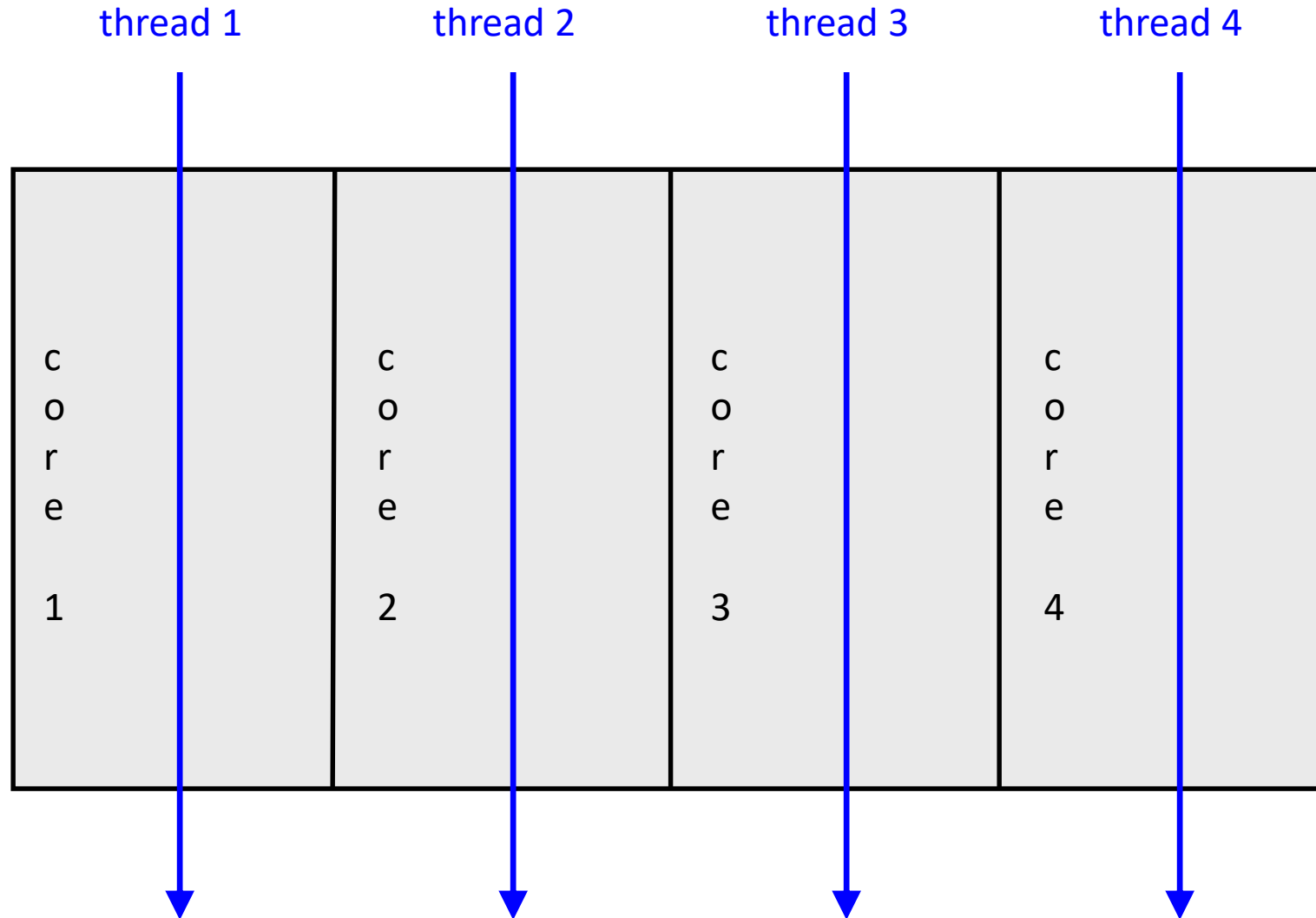


Multi-core CPU chip

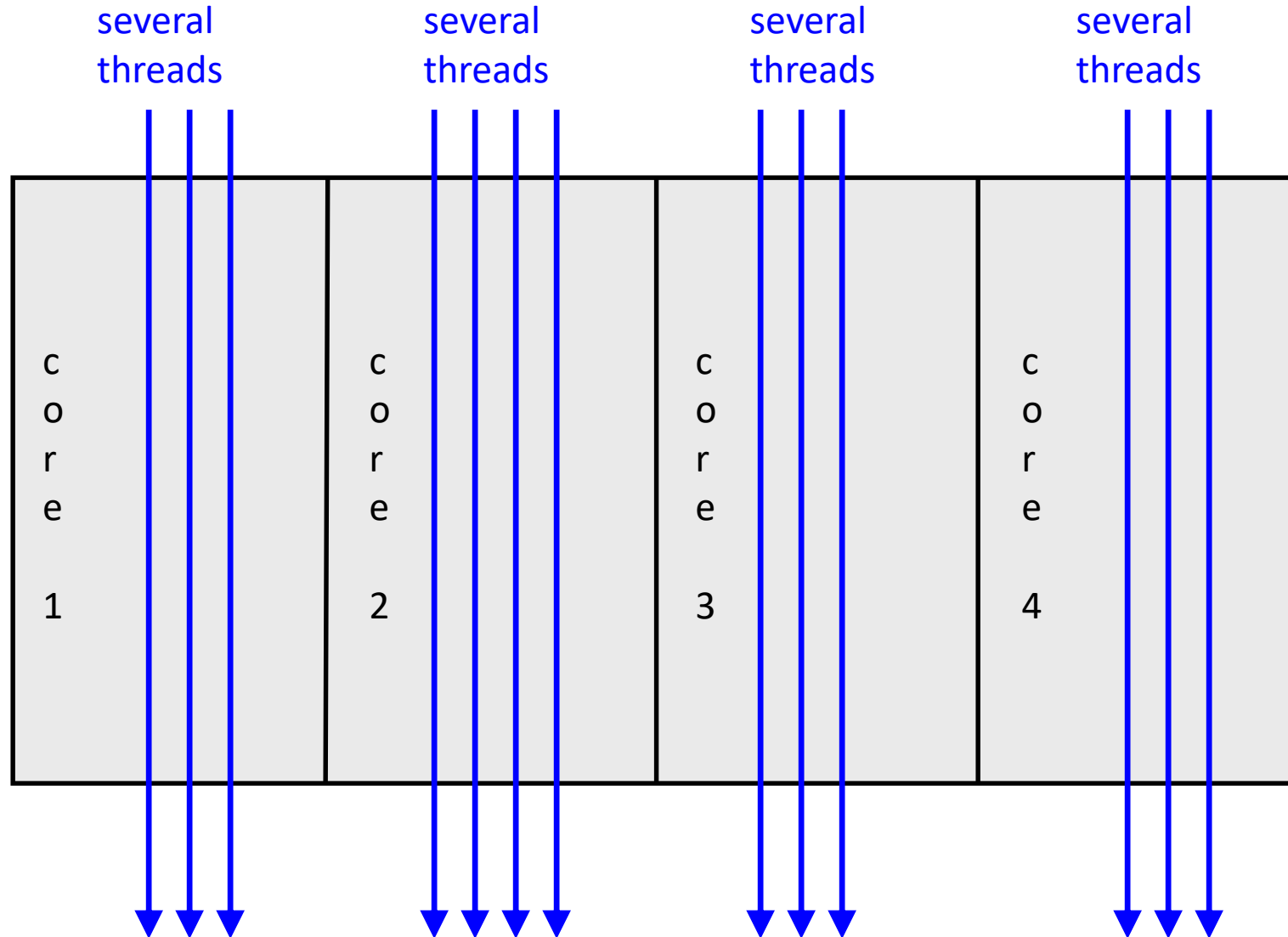
- The cores fit on a single processor socket
- Also called CMP (Chip Multi-Processor)



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 designed to execute the calculations and operations essential for running 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 a processor**

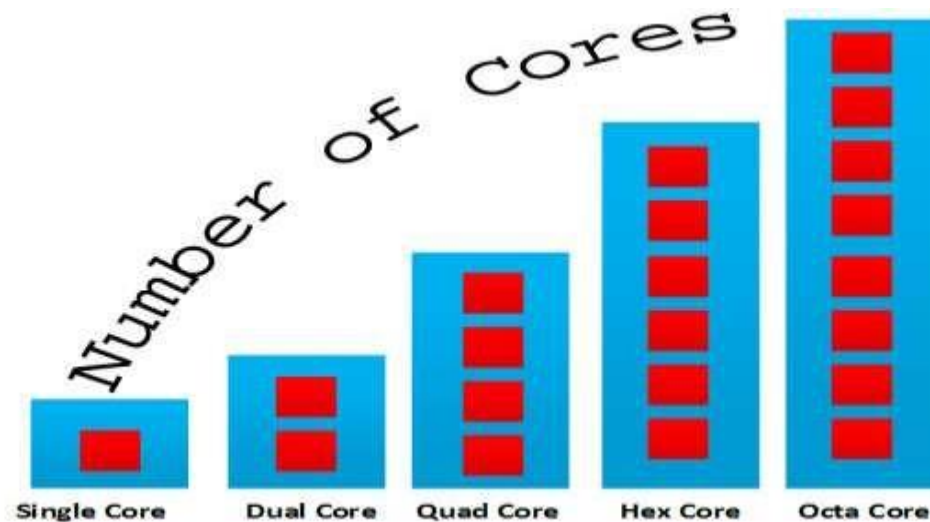
The four primary functions of a processor are **fetch**, **decode**, **execute** and **write back**.

- **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.

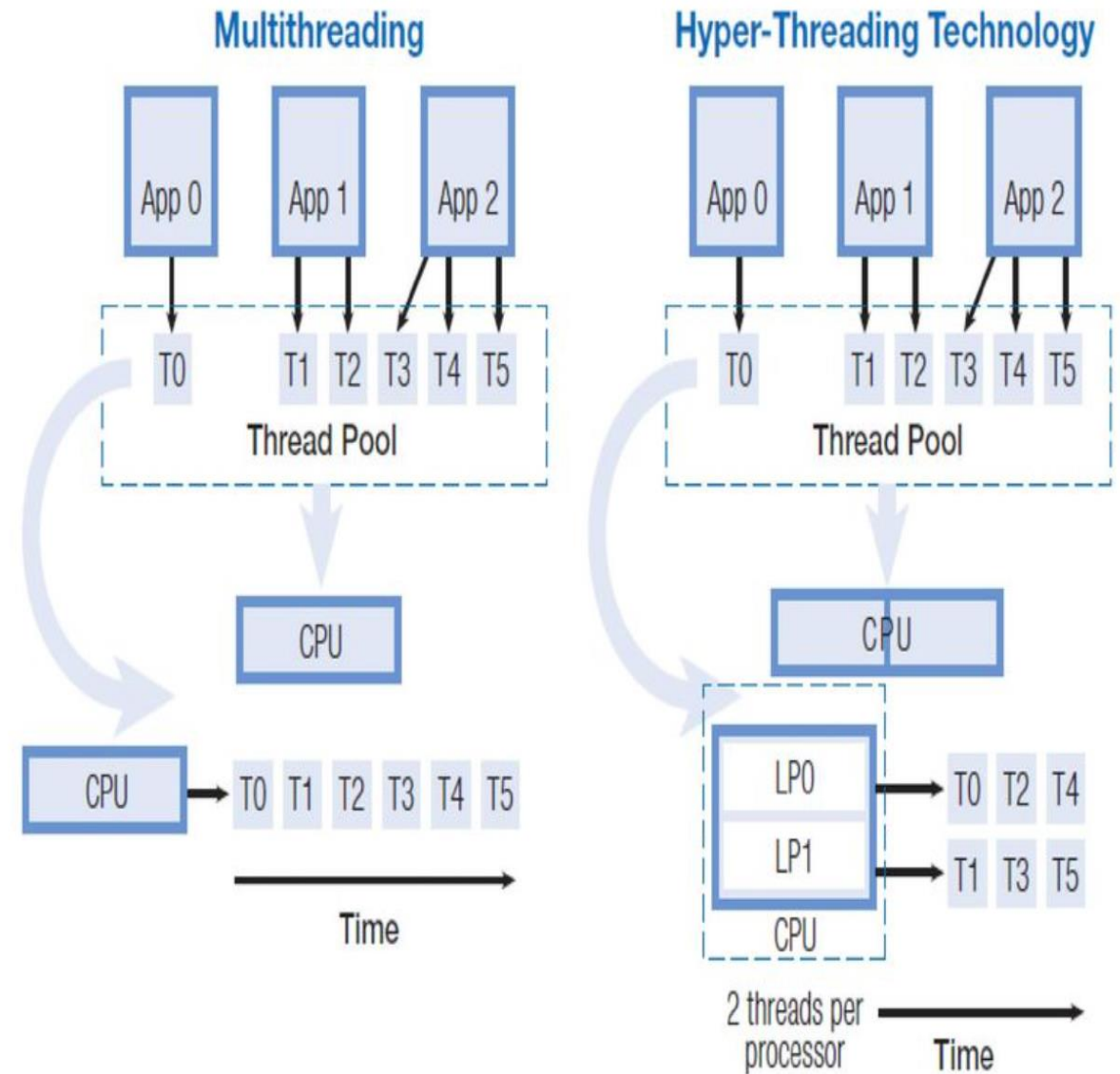
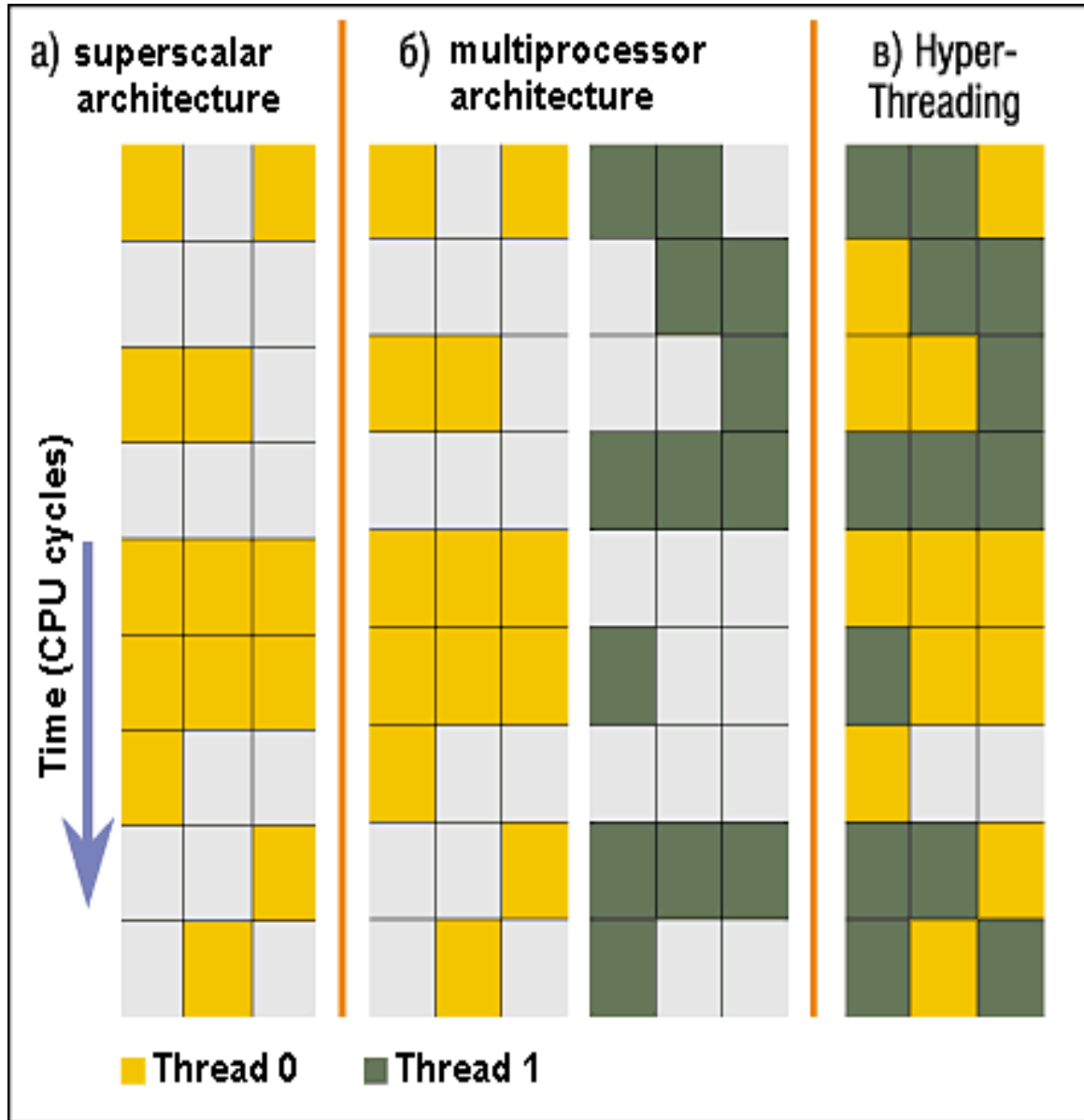
Disadvantages

- 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 performance 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 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.

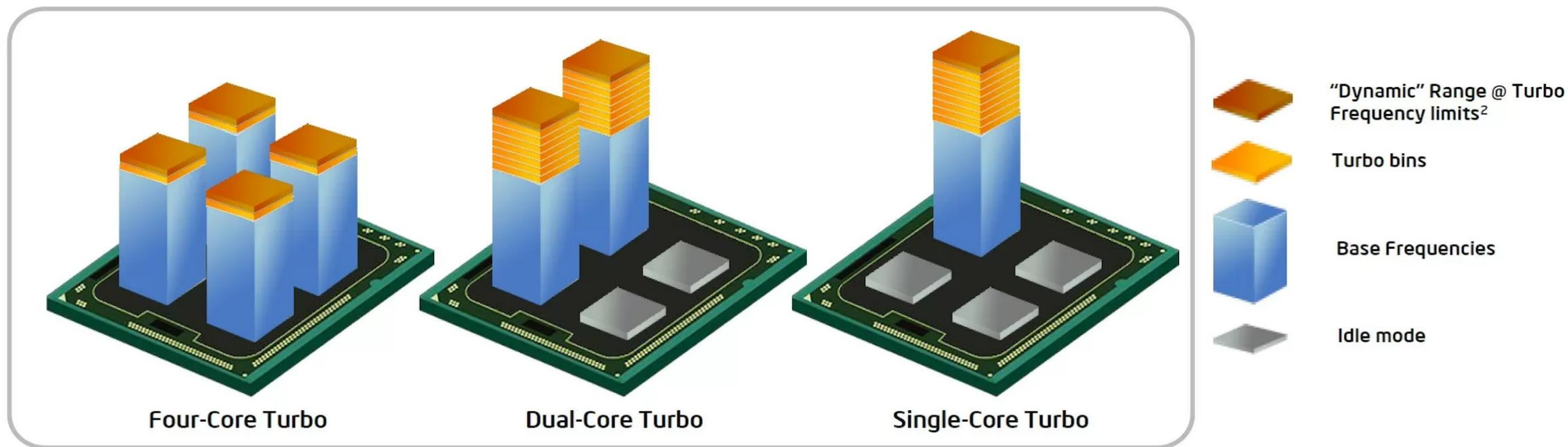
Turbo Boost Technology(2.0)

- 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).
- Boosts all-core frequency above base clock speed up to specified maximum frequency during more intensive workloads, available if the CPU's running under its power, current, and temperature limits.
- It's a power-efficient technology that lets your CPU run at a slower base frequency during light work, then boosts to a higher frequency for peak workloads.
- Turbo Boost 2.0 boosts all cores. It's also worth remembering that a CPU must be operating within power, current, and temperature limits before the speed increase takes effect.

Turbo Boost Technology(3.0)

- Intel® Turbo Boost Max Technology 3.0 identifies up to two of the fastest cores on your CPU, known as “**favored cores.**” Then it applies a frequency boost to those cores (or that core) and directs critical workloads to them.
- Intel® Turbo Boost Max Technology 3.0 doesn’t replace Turbo Boost 2.0. It’s another technology that provides an extra boost to the favored core(s). This helps benefit performance in lightly-threaded applications.
- Games and many common applications rely⁴ on high-frequency cores and benefit from Intel® Turbo Boost Max Technology 3.0.
- 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

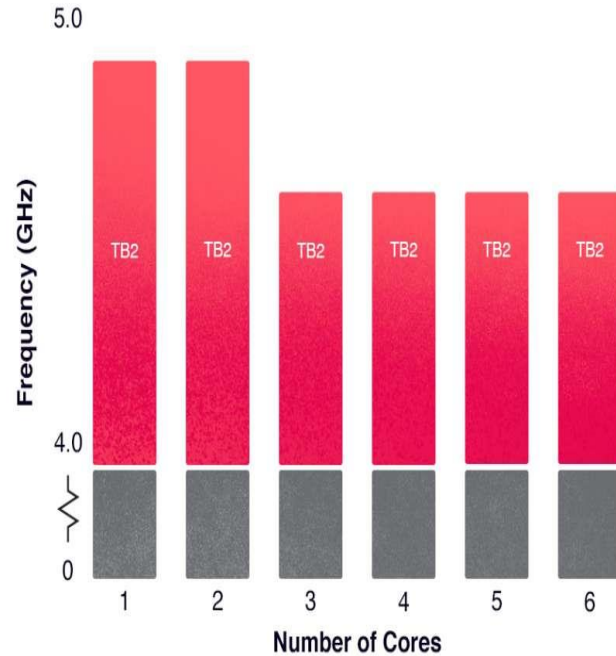
Intelligent.

- ✓ 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

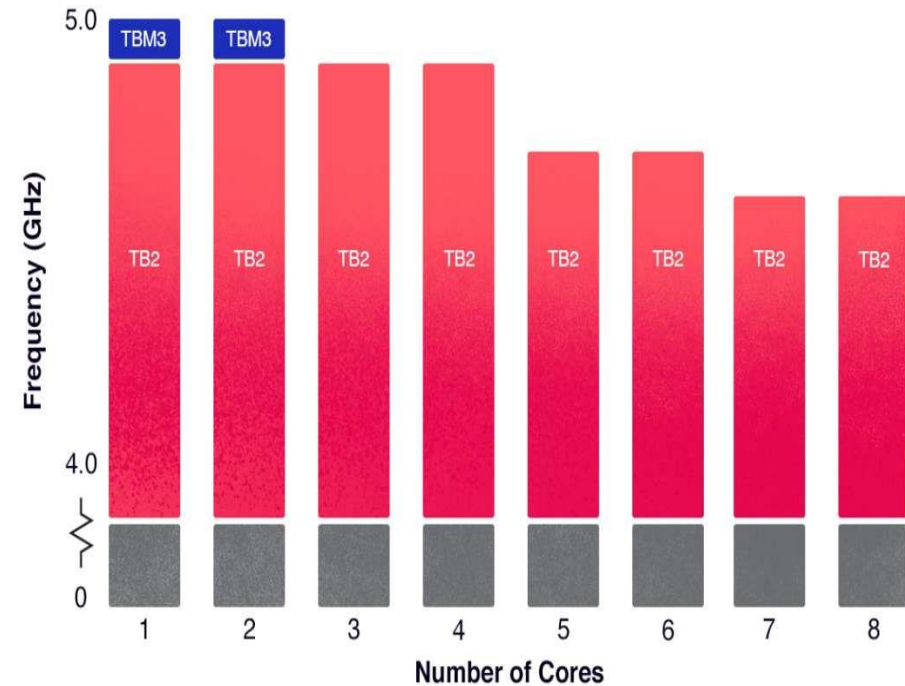
Turbo Boost Technology(Con..)

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:

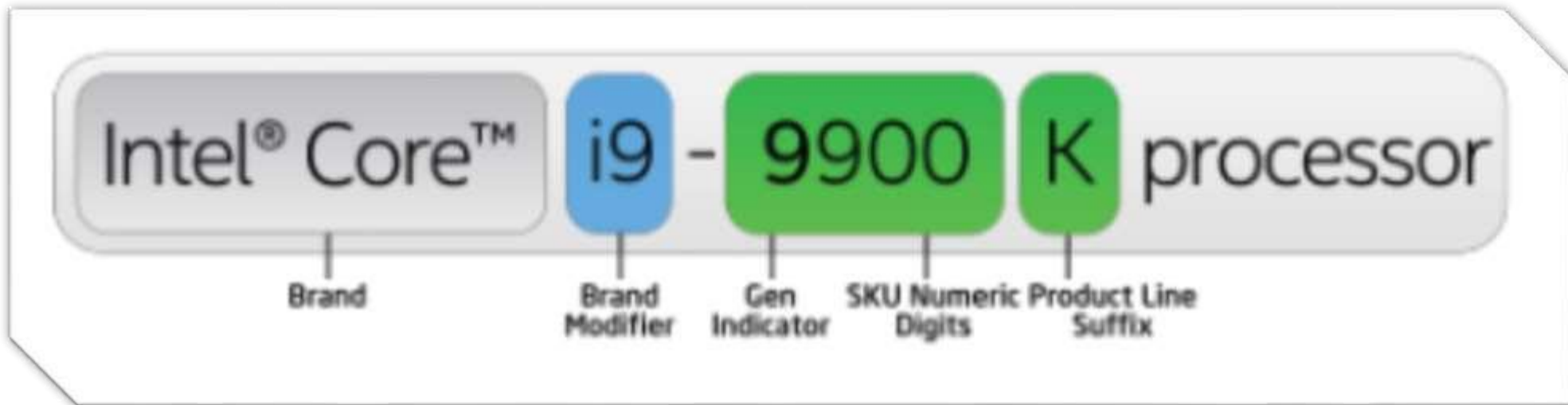
- Big cache size
- Very fast
- Better cooling system
- Provide High data visualization technology to users to view high quality images and video graphics.
- The i7 processor is marketed primarily to gaming enthusiasts, digital artists such as filmmakers and animators, multimedia editing, and specialized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



Stock keeping unit (SKU) is typically 8–12 characters long. Each character in an SKU represents a specific feature of the product, such as its brand, style, color, size, or department.

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™ i7-1/10/2019 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 Thread ripper 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 !