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

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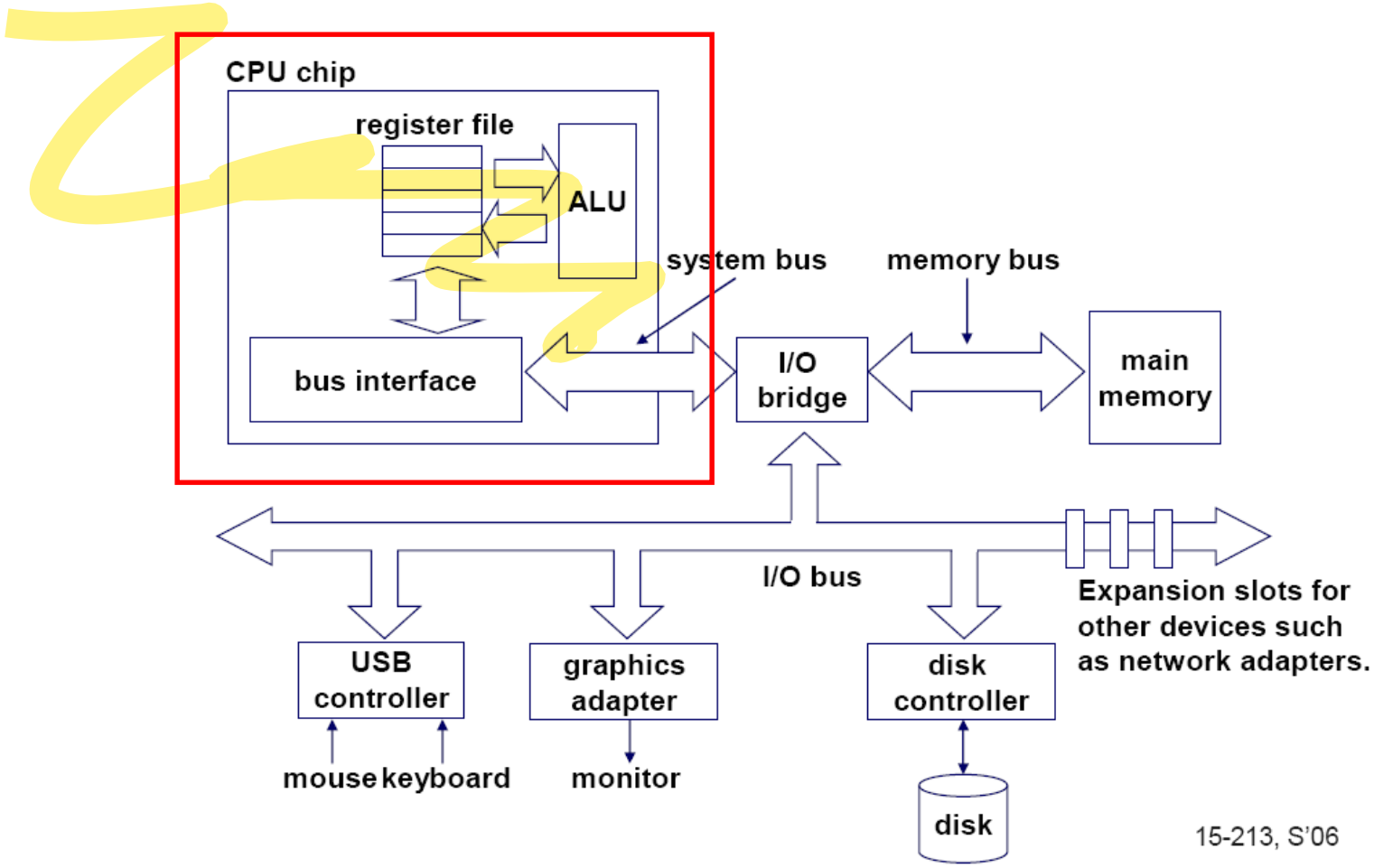
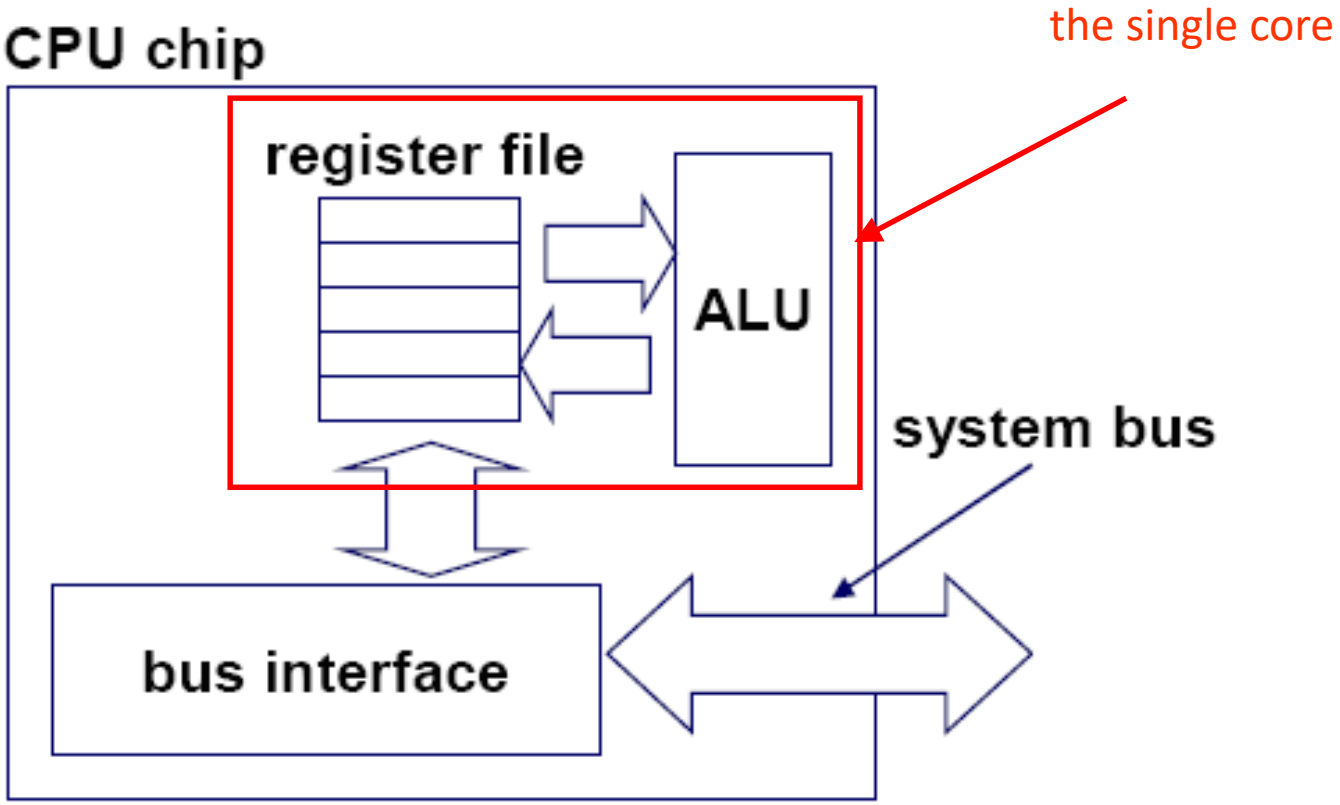
Single-core computer

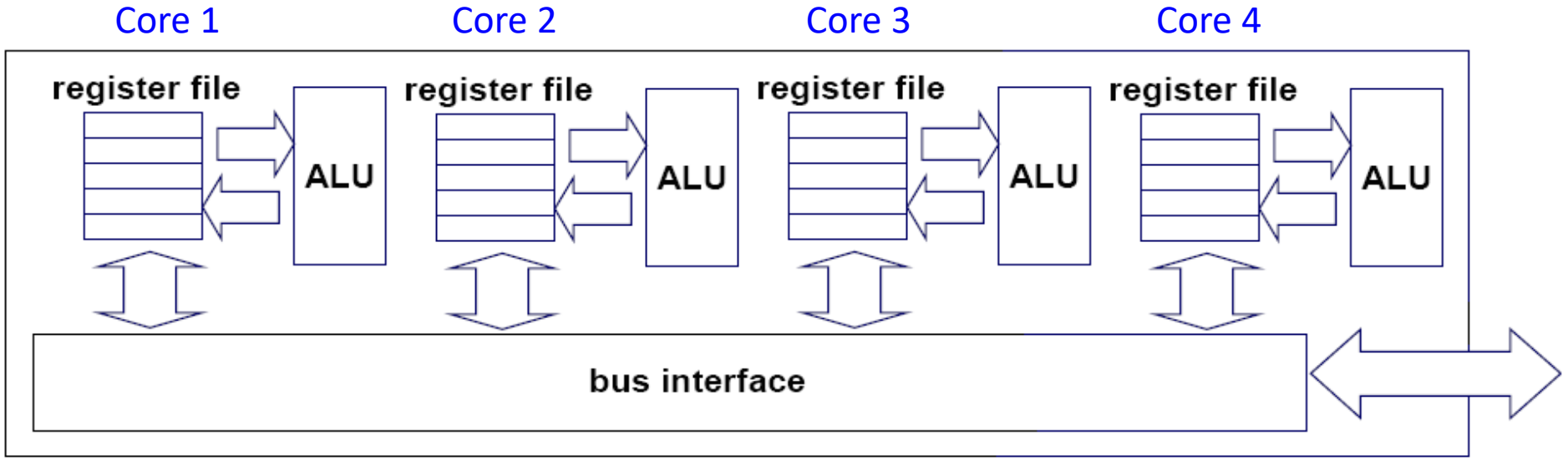


Single-core CPU chip



Multi-core architectures

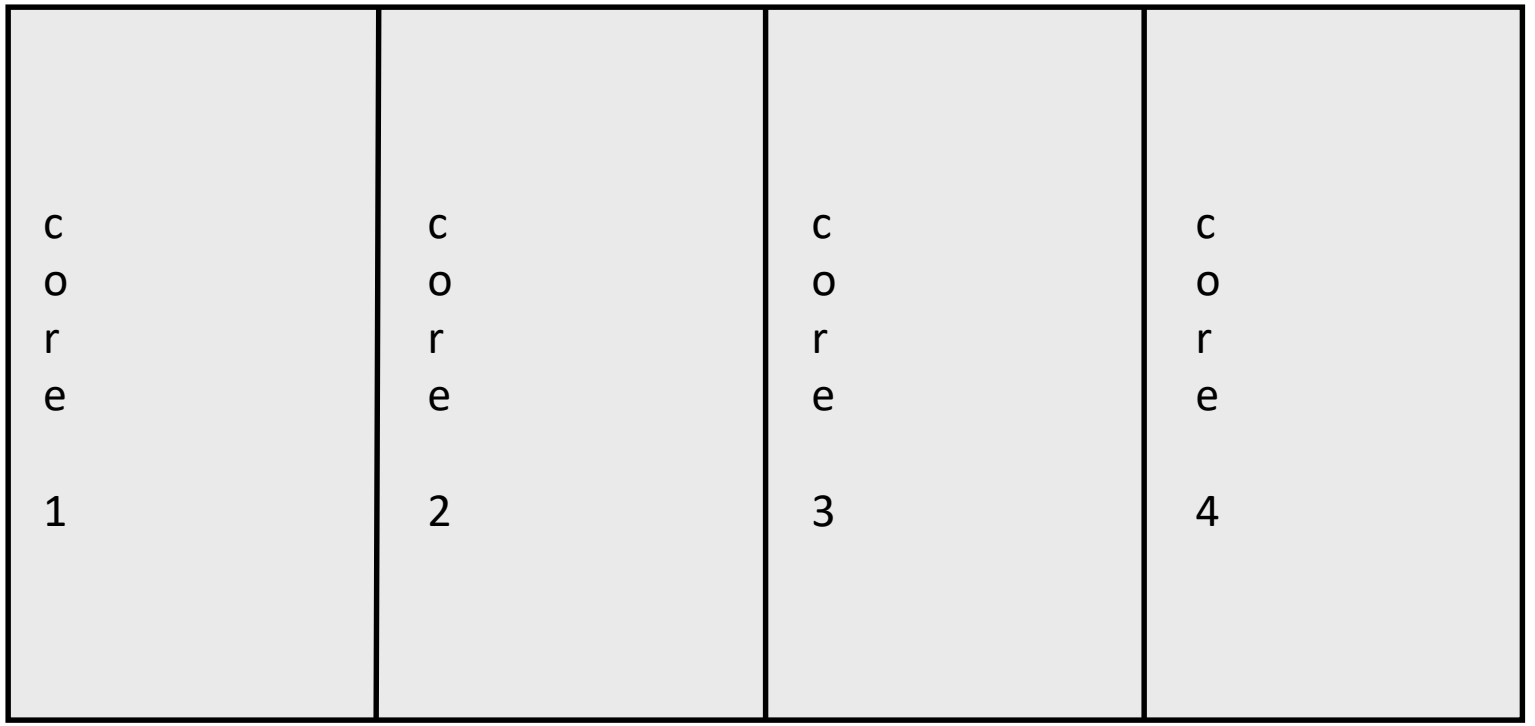
- This lecture is about a new trend in computer architecture:
  Replicate multiple processor cores on a single die.



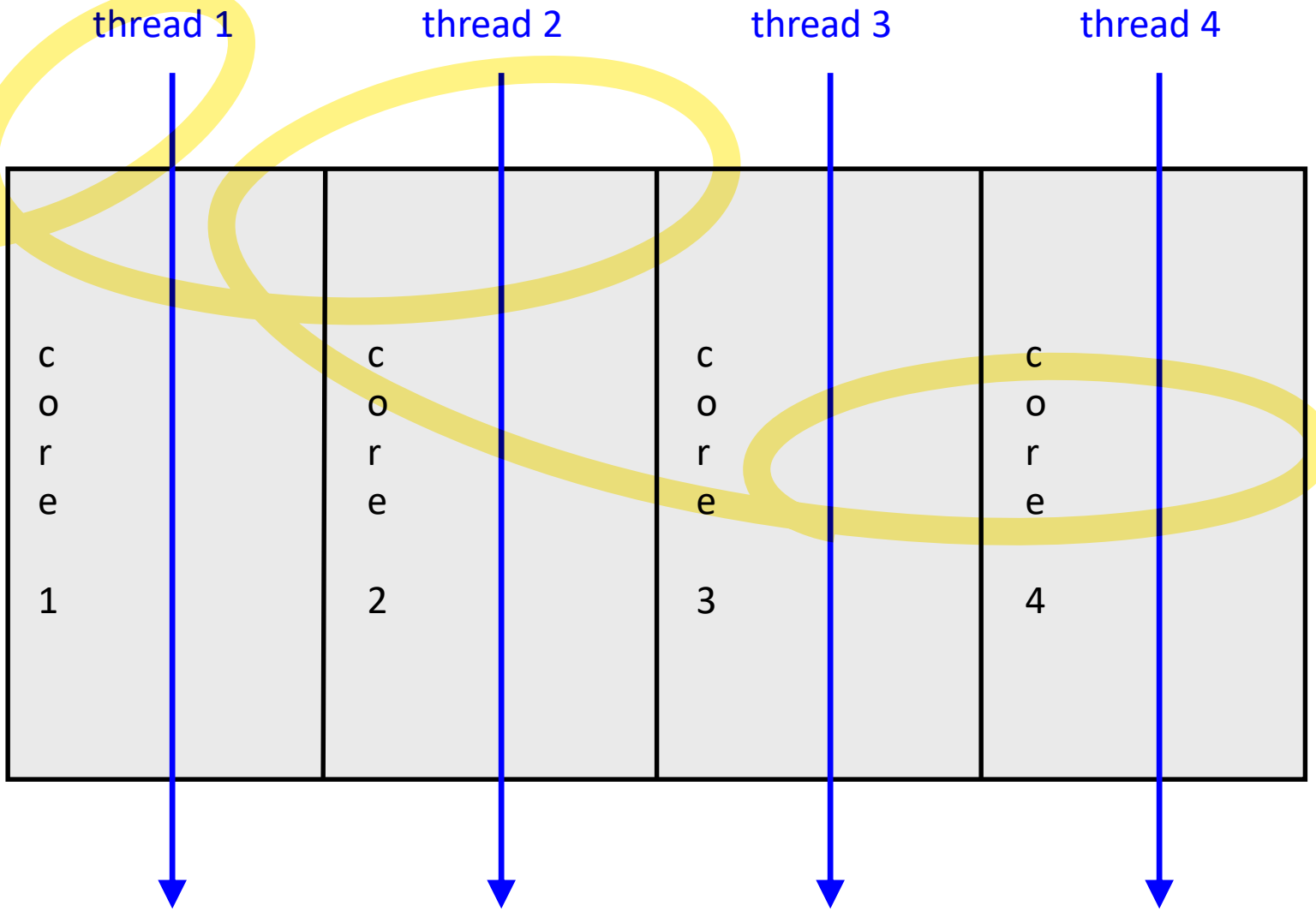
Multi-core CPU chip

Multi-core CPU chip

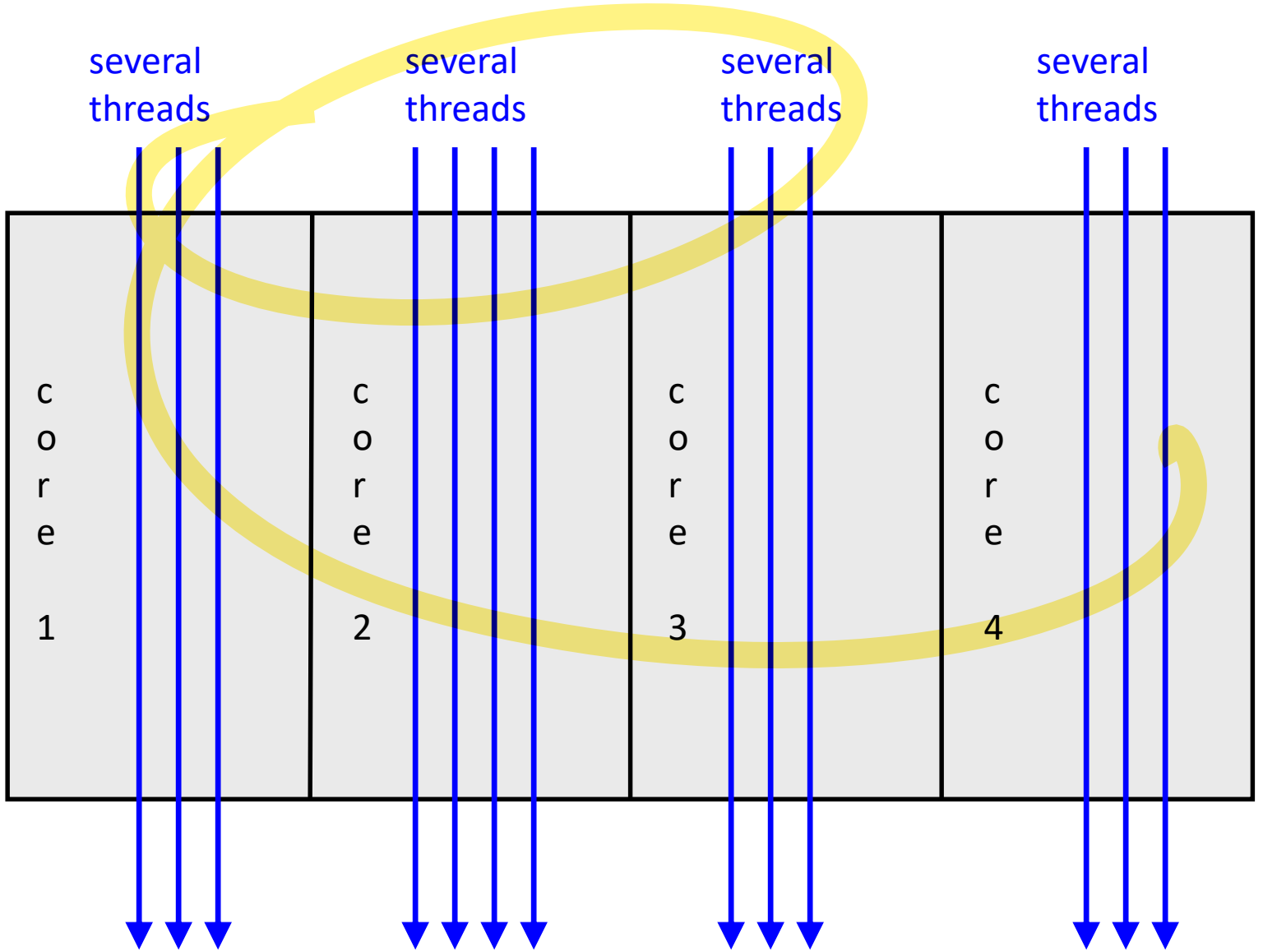
- The cores fit on a single processor socket
- Also called CMP (Chip Multi-Processor)



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.

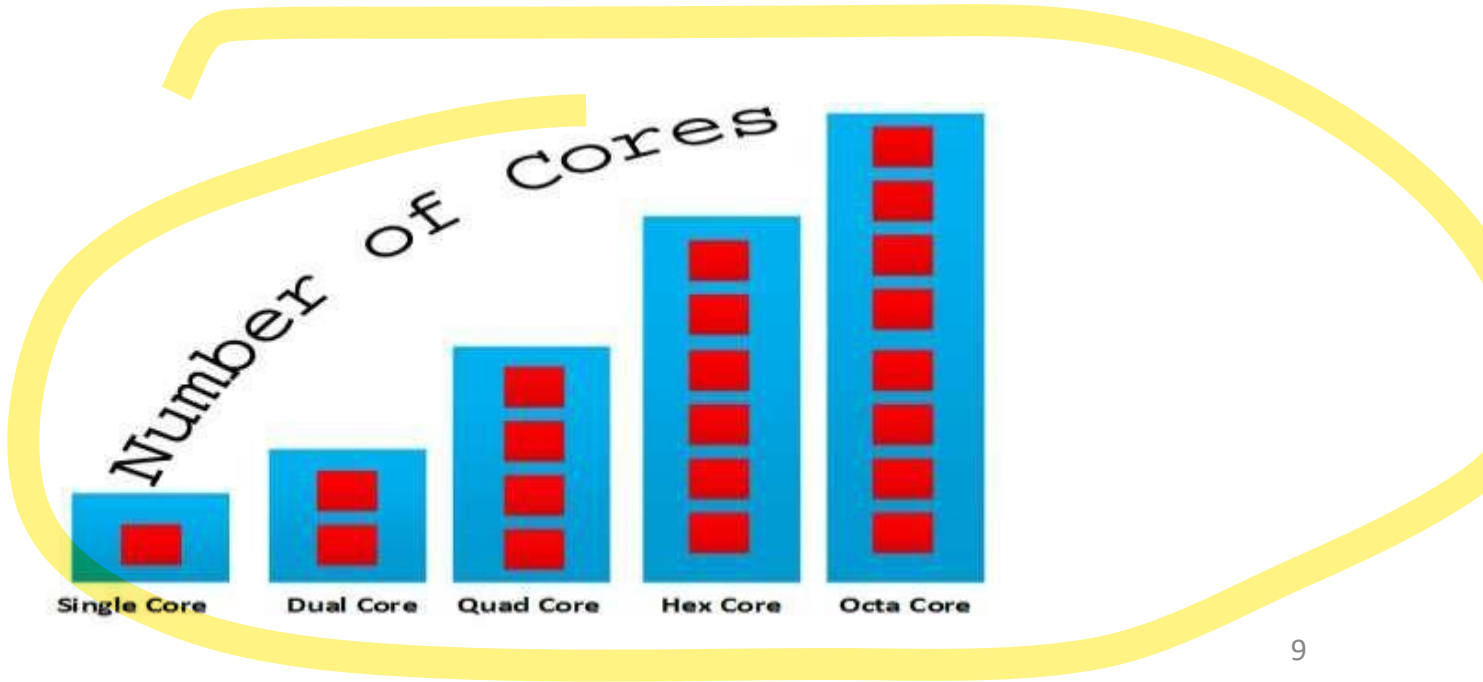
➢ **cache memory** in the CPU saves time to fetch instruction from (RAM).

➢ **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.

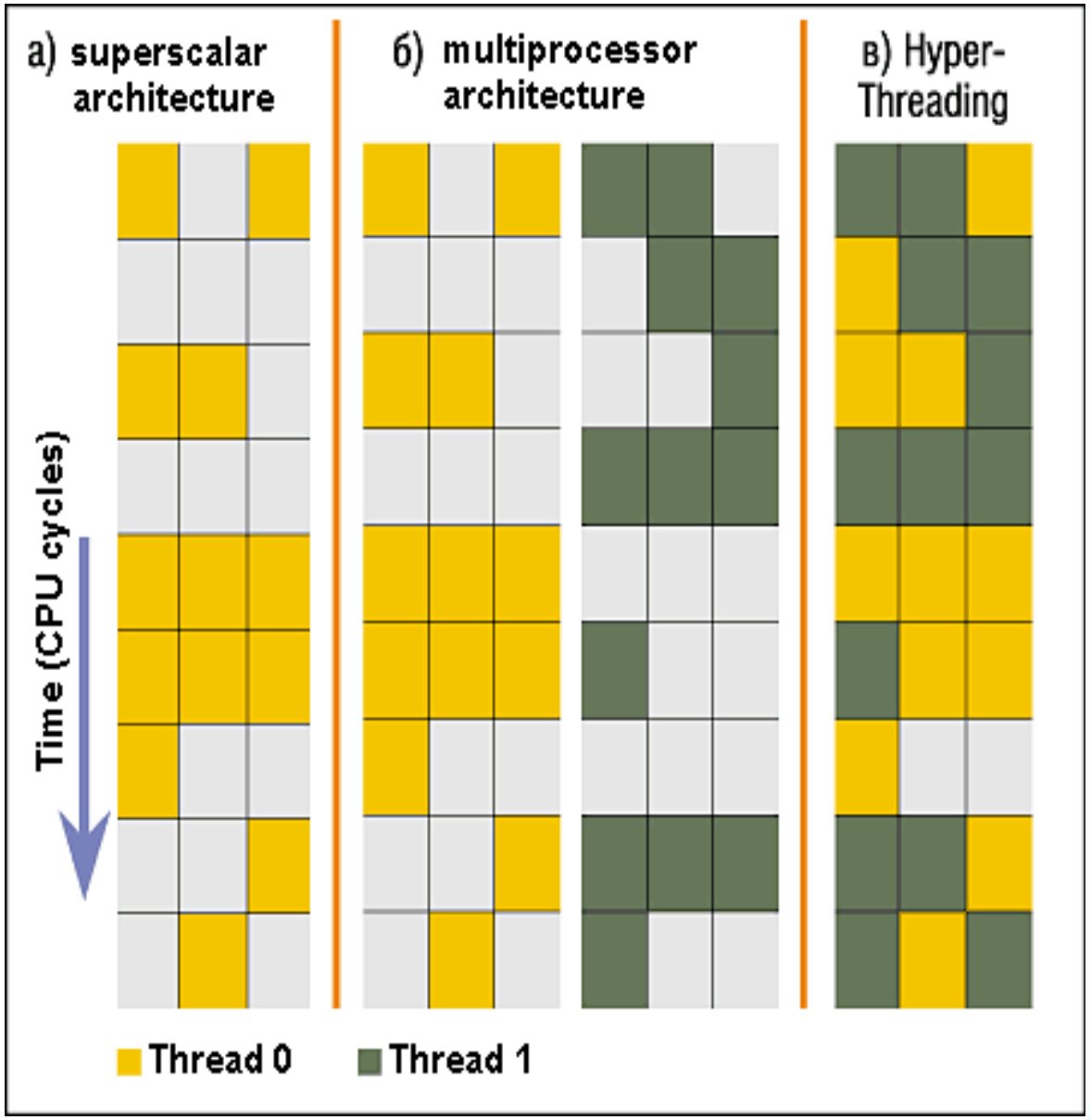
Disadvantages

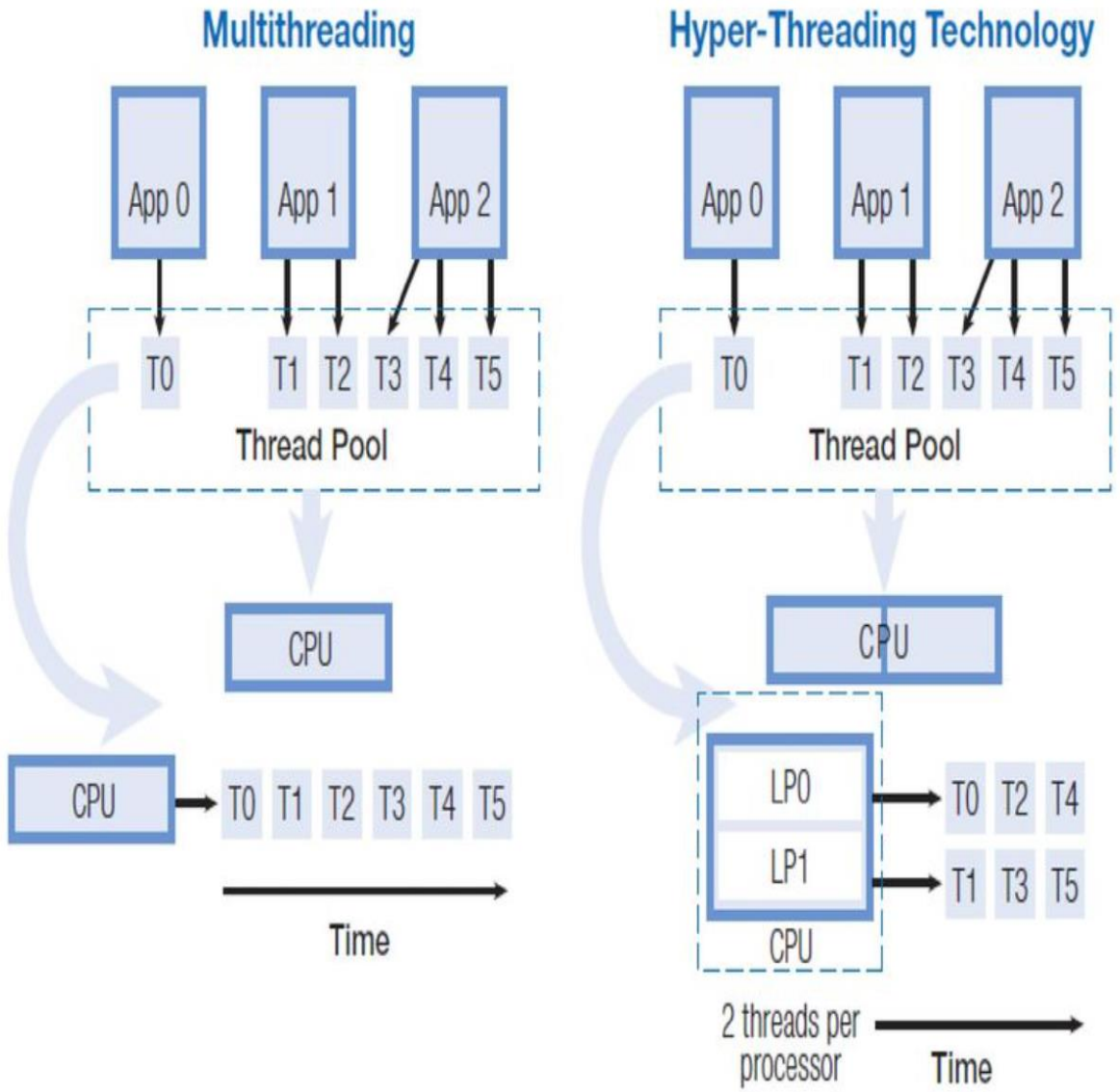
- Slower than latest version (Core i5,i7 & i9) processor.
- Get over-heated.
- Graphics quality is low than latest version.

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.

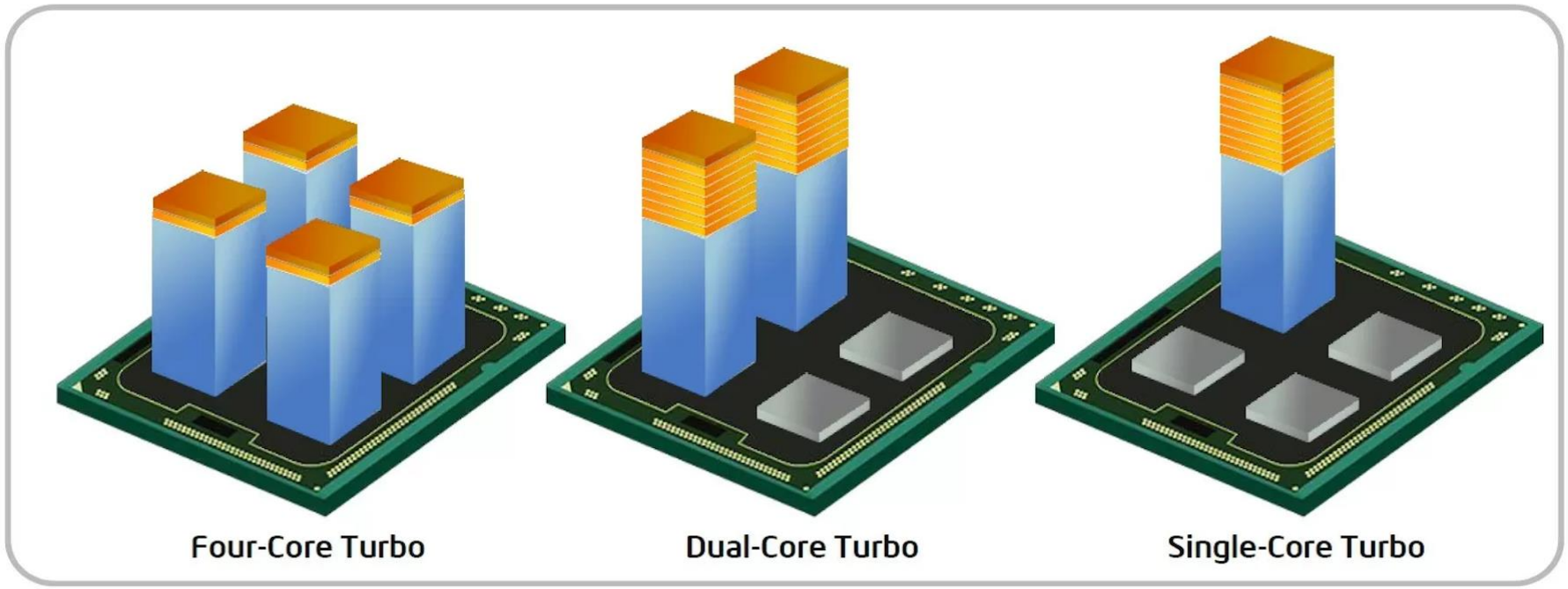
Turbo Boost Technology(2.0)

- Intel® Turbo Boost Technology 2.0[2] 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 Technology[1] 2.0



Efficient.

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

Dynamic.

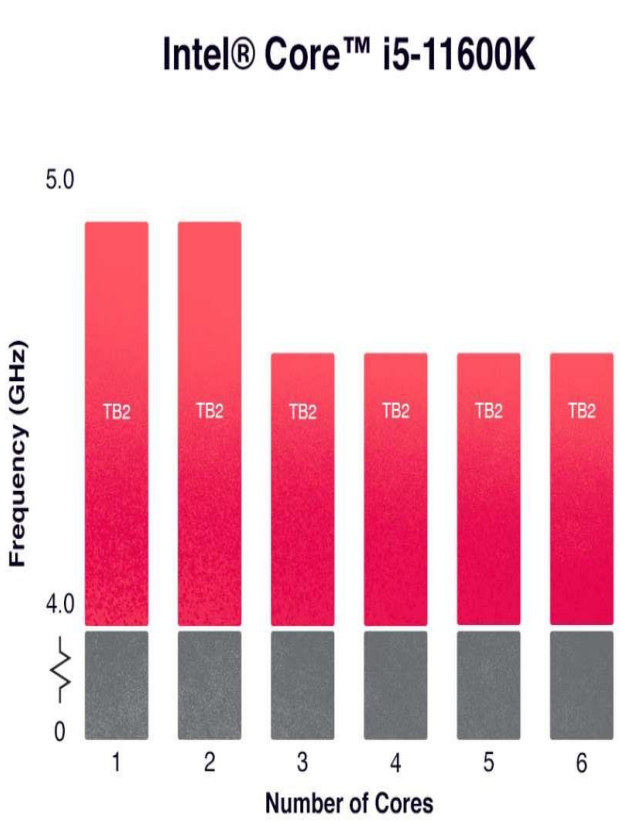
- Boosts power level to achieve performance gains for high intensity "dynamic" workloads

Intelligent.

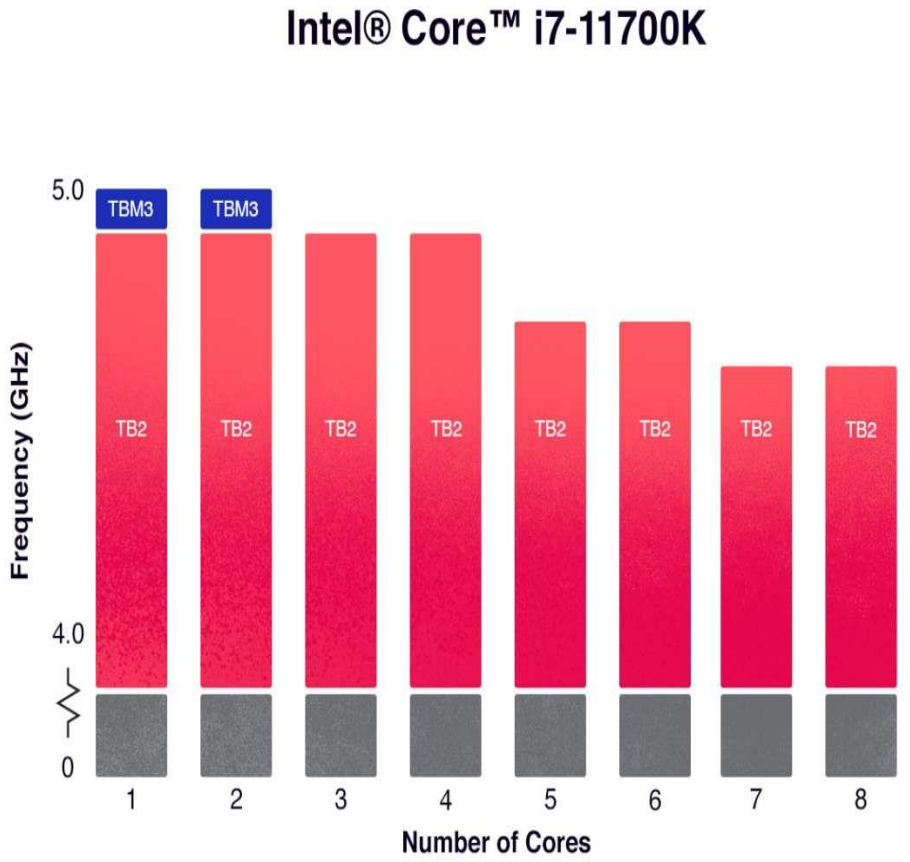
- Power averaging algorithm manages power and thermal headroom to optimize performance

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

Turbo Boost Technology(Con..)



Turbo Boost 2.0



Turbo Boost 3.0

https://www.intel.com/content/www/us/en/gaming/resources/how-intel-technologies-boost-cpu-performance.html

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:

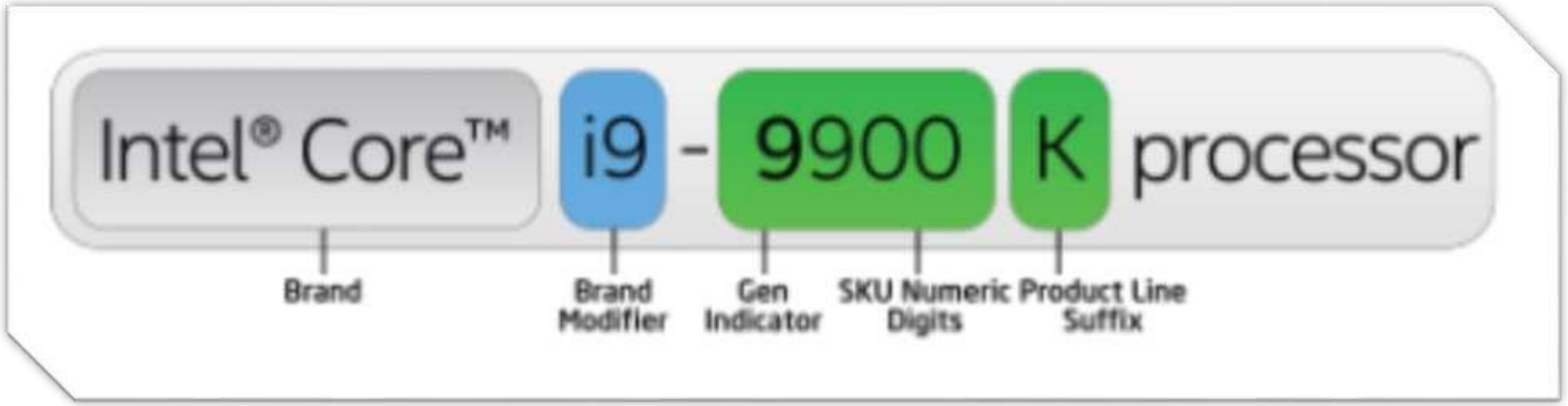
- Big cache size
- Very fast
- Better cooling system
- Provide High data visualization technology to users to view high quality images and video graphics.
- The i7 processor is marketed primarily to gaming enthusiasts, digital artists such as filmmakers and animators, multimedia editing, and specialized 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	✗	✓	✓
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	ultra-low power	
H	High Performance Graphics	7th Gen Intel® Core™ i3-7100H processor
HQ	High performance graphics, quad core,	7th Gen Intel® Core™ i7-7920HQ processor (Gamming Laptops)
HK	High performance graphics, unlocked	6th Gen Intel® Core™ i7-6820HK 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 with7nm 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),

Megatransfer/ millontransfer per second: https://www.kingston.com/en/blog/pc-performance/mts-vs-mhz

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 !