

ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ / ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ

УДК 004.94

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TECHNOLOGY INSIDE THE PROCESSOR

The article deals with the processors technologies and the reasons for their development. The principles for operation of hyper-threading technology, hardware coding and video decoding unit are considered. The article describes how these technologies work.

Keywords: hyper-threading, processor, codecs, technologies, CPU frequency.

Стаття розглядає технології, які містяться в процесорах та для чого вони були створені. Розглянуто принципи роботи технології багатопоточності, блоку апаратного кодування, декодування відео. Описано, як дані технології працюють.

Ключові слова: багатопоточність, процесор, кодеки, технології, частота процесора.

The power of processors is often measured by the number of GHz. The more gigahertz, the better the processor, but luckily it's over. In the 2000s, all manufacturers compared this indicator. And we used to think that it is decisive, but in fact in 2010 the growth of clock speed stopped, but processors continued to increase their performance. If you look at the two chips of 2010 and 2020, they have almost the same gigahertz, and benchmark performance is four times different.

If you look at the two chips from 2010 and 2020, they have almost the same number of gigahertz, and the benchmark performance is four times different (Image 1).

As it turns out, there are many complex factors that affect the speed of operation: transistors density, core architecture, etc. But there is another thing that many do not know or forget. It is smart technology that is inside the processors.

	Intel Core i7-10700K @ 3.80GHz	Intel Core i7-2600K @ 3.40GHz
Price	\$379.88 BUY NOW!	\$327.04 BUY NOW!
Socket Type	FCLGA1200	LGA1155
CPU Class	Desktop	Desktop
Clockspeed	3.8 GHz	3.4 GHz
Turbo Speed	Up to 5.1 GHz	Up to 3.8 GHz
# of Physical Cores	8 (Threads: 16)	4 (Threads: 8)
Max TDP	125W	95W
Yearly Running Cost	\$22.81	\$17.34
First Seen on Chart	Q2 2020	Q4 2010
# of Samples	581	6839
Cross-Platform Rating	40777	11510
Single Thread Rating	3080	1733
CPU Mark	19643	5429

Image 1. Comparison of processors

Let's go back to 2002, when processors were mostly single-core and not very efficient. So, there was an acute problem with multitasking, because even then people wanted not only to edit excel tablets, but also listen to music or do something else. Then the world was shown the technology of hyper-threading, which solved the problem of multitasking. Suppose you are running

one very resource-intensive program that loads the processor. If the task is complex, so as not to overload the CPU core, the program divides tasks into streams. If you have a multi-core processor, this allows you to speed up work greatly. One stream deals with one core, another stream with another. As a result, the task is performed twice as fast. It is called hyper-threading.

But then there were no dual-core processors. What is the essence of hyper-threading then? Rare tasks can load the processor core by 100% even if they are very labour-intensive ones. Some processor units may not just be needed in this case and will stay idle. Hyper-threading technology has solved this problem by pushing the unoccupied parts of the processor to the actual problem. As a result, two tasks are performed on one core and nothing is idle. But hyper-threading will not turn a single-core processor into a dual-core processor. There can be a resource conflict inside one core, no double performance gain in all tasks, but hyper-threading gives a significant increase.

Hyper-threading is a hardware feature. A core with support for this technology is physically larger than a crystal without it by an average of 5%, while hyper-threading support allows the processor to be loaded by 90-95%, compared to 70% for processors where there is no such feature. As a result, we get an increase of 20-30% [3]. Now, however, when there are 4 or 8 cores in processors, hyper-threading helps out. Archivers, 3D modeling programs, photo and video editors especially benefit from hyper-threading. And where there are a lot of mathematical calculations, the gain in general can be up to 90%.

The technology is also very useful when working with background processes. If you run a resource-intensive program, background tasks that are of lower priority will not distract the processor.

In 2008, hyper-threading already existed, but the frequencies and the number of cores continued to grow. The processor becomes really powerful and it no longer makes sense to constantly keep them at peak frequencies. Then Intel releases the first core i7 processors with an auto-overclocking technology called Turbo boost. If you start your computer and look through the task manager for the CPU frequency, it will most likely run at its base frequency. But if, for example, you open a browser tab or any other application, the current frequency will rise significantly above normal. This will avoid computer crashes at peak times. Now this is the usual behaviour of the processor, but before the advent of Turbo boost, in order to avoid freezing during loading, people had to manually overclock the processor and work at peak frequencies even when it was not necessary. That is why processors often broke and in laptops it negatively affected the autonomy. Turbo boost has solved the problem. The system chooses when you need overclocking and when not, but there is one nuance. If cooling allows, then most likely you will see overclocked frequencies almost always. Previously, the frequency was regulated by the system and it took time to overclock the processor. Therefore, it did not make sense to reduce the frequency back for a short time.

The latest version of Turbo boost 2.0 technology has a feature called Speed shift, it allows you to adjust the frequency even faster. But there is another feature associated with frequency control. Each core in the processor has its own overclocking potential. Some cores overclock better, some worse. Since 2016, this feature is also has been taken into account. The new Turbo boost essentially finds alpha cores that are fast and energy efficient, and allocates the resource in such a way that more tasks go to them [2].

Along with the increase in the performance of home computers, it became clear that people very often watch videos, movies or Youtube on computers and a problem arose. Video codecs sharpened for strong compression for the Internet began to load processors very heavily at that time. It became clear that to handle such popular tasks one needs to create separate hardware modules. So, in 2010 there was a function Quick sync video. This is a hardware unit for encoding and decoding video. It effectively plays video without loading the CPU at all, which saves a lot of battery. It also allows you to quickly compress the video to the desired format and almost no use of the CPU core.

Now almost all videos are encoded with the H.265 codec, it is very efficient and difficult to process by a computer. Previously, it was considered that editing video in this codec is unrealistic.

A computer just cannot handle it, but it's quite normal. The current tenth generation of Intel processors supports all modern codecs. And in the new generation Tiger Lake added support for AV-1 decoding of the future codec Youtube and Netflix. Also, recently, functions such as handwriting recognition, recognition of faces or objects in a photo are becoming commonplace in gadgets, and this usually requires a neural engine. For example, in the case of the Google photo application, it is on the Internet on Google servers, but since 2019 Intel has built its neural engine into Ice Lake processors.

Many programs already use this engine. In Adobe Premiere you can automatically encode videos in different formats, for instance, to make vertical videos for Instagram Stories in one click. The processor will find the desired object and will dynamically centre the frame on it or a neural engine can recognize photos in the local library and tag various objects on it. This technology is supported by Quick Faint or Nero AI Photo Tagger. With Topaz Giga Pixel AI you can improve the quality of photos or videos, and cut an object from the background in one click in Photoshop [1].

The development of technology does not stand still, and every day more and more things appear and improve that can make our life easier. And even such a thing as a processor, which we usually do not see, contains an incredible amount of technological solutions and capabilities that we use every day. And we can only guess how much they can improve and develop the processor in the future.

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УДК 004.93'12

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АГРОӨНДІРІСТІК КЕШЕН ҮШІН КОМПЬЮТЕРЛІК КӨРУДІ ҚОЛДАНУ АРҚЫЛЫ БАҒДАРЛАМАЛЫҚ ЖАСАҚТАМА ӘЗІРЛЕУ

Мақала – компьютерлік көру, машиналық оқыту және агроөнеркәсіптік кешендерге арналған компьютерлік көру негізіндегі жасалған шешімдерді талдайды. Талдау нәтижесінде объектілерді танудың ең ойластырылған алгоритмдері және оларды тез және дәл тану үшін жақсарту жолдары анықталған. Зерттелетін мәселелер ақпараттық технологиялар мен агроөнеркәсіптік кешен мамандарын қызықтырады.

***Түйінді сөздер:** компьютерлік көру, машиналық оқыту, агроөнеркәсіптік кешен, объектілерді тану, алгоритм, ақпараттық технологиялар.*

The article is a study of computer vision, machine learning and an analysis of existing solutions based on computer vision intended for agro-industrial complexes. As a result of the performed analysis, the most thought-out algorithms for object recognition and ways of improving them for faster and more accurate recognition were identified. The issues under study are of interest to specialists in information technology and the agro-industrial complex.

***Key words:** computer vision, machine learning, agro-industrial complex, object recognition, algorithm, information technology.*