**Процессоры с расширением Искусственного интеллекта**

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**AI Enhanced Processors**

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*Аннотация.* В статье рассматриваются преимущества использования выделенного движка для Искусственного Интеллекта (ИИ) в современных компьютерных процессорах. Отмечается, что выделенный движок для ИИ обеспечивает улучшение производительности, эффективность стоимости и энергоэффективность, повышенная надёжность.

*Ключевые слова: искусственный интеллект, процессор, транзистор, блок нейронной обработки*.

*Abstract.* The article discusses the advantages of using dedicated Artificial Intelligence (AI) engine in modern computer processors. It is noted that dedicated AI engine provide performance enhancement, cost and energy efficiency, increased sustainability.

*Keywords: artificial intelligence, processor, transistor, neural processing unit.*

The Moore’s law claims that the number of transistors on an integrated circuit will double every two years.

According to Intel data, gathered over the last 50 years, they forecast that the rate of transistors count growth will keep up just as the Moore’s law predicts.

But physically we are getting so close to the dead-end size of the single transistor, so that it could not be possible to push forward the development of much denser arrangement. This leads to the fact, that we might use some other techniques and technologies to increase the processing limits.

This leads us to the obvious question: what are the other possible ways for us or manufacturers to push processing limits further?

There were several ways how manufacturers tried and actually increased the processing speeds. The simplest of them – making a superscalar processors (bigger than the ordinary once).

The Reduced Instruction Set Computing (a.k.a. RISC) was also implemented (worth mentioning ARM processors).

Multi-core and multi-threading were designed to increase overall processing capacity and efficiency.

Resolving a power consumption and cooling problems can lead to frequency scaling and dynamic voltage, which are being followed with performance benefits too.

So, the term AI enhanced processors or simply AI processors encompasses both CPUs and discrete acceleration hardware, including GPUs, FPGAs, and purpose-built AI accelerators such as neural processing units (NPUs).

Let’s examine the benefits of having purpose-built AI accelerators.

The first one is - Performance Enhancement

Purpose-built AI accelerators in CPUs, such as Intel's Advanced Matrix Extensions (Intel AMX), significantly boost the performance of AI workloads. They were designed to speed up computations like matrix multiplications, which are crucial for deep learning and other AI tasks.

Second thing is - Cost Efficiency

CPUs with built-in AI accelerators can be more cost-effective compared to using discrete GPUs because they eliminate the need for additional hardware components, reducing the overall cost of ownership and the complexity of the system.

And last, but not least - Energy Efficiency and Sustainability

CPUs with integrated AI accelerators consume significantly less energy compared to GPUs, which is crucial for sustainability.

The integration of purpose-built AI accelerators within CPUs offers several significant benefits, particularly in the context of artificial intelligence (AI) workloads.

This undoubtedly leads to overall performance benefits since all processor loads can spread not only between the cores and threads of main processing units, but also these NPUs.

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