AI4 WASTE

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2023-2-PT01-KA210-ADU-000184346

TOOLBOX

AI Concepts and Definitions

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Intro to AI

AI is a multi-use technology. Like electricity it can be applied in lots of different ways, to lots of different scenarios.

AI encompasses developing computer systems capable to exhibit intelligent behaviour.

These tasks include:

- learning from experiences,
- interpreting complex data,
- making decisions based on the information gathered,
- understanding natural language,
- recognizing patterns or objects, etc.

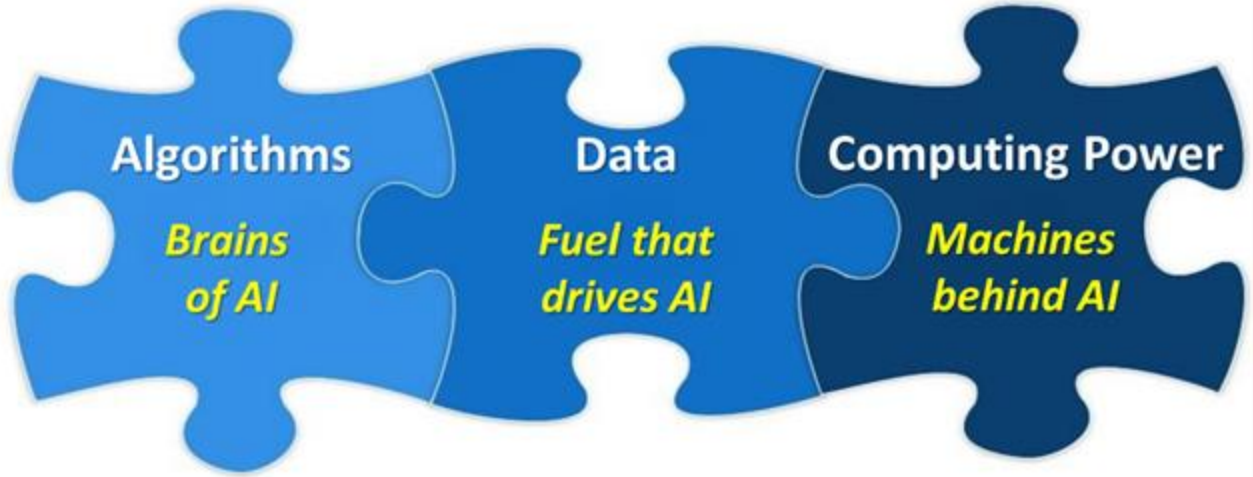
The essence of AI lies in its ability to mimic cognitive functions associated with the human mind, such as learning and problem-solving.

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Core Components of AI

Algorithms tell computers what to do. Data tells computers what to learn. Computing power gives machines the power to learn and make decisions



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Core Components of AI

DATA

Data is the foundation of AI. The quality and quantity of data significantly impact the performance of AI models.

- **Structured Data**: Databases and spreadsheets are organized in a tabular format (e.g. transaction records)
- **Unstructured Data**: Data that is not organized in a predefined manner, such as text, images, audio, and video (e.g. social media posts).

Data preprocessing includes cleaning, normalizing, and transforming data to ensure it is in the right format and quality for analysis.

COMPUTING POWER

The complexity of AI models require significant computational resources to process large datasets and perform complex calculations.

- **Central Processing Units**: General-purpose processors that handle various computing tasks.
- **Graphics Processing Units**: Specialized processors designed for parallel processing are ideal for training deep learning models. GPUs can efficiently handle the massive computations required for training neural networks.
- **Tensor Processing Units**: Custom-designed processors by Google specifically for AI tasks, offering optimized performance for training and inference of machine learning models.

MODELS

AI models are mathematical representations of real-world processes created by training algorithms on data. These models can make predictions, recognize patterns, and make decisions based on new input data

- **Machine Learning Models**: classification, regression, and clustering.
- **Deep Learning Models**: neural networks with multiple layers capable of learning complex patterns in data.
- **Ensemble Models**: combination of multiple models to improve performance and robustness: bagging, boosting, and stacking.

Model training and testing

Model deployment and maintenance

ALGORITHMS

Algorithms are step-by-step procedures or formulas for solving problems. In AI, algorithms process data, make decisions, and learn from patterns

- **Supervised Learning** Algorithms (e.g. SVM, RF)
- **Unsupervised Learning** Algorithms (e.g. K-means, PCA)
- **Reinforcement Learning Algorithms** (e.g. game playing and robotic control)

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AI and XAI

AI systems can also continuously 'learn from experience' and therefore not possible to program that logic by a series of defined steps and decisions.

- An important concept in AI called 'Explainable AI (XAI)'.
- It is possible to verify the output of an AI system as correct (for example did a patient really have cancer or not), but it may not be possible to know exactly how the AI system got to a decision or outcome, as the AI has calculated the 'interim steps' by itself, without human programming of the specific steps to be taken.
- AI systems are therefore sometimes referred to as 'black boxes' with details of exactly how they work and operate - in some cases - not fully known, or understood.

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Big Data Concepts

In particular ‘big data’ supports the rise of AI in the following ways :

- 1. **Training Data**: AI systems require substantial amounts of training data to learn patterns. This makes their predictions and decisions more accurate.
- 2. **Feature Extraction**: large and diverse datasets help AI algorithms to accurately identify and extract features from within data.
- 3. **Model Performance**: big data enhances the performance and robustness of AI models, allowing them to handle a wide range of situations and inputs.
- 4. **Predictive Analytics**: large datasets and AI can be used by businesses to forecast trends, regime shifts, reasons of changes, etc.

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Big Data Concepts

- 5. **Personalisation**: when AI systems can access large volumes of data on human behaviours, preferences, and interactions they can provide tailored suggestions and experiences for users.
- 6. **Natural Language Processing (NLP)**: NLP models, such as AI powered chatbots, virtual assistants and language translation systems, benefit from diverse and extensive language data, such as books, articles and social media posts.
- 7. **Real-Time Decision Making**: as the 'velocity' of big data accelerates AI systems can process and analyse this data in (near) real time to provide instant recommendations, or decisions that require extra warnings.

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Computing Power

Types of Computing Resources:

- Central Processing Units (CPUs): General-purpose processors that handle various computing tasks. While essential, they are often not sufficient for high-performance AI tasks.
- Graphics Processing Units (GPUs): Specialized processors designed for parallel processing are ideal for training deep learning models. GPUs can efficiently handle the massive computations required for training neural networks.
- Tensor Processing Units (TPUs): Custom-designed processors by Google specifically for AI tasks, offering optimized performance for training and inference of machine learning models.

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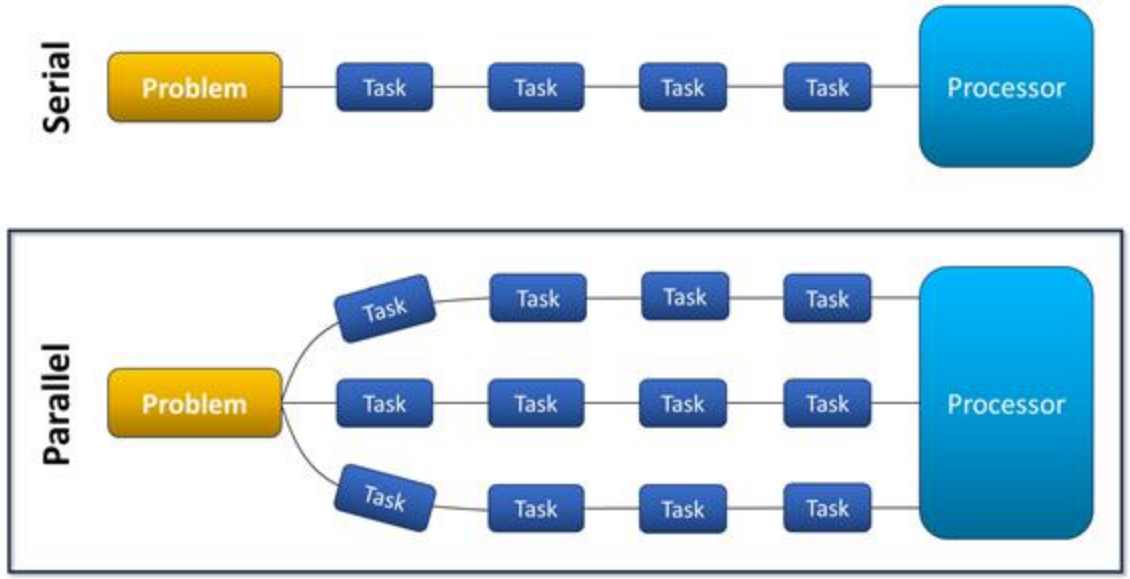
Computing Power

Computing power is crucial for training and deploying AI models. The complexity and size of modern AI models require significant computational resources to process large datasets and perform complex calculations.

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Computing Power

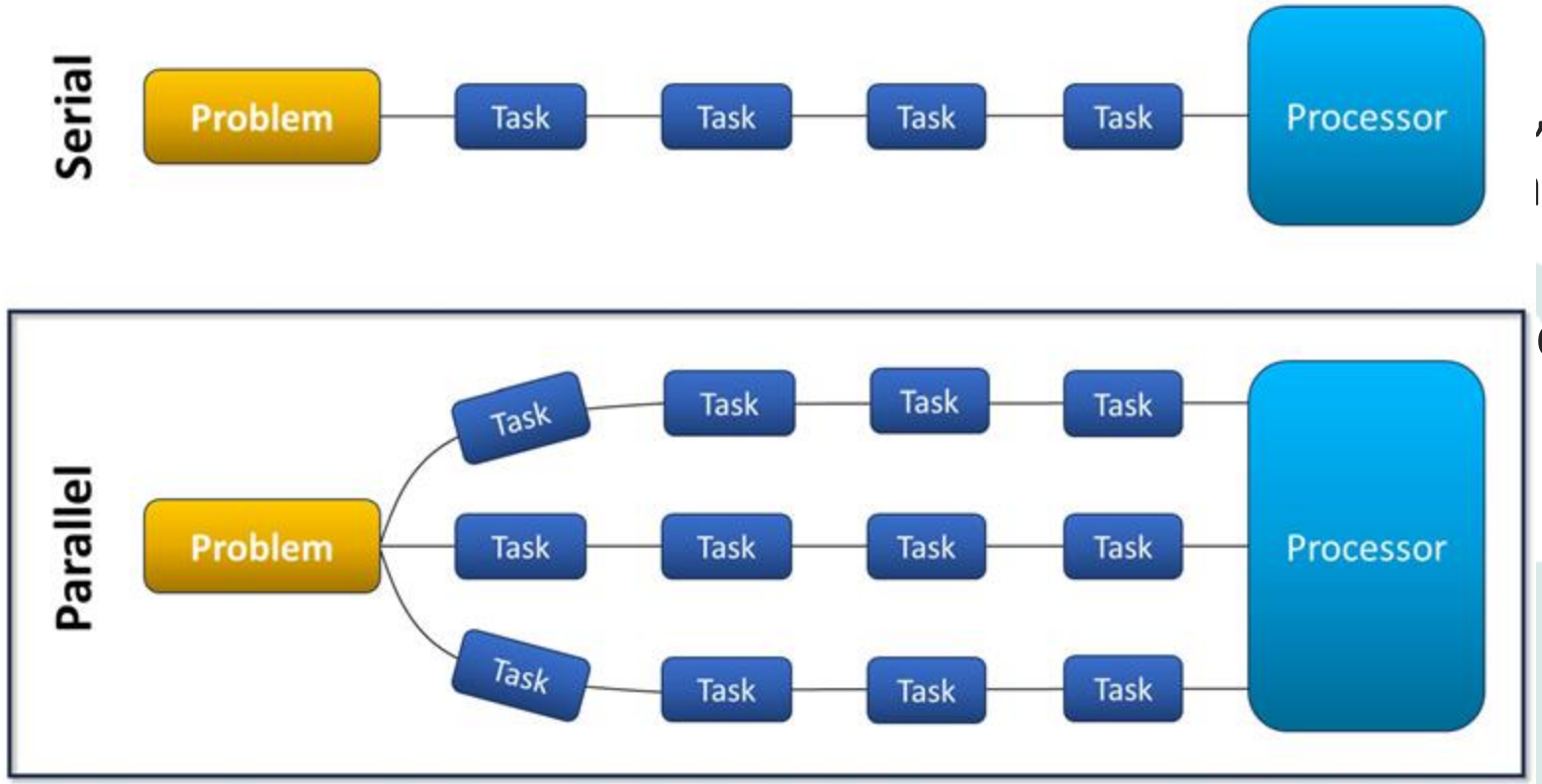
A key innovation is to process tasks in parallel (rather than sequentially as in normal computers), which turns out the accelerated parallel processing required to create lifelike graphics in computer games and movies is ideal for powering AI applications and especially deep learning systems, such as sophisticated computer vision aided assistants.



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Exploring the World of Artificial Intelligence

After reviewing this presentation, we recommend diving into "**Types of AI**" for a deeper understanding.

Expand Your Knowledge

Understanding the types of AI will provide insights into their applications, limitations, and potential impacts on our world.

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