

Artificial Intelligence – AI Technologies, Applications, and Limitations

Estimated Learner Skill Level: Beginner or Intermediate

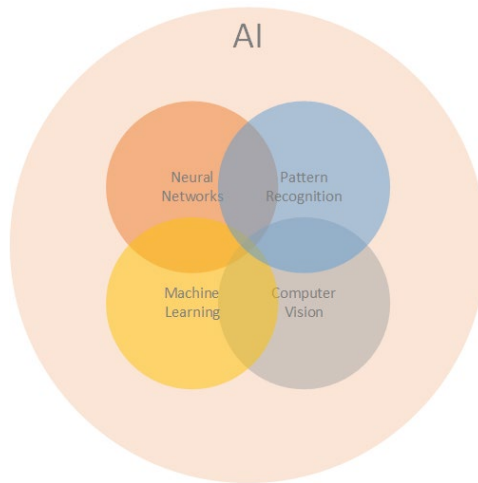
AI Technologies

Below are some examples of AI technologies.

- Neural networks
 - Autoencoders (AEs)
 - Convolutional Neural Networks (CNNs)
 - General Adversarial Networks (GANs)
 - Long Short-Term Memory (LSTM)
 - Multi-Layer Perceptron (MLP)
 - Recursive Neural Networks (RNNs)
 - Self-Organising Maps (SOMs)
- Decision trees
- Ensemble methods
 - Gradient boosting
 - Random forests
- Regressors
- Naïve Bayes
- Vector machines
 - Relevance vector machines
 - Support vector machines
- Transformers

In this picture, some AI technologies are put together. Notice the overlap between technologies.





Applications

Examples of AI applications include (all the following except transformer (GPT) are from Centria’s projects):

- **Neural Networks:** classification tasks, such as waterway condition detection at a harbour or determining the material of an object on an assembly line.
- **Decision Trees and Ensemble Methods:** classification and regression tasks; for example, determining the success of a network measurement carried out by an autonomous vehicle in a telecommunications project or detecting the amount of waste in a container in a waste management project.
- **Regressors:** predicting continuous variables, such as electricity price, total heat demand in building services, or feed quality in agriculture.
- **Bayesian:** natural language processing; for example, detecting fake news from an article feed.
- **Vector machines:** classification tasks; for example, classifying cyber-attacks by type.
- **Transformers:** large language models, such as GPT (GPT = Generative Pretrained Transformer) used in ChatGPT.

Exercise: Match technologies and applications.

Neural Network	Snow level estimation
Ensemble Methods	Advanced chatbots
Regressors	Detecting door status in a webcam stream
Bayesian	Real-time customer segmentation and recommendation system
Vector Machines	Categorising magazine articles by text content
Transformers	Biological analysis
	3,6,1,2,4,5



Limitations

Data amount: AI models may require plenty of data for training. This, in turn, can require a lot of storage space for the saved AI models and the datasets they are trained on.

Processing power: Training (and sometimes using) AI models may require a lot of computation power.

Overfitting/underfitting: AI models can give excellent results on training data but perform poorly on unfamiliar data (that they have not seen during training), or conversely, AI models can give poor or satisfactory results on training and non-training data, but there is still room for improvement. In the former case, it is said the model overfits, whereas in the latter case, it is said the model underfits.

Hallucination: Generative AI models can sometimes give nonsensical or incorrect answers and present them as facts. This is known as hallucination and makes it necessary for the AI user to utilise critical thinking when applying solutions proposed by the model.

Exercise: What are some major limitations of AI technologies in 2024?

Available storage space limits the _____ that can be used for training and testing an AI model. In addition, _____ is needed for the computations. Unbalanced datasets can lead to _____ (two problems; separate with "/"). Finally, _____ happens when generative AI presents incorrect things as facts.

Data amount _ processing power _ overfitting/underfitting _ hallucination

Next Step

[Move on to AI Software Development.](#)

