Applied statistics and Machine learning in Python with subsurface applications

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Big Data

Big data has been one of the main keywords to represent the latest digital innovation (before AI with gen AI)

Big data implies Machine learning applications based on:

1. Large volume of data
2. Fast process speed
3. Variety of data types and resolution

Examples:

- IoT
- Social Media
- Internet Marketplaces (Amazon)
- Healthcare
- Transport

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Big data has to face three main problems:

1. Storage: strategies to dump useless data and/or store continuously generated large data volumes
2. Analysis: data has to be indexed and analysed on-the-fly
3. Privacy: proprietary data access has to be limited

As one can note, these challenges are still present in gen AI.

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Goal

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Generative AI

A generative AI model is a type of artificial intelligence that is designed to generate new content, based on the data it has been trained on.

It started in 1932, with the **mechanical brain** by Georges Artsrouni that was supposed to translate automatically between languages,

Here a nice recaps of Generative AI and its storyline

Generative AI

Key characteristics of generative AI models include:

1. Learning from Data: They are trained on large datasets, enabling them to learn patterns, styles, or features inherent in the data.
2. Generating New Content: Generative models can create new data instances. For example, a model trained on a dataset of paintings can generate new images in the style of those paintings.

Trained generative models are thus able to input information at a low resolution/dimension and give output with a much greater dimensionality.

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Applications

Here a list of possible applications:

- Images/video: Image generation, Super-resolution, Deep fakes.
- Music: noise filter, voice and music generation, voice deep fake.
- Text(LLM): chatGPT, bard, Gemini, etc.
- Chemistry: DeepMind (Alpha Fold).
- Coding (co-pilot)
- Speech
- Attacks and Hacking (Security testing)
- Generating training sets
- And many more

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Science fiction?

This is scary:

1. Virtual best friends
2. Medical images to show diseases consequences
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Problems (currently)

New possibilities do not come with side effects.

1. Lack of transparency: how the output is generated, and why?
2. Accuracy: a lot of hallucinations
3. Bias: human biases are kept, supported and eventually increased
4. Intellectual properties (IP): who owns what is produced?
5. Cybersecutiry and frauds: mass cyber attacks can be created
6. Sustainability: massive quantity of electricity is used
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Where generative AI is ?

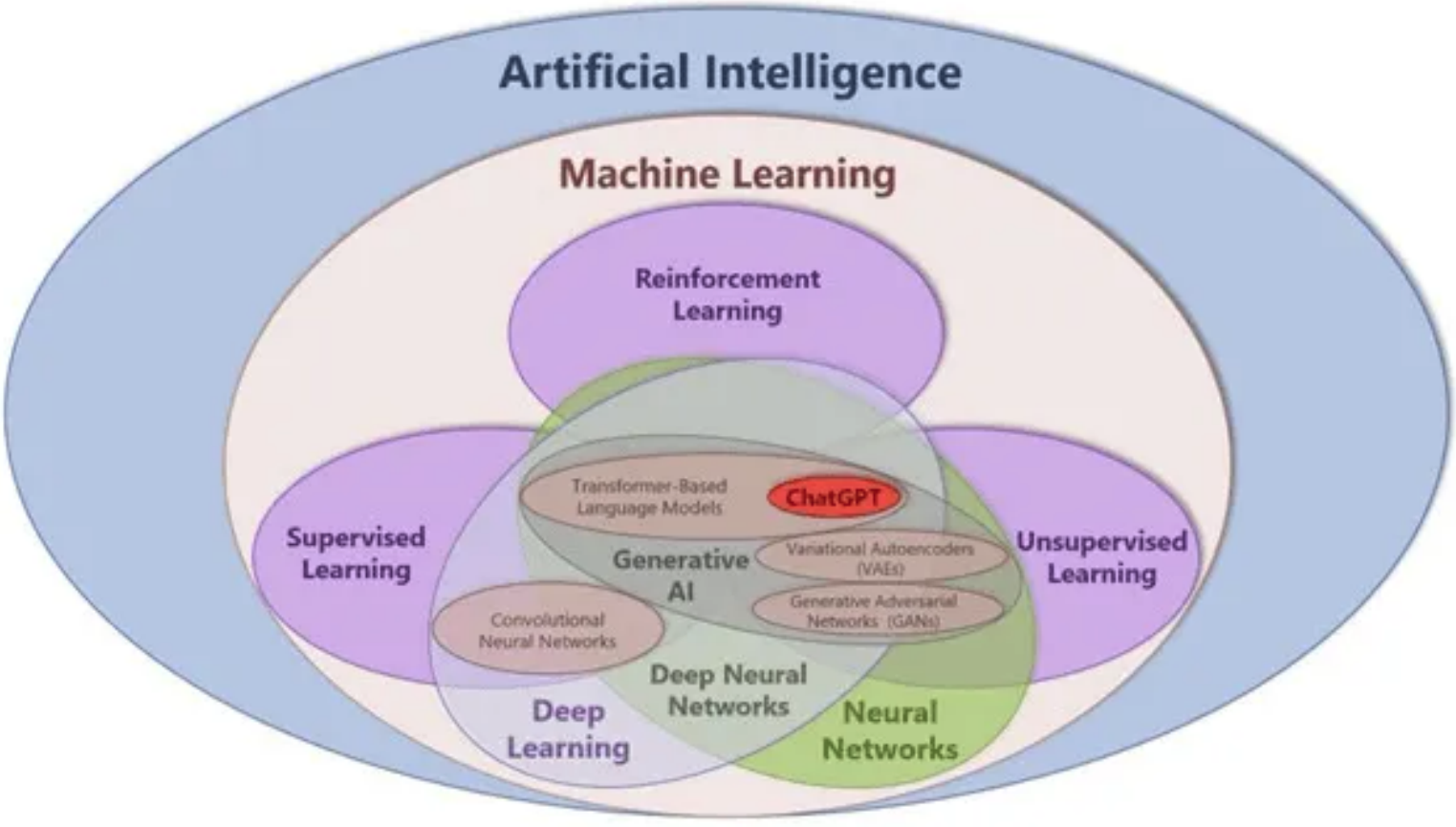

Image: https://iot-analytics.com

Structure of generative AI

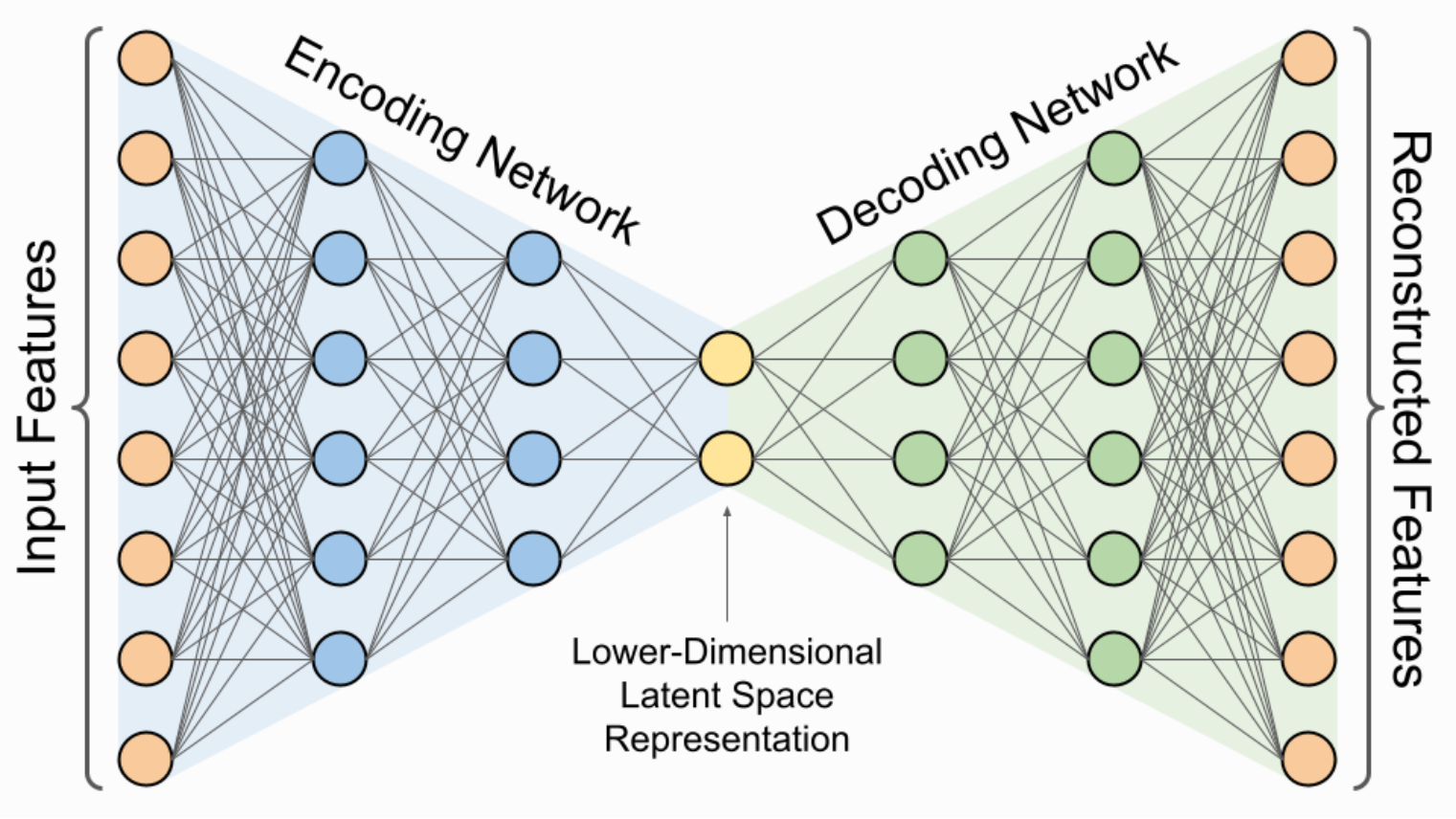

Image: https://www.rapidops.com

A new field?

Generative AI is actually a new evolution.

It is based on Neural Network, and in comprises a set of advanced tools (numerical recipes):

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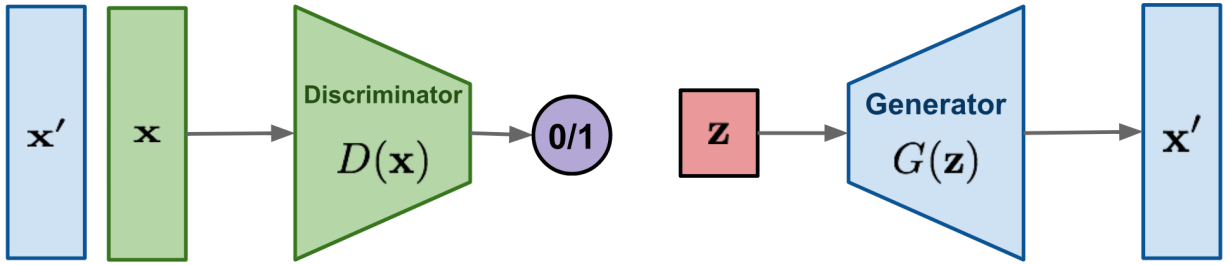
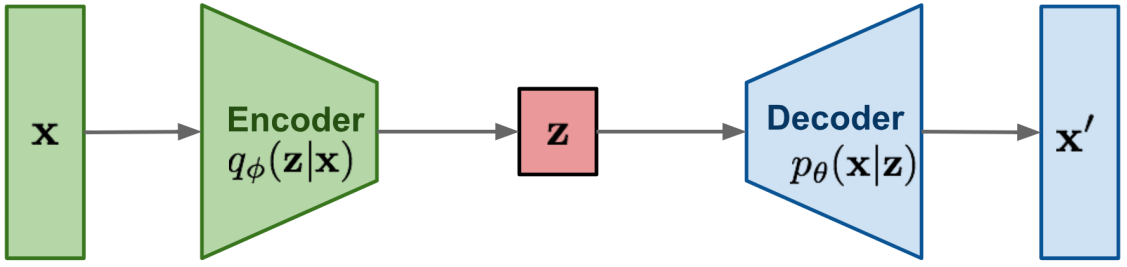
Types of generative AI

It is quite an advanced technique

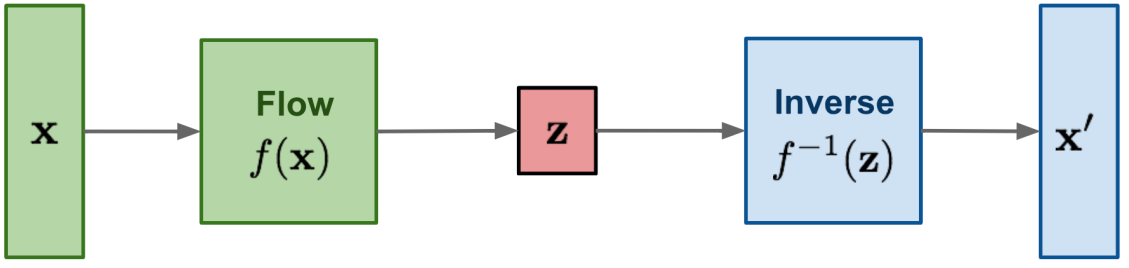
GAN: minimax the classification error loss.



VAE: maximize ELBO.



Flow-based generative models: minimize the negative log-likelihood



Source: Lilian Weng

Multimodal AI

An AI that processes and interprets multiple types of data inputs — such as text, images, audio, and video

M-AI can make decisions or provide insights (it thus combines unsupervised, supervised and reinforcement learning).

It uses an integrated set of different neural networks with different architectures each of which is designed to handle specific types of input data.

Applications:

- Autonomous Vehicles
- Healthcare Diagnostics
- Humanoids
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- AI war-drone
- votation frauds
- propaganda campaigns
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- energy and material demanding

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AI trends (2024)

- Generative AI
- Augmented reality
- Ethical and explainable AI
- Democratic AI
- Sustainable AI

AI potential (2024)