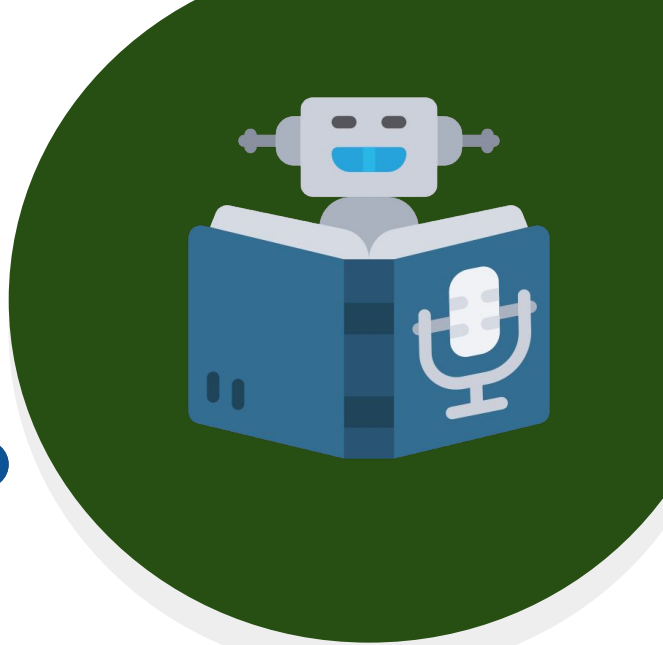
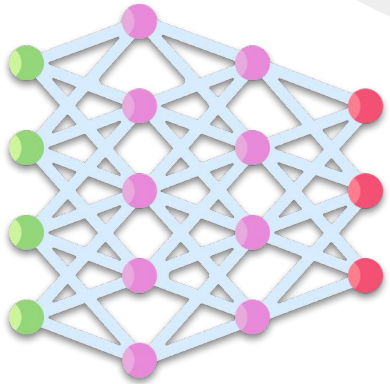
Neural Networks

Nisal Mihiranga





Facilitator

Nisal Mihiranga

Areas of Interest & Expertise:
AI, Technology, Science, Teaching, Consulting, Mentoring

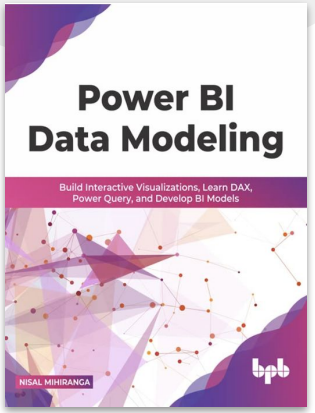
Experience:
Head of AI and Data Science, Architect at
Zone24x7 pvt Ltd
Corporate Trainer

12 Years of Industry exposure to Data Engineering, Data Science and Business Intelligence

Credentials:
M.Sc in Data Science

B.Sc in Information Technology

Microsoft Certified Trainer



Curriculum

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Week	Module
Week 1	Python for Machine Learning
Week 2	Introduction to Machine Learning
Week 3	Data Transformation and Analysis
Week 4	Classification
Week 5	Regression
Week 6	Clustering Algorithms
Week 7	**Neural Networks**
Week 8	MLOPS, Machine Learning in Cloud

Agenda

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Week	7th Week
Day	26th Oct
Duration	4hrs

TIME	TOPIC & ACTIVITY	COMPLETED-
30 Mins	Recap last week and Introduction to Deep Learning	Yes
20 Mins	Neural Networks	Yes
40 Mins	Applications of Neural Networks	Yes
20 Mins	Break	
30 Mins	Building a Neural Network	Yes
20 Mins	Types of Neural Networks	Yes
5 Mins	Q&A Session on lesson learn	Yes

Learning Objectives

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- Understanding Fundamental concepts of Neural Networks
- Ability to explain Key Neural Network Architectures
- Gain skills in building and training a neural network

Intro to Deep Learning

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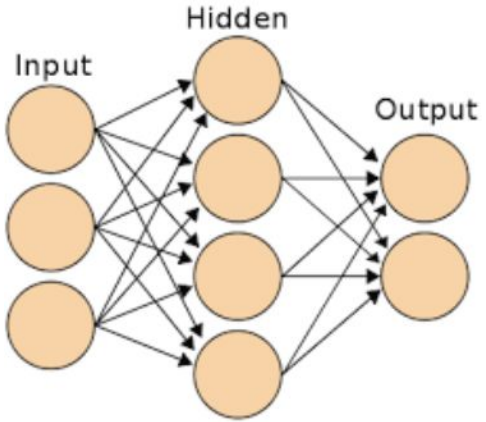
Deep learning, a subset of machine learning, uses Artificial Neural Networks to process and analyze information. These networks consist of multiple layers, including input, output, and hidden layers. When there are three or more layers, it is termed "deep" learning. Inspired by the human brain



Artificial Intelligence

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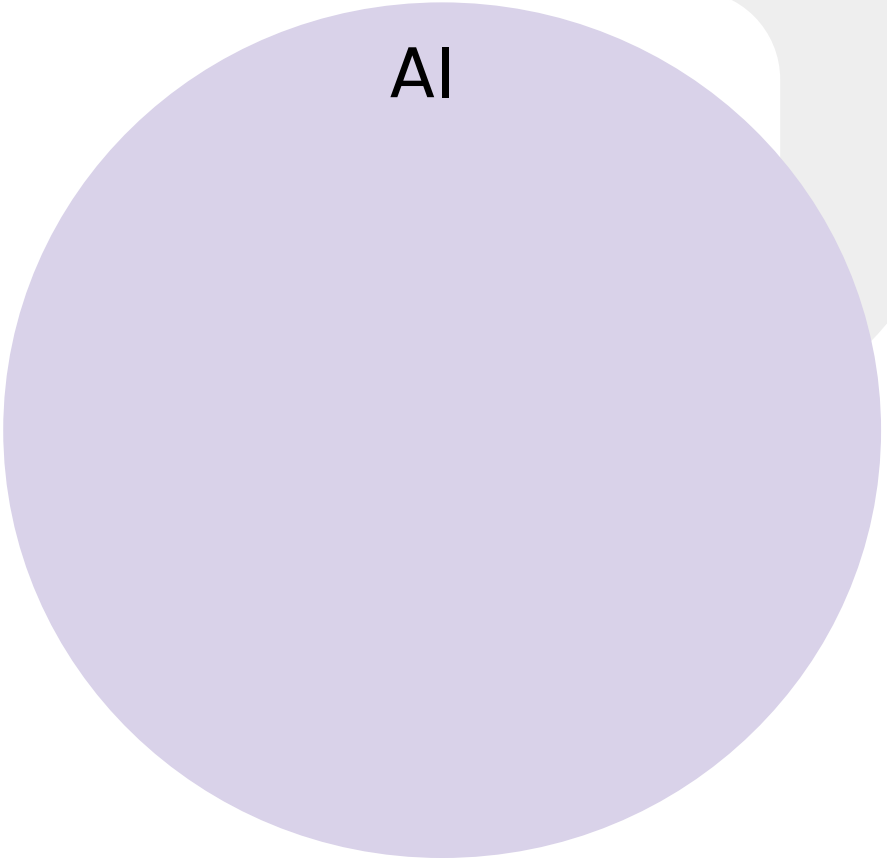
AI includes everything from rule-based systems (like a simple chess-playing program) to advanced systems that use machine learning or deep learning to make decisions.



Machine Learning

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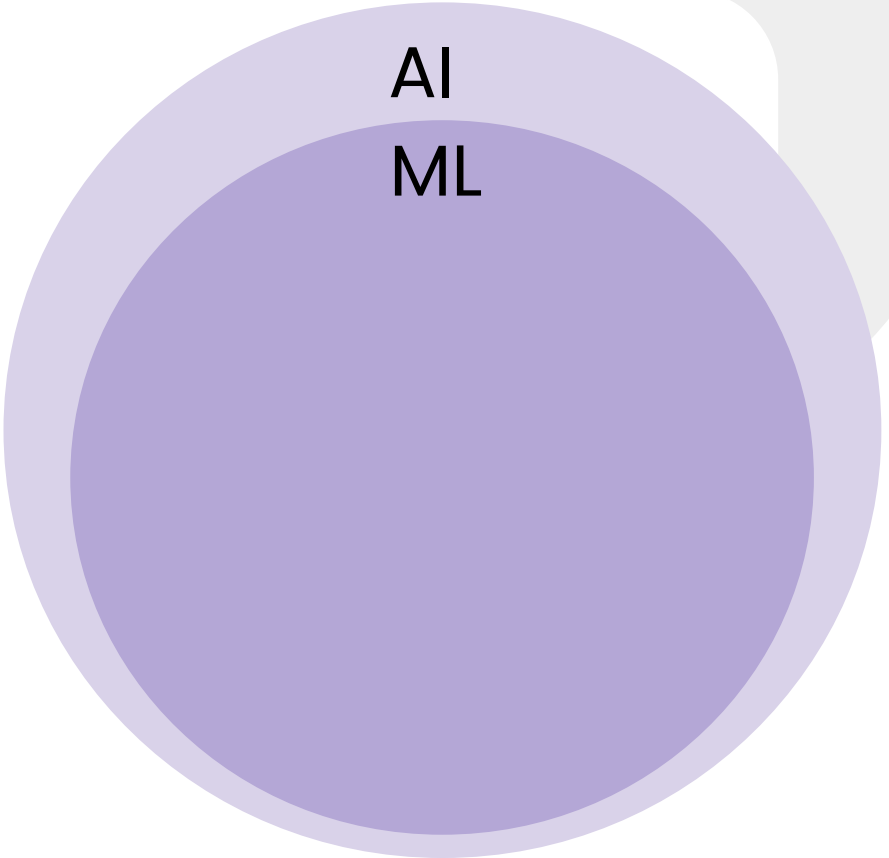
Machine Learning refers to algorithms that allow computers to learn from data without being explicitly programmed. It relies on statistical techniques to infer patterns from data and make decisions or predictions.



Deep Learning

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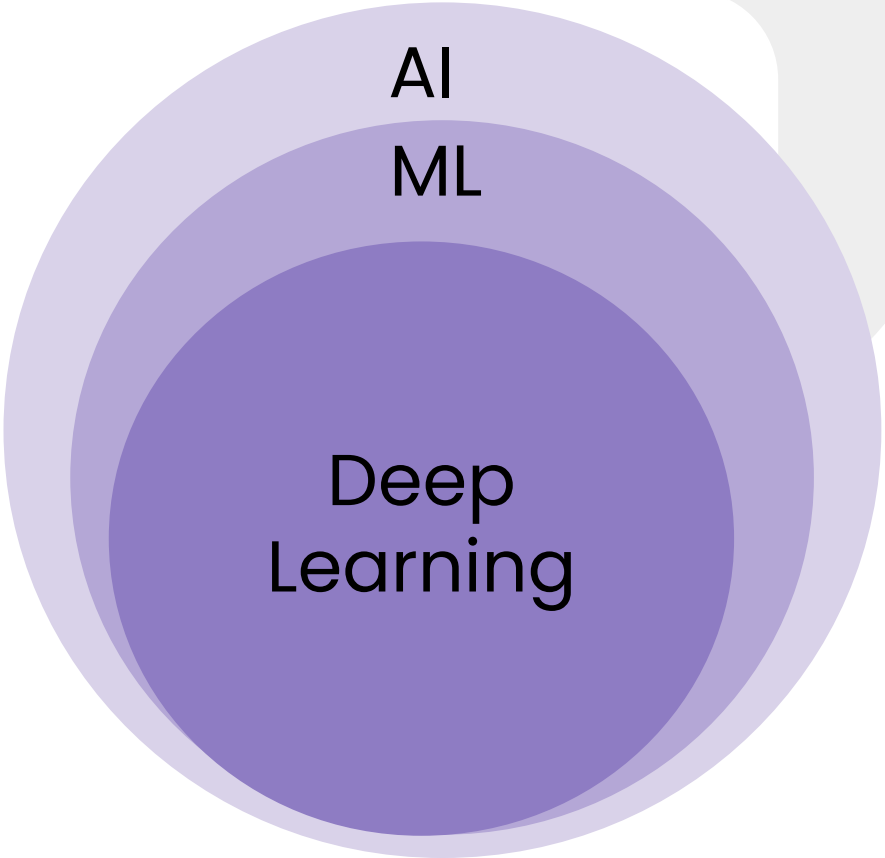
DL is a specialized subset of ML that uses neural networks with many layers (hence “deep”) to analyze various factors of data. These neural networks attempt to simulate the behavior of the human brain, enabling it to “learn” from large amounts of data.



Intro to Deep Learning

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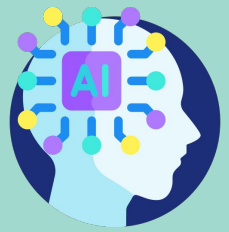
Artificial Intelligence

Any technique that enables computers to mimic human behavior

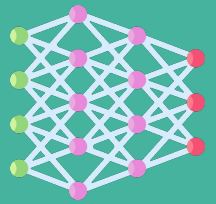


Machine Learning

Ability to learn without explicitly being programmed

Deep Learning

Extract patterns from data using neural networks



Deep Learning vs ML

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Machine Learning

- Often performs well with smaller datasets.
- Relies heavily on feature extraction and selection by human experts

Deep Learning

- Requires large amounts of data to perform effectively.
- Automatically extracts features from raw data, reducing the need for manual feature engineering.

Deep Learning vs ML

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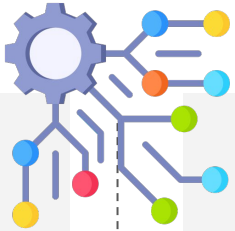
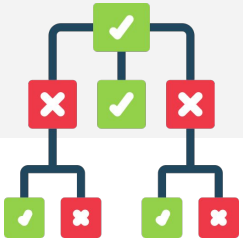


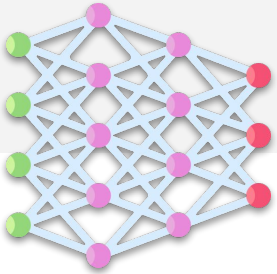
Machine Learning

- Uses simpler models such as decision trees, support vector machines (SVM), and linear regression.
- Models are generally easier to interpret and explain.



Deep Learning

- Utilizes complex architectures like deep neural networks with many layers.
- Models can capture intricate patterns in data but are often seen as "black boxes" due to their complexity.



Deep Learning vs ML

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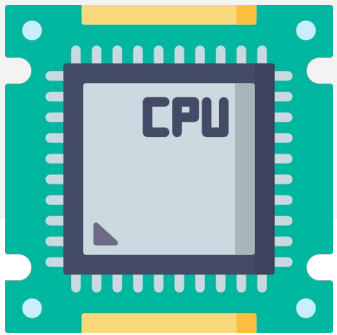
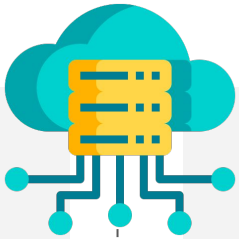
Machine Learning

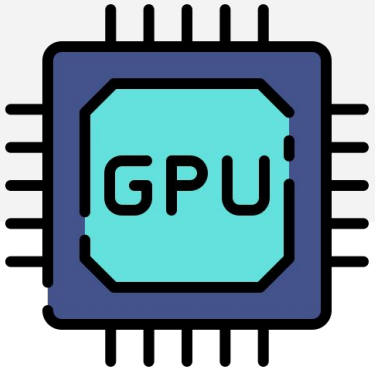
- Typically requires less computational power.
- Can be run on standard CPUs.





Deep Learning

- Demands significant computational resources.
- Often requires GPUs or TPUs to handle the intense computations during training



Deep Learning vs ML

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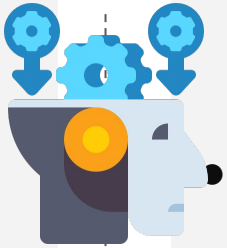
Machine Learning

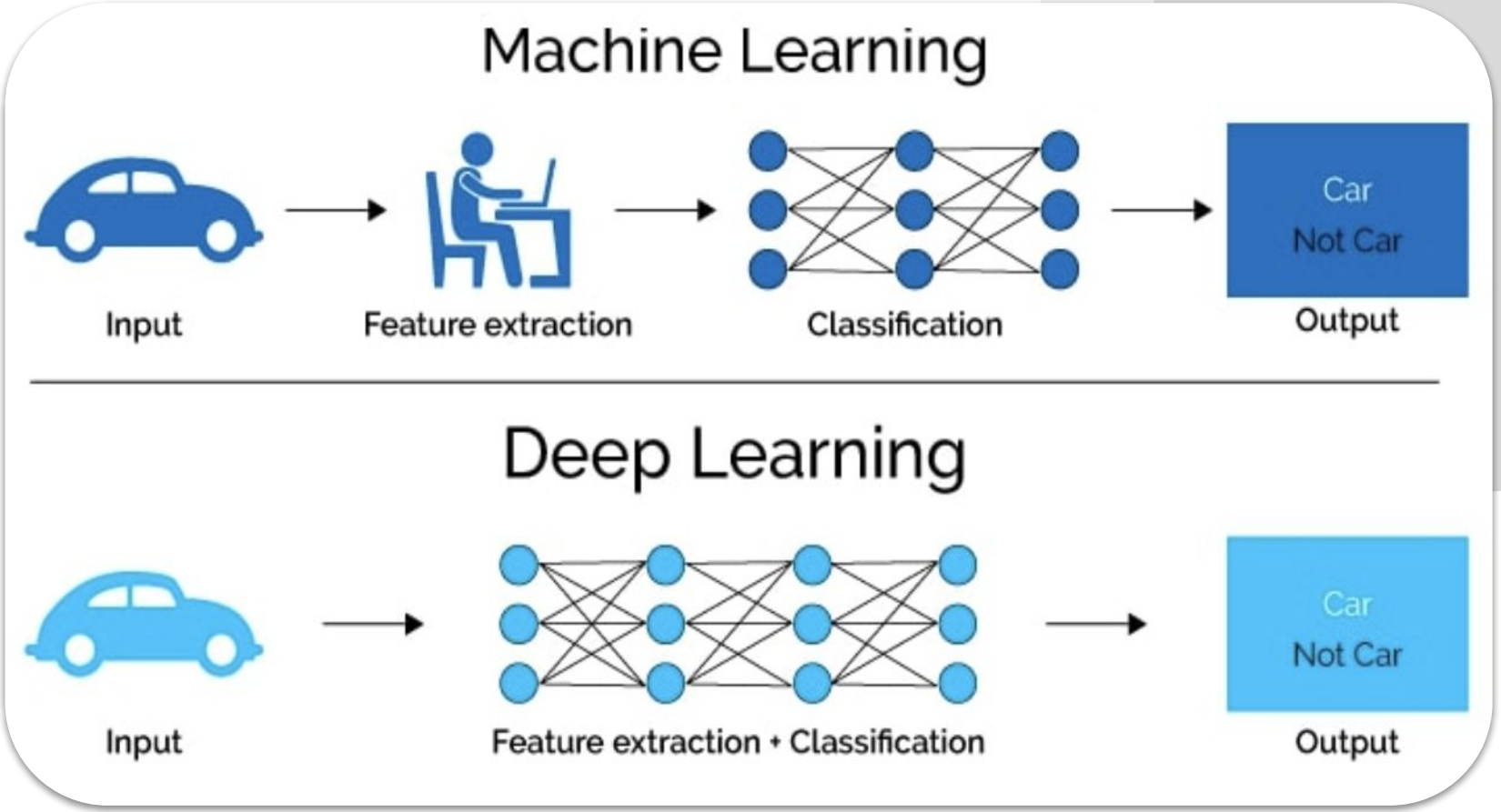
- Heavily dependent on domain expertise for feature engineering.
- Success of the model often relies on the quality of the selected features.

Feature Engineering



Deep Learning

- Automatically learns relevant features from the data.
- Reduces the need for extensive domain-specific feature engineering.


Machine Learning
Input
Feature extraction
Classification
Car
Not Car
Output
Deep Learning
Input
Feature extraction + Classification
Car
Not Car
Output

Deep Learning vs ML

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Machine Learning

- Effective for a wide range of tasks but may struggle with complex problems.

Deep Learning

- Excels in tasks involving unstructured data such as images, audio, and text.
- Achieves state-of-the-art results in various domains like computer vision and natural language processing.

Basic Structure of Neural Network

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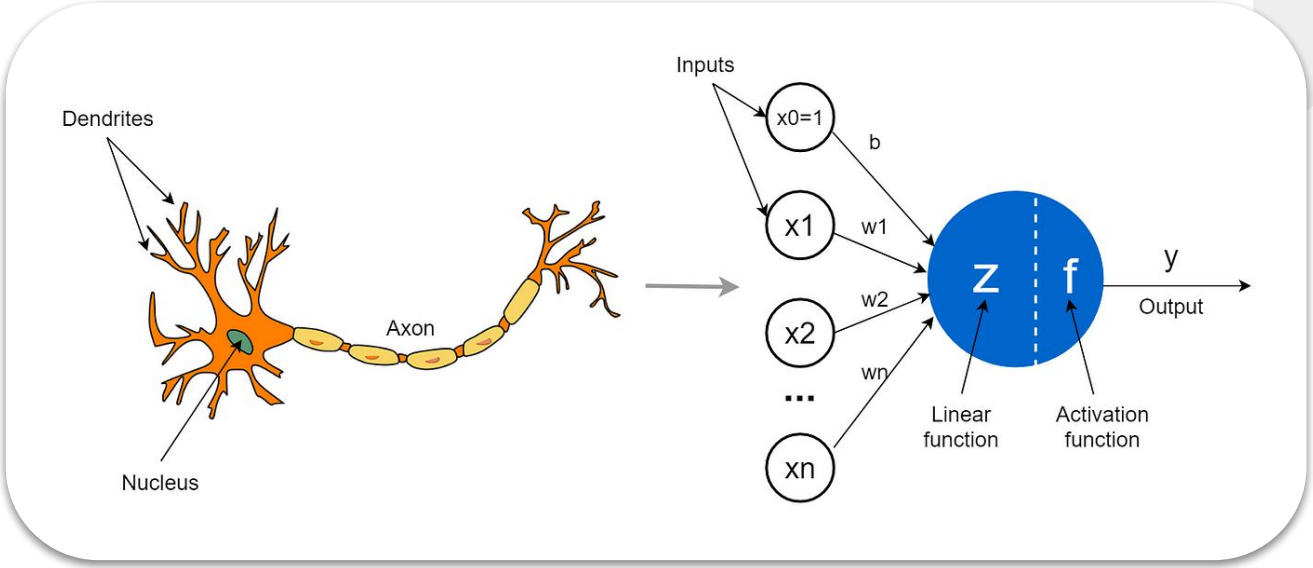
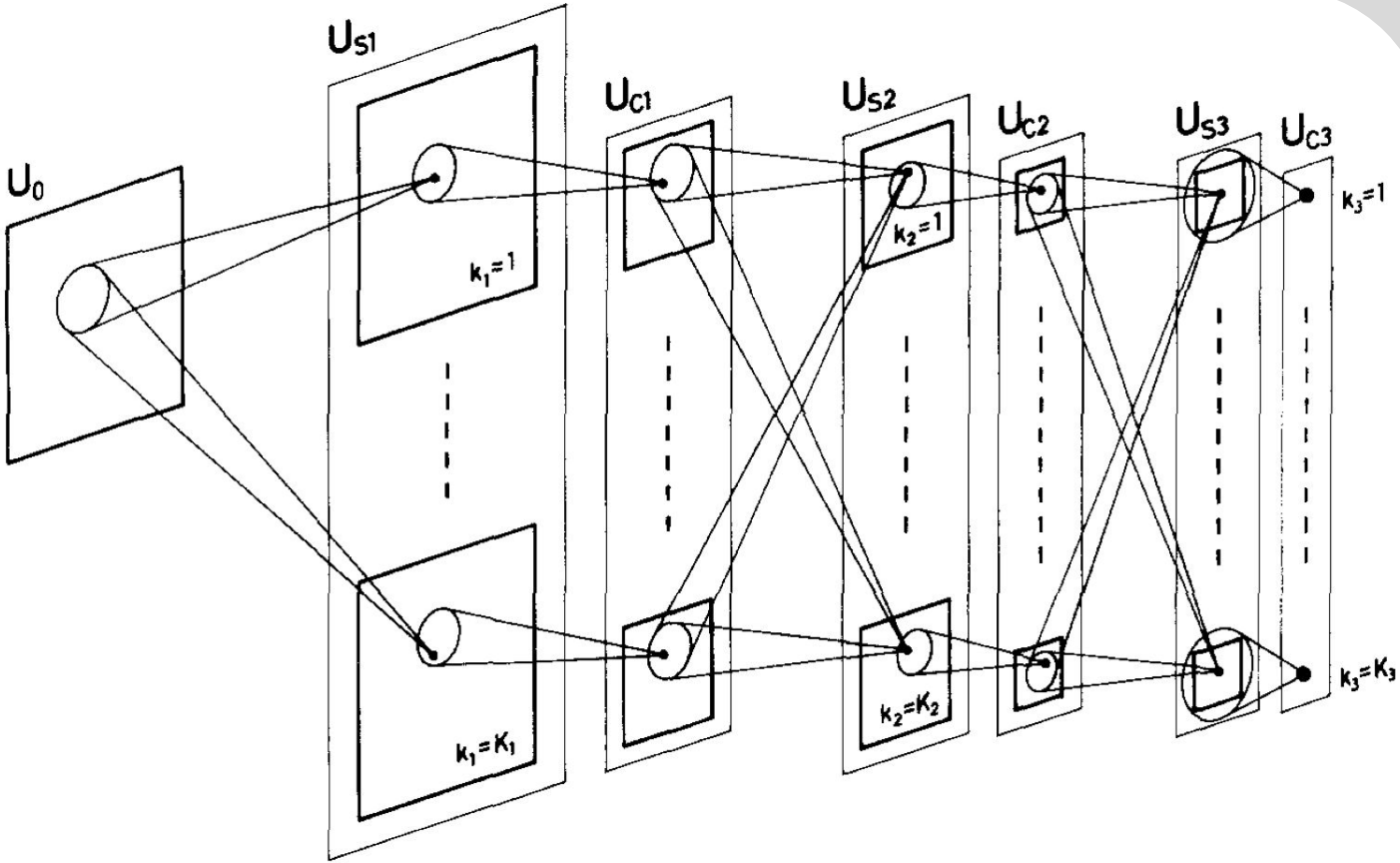
- Deep learning primarily uses neural networks, which are computational models inspired by the human brain. These networks consist of layers of nodes (neurons), each layer transforming the input data to extract features and make predictions.





Fukushima. Neocognitron: A self-organizing neural network model for a mechanism of pattern recognition unaffected by shift in position. Biological Cybernetics, 36(4):193–202, April 1980.

Structure of a Neural Network

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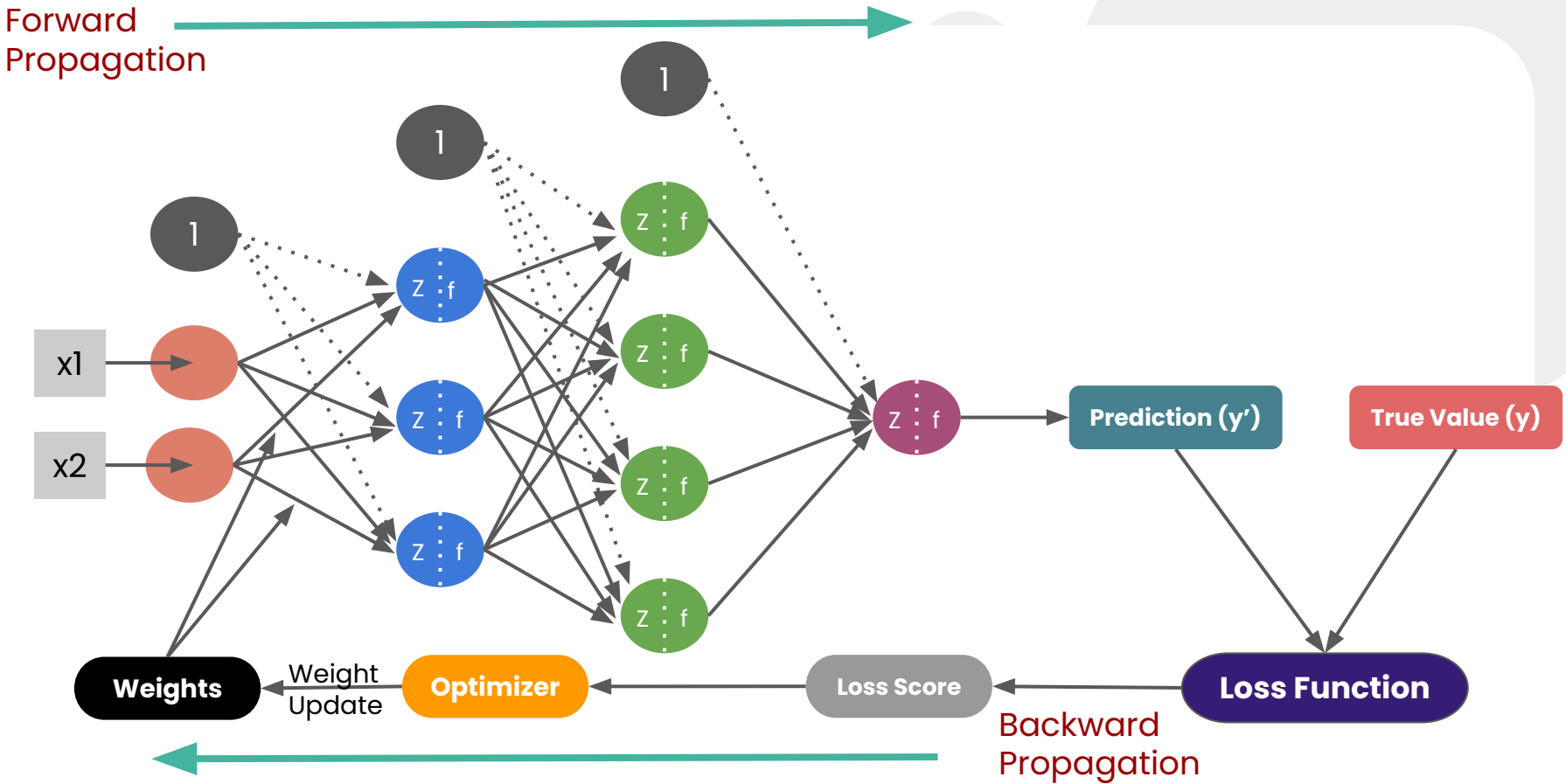

Forward Propagation

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- Input data is fed through the network.
- Each neuron calculates a weighted sum of its inputs, adds a bias, and applies an activation function.
- The transformed data is passed to the next layer.

Example

- Input values: x_1, x_2
- Weights: w_1, w_2
- Bias: b
- Neuron output: $y = \text{Activation}(w_1 \cdot x_1 + w_2 \cdot x_2 + b)$

Backward Propagation

Adjust weights and biases to minimize the error between the predicted output and the actual output.

Activation Functions

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Introduce non-linearity into the model, allowing it to learn complex patterns.

Sigmoid

Outputs values between 0 and 1, useful for binary classification.

ReLU (Rectified Linear Unit)

Outputs the input directly if positive, otherwise zero. Commonly used in hidden layers.

Tanh

Outputs values between -1 and 1, useful for zero-centered data

20 mins Break

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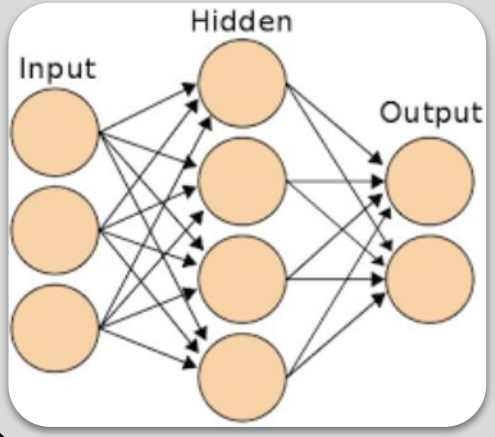
Types of Neural Networks



Convolutional Neural Networks

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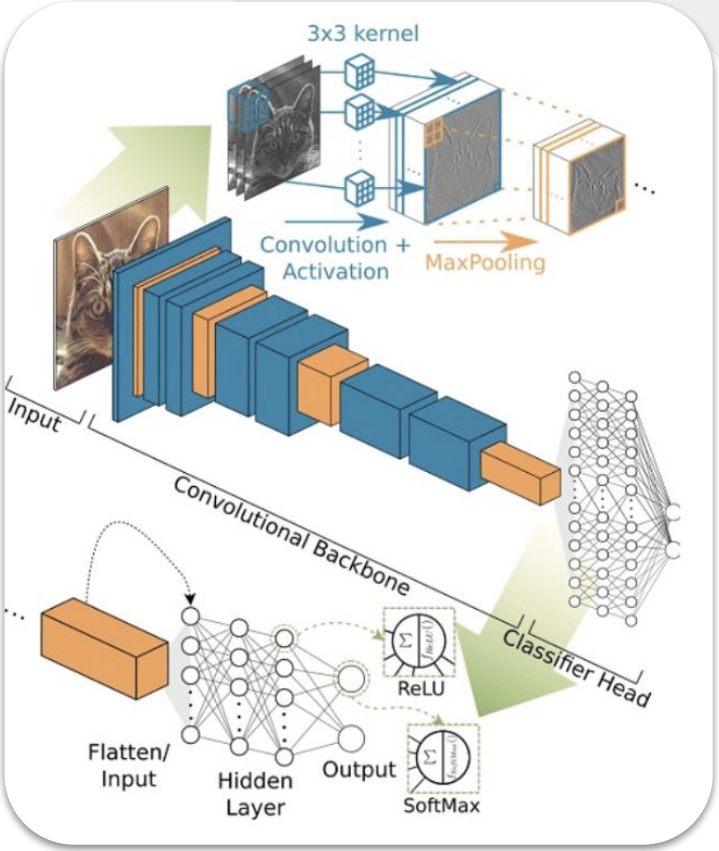
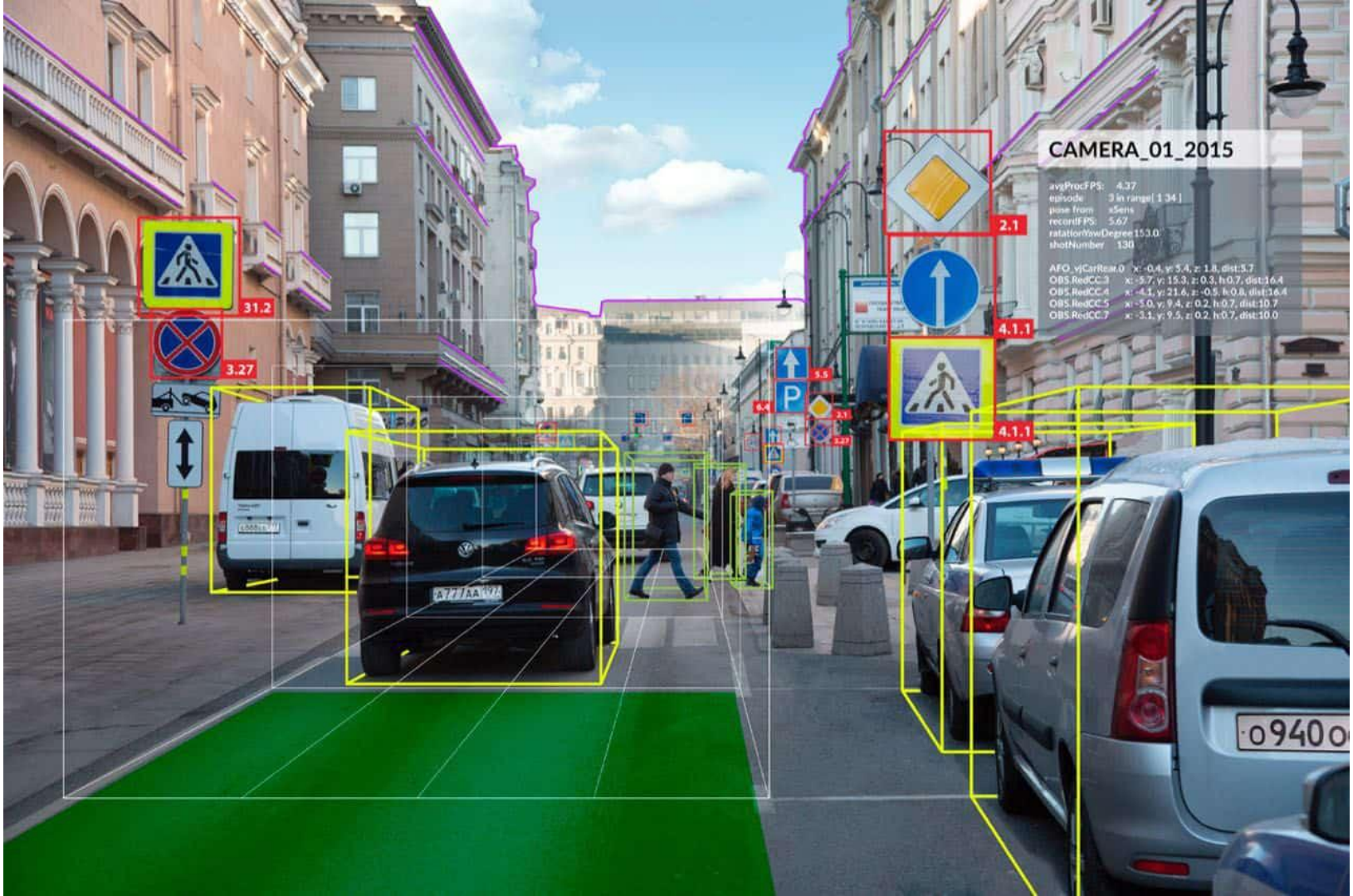
Convolutional Neural Networks (CNNs) are a class of deep learning models specifically designed for processing structured grid data, like images.

Applications:

- Image Classification
- Object Detection




CAMERA_01_2015
avgProcFPS: 4.37
episode 3 in range[1 34]
pose from x5ens
recordFPS: 5.67
ratationYawDegree 153.0
shotNumber 130
AFO_vjCarRear.0 x: -0.4, y: 5.4, z: 1.8, dist:5.7
OBS.RedCC.3 x: -5.7, y: 15.3, z: 0.3, h:0.7, dist:16.4
OBS.RedCC.4 x: -4.1, y: 21.6, z: -0.5, h:0.8, dist:16.4
OBS.RedCC.5 x: -5.0, y: 9.4, z: 0.2, h:0.7, dist:10.7
OBS.RedCC.7 x: -3.1, y: 9.5, z: 0.2, h:0.7, dist:10.0
31.2
3.27
2.1
4.1.1
4.1.1
5.5
3.1
3.27
P
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Recurrent Neural Network

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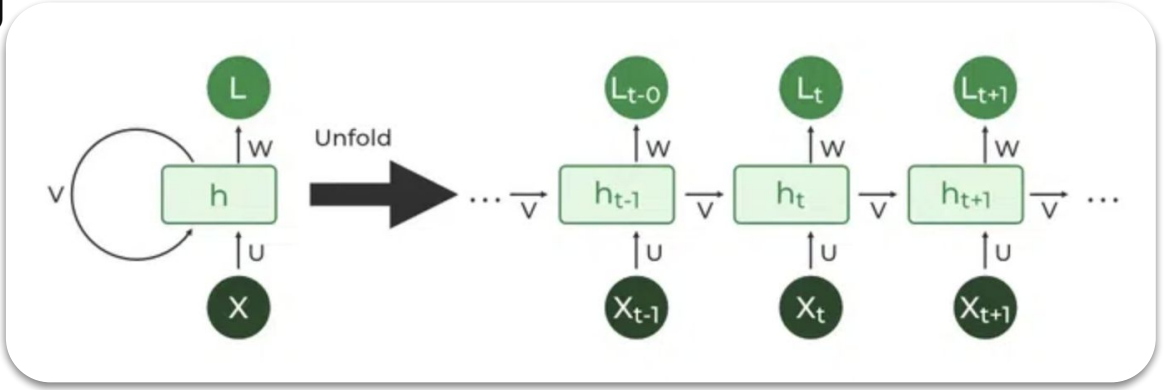
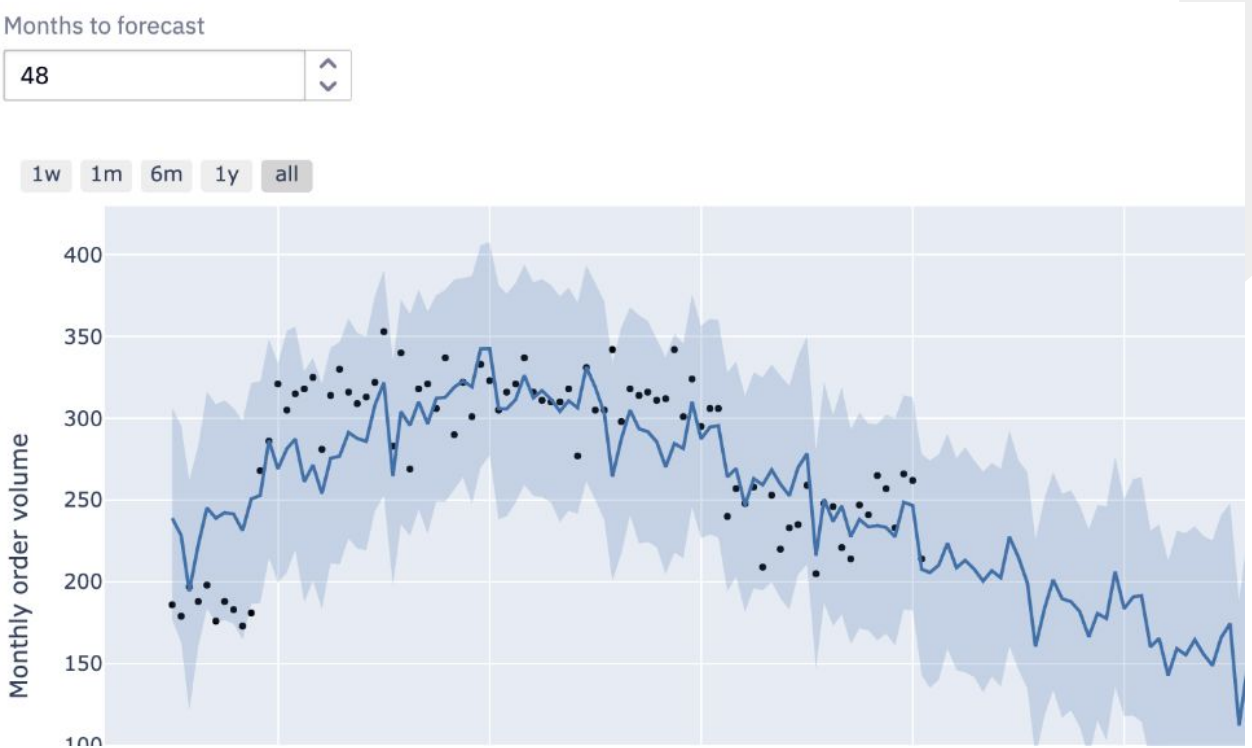
Recurrent Neural Networks (RNNs) are a class of neural networks designed for sequential data, where the order of data points is important.

Applications:

- Natural Language Processing
- Time Series Forecasting
- Speech Recognition



Applications of RNN



Generative Adversarial Networks

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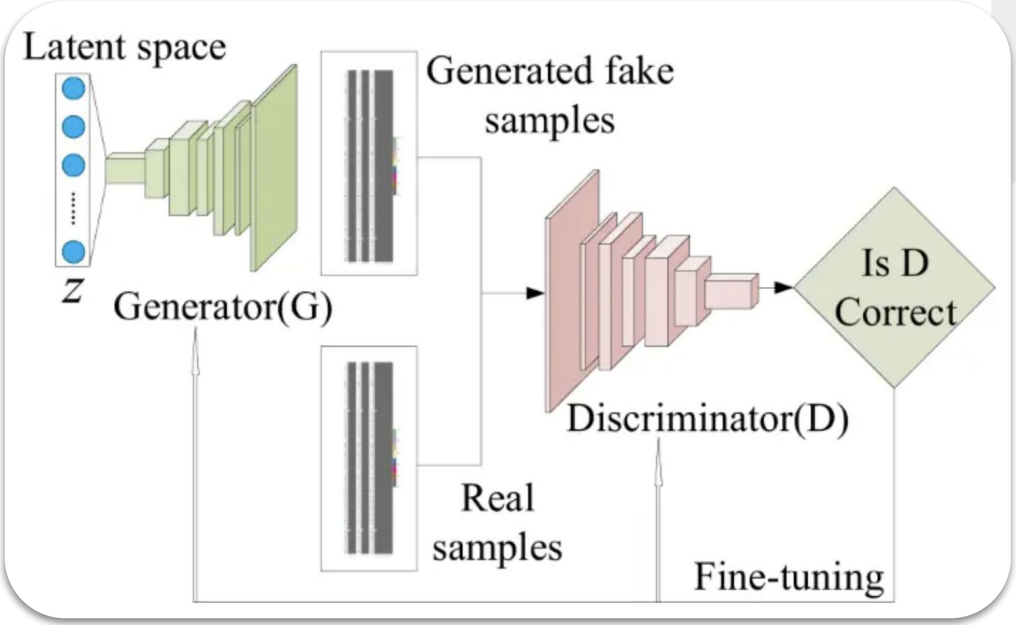
Generative Adversarial Networks (GANs) are a class of neural networks used for generating new, synthetic data that resembles a given training dataset.

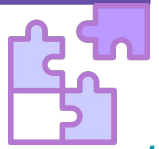
Applications:

- Image Generation
- Data Augmentation



Activity

Quiz



https://forms.gle/f5ZxXJxuqZvEQ6TN9

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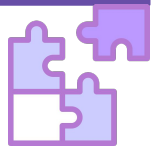
Activity

Building a Neural Network



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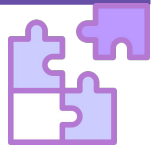
Activity

Reading



https://cloud.google.com/discover/deep-learning-vs-machine-learning

Q&A

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Thank You

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