Introduction to Machine learning In Detailed

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1 Introduction of Machine Learning

In this module we are going to learn to we can use the machine in a effective ways and for the better utilization of any machine and how we can use the different techniques to teach a machine so that a machine can replicate the human behavior and work effectively. so there are some basics terms, which is we have to learn it.

- Machine Learning is the ability of a machine to learn from and replicate the human behavior.
- It allows programs to learn automatically and make computers more intelligent.

1.0.1 Key Differences in Artificial Intelligence(AI), Machine Learning(ML) and Deep Learning(DL)

- ML referes the algorithms that learn and perform based on the data exposed to it. Machine Learning is used to classify the profile of the bot's competitor, the human, as:
- DL referes to layers of neural networks built with Machine Learning algorithms.
- AI makes decisions with the help of a multi-layered neural network that uses DL AI leverages different techniques, including ML and DL.

1.0.2 Machine Learning Algorithms

1. Algorithms are a set of instructions used to solve problems.
2. ML algorithms help to:
    - Predect.
    - Classify.
    - Improve performance of any software application.

1.0.3 Uses of Machine Learning

1. The predictions by ML are used to:
    - Shape policies.
    - Make weather forecast.
    - Determine traffic rules, CO2, emission, forest degradation, visibility in the sky, wildfire, heatwaves, and even the size of chimneys.

1.0.4 Data and ML

1. ML is dependent on data.

2. performance of algorithms is evaluated based on the quality of the input data.

1.0.5 Types of Machine Learning

Depending on wheather the algorithm can self-train and predict a condtion or needs to identify patterns to derive outcomes.

1.0.6 1. Supervised Learning

In supervised learning, the algorithm learns from labeled training data, meaning each input is paired with the correct output. The model makes predictions based on this data and is corrected when wrong. It is used for: - **Classification**: Predicting categorical outcomes (e.g., spam vs. non-spam emails). - **Regression**: Predicting continuous outcomes (e.g., stock prices, temperature).

Examples: - Linear Regression - Decision Trees - Support Vector Machines (SVM)

1.0.7 2. Unsupervised Learning

In unsupervised learning, the model learns from unlabeled data and tries to uncover hidden patterns or structures. The data does not have pre-defined outputs.

- **Clustering**: Grouping similar data points (e.g., customer segmentation).
- **Dimensionality Reduction**: Reducing the number of input features (e.g., Principal Component Analysis).

Examples: - K-means clustering - Hierarchical clustering - Autoencoders

1.0.8 3. Semi-Supervised Learning

Semi-supervised learning uses a combination of labeled and unlabeled data. It is useful when labeling a large dataset is time-consuming or expensive. The model first learns from a small set of labeled data and then extends this learning to a larger set of unlabeled data.

Example: - Self-training algorithms

1.0.9 4. Reinforcement Learning

In reinforcement learning, an agent learns to make decisions by interacting with an environment and receiving feedback in the form of rewards or penalties. It learns to take actions that maximize cumulative rewards over time.

Examples: - Q-learning - Deep Q-Networks (DQN) - Policy gradient methods

1.0.10 5. Self-Supervised Learning

Self-supervised learning is a type of unsupervised learning where the data itself provides the labels. The model learns from part of the data to predict another part (e.g., predicting the next word in a sentence).

Examples: - Generative models like GPT, BERT

1.0.11 6. Transfer Learning

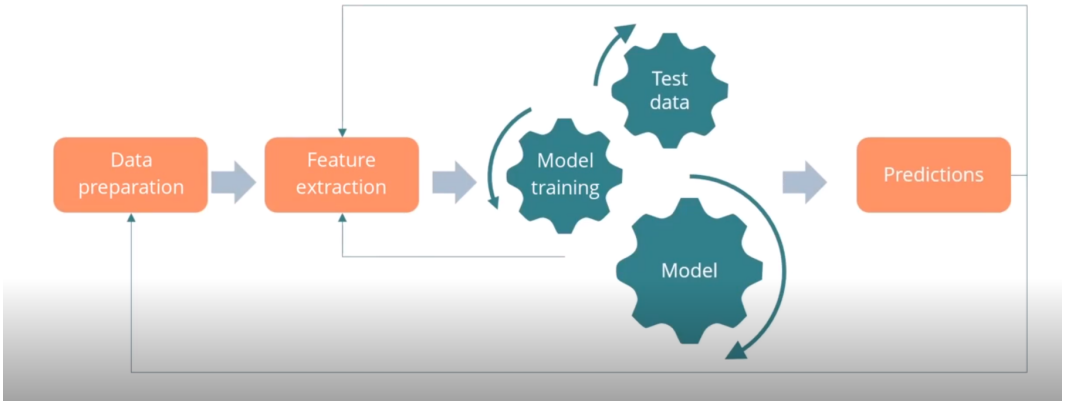
Transfer learning allows a model trained on one task to be reused on a new but related task. This approach is common when there's limited data for the new task but abundant data for the original task.

Example: - Pre-trained models like ResNet, BERT, and GPT used in different domains.

Each type of machine learning is used for different problems, and the choice depends on the specific task and available data.

1.0.12 Machine Learning Pipeline

1. A machine learning(ML) pipeline is a series of sequential steps used to codify and automate ML workflows to produce ML models.
2. ML pipeline is an end-to-end construction that includes and orchestrates:
   - Data extraction.
   - Raw data input.
   - Preprocessing.
   - Model parameters.
   - Model training.
   - Deployment.
   - Predicting outputs.
3. The term pipeline implies a one-way flow of data but ML pipelines are cyclical and iterative.
4. Every step in the sequence is repeated until a successful algorithm is achieved.



1.0.13 Machine Learning and Operations Professionals (MLOps)

MLOps is a set of practices that combines: - ML - DevOps - Data engineering

Ensures reliable and efficient deployment and maintenance of ML models in production systems.

MLOps aims to: - Improve communication and collaboration between MLOps. - Shorten and manage complete development life cycle. - Ensure continuous delivery of high-quality predictive services.

3 phases of MLOps

- Design:
  - Undersanding the business and data, and then designs the ML-powered software

- Model development:
  - Applicability of ML for the problem is verified by implementing proof of concept(POC)
- Operations.
  - Delevers the developed ML model in production

All three MLOps phases are interconnected and influence one another.

The tools used for MLOps are

- Kubeflowl
- MLFlow
- Data version control(DVC)
- Pachyderm
- Metaflow
- Kedro
- Seldon Core
- Flyte

1.0.14 CI/CD Pipeline Automation

A continuous integration(CI) or continuous delivery(CD) system is used to: - Test and deploy new pipeline implementations automatically - A CI/CD pipeline automation helps with dynamic changes in the data and business environment

Automated Machine Learning(AutoML)

- Combines the best practices in automation and machine learning
- It enables organizations to build and deploy ML models using:
  - Predefined templates
  - Frameworks
  - Processes to speed up time to completion
  - Enhances functionality of ML models

The tools used for AutoML are:

- Run:AI
- Auto-Keras
- H20AutoML
- SMAC
- AUTOWEKA
- AUTO-SKLEARN
- AUTO-PYTORCH
- ROBO

2 Python Libraries Used in Machine Learning

- Numpy
- Pandas
- Matplotlib

- TensorFlow
- Aesara based on Theano
- SciPy
- Scikit-learn
- Keras
- PyTorch

Numpy and pandas helps to manage preparation, loading, and manipulation of data.

TensorFlow and Aesara is used for fast numerical computing.

Matplotlib is used to plot data.

SciPy helps solve mathematical equations and algorithms.

Scikit-learn provides efficient versions of common algorithms to develop ML models.

keras makes the implementation of neural networks easy.

PyTorch specializes in deep learning applications and accelerates the path from prototyping to deployment.