

Software Engineering in Practice

Machine Learning & MLOps Lab

Apostolis Garos (apostolisgaros@gmail.com)

Ilias Balampanis (ibalampanis@aueb.gr)

Machine Learning and MLOps Lab

Goals

By the end of this lecture, you'll gain insights into:

-  **ML Basic Workflow:** Understanding the steps of a ML model development
-  **MLOps Introduction:** Discovering how ML models transition from development to production

Agenda

1. Introduction to Machine Learning 
2. Basic ML Workflow
3. Types of Machine Learning
4. Introduction to MLOps
5. Practical Demonstration

Why Machine Learning Matters

- **Efficiency and Automation:** Automate human-like tasks such as speech recognition and decision making.
- **Data Insights:** Unlock insights from data, leading to informed decisions quickly.
- **Innovation:** New products, services, and technology engagement methods.

What are some real-world applications of machine learning?

Machine Learning in Entertainment



- **Application:** Personalizing content recommendations.
- **Example:** Netflix
- **Usage:** ML-powered algorithms tailor content to user preferences, enhancing viewer satisfaction and engagement.
- **Impact:** Netflix's recommendation system is estimated to save **\$1 billion per year** by reducing churn.

Machine Learning in Programming



- **Application:** AI Pair Programmer
- **Example:** GitHub Copilot
- **Usage:** GitHub Copilot, auto-suggests code snippets and functions as you type, to enhance your productivity.
- **Impact:** GitHub's research shows that developers using GitHub Copilot can finish tasks up to 55% faster.

Machine Learning Across Industries



- **Application:** Versatility in text generation for various tasks.
- **Example:** ChatGPT by OpenAI
- **Usage:** Assists in writing, coding, tutoring, and more, showcasing ML's adaptability.
- **Impact:** Game-changer for (almost) anyone.

What is Machine Learning? 🤖

Definition: Machine Learning is a subset of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

What is Machine Learning? 😐

Definition: Machine Learning is a subset of artificial intelligence (AI) that provides systems the ability to *automatically learn and improve from experience* without being explicitly programmed.

What is Machine Learning? 😊

Definition: Machine Learning is a subset of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience *without being explicitly programmed.*

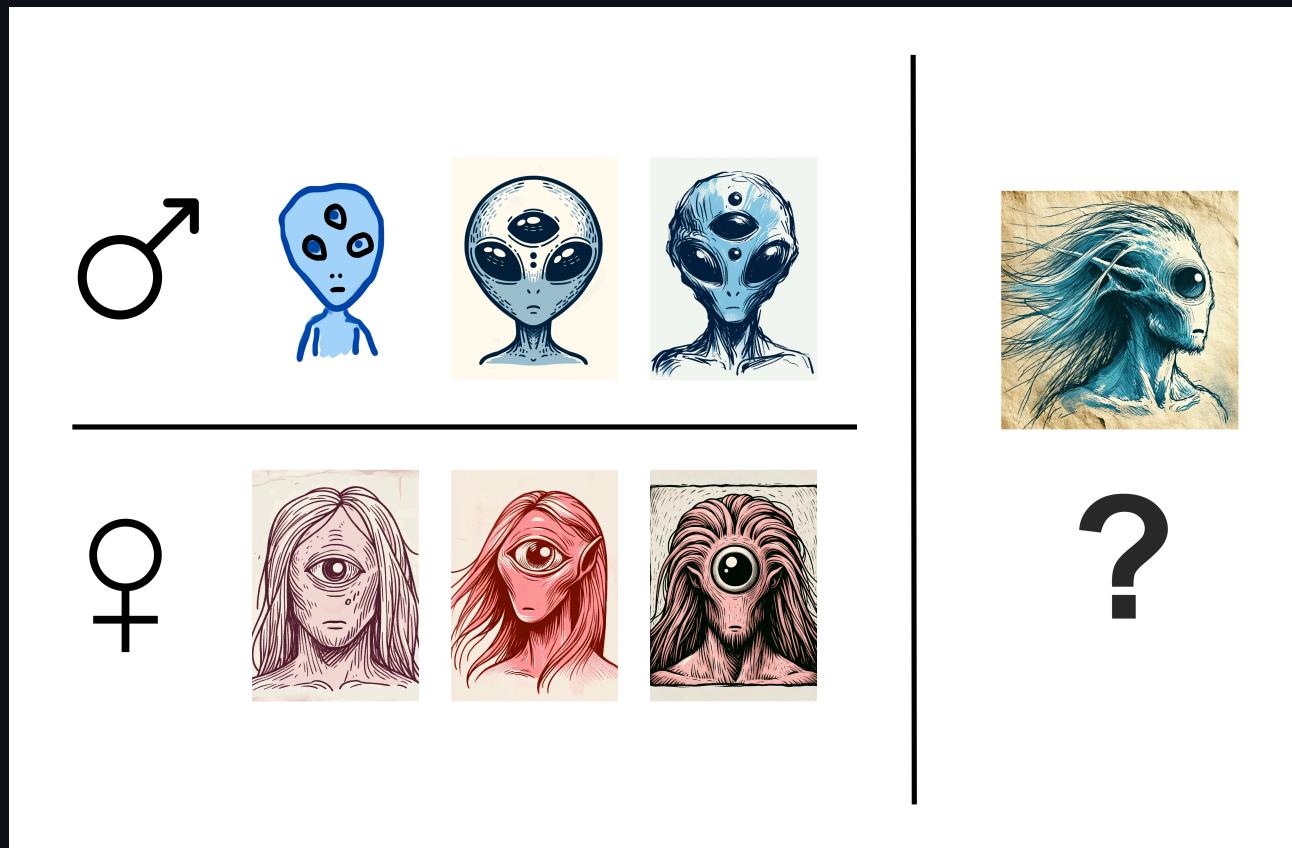
Interactive Exercise: Alien Gender Classification

- **Task:** We'll look at sketches of aliens, labeled as male or female.
- **Your Challenge:** Predict the gender of a new unlabeled alien.

Interactive Exercise: Alien Gender Classification



Interactive Exercise: Alien Gender Classification



What is Machine Learning?

Definition: Machine Learning is a subset of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

Agenda

1. Introduction to Machine Learning
2. Basic ML Workflow 
3. Types of Machine Learning
4. Introduction to MLOps
5. Practical Demonstration

Basic Machine Learning Workflow

1. **Data Collection:** Gathering data.
2. **Data Preprocessing:** Cleaning and organizing data.
3. **Model Selection:** Choosing the right model.
4. **Training:** Using data to learn patterns.
5. **Evaluation:** Assessing performance.
6. **Iteration:** Refining for accuracy.

The important part: DATA



- **Data Collection:** Foundation of ML. Quality and quantity are crucial.
- **Preprocessing:** Cleaning, handling missing values, encoding, normalizing.

The fun part: MODELS

- **Model Selection:** From simple (linear regression) to complex models (neural networks), based on data and problem.
- **Training:** Process of learning the data patterns.
- **Evaluation:** Using accuracy or other metrics.

Agenda

1. Introduction to Machine Learning
2. Basic ML Workflow
3. Types of Machine Learning 
4. Introduction to MLOps
5. Practical Demonstration

Types of Machine Learning

- **Supervised Learning:** Learning from labeled data (e.g., spam detection).
- **Unsupervised Learning:** Finding patterns in unlabeled data (e.g., customer segmentation).
- **Reinforcement Learning:** Making decisions from feedback (e.g., video game AI).

Deep Dive: Supervised Learning

- **Process:** Learning from input-output pairs and adjusting based on prediction accuracy.
- **Applications:**
 -  **Spam Detection:** Email platforms like Gmail use supervised learning to filter out unwanted emails.
 -  **Sentiment Analysis:** Social media platforms analyze user comments to gauge public sentiment towards products or events.
 -  **Medical Diagnosis:** AI-driven tools assist doctors by providing more accurate diagnoses based on patient data.

Deep Dive: Unsupervised Learning

- **Process:** Discovering patterns and relationships in data without any labels.
- **Applications:**
 -  **Customer Segmentation:** Retailers use unsupervised learning to group customers based on purchasing behavior.
 -  **Anomaly Detection:** Credit card companies use it to identify unusual patterns that may indicate fraud.
 -  **Content Recommendation:** YouTube utilizes unsupervised learning to cluster similar videos, enhancing video suggestions.

Deep Dive: Reinforcement Learning

- **Process:** Learns through trial and error, guided by rewards for correct actions and penalties for mistakes, aiming to achieve specific goals.
- **Applications:**
 -  **Game Playing:** AlphaGo by DeepMind learned to win at Go by practicing thousands of games.
 -  **Robotics:** Boston Dynamics' robots navigate and adapt to obstacles with reinforcement learning.
 -  **Personalized Recommendations:** Spotify personalizes playlists by learning from user feedback.

Agenda

1. Introduction to Machine Learning
2. Basic ML Workflow
3. Types of Machine Learning
4. **Introduction to MLOps** 
5. Practical Demonstration

Introduction to MLOps

- **Definition:** MLOps (Machine Learning Operations) combines Machine Learning, DevOps, and Data Engineering to streamline and automate the ML model lifecycle.
- **Goal:** Ensure that ML models are not just developed but also reliably deployed and maintained in production environments.

Why MLOps Matters

- **Speed and Efficiency:** Accelerates the transition from experimentation to production.
- **Reproducibility:** Ensures models are traceable and results are repeatable.
- **Scalability:** Facilitates the management of growing data and model complexity.

Key Components of MLOps

- 1. Data Management:** Ensuring data quality and accessibility.
- 2. Model Training and Deployment:** Automating the integration, testing, releasing, and deployment of models.
- 3. Monitoring and Maintenance:** Continuous monitoring of model performance and data drift, with provisions for easy updates.

MLOps Tools and Technologies

- **Workflow Orchestration:** Tools like Apache Airflow and Kubeflow automate and manage ML workflows.
- **Model Serving:** TensorFlow Serving, TorchServe, and MLflow for deploying trained models into production.
- **Monitoring:** Prometheus, Grafana, and custom metrics for tracking model performance and data quality.

Practical Example of MLOps 🚀

Enhancing music apps with AI-Driven Recommendations

- **Monitoring & Retraining:**
 - **Automated Retraining:** Regular updates using new data keep the engine aligned with music trends and user preferences.
 - **Deployment Automation:** Tools ensure smooth updates, giving listeners ever-fresh playlists.
 - **Consistency Checks:** Post-update tests ensure recommendations always hit the mark.

Agenda

1. Introduction to Machine Learning
2. Basic ML Workflow
3. Types of Machine Learning
4. Introduction to MLOps
5. Practical Demonstration 

Practical Demonstration



- **Project:** Sentiment Analysis on IMDB Movie Reviews
- **Overview:** Perform sentiment analysis on a dataset of 50,000 movie reviews from IMDB.
- **Contents:** Jupyter notebook outlining the process from data collection to model evaluation and iteration.
- **Github repo:** [IMDB Sentiment Analysis](#)

Exploring Data Careers: Who Does What?

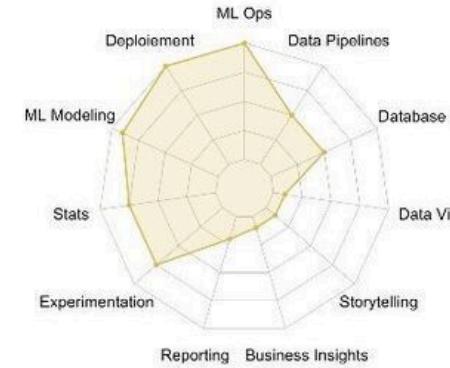
- **Data Engineer:** Builds the data pipelines and architecture for ML deployment.
- **Machine Learning Engineer:** Develops and deploys ML models for production.
- **Data Scientist:** Analyzes data to discover insights and trends.
- **Data Analyst:** Interprets data to inform business decisions.

Types of Data Professionals

Data Engineer



ML Engineer



Data Scientist



Data Analyst



Thank you for your attention! 🙏

"Machine intelligence is the last invention that humanity will ever need to make."

Nick Bostrom