Applied Machine Learning
Introduction

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August 10, 2024

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EMERALD INTERNATIONAL COLLEGE

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2 Introduction to Inference and Learning

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5 Unsupervised Learning

6 Reading Material

ML Application

1. HealthCare
   - Medical Diagnosis: ML algorithms analyze medical images, genetic data, and patient records to assist in diagnosing diseases like cancer, diabetes, and heart conditions.
   - Predictive Analytics: Predicting patient outcomes, hospital readmission rates, and disease outbreaks.
   - Personalized Medicine: Recommending personalized treatment plans based on individual patient data and genetic profiles.

2. Finance
   - Fraud Detection: Identifying unusual patterns in transaction data to detect fraudulent activities.
   - Algorithmic Trading: develop trading strategies that can analyze market trends and make trading decisions.
   - Credit Scoring: Assessing creditworthiness of individuals and businesses by analyzing financial histories and behaviors.

ML Application

3. Retail
   - Recommendation Systems: Suggesting products to customers based on their browsing and purchase history (e.g., Amazon, Netflix).
   - Inventory Management: Optimizing stock levels by predicting product demand and ensuring timely restocking.
   - Customer Segmentation: Classifying customers into different segments based on purchasing behavior to target marketing efforts more effectively.

4. Transportation
   - Autonomous Vehicles: Developing self-driving cars that use ML to perceive the environment, make decisions, and navigate.
   - Predictive Maintenance: Monitoring the health of infrastructure to predict failures and schedule maintenance before breakdowns occur.

ML Application

5. Natural Language Processing (NLP)

- **Chatbots and Virtual Assistants**: Creating conversational agents like Siri, Alexa, and customer support bots that can understand and respond to human language.
- **Sentiment Analysis:** Analyzing text data from social media, reviews, and feedback to gauge public sentiment about products, services, or events.
- **Machine Translation:** Translating text or speech from one language to another (e.g., Google Translate).

6. Computer Vision

- **Image and Video Analysis:** Identifying objects, faces, and activities in images and videos for applications like surveillance, facial recognition, and content moderation.
- **Medical Imaging:** Assisting radiologists by analyzing X-rays, MRIs, and CT scans to detect abnormalities.
- **Augmented Reality:** Enhancing real world environment

ML Application

7. Agriculture
   - **Precision Farming:** analyze soil data, weather conditions, and crop health to optimize farming practices and increase yields.
   - **Crop Monitoring:** Detecting diseases, pests, and nutrient deficiencies in crops using drone and satellite imagery.
   - **Automated Irrigation Systems:** Controlling irrigation based on real-time data to conserve water and improve crop health.

8. Manufacturing
   - Quality Control: Inspecting products for defects using ML models trained on image data.
   - Predictive Maintenance: Monitoring equipment performance to predict failures and schedule maintenance, reducing downtime and costs.
   - Supply Chain Optimization: Improving supply chain efficiency by forecasting demand and managing inventory levels.

ML Application

9. Education
  - Personalized Learning: Tailoring educational content and learning paths to individual students based on their performance and learning styles.
  - Automated Grading: Using ML to grade assignments and exams, providing instant feedback to students.
  - Predictive Analytics: Identifying students at risk of dropping out or underperforming to provide timely interventions.

10. Entertainment
  - Content Recommendation: Suggesting movies, music, and other content based on user preferences (e.g., Netflix.
  - Content Creation: Using ML to generate music, art, and writing, enhancing creativity and production processes.
  - Game Development: Creating intelligent non-player characters and adaptive game environments that respond to player actions

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Definition

- **Inference** and **learning** are two fundamental concepts in the field of AI and ML.
- **Inference**: It is the process of drawing conclusions (predictions or decisions based on a model) from data and models. It involves using known facts and rules to determine unknown information.
- **Learning** in AI: refers to the process of improving a model's performance on a given task through experience or data.

Types of Learning

- **Supervised Learning:** Involves training a model on a labeled dataset, where the correct output is provided for each example. Example: Classifying emails as spam or not spam based on a dataset of labeled emails.

- **Unsupervised Learning:** Involves training a model on a dataset without labeled responses, finding patterns or structures in the data. Example: Grouping customers into clusters based on purchasing behavior.

- **Reinforcement Learning:** training an agent to make a sequence of decisions by rewarding or punishing it based on its actions. Example: Teaching a robot to navigate a maze by giving it rewards for reaching the end.

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Definition

- ML is a field of study that gives computers the ability to learn without being explicitly programmed - Arthur Samuel (1959)
- A computer program is said to learn from experience **E** with respect to some *task* **T** and some performance measure **P**, if its performance on **T**, as measured by **P**, improves with *experience* **E**.

Quiz

Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam. What is the task T in this setting?

- Classifying emails as spam or not spam.
- Watching you label emails as spam or not spam.
- The number (or fraction) of emails correctly classified as spam/not spam.
- None of the abovethis is not a machine learning problem

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Supervised Learning

- Supervised learning - "right answers given"
- Regression: Predict continuous valued output (price)
- Classification: Discrete valued output (0 or 1) - Example: Cancer (malignant, benign)

Unsupervised Learning ...

- Unsupervised learning - a type of ML that learns from data without human supervision.
- Unsupervised ML models are given unlabeled data and allowed to discover patterns and insights without any explicit guidance or instruction.

Unsupervised Learning ...

In general, there are three types of unsupervised leaning tasks

- Clustering
- Association rules,
- Dimensionality reduction

Quiz

Of the following examples, which would you address using an unsupervised learning algorithm? (Check all that apply.)

- Given email labeled as spam/not spam, learn a spam filter.
- Given a set of news articles found on the web, group them into set of articles about the same story.
- Given a database of customer data, automatically discover market segments and group customers into different market segments.
- Given a dataset of patients diagnosed as either having diabetes or not, learn to classify new patients as having diabetes or not.

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