MACHINE LEARNING IN POLITICAL SCIENCE

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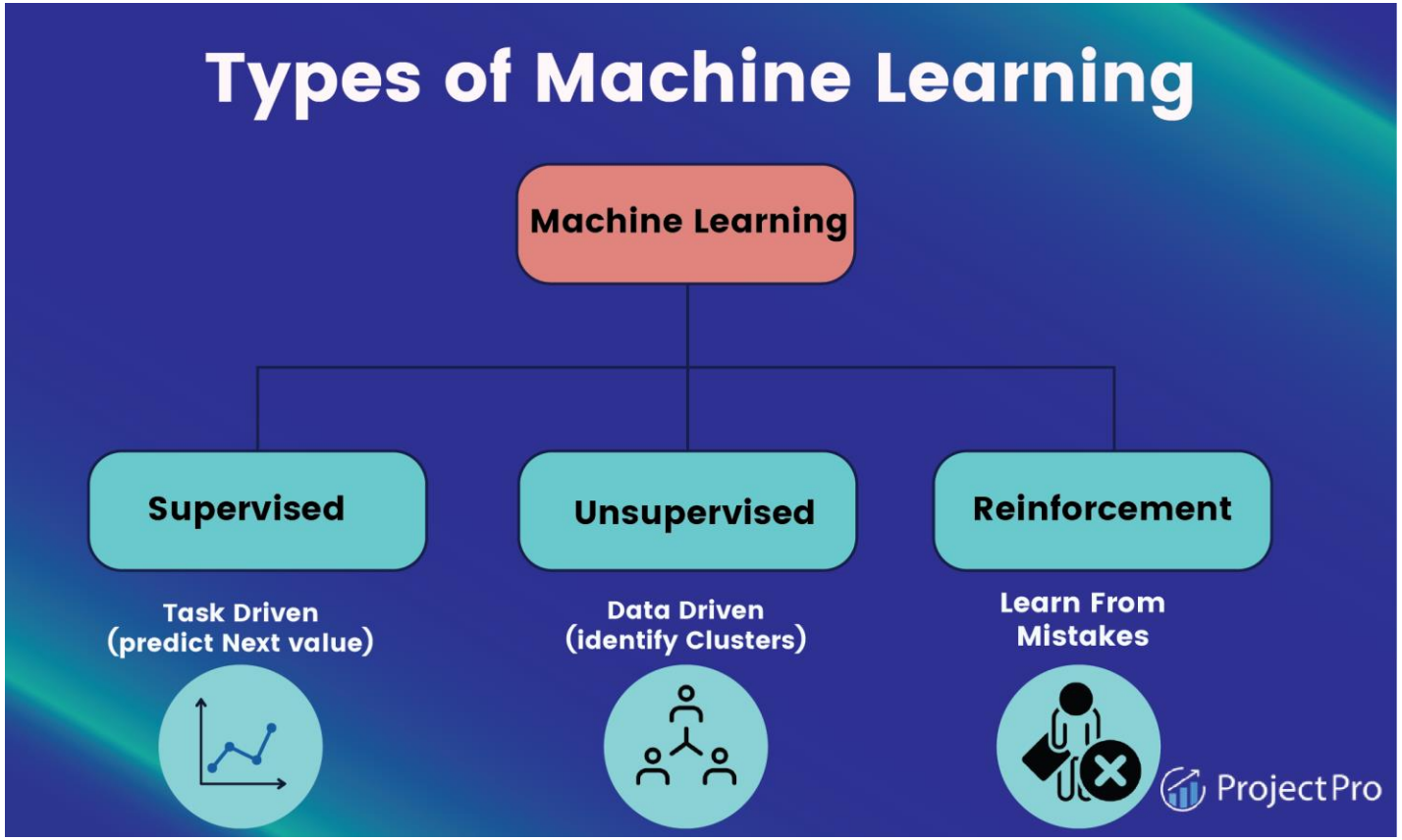
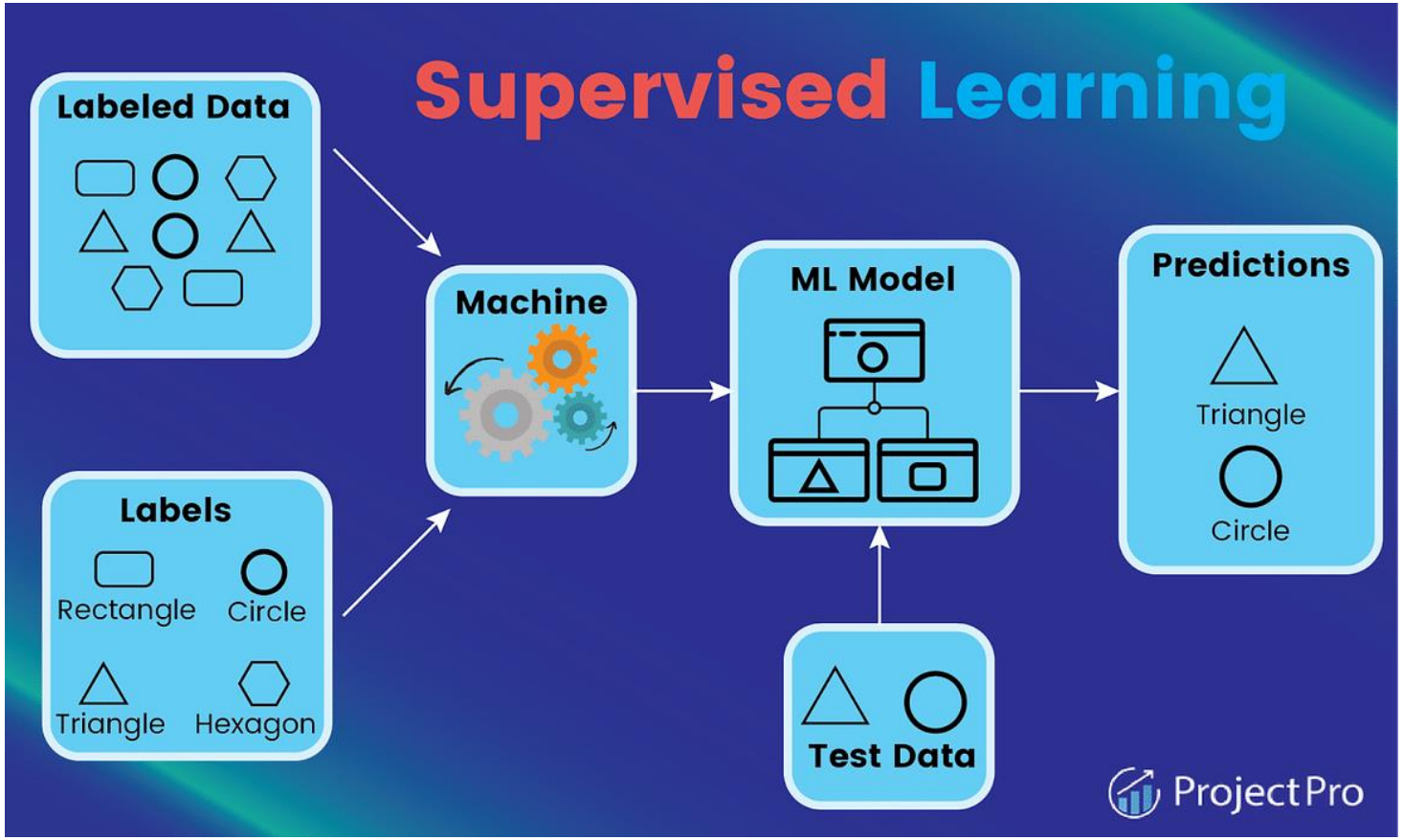
MACHINE LEARNING



I. SUPERVISED LEARNING ALGORITHMS



1.1 CLASSIFICATION

- Predicts the label of a class
- Predict the dataset's categories
- Example: "Yes" or "No“
- Commonly Used Algorithms:
- Decision Tree Algorithm
- Logistic Regression
- Random Forest Algorithm
- Support Vector Machine Algorithm

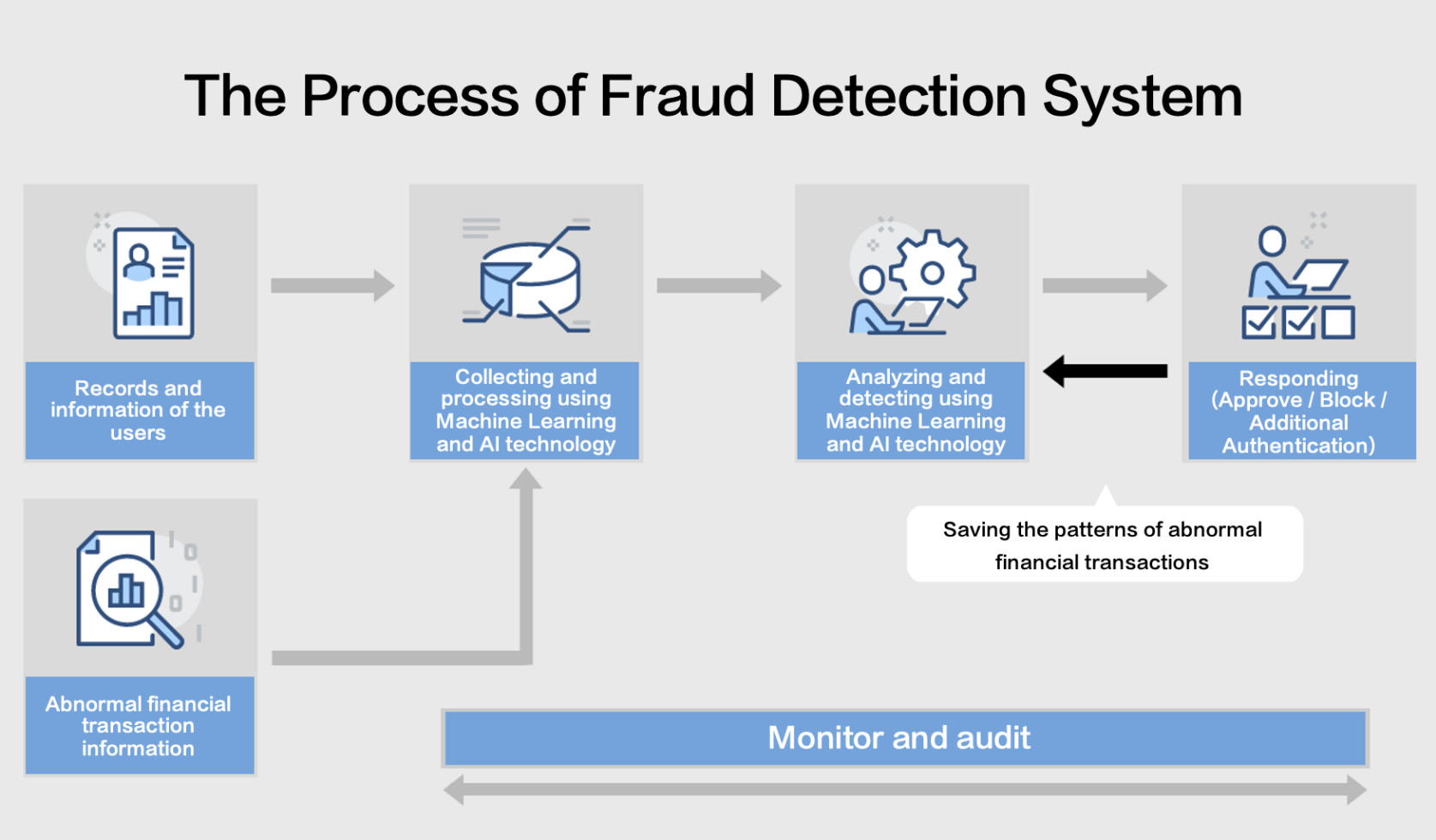
1.2 REGRESSION

- Predicts the numerical label/continuous variables

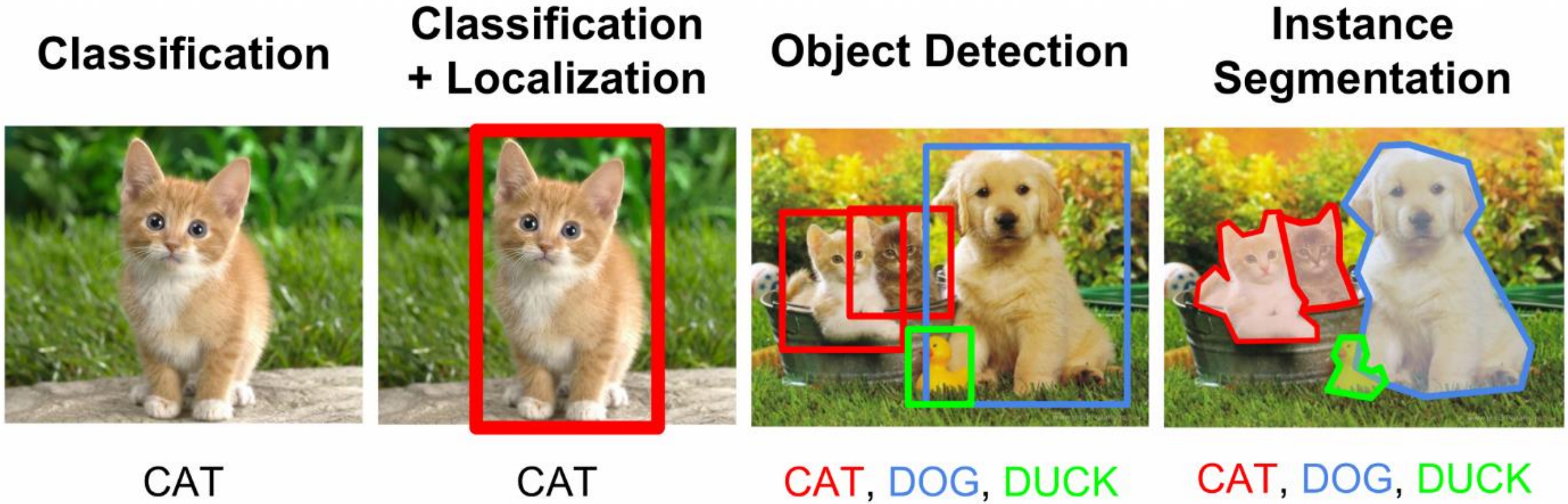
- Example: weather prediction

- Commonly used algorithms:
- Decision Tree Algorithm
- Lasso Regression
- Multivariate Regression Algorithm
- Simple Linear Regression Algorithm

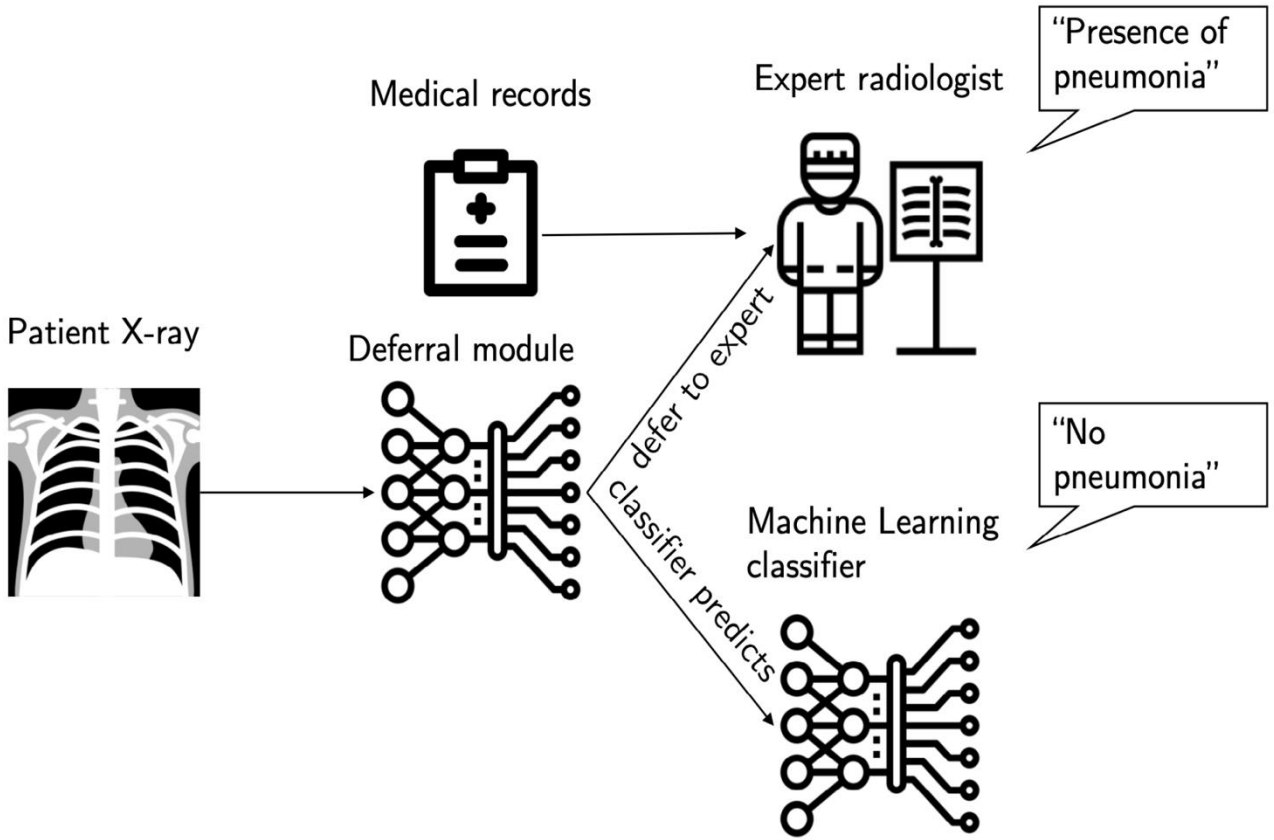
APPLICATION 1: FRAUD DETECTION



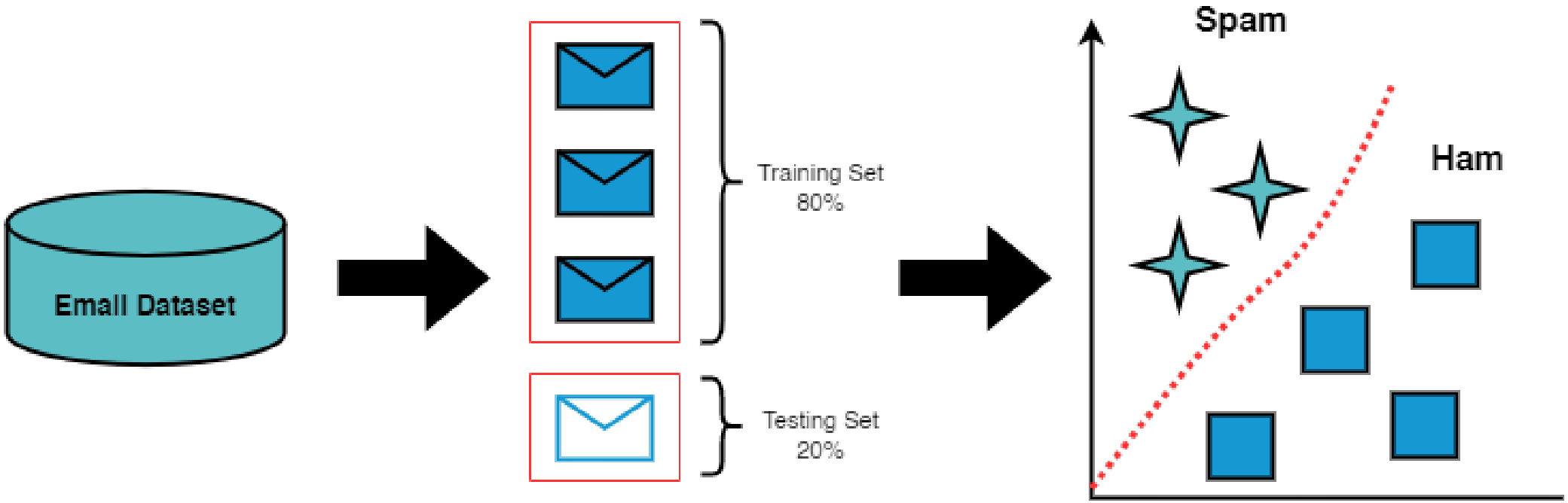
APPLICATION II: IMAGE SEGMENTATION



APPLICATION III: MEDICAL DIAGNOSIS



APPLICATION IV: SPAM DETECTION

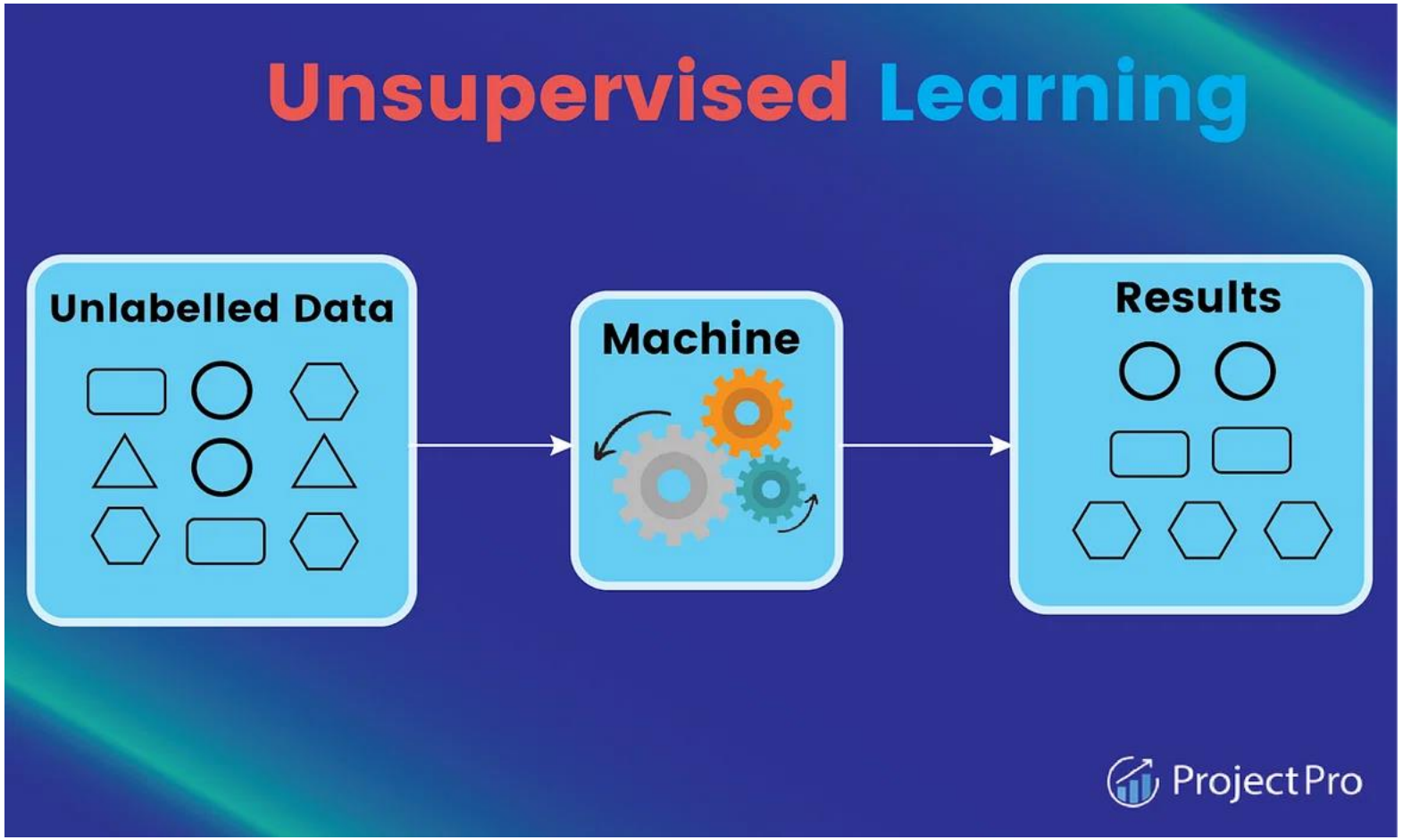


Instance Gathering

Training and Testing

Classification

2. UNSUPERVISED LEARNING ALGORITHMS



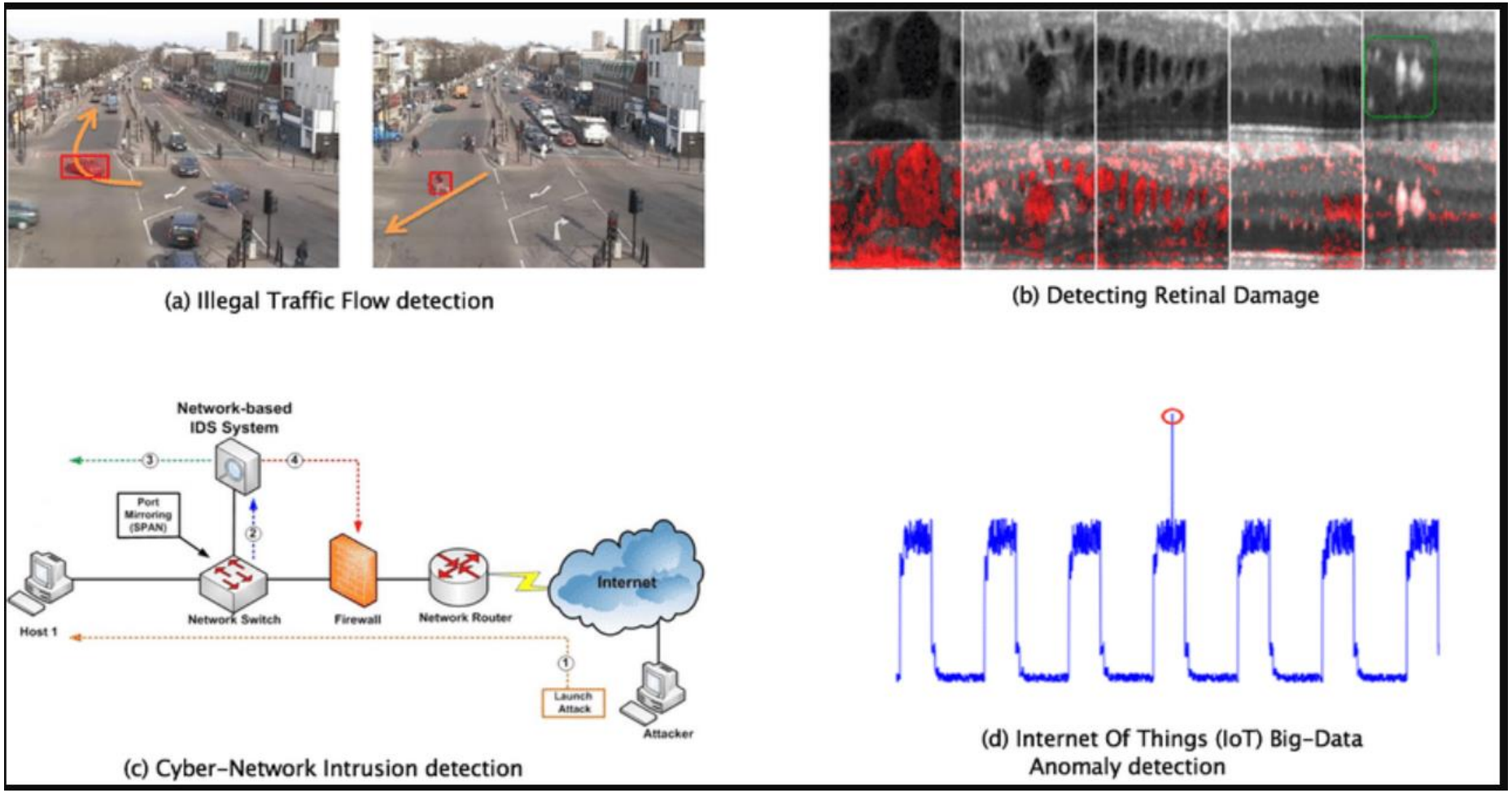
2.1 ASSOCIATION

- Finds relations between variables in a large dataset
- Goal: discover and map data dependent on the other to produce maximum profit
- Example: web usage mining
- Commonly used algorithms:
- Apriori algorithm
- Eclat
- FP-growth algorithm

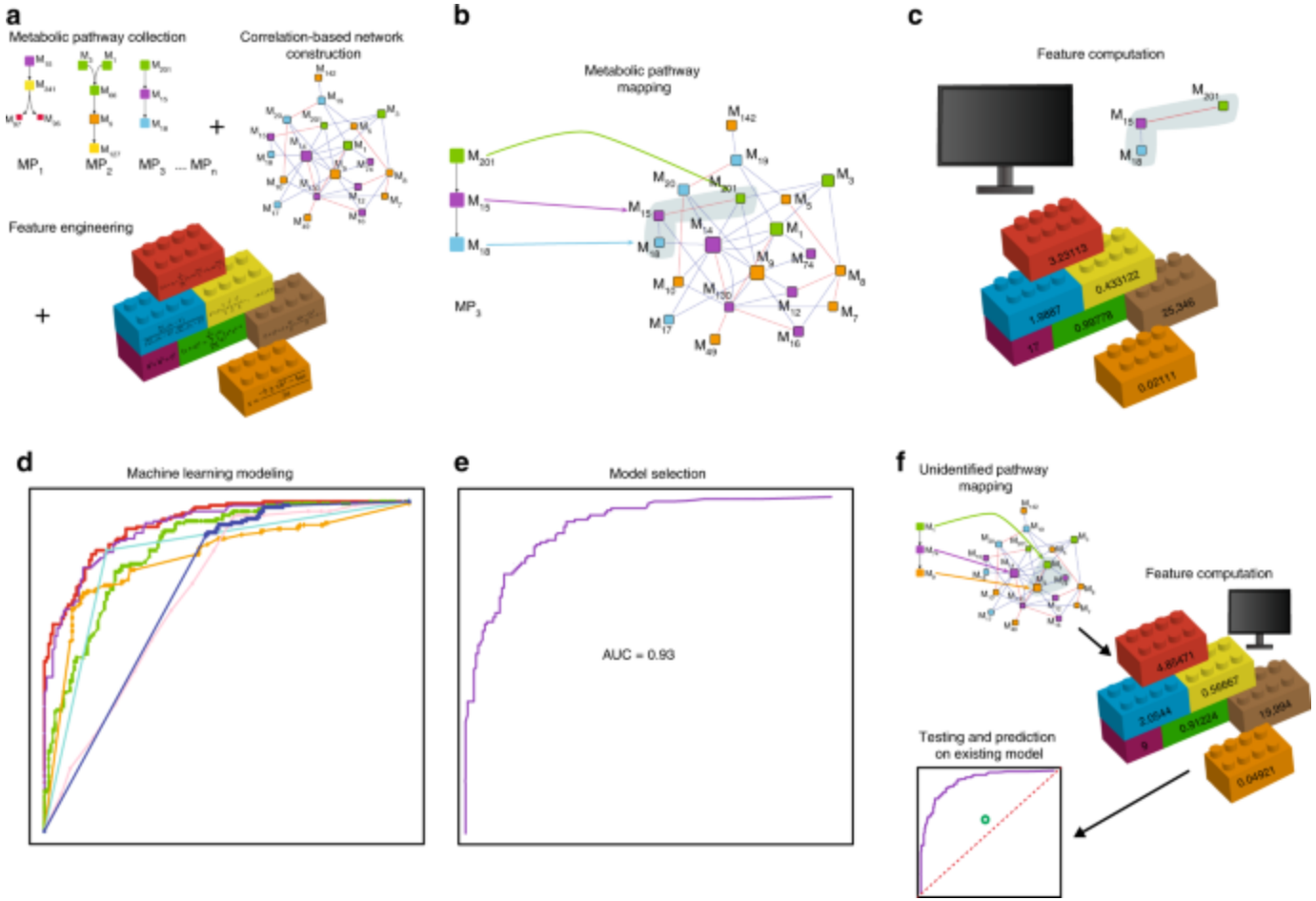
2.2 CLUSTERING

- A method of grouping each set of similar objects into a cluster
- Goal: discover inherent groups from the dataset
- Example: retail marketing
- Commonly used algorithms:
- K-Means Clustering Algorithm
- DBSCAN Algorithm
- Independent Component Analysis
- Mean-Shift Algorithm
- Principal Component Analysis

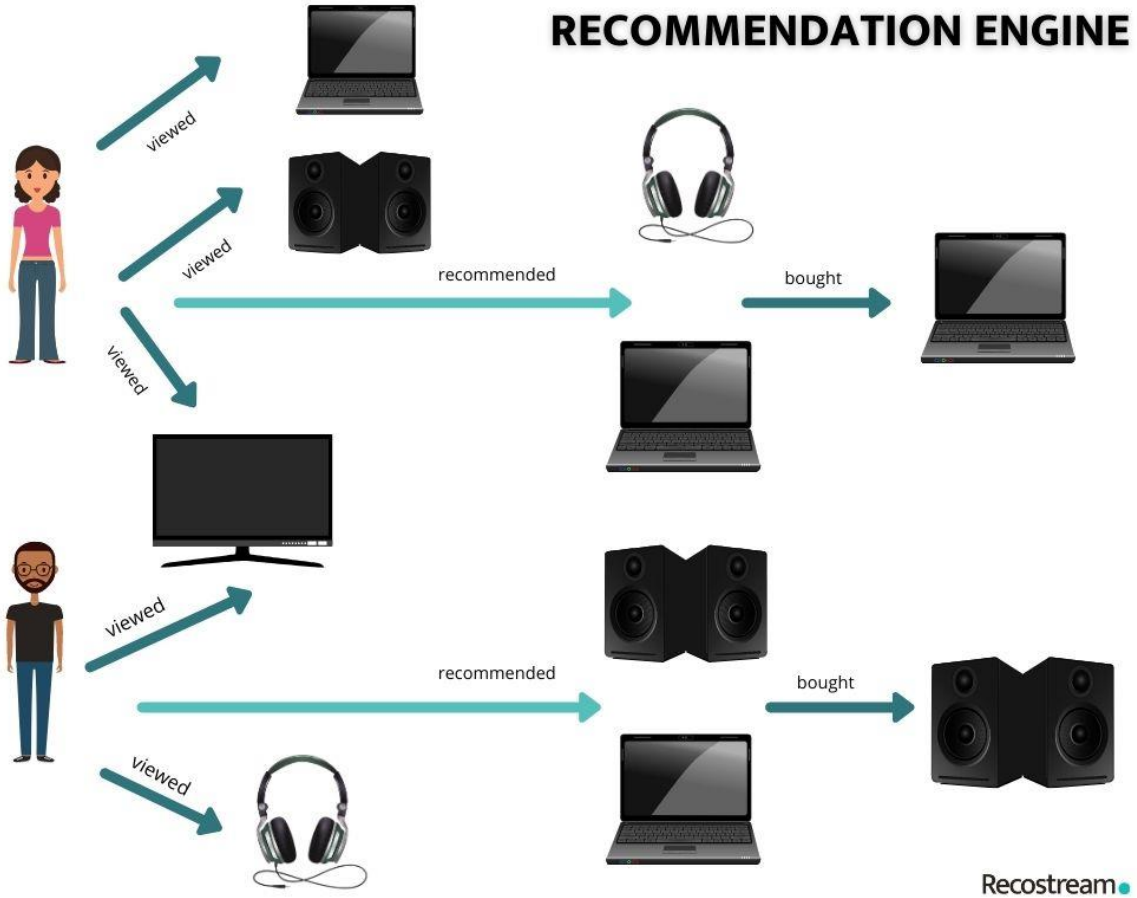
APPLICATION I: ANOMALY DETECTION



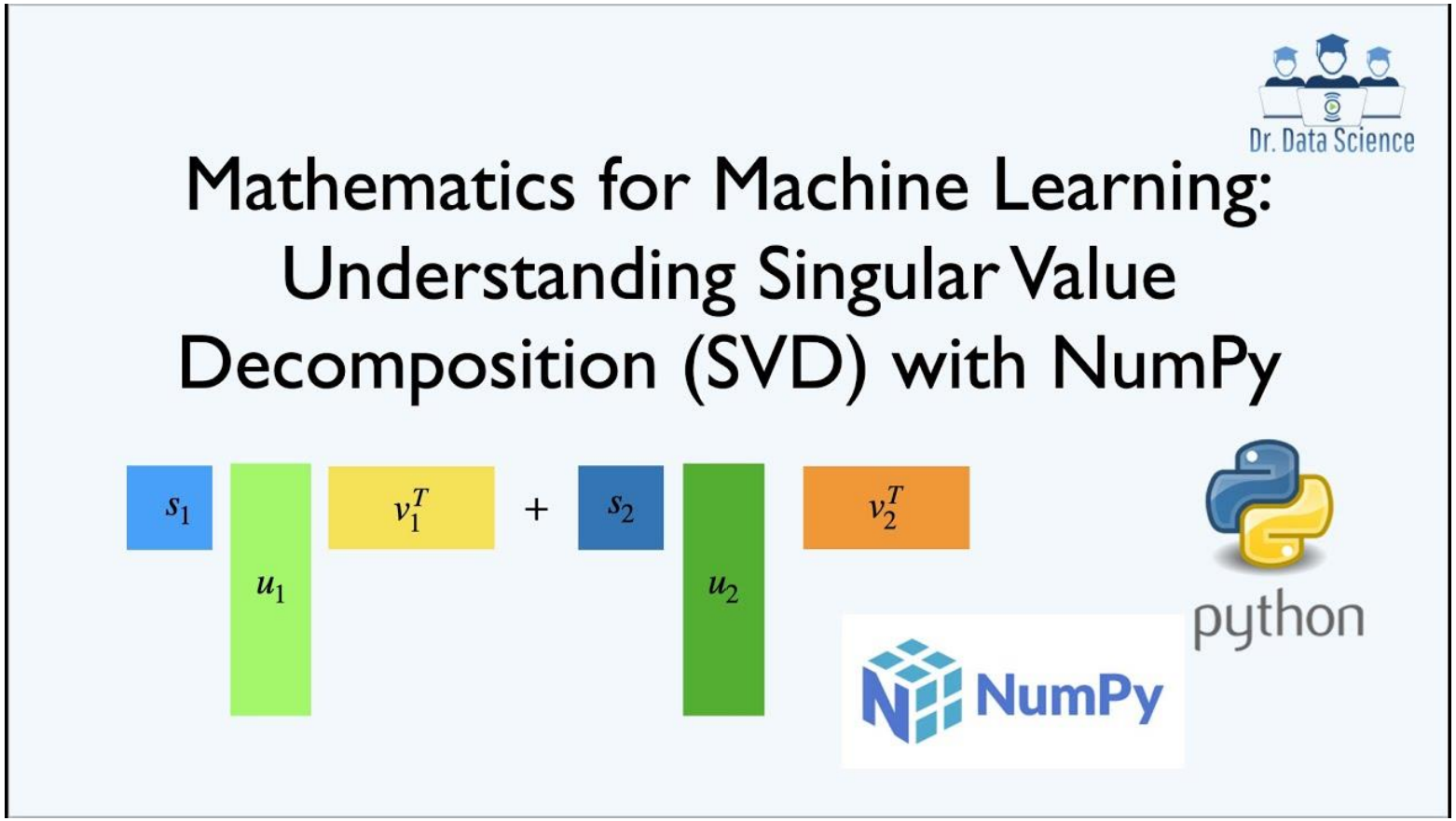
APPLICATION II: NETWORK ANALYSIS



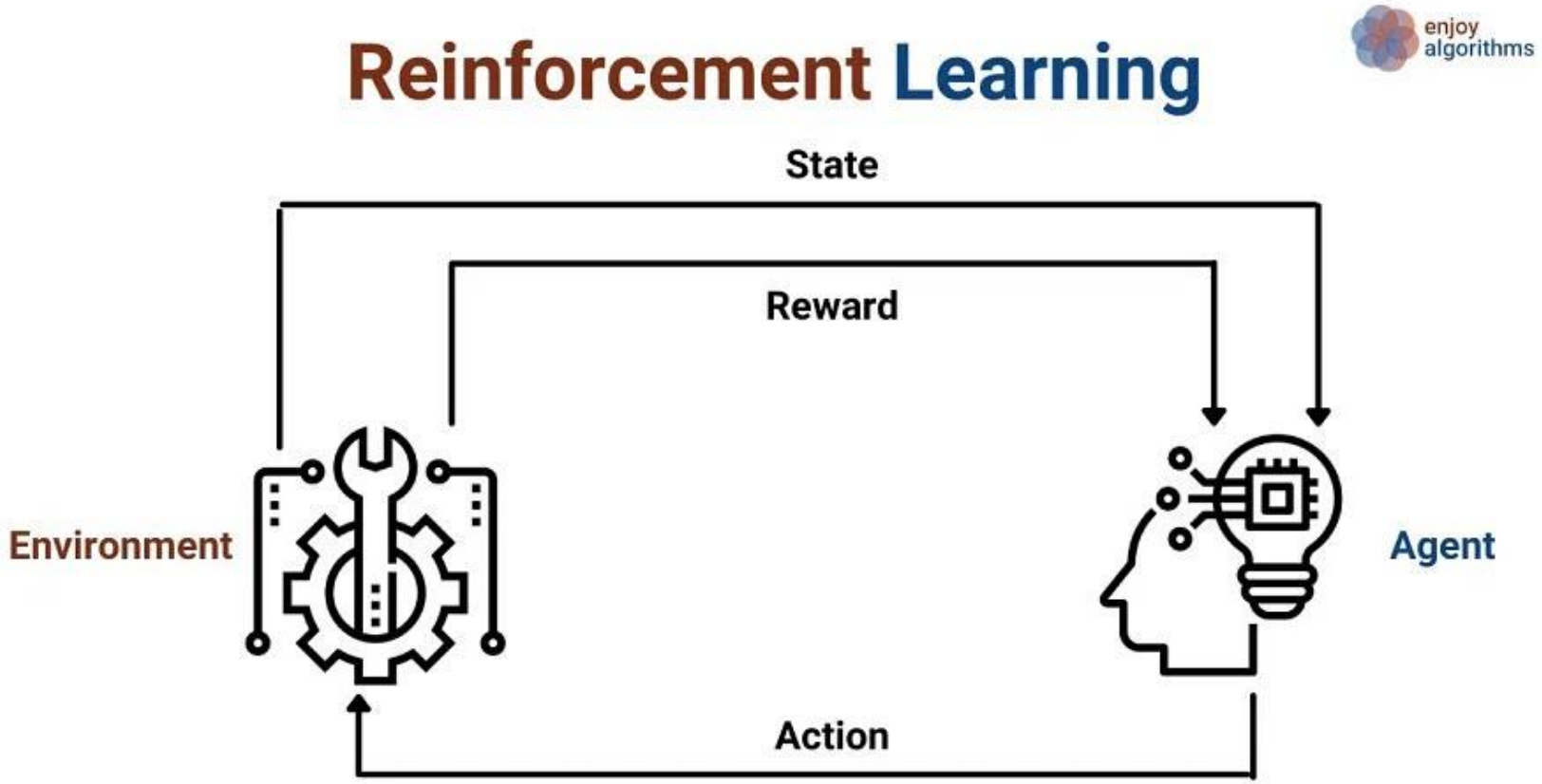
APPLICATION III: RECOMMENDATION SYSTEMS



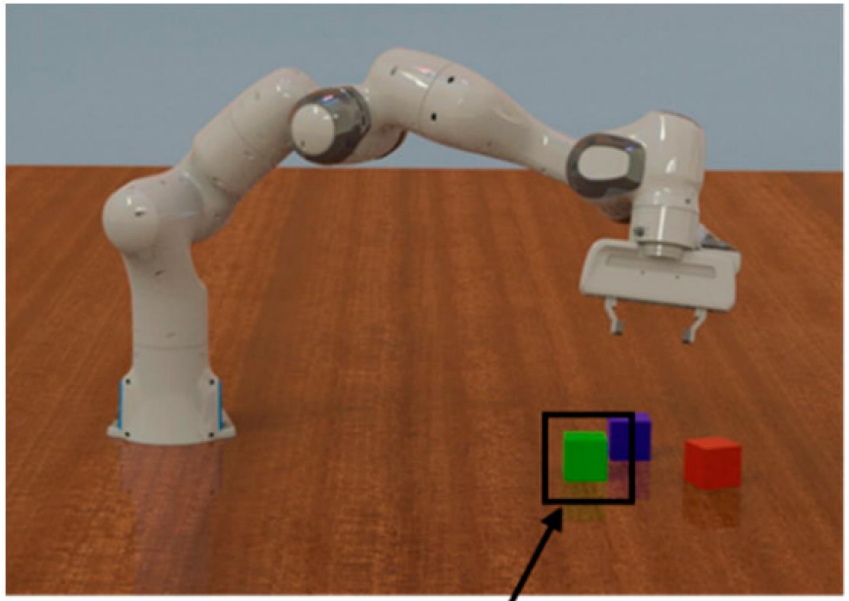
APPLICATION IV: SINGULAR-VALUE DECOMPOSITION



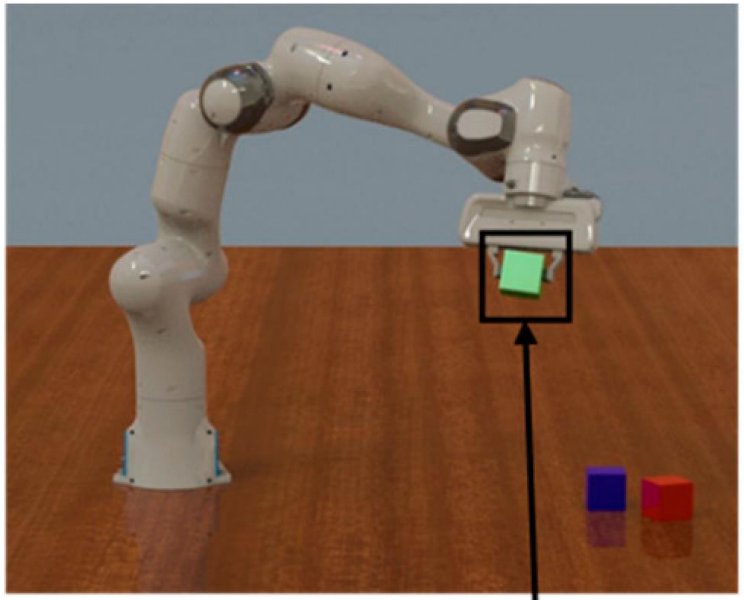
3. REINFORCEMENT LEARNING ALGORITHMS



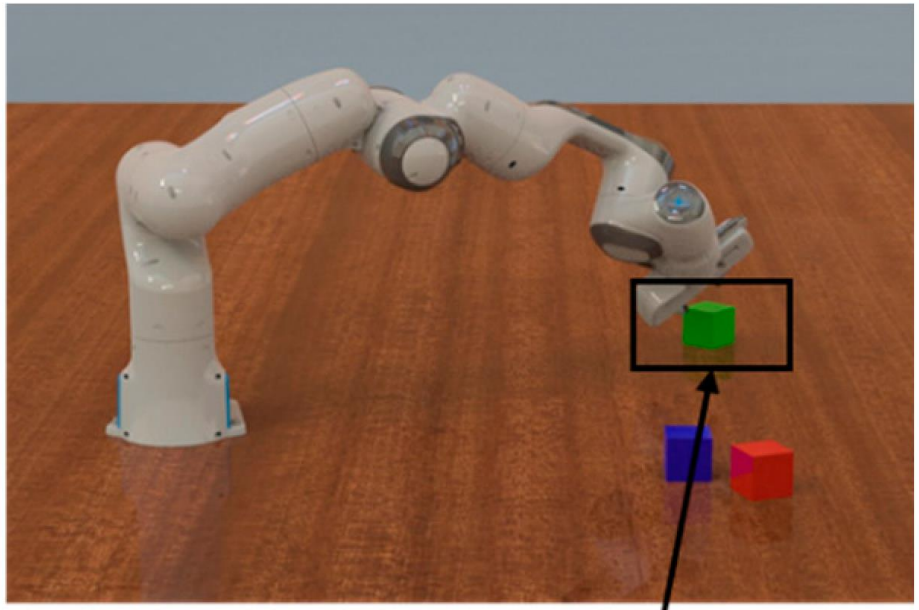
APPLICATION I: ROBOTICS



Target Object

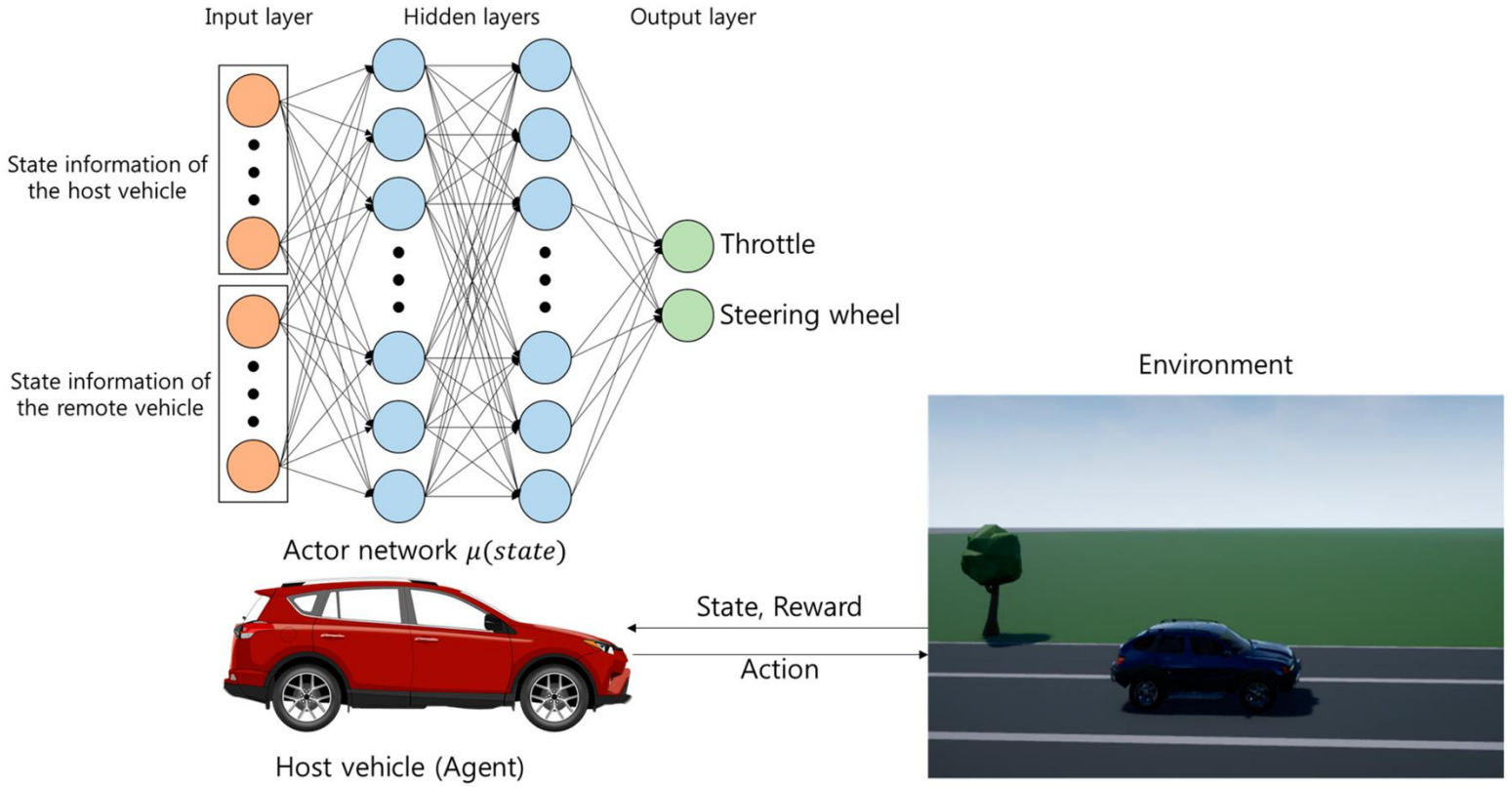


Target Selected

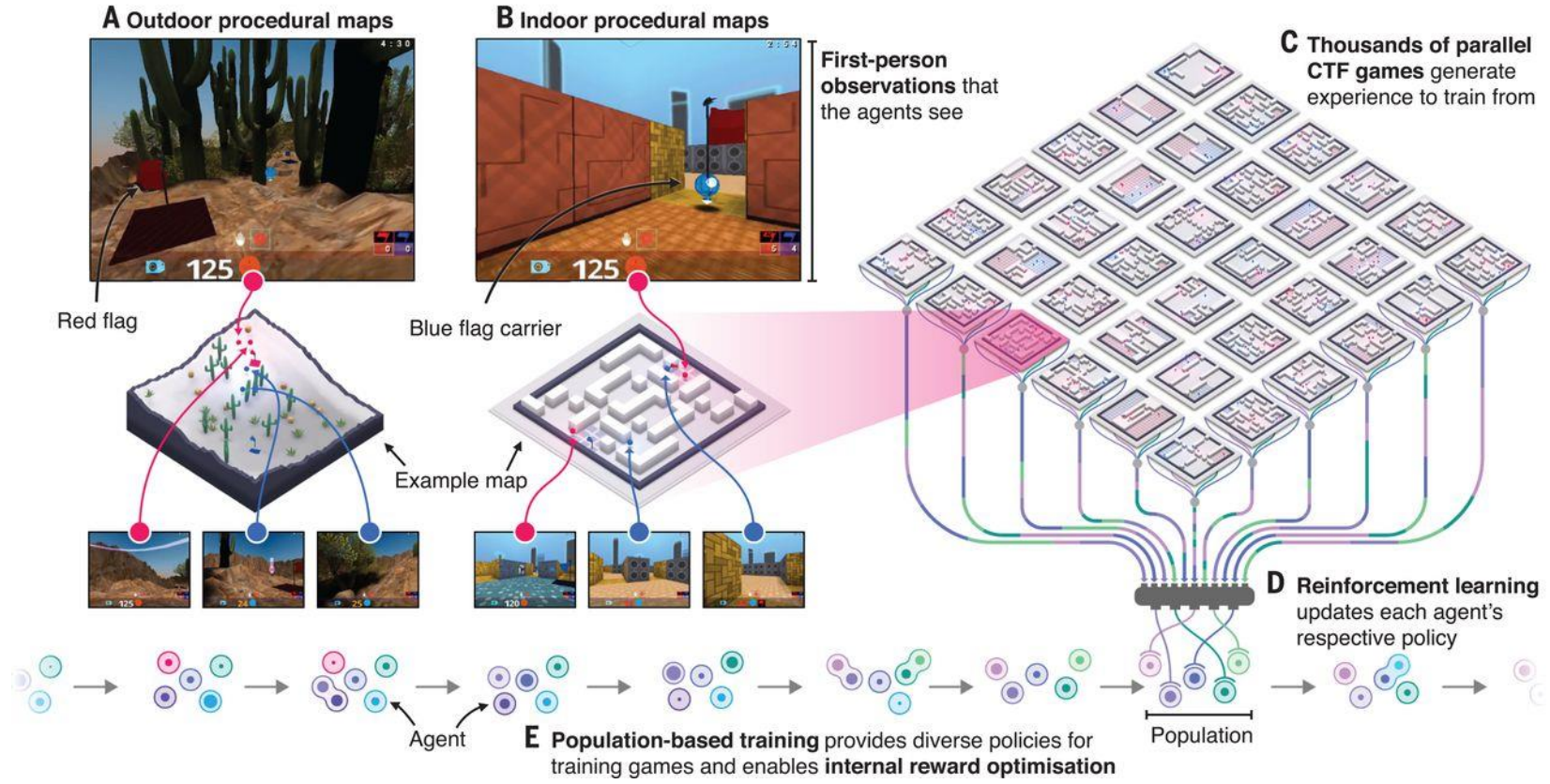


Successful Placement

APPLICATION II: SELF-DRIVING AUTOMOBILES



APPLICATION III: VIDEO GAMES



APPLICATION IV: CHATGPT

Step 1

Collect demonstration data and train a supervised policy.

A prompt is sampled from our prompt dataset.

A labeler demonstrates the desired output behavior.

This data is used to fine-tune GPT-3.5 with supervised learning.

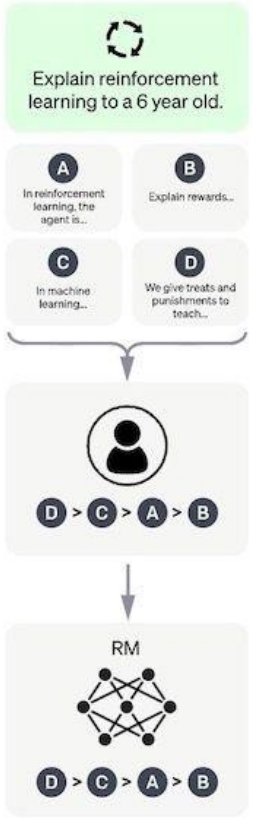
Step 2

Collect comparison data and train a reward model.

A prompt and several model outputs are sampled.

A labeler ranks the outputs from best to worst.

This data is used to train our reward model.



Step 3

Optimize a policy against the reward model using the PPO reinforcement learning algorithm.

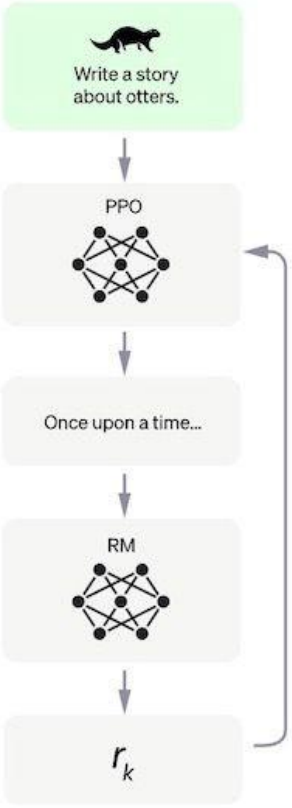
A new prompt is sampled from the dataset.

The PPO model is initialized from the supervised policy.

The policy generates an output.

The reward model calculates a reward for the output.

The reward is used to update the policy using PPO.



- Introduction to the Virtual Issue: Machine Learning in Political Science
- https://www.cambridge.org/core/services/aop-file-manager/file/5c348274e401b41903dae11b/PAN-VSI-Intro-0119-Machine-learning.pdf

- Machine Learning for Social Science: An Agnostic Approach
- https://www.annualreviews.org/doi/pdf/10.1146/annurev-polisci-053119-015921?download=true

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