

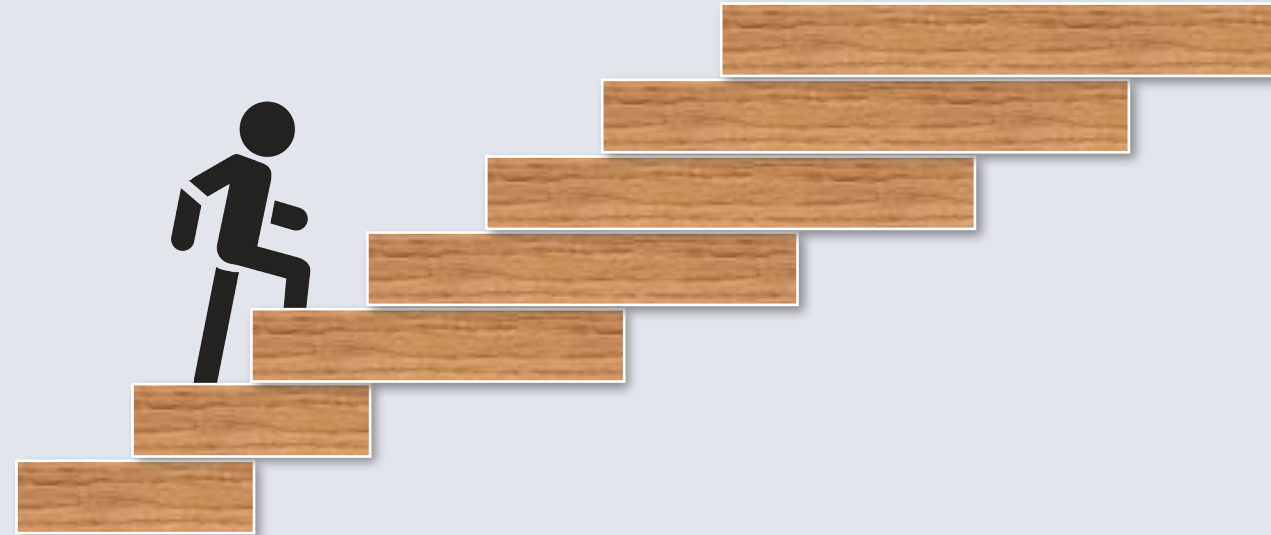
Lecture 3

Machine Learning-I

Previous Week Recap (..)



- Types of AI
 - Based on Capability
 - Based on Functionality
 - Based on Applications
- Working Areas
 - Facial expression recognition
 - Object detection
- Assessment 1 released (Guide)



Today's Contents



- Machine Learning ML
- Types of Machine Learning
- Relation between ML and AI
- Key steps in developing ML model

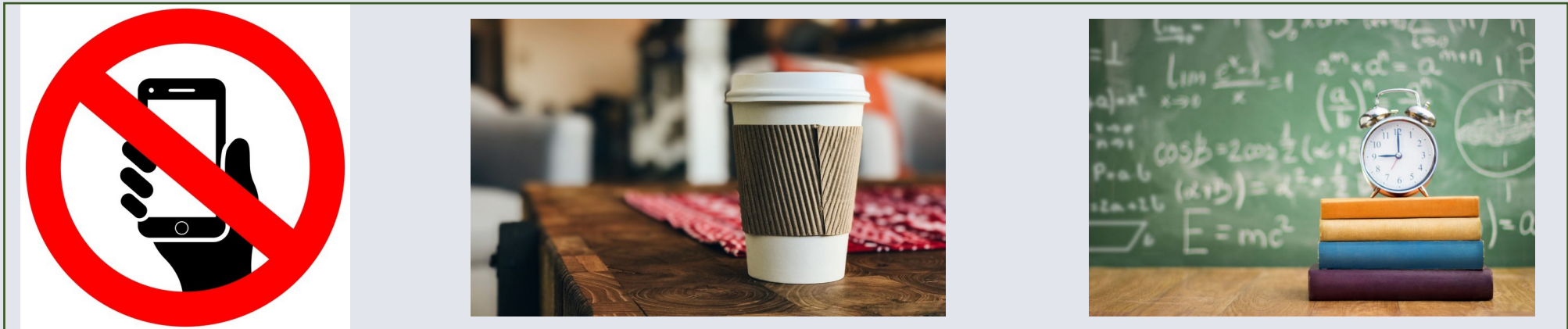


Today's Contents



Learning Objectives of Today's Lecture

- How Machine Learning ML and Artificial Intelligence AI relates.
 - Learning key concepts, algorithms and types in ML.
 - Steps involve in developing ML model
-
- **Important Directions**



Machine Learning ML

- What is Machine Learning?



Machine Learning ML



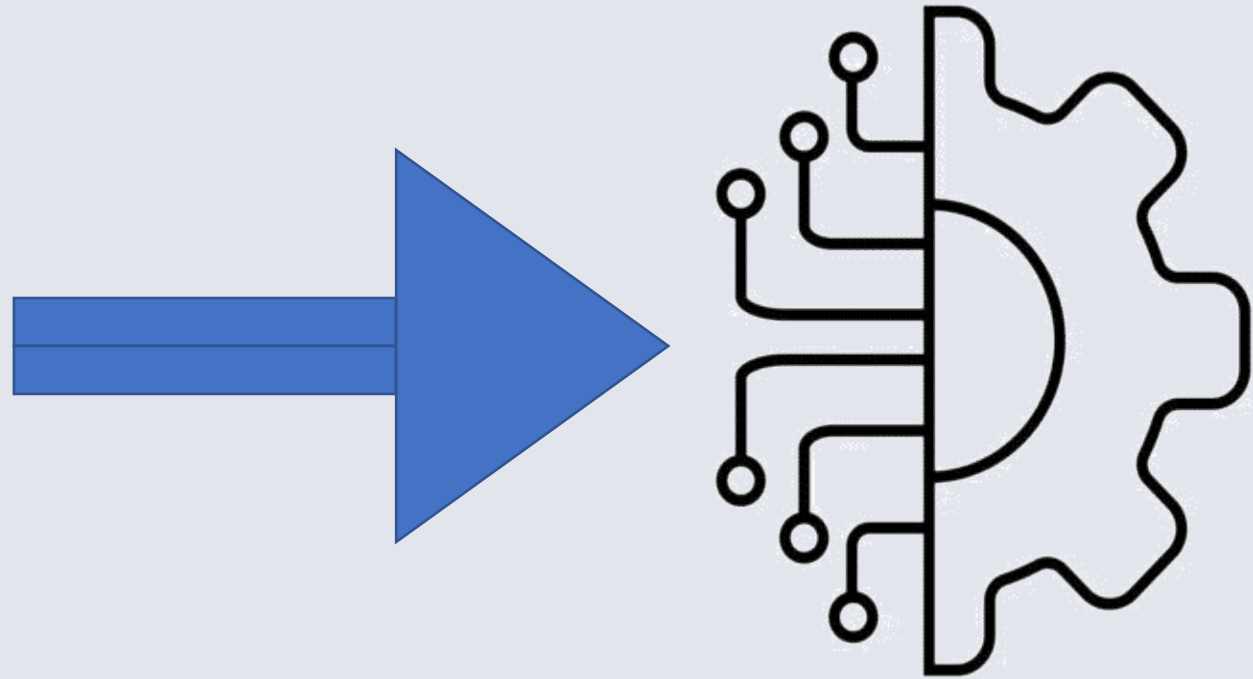
- What is Machine Learning?



Irregularities in Shape

Machine Learning ML

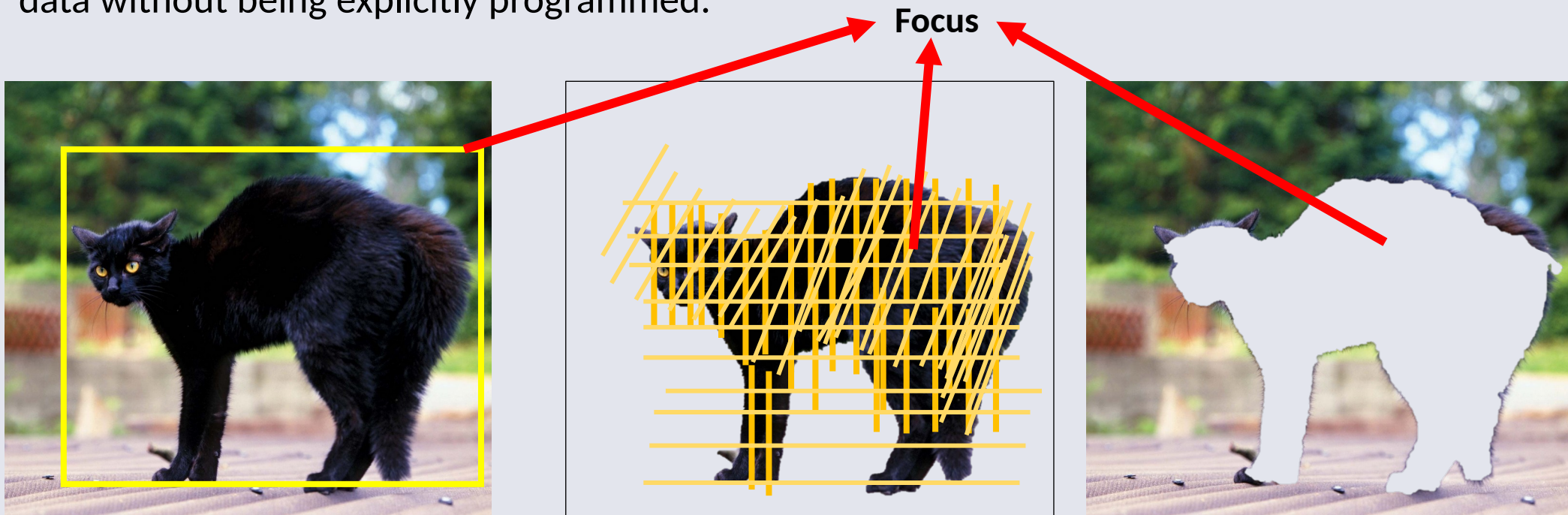
- What is Machine Learning?



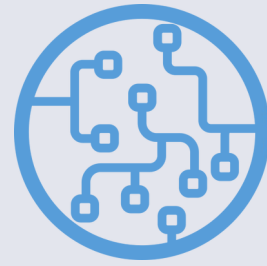
Machine Learning ML

- What is Machine Learning ML?

Subfield of AI that focuses on giving machines the ability to learn and make decisions from data without being explicitly programmed.



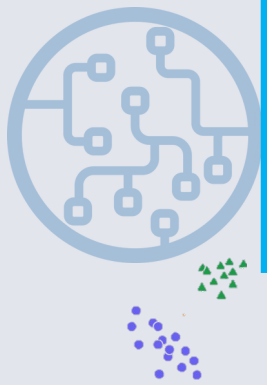
Types of Machine Learning



Machine Learning

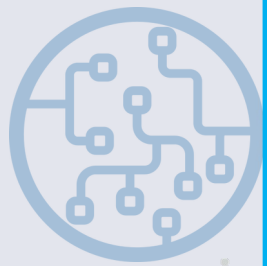
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Supervised Learning



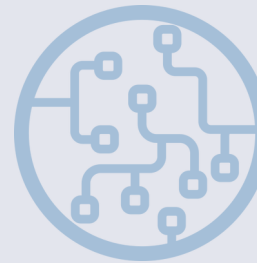
2

Unsupervised Learning

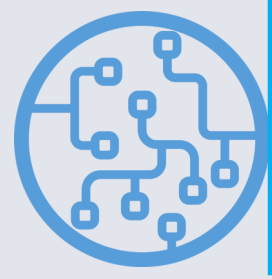


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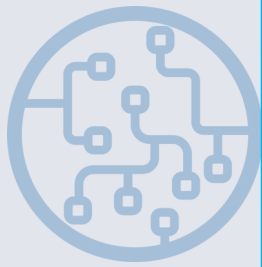
Reinforcement Learning



Types of Machine Learning



Machine Learning



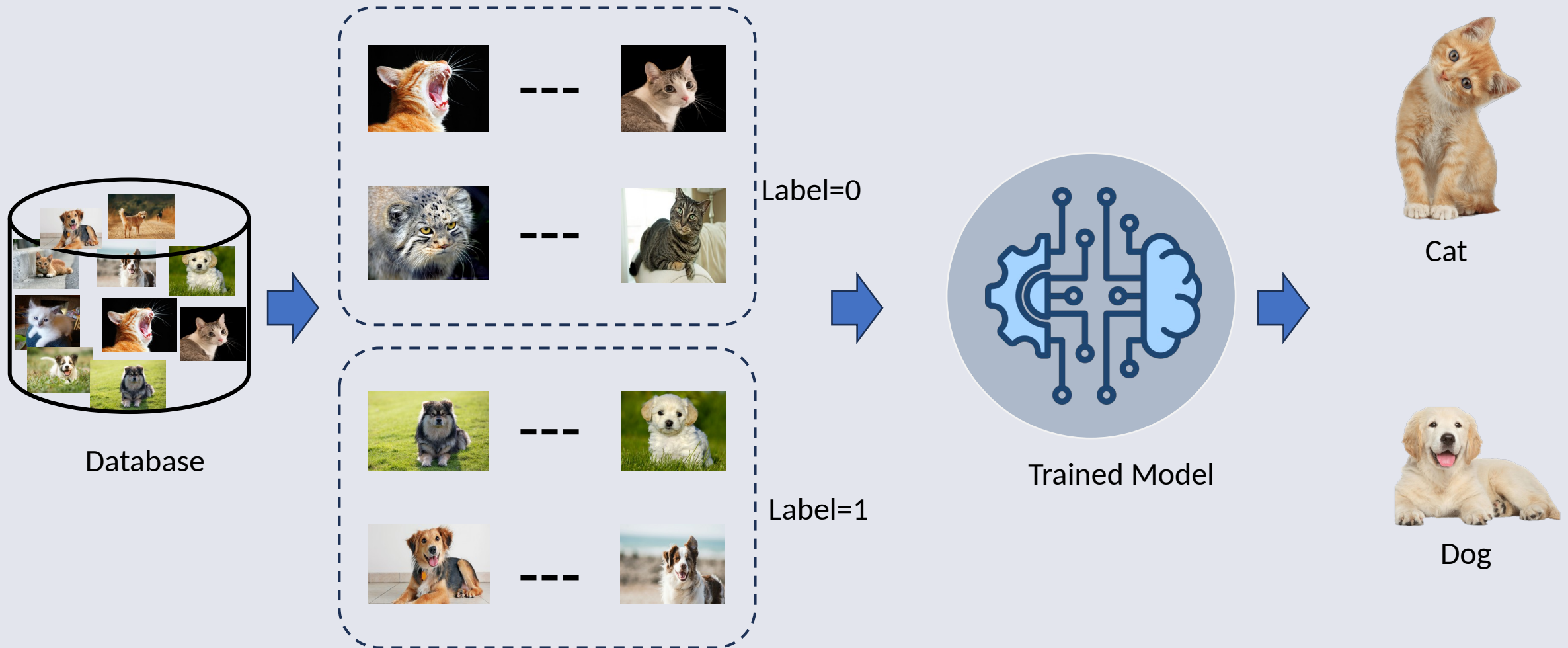
1

Supervised Learning

- Model training is performed with Label data
- Learning algorithm is provided with inputs and the corresponding correct outputs (labels).

Types of Machine Learning (Supervised Learning)

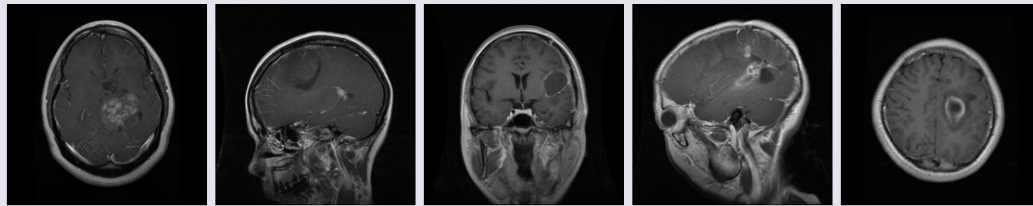
Example 1: Image Classification (*Cat & Dog*)



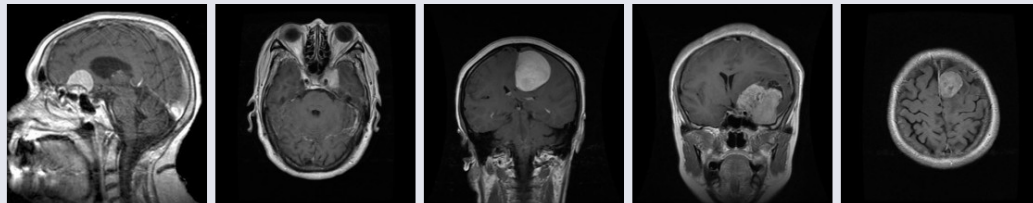
Types of Machine Learning (Supervised Learning)



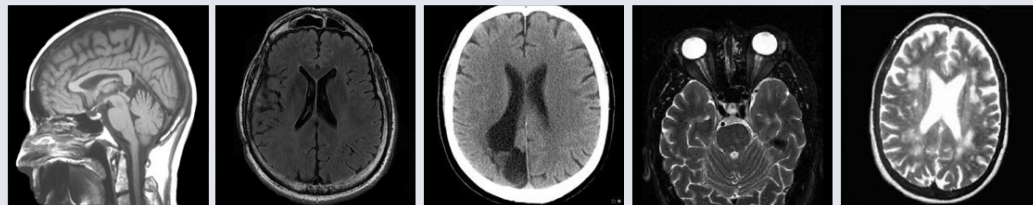
Example 2: Image Classification (*Brain Tumors*)



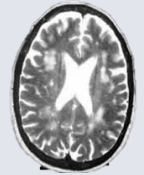
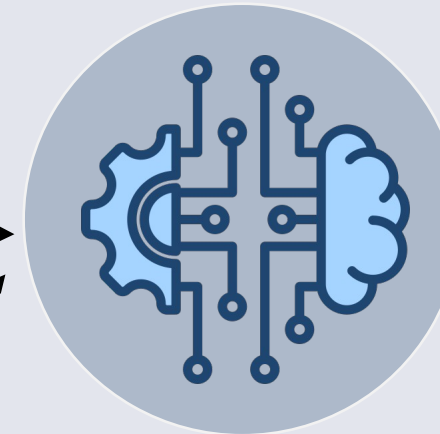
Glioma



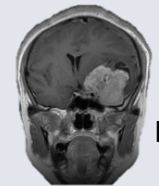
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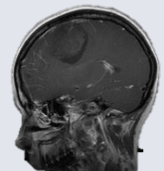
No-Tumor



No-Tumor



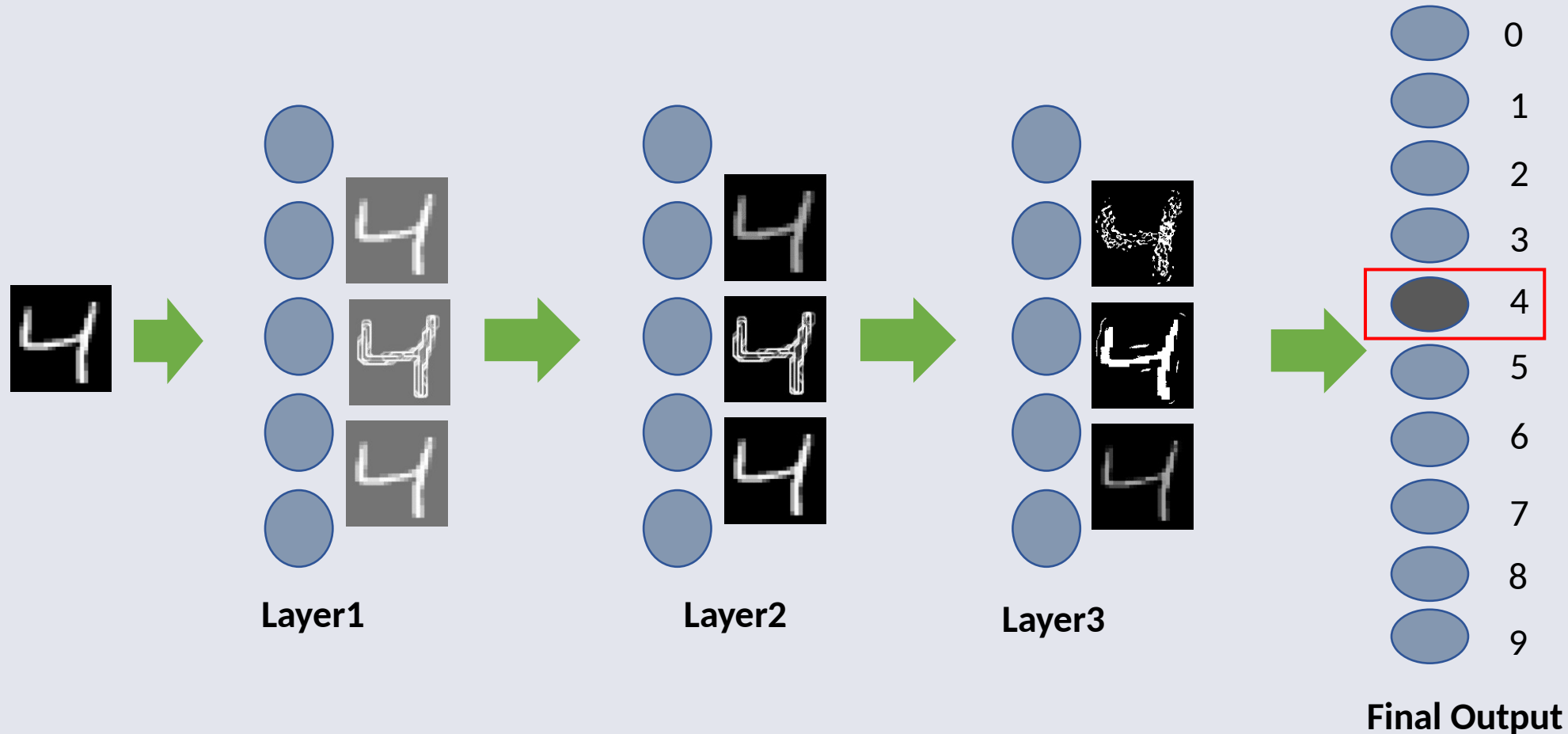
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Glioma

Types of Machine Learning (Supervised Learning)

Example 3: Text Classification (*digits classification*): DIGITS dataset



Types of Machine Learning (Supervised Learning)

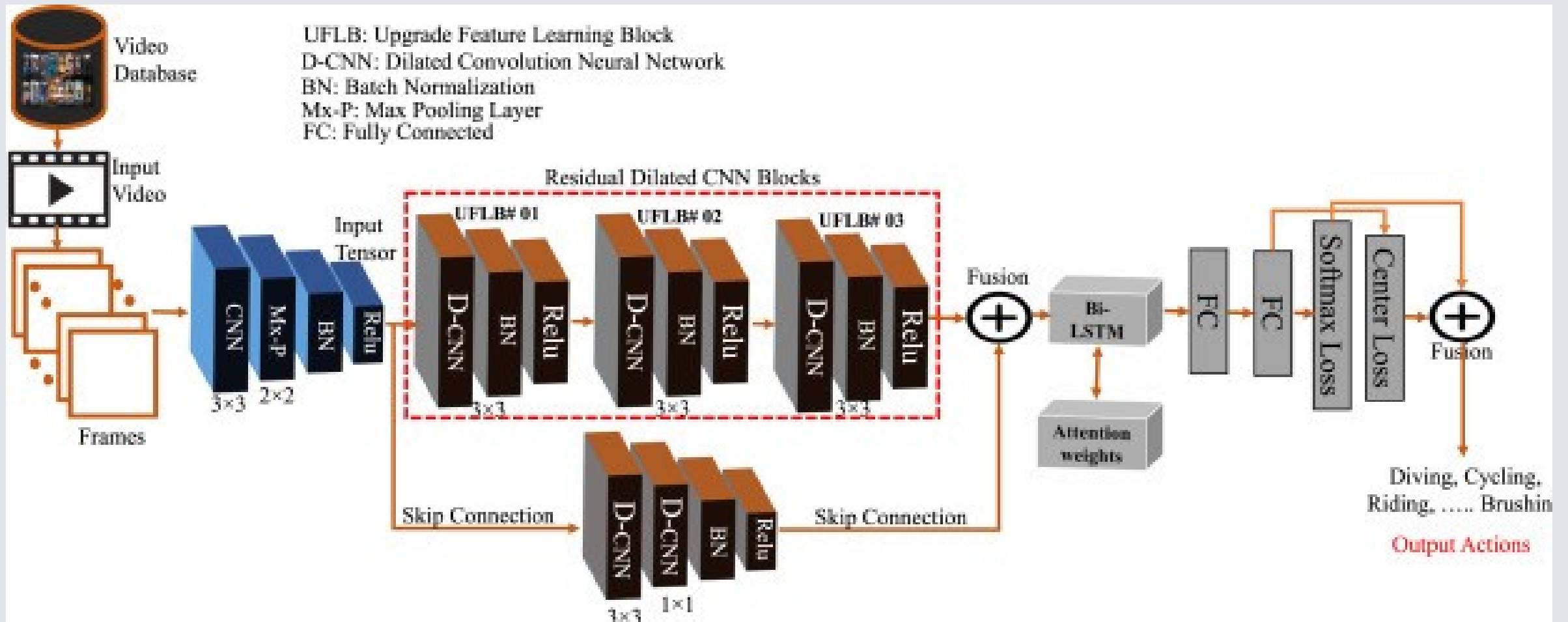
Example 4: Video classification (Activity recognition)



Types of Machine Learning (Supervised Learning)



Example 4: Activity recognition

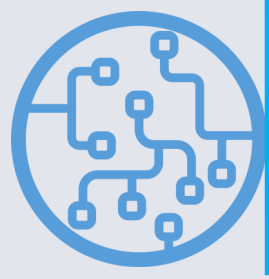


Types of Machine Learning (Supervised Learning)

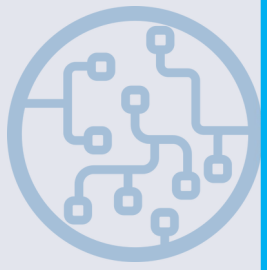
Algorithm in Supervised Learning

- **Linear Regression:** Predicts continuous outcomes.
- **Logistic Regression:** Used for binary classification tasks.
- **Support Vector Machines (SVM):** Finds the hyperplane that best separates different classes.
- **Decision Trees:** Tree-like models used for both classification and regression tasks.

Types of Machine Learning



Machine Learning



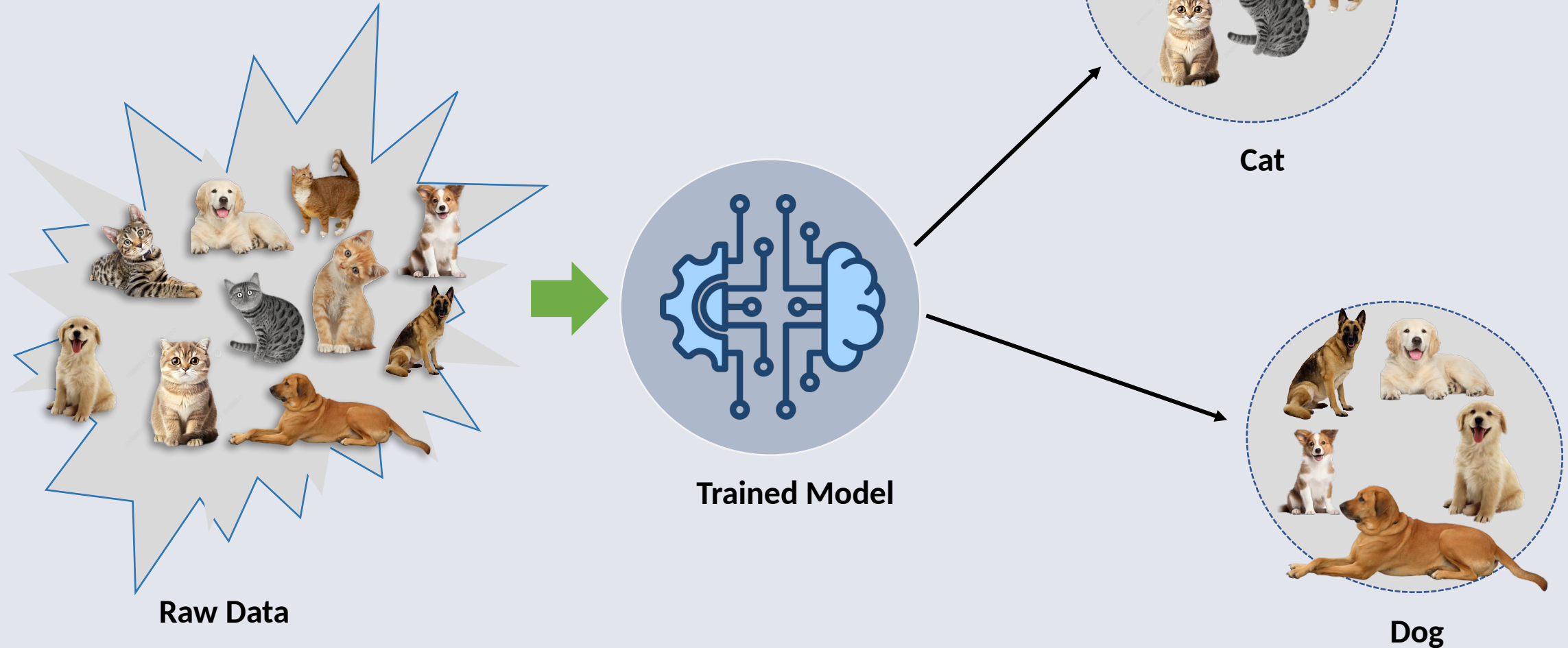
2

Unsupervised Learning

- Model training is performed without Label data
- Learning algorithm finds patterns/structure/features in the data

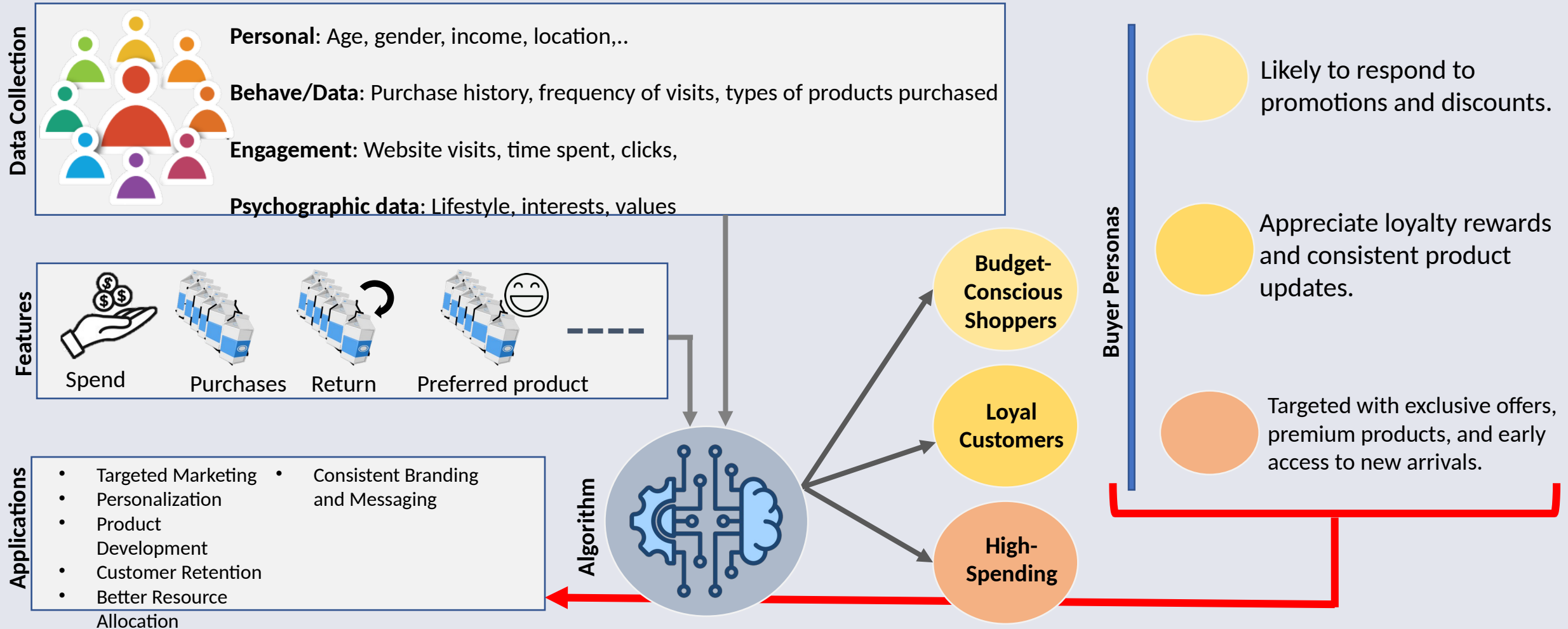
Types of Machine Learning (Unsupervised Learning)

Example 1: Image Clustering



Types of Machine Learning (Unsupervised Learning)

Example 2: Customer Segmentation

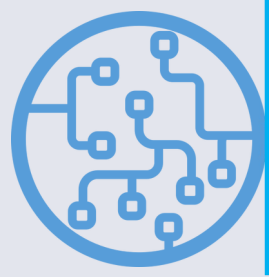




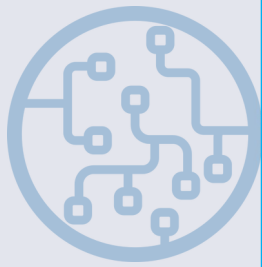
Algorithms in Unsupervised Learning

- **K-means cluster:** Divides data into K clusters, each data point belongs to the cluster with the nearest mean..
- **Principal Component Analysis (PCA):** Reduces the data dimensionality by finding the main components that capture the most variance..

Types of Machine Learning



Machine Learning



3

Reinforcement Learning

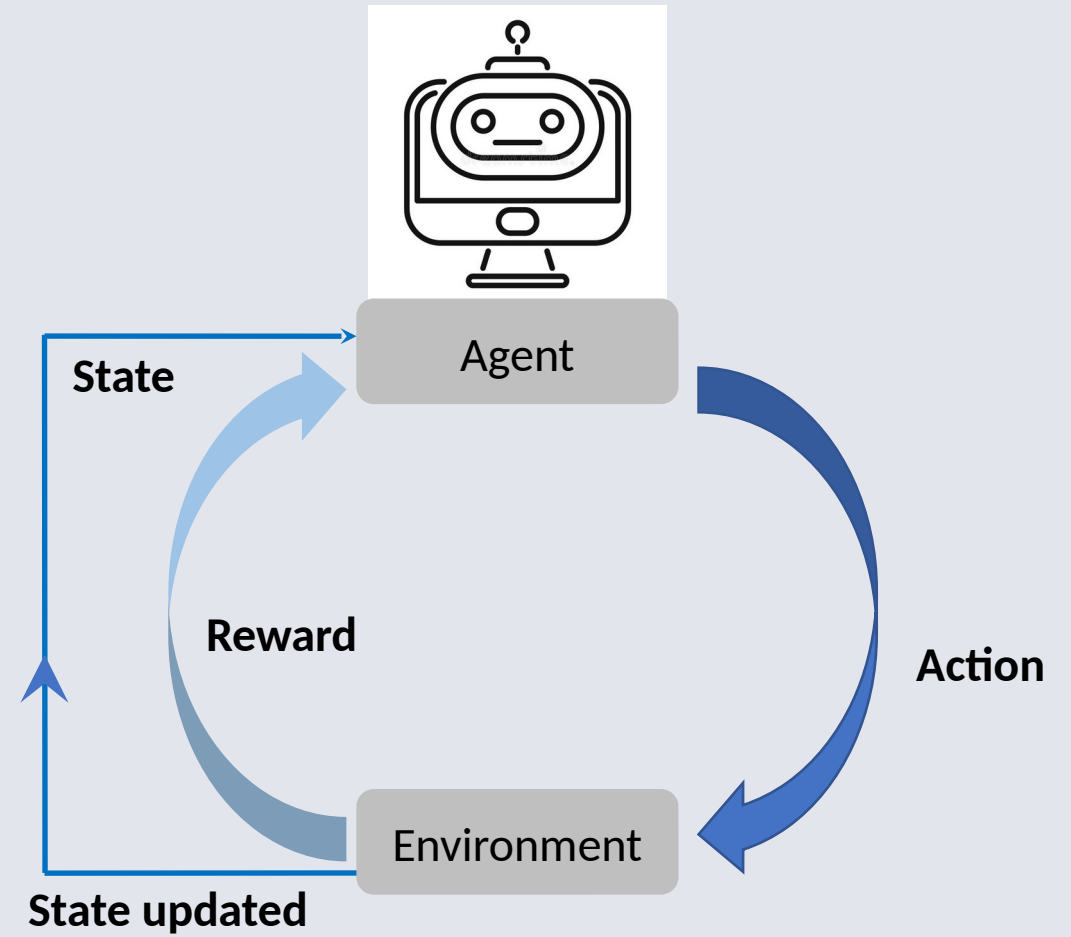
- Involves an agent that learns to interact with its environment to maximize a reward signal.
- The agent takes actions, receives feedback (reward / punishment), and adjusts its behavior accordingly.

Types of Machine Learning (Reinforcement Learning)

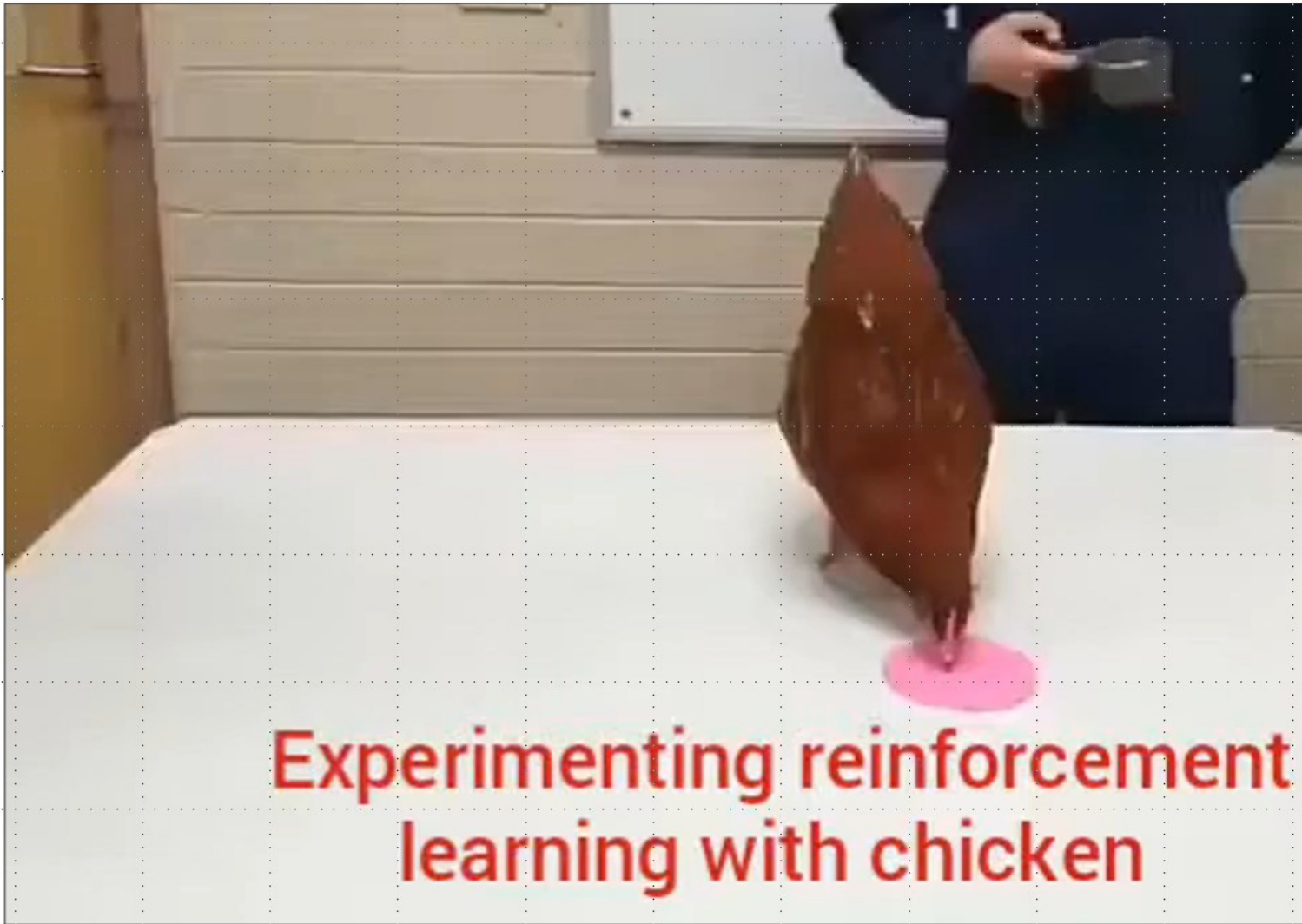


Key Concepts in RL

- **Agent:** Decision maker/taker.
- **Environment:** Space the agent interacts with.
- **Rewards:** Feedbacks/points for positive/good actions.
- **Policy:** Strategy the agent learns for choosing actions.



Types of Machine Learning (Reinforcement Learning)



[Reinforcement learning on a chicken \(youtube.com\)](https://www.youtube.com/watch?v=K3vXU8v8v8k)

Real-world example

Agent: Chicken

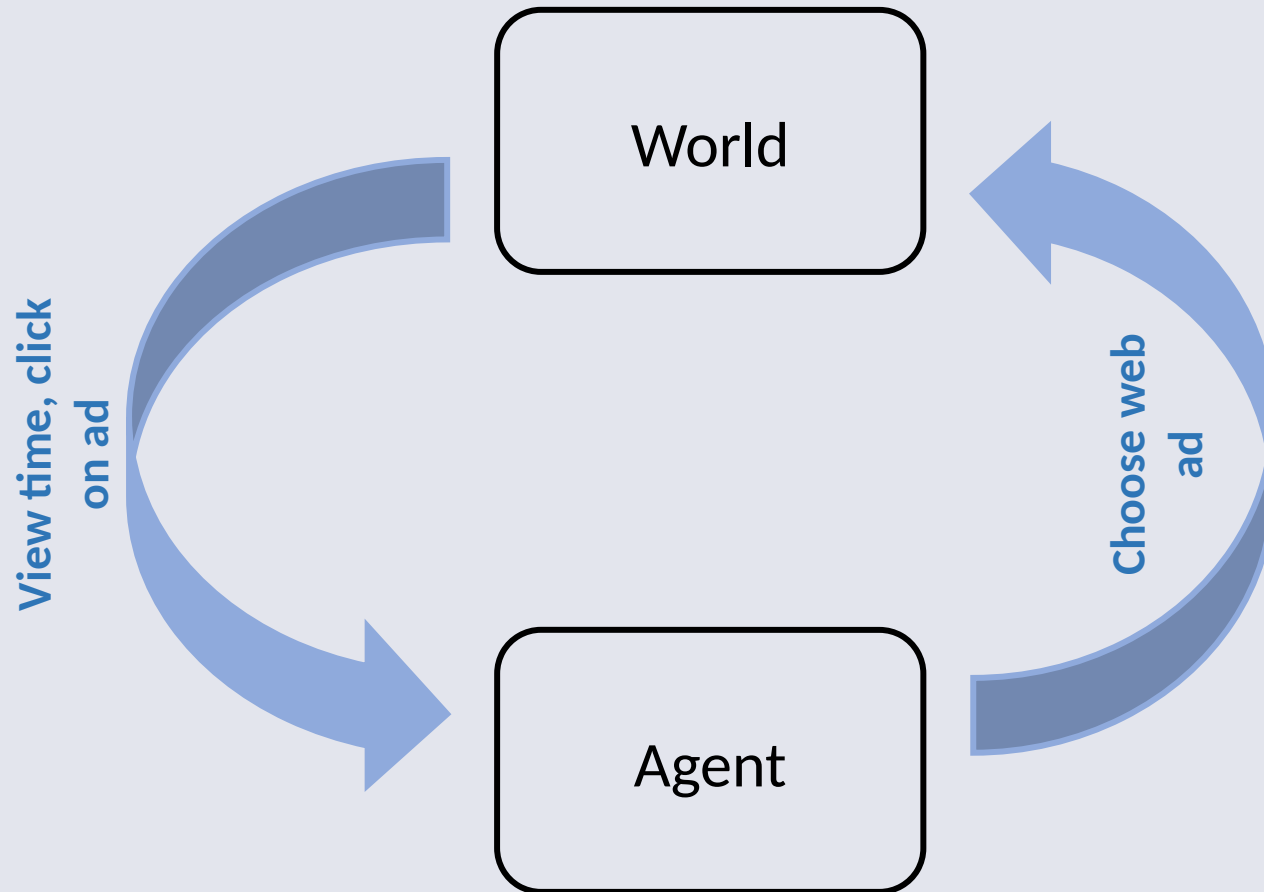
Action: Touching Pink circular shape page

Reward: + corn grain



Agent Environment

Types of Machine Learning (Reinforcement Learning)



Example 1: Web Advertising

Agent: Running a website

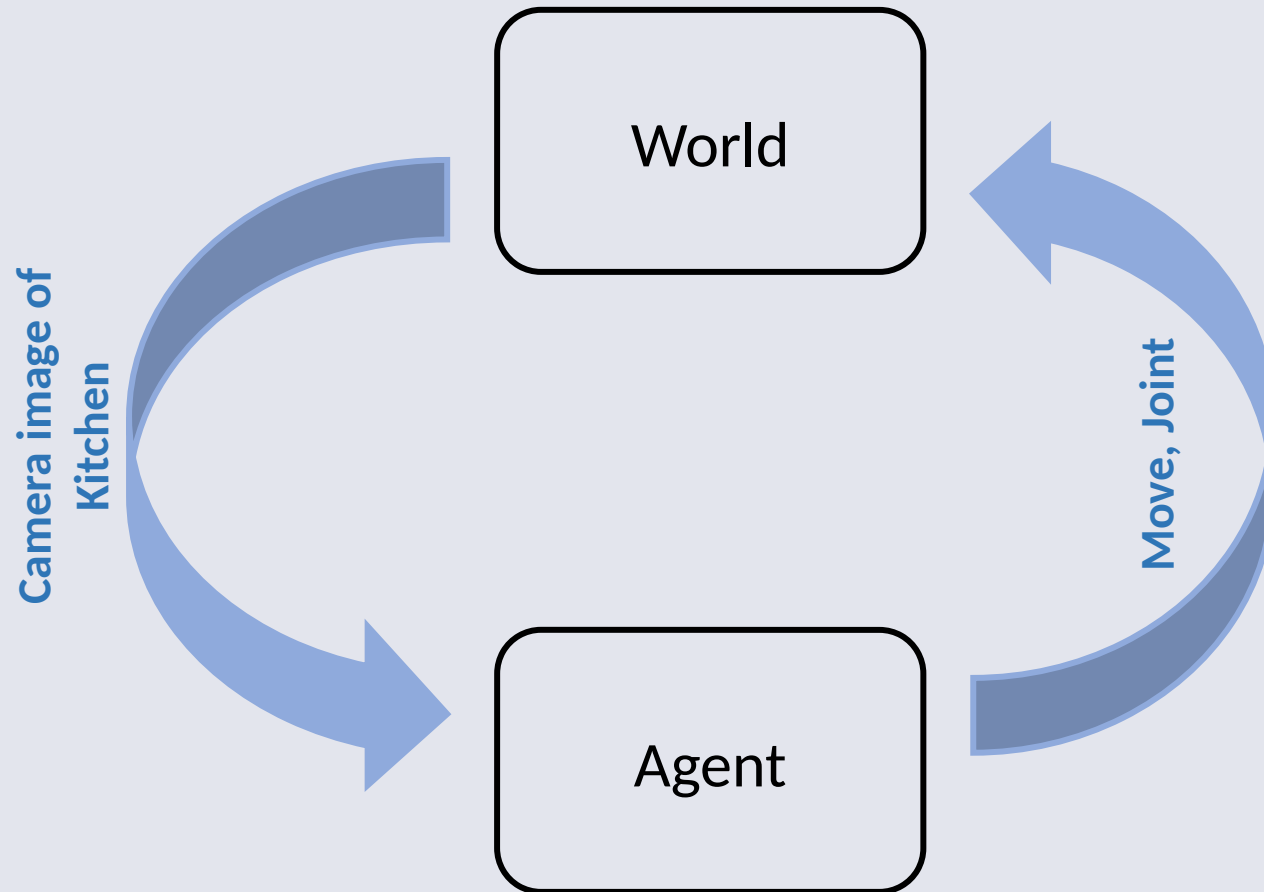
Which web ad has to be choose to give it to a customer

Goal: Choose action to max total expected future reward

:May require balancing immediate and long term rewards

:May require strategic behavior to achieve high rewards

Types of Machine Learning (Reinforcement Learning)



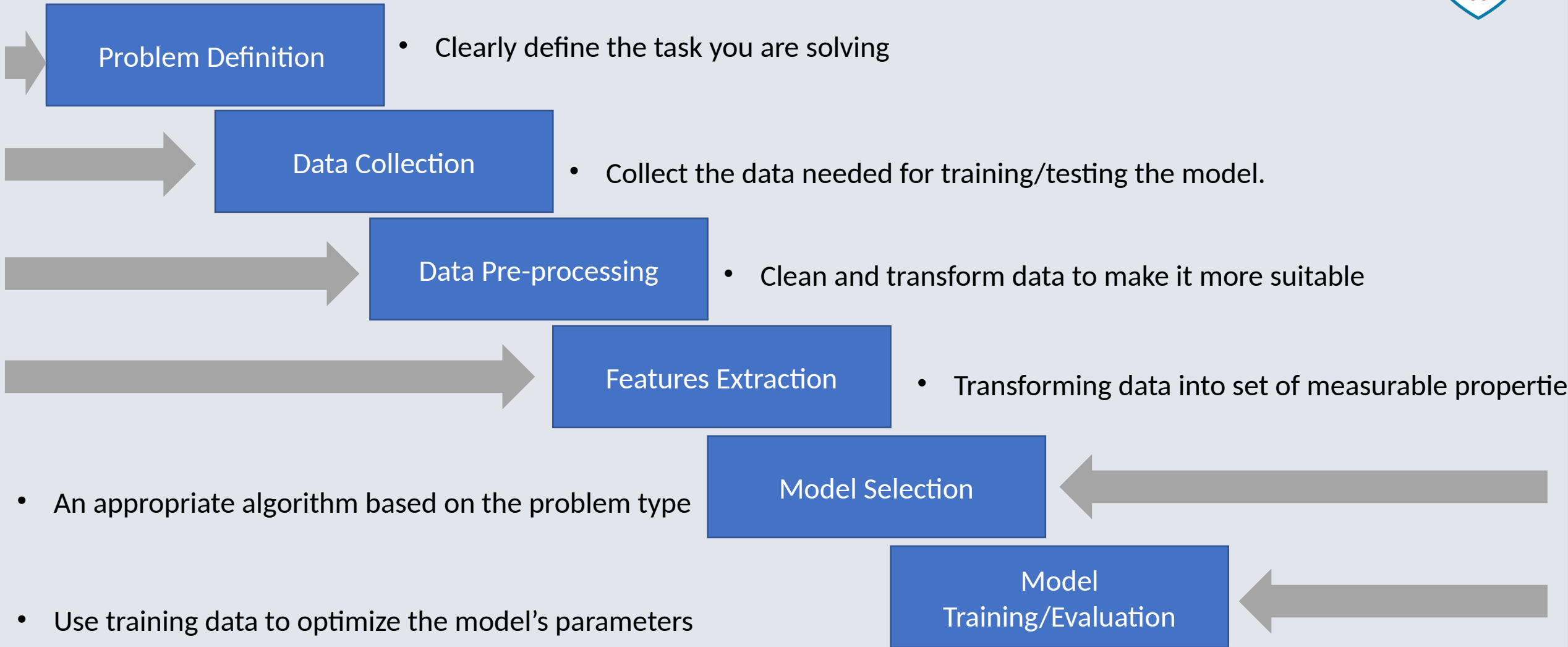
Example 2: Robot Unloading Dishwasher

Agent: Joints movements

Reward + if there no dishes on the counter

Generally, it might the delay reward for long time there's going to be dishes on the counter

Key steps in developing ML model



Key steps in developing ML model

Problem Definition

- Clearly define the task you are solving

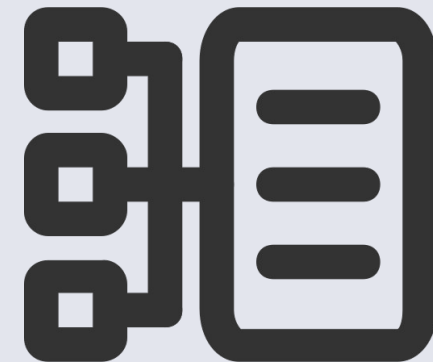
Example: Predicting house prices, classify emails, detect suspicious object, etc.



Data Collection

- Collect the data needed for training/testing the model.
- More high-quality data, better to perform.

Example: House price dataset, image dataset, etc.



Key steps in developing ML model

Data Pre-processing

- Clean and transform data to make it more suitable

Issues: Incomplete, noisy, inconsistent.

Steps: Handling missing values, Normalization, Rescaling.

Features Extraction

- Transforming data into a set of measurable properties

Reduce the complexity of data.

Retaining essential information

Key steps in developing ML model

Examples:

Numerical Data: Principal Component Analysis (PCA), Statistical Features.

Text Data: Bag of Words, Word Embeddings (e.g., Word2Vec), TF-IDF (Term Frequency-Inverse Document Frequency).

Image Data: Edge Detection, Histogram of Oriented Gradients (HOG), CNN

Model/Algorithm Selection

- Choose an appropriate algorithm based on the problem type

Classification: Logistic regression, decision trees, SVM.

Regression: Linear regression, random forests.

Clustering: K-Means, hierarchical clustering.

Key steps in developing ML model

Model Training & Evaluation

- Use training data to optimize the model's parameters
 - Learns by minimizing the error or loss function.

Evaluation using test set to ensure it generalize well to new data

- **Classification Metrics:** Accuracy, precision, recall, F1-score, Confusion matrix
- **Regression Metrics:** Mean Squared Error (MSE), R-squared.

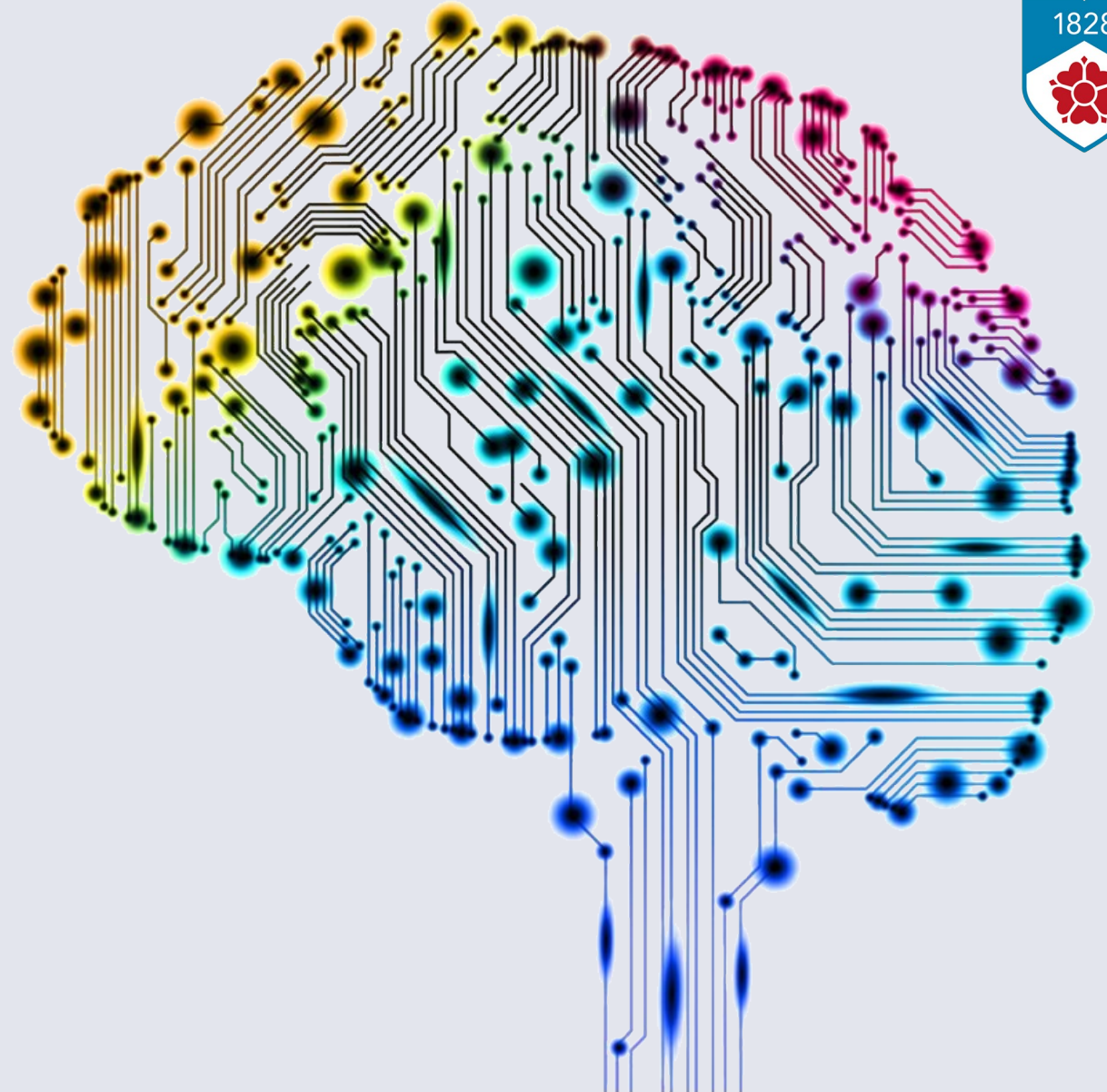
Solve House Price Prediction Problem using LR

Follow the code, write each snippet carefully and run the code.

Next Week



- **Key Challenges in Machine Learning**
- **Supervised Learning**
 - Linear Regression
 - Logistic Regression
 - Support Vector Machines (SVM)
 - Decision Trees





Any Question?