19Z601- Machine Learning

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Syllabus

INTRODUCTION : Types of Learning - Designing a learning system - concept learning - **Find-s Algorithm - Candidate Elimination** - Data Preprocessing - Cleaning - Data Scales - Transformation - **Dimensionality Reduction.** (9)

LINEAR MODELS : Linear Regression Models ,Maximum Likelihood Estimation - Least Squares - Bias-Variance Decomposition - Bayesian Linear Regression - **Linear Models for Classification, Probabilistic Generative Models - Probabilistic Discriminative Models - Linear Discriminant Analysis** (9)

Syllabus

NEURAL NETWORKS AND DECISION TREES : **Feed-forward Networks - Network Training - Delta Rule- Gradient Descent – Error Backpropagation - Regularization in Neural Networks - Generalisation - Decision Tree Learning- Representation - Inductive Bias- Issues** (9)

KERNEL AND GRAPHICAL METHODS : Constructing Kernels - Radial Basis Function Networks – Gaussian Processes - Maximum Margin Classifiers - SVM - Bayes Theorem - Naive Bayes - Bayesian Networks (9)

Syllabus

UNSUPERVISED AND REINFORCEMENT LEARNING : Measures of Similarity and Dissimilarity - Clustering - Partitioning methods - KMeans - Hierarchical Methods - Outliers - Reinforcement Learning - Reinforcement Learning Tasks - **Q-learning** (9)

Text Books and Reference Books

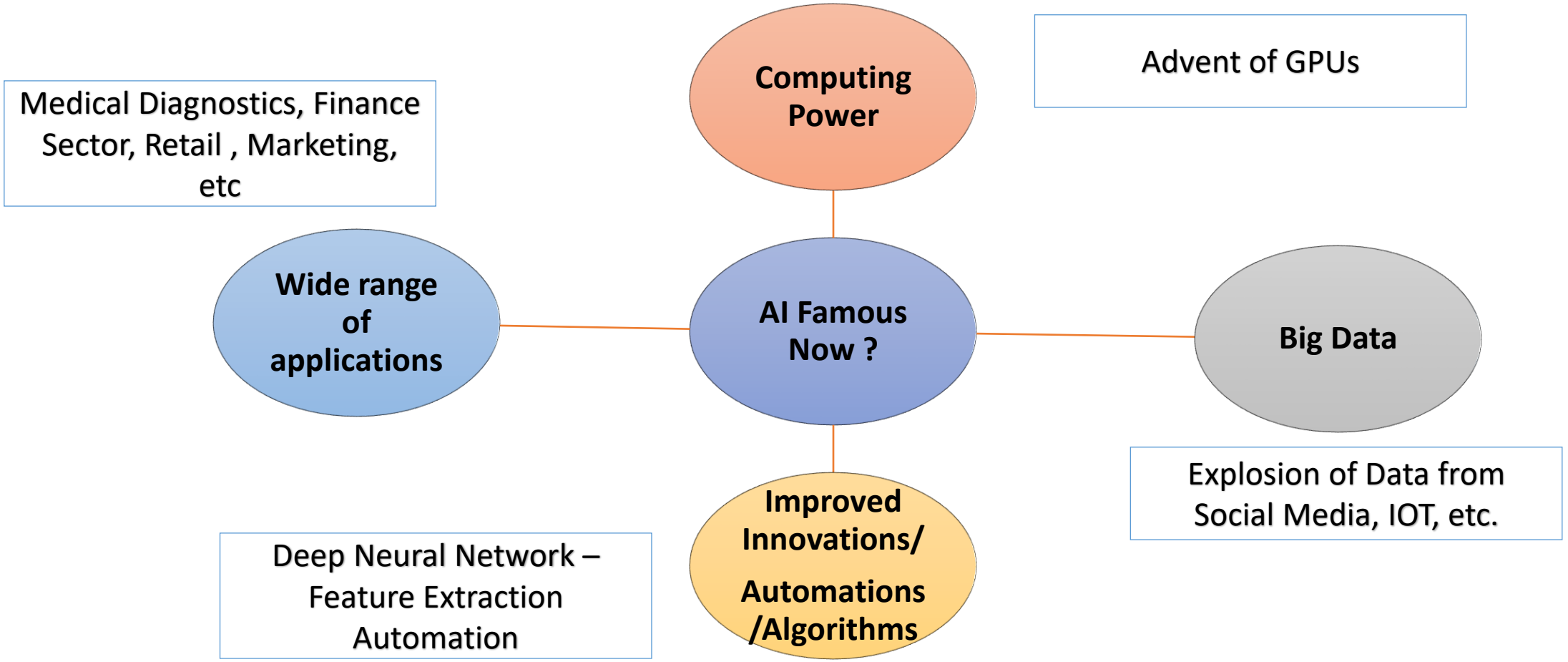
TEXT BOOKS:

1. **Tom Mitchell , "Machine Learning", McGraw Hill, 2017.**
2. **Christopher M Bishop , "Pattern Recognition and Machine Learning Learning", Springer, 2011.**

REFERENCES:

1. Ethem Alpaydin , "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2015.
2. Trevor Hastie, Robert Tibshirani, Jerome friedman , "The Elements of Statistical learning", 2nd Edition, Springer, 2017.
3. Kevin Murphy , "Machine Learning - A Probabilistic Perspective", MIT Press, 2012.
4. Yaser S. Abu-Mostafa , "Learning from Data", AML, 2017.

What is AI ? Why AI famous now?



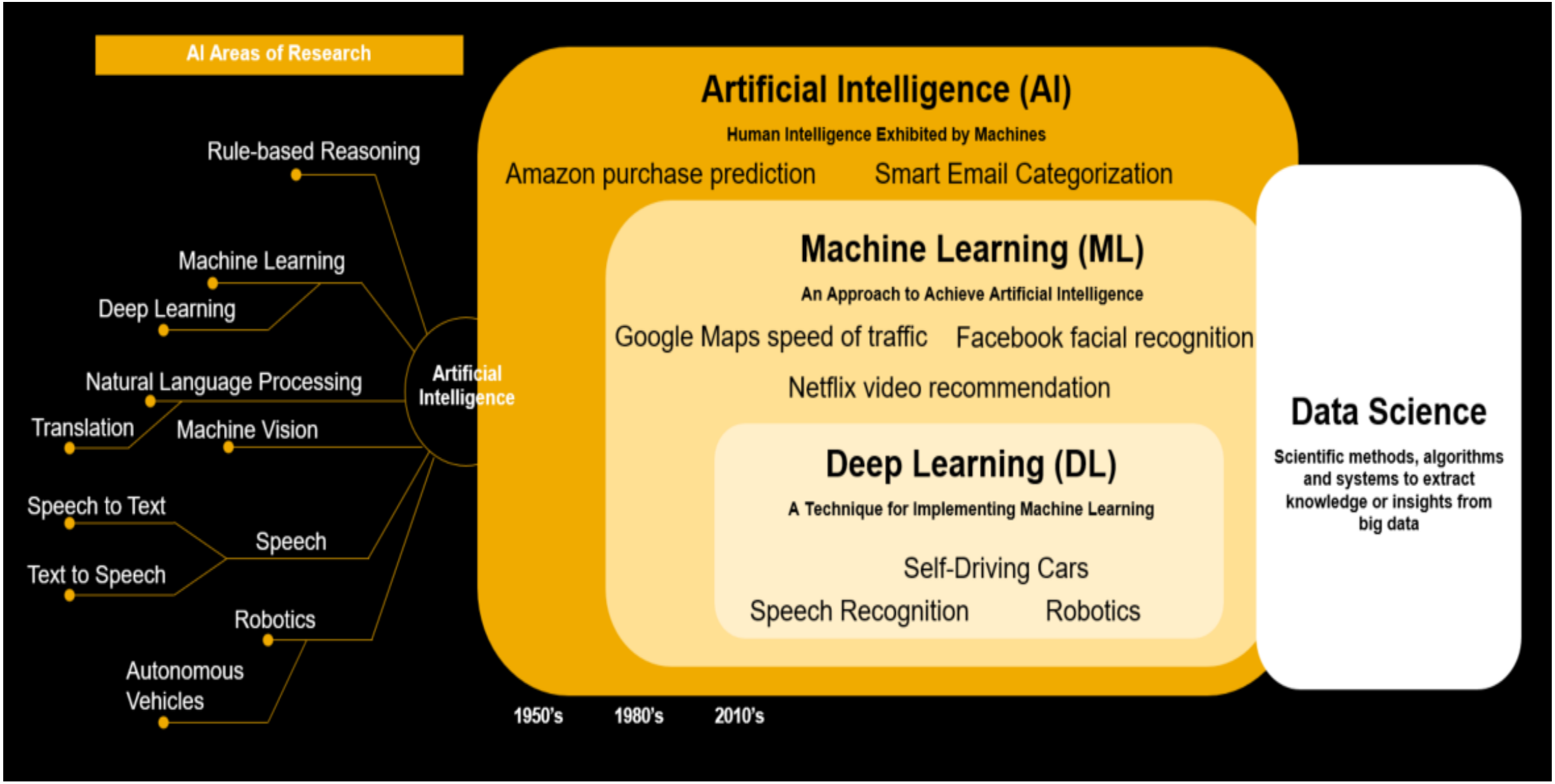
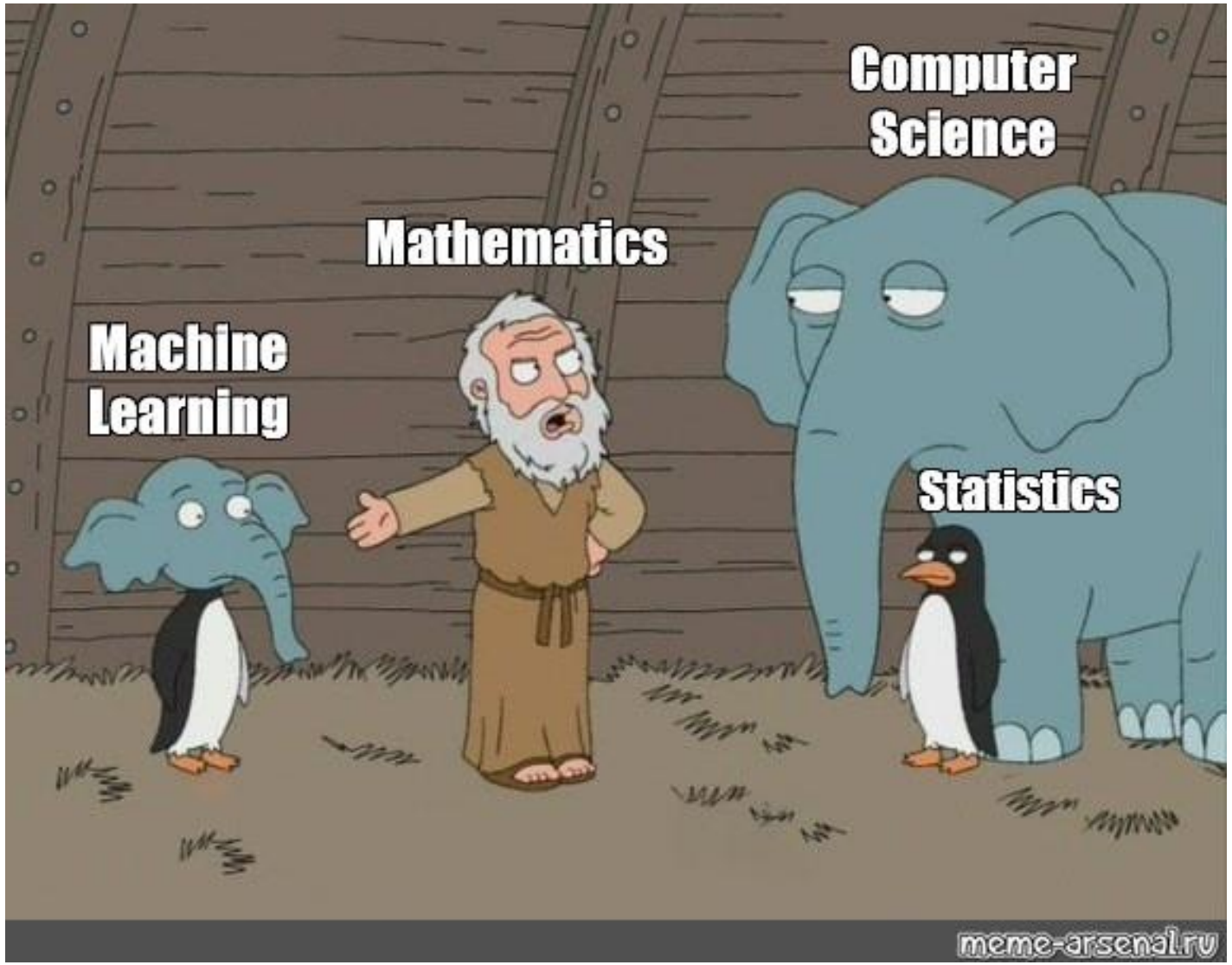


Image Source : https://medium.com/@marcellvollmer/how-to-make-it-simple-to-explain-ai-ml-dl-and-data-science-a49e54d54a12

What is Machine Learning?



What is Machine Learning ?

- **Sub field of Computer Science**
- **Building Algorithms**
- **Process of Solving a practical problem**
  - **Gathering a dataset**
  - **Algorithmically building a statistical model based on that dataset**
- **Used to solve practical problem (statistical model)**

Definition (Tom Mitchell Book)

What is #MachineLearning?

"A **computer program** is said to **learn** from **experience E** with respect to some **class of tasks T** and **performance measure P**, if its **performance at tasks in T**, as measured by **P**, improves with **experience E.**"

AI CARE

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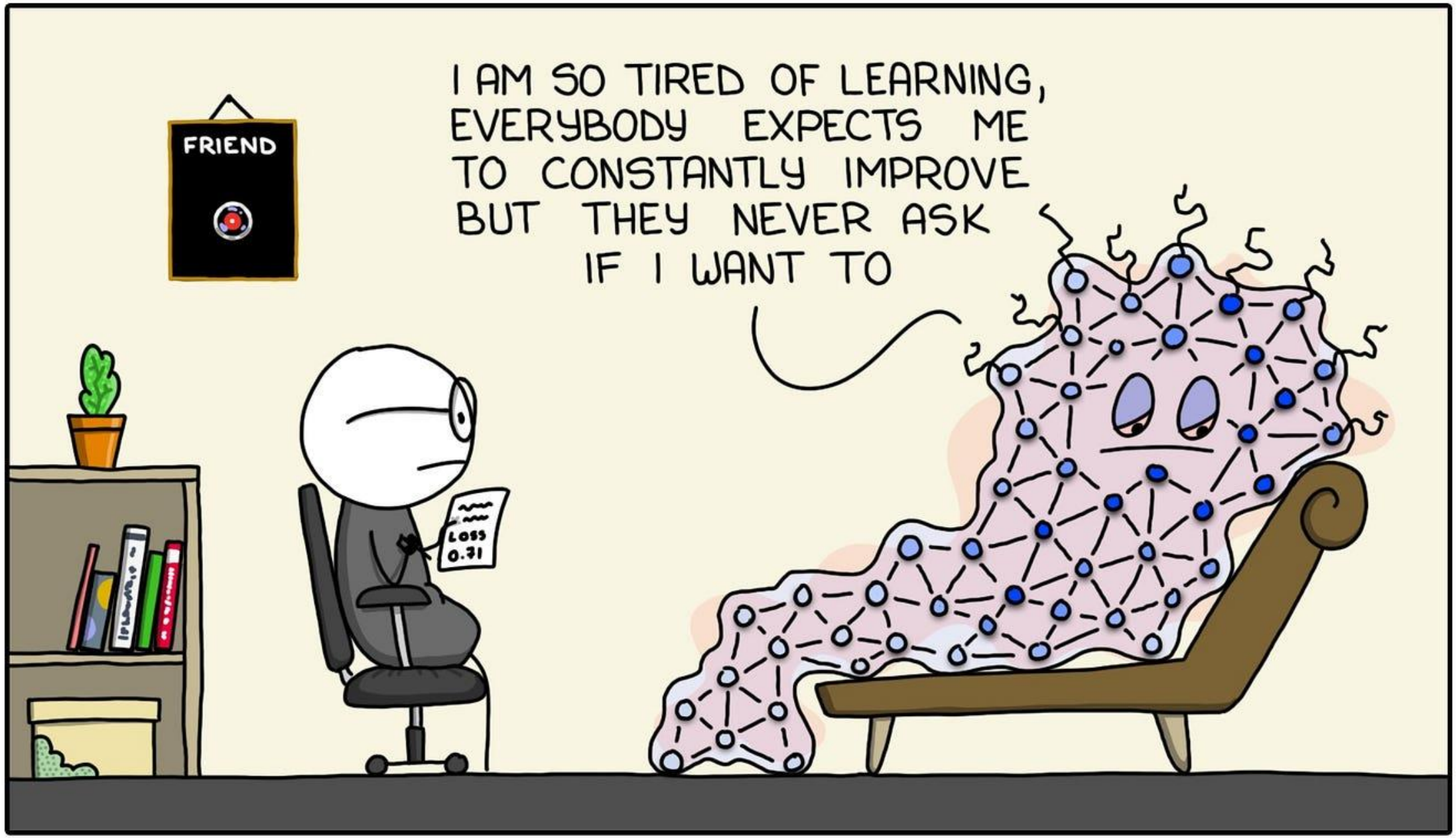


Examples

A Checkers Learning Problem

- **Task T: Playing checkers**
- **Performance measure P: Percent of games won against opponents**
- **Training experience E: Playing practice games against itself**

Examples

A handwriting recognition learning problem:

- **Task T:** Recognizing and classifying handwritten words within images
- **Performance measure P:** Percent of words correctly classified
- **Training experience E:** A Database of handwritten words with given classifications

Examples

A robot driving learning problem:

Task T: Driving on public four-lane highways using vision sensors

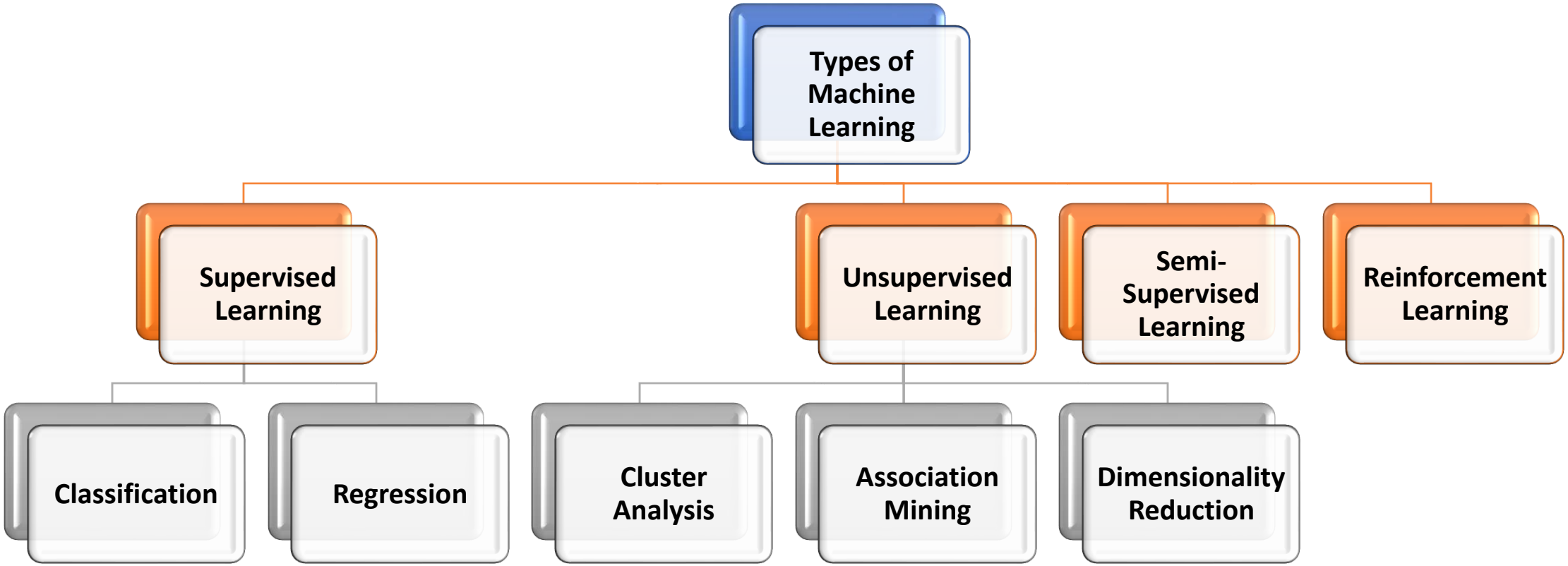
Performance measure P: Average distance traveled before an error (as judged by human overseer)

Training experience E: A sequence of images and steering commands recorded while observing a human driver

Concept Check Question

Create an Example for Learning Problem with **Task (T), Performance (P) and Training Experience (E).**

Types of Learning



Supervised Learning - Classification

	Sepal length	Sepal width	Petal length	Petal width	Class
1	5.1	3.5	1.4	0.2	setosa
2	4.9	3.0	1.4	0.2	setosa
3	4.7	3.2	1.3	0.2	setosa
⋮	⋮	⋮	⋮	⋮	⋮
150	5.9	3.0	5.1	1.8	virginica

Input Attributes : Independent Variables
Example : Sepal Length, Sepal Width, Petal Length, Petal Width

Target Attribute/Label : Discrete Form (a value from a finite set of values)
Example :
Number of Labels : 2
Labels : [Setosa, Virginica]
Label Encoding : [0,1]

Supervised Learning - Regression

1 Ball	2nd Ball	3rd Ball	4th Ball	5th Ball	6th Ball
4	2	4	4	4	4
6	1	6	6	6	6
1	1	1	1	0	1
2	1	2	1	2	2

Input Attributes : **Independent Variables**
Example : 1st Ball, 2nd Ball, 3rd Ball, 4th Ball, 5th Ball

Target Attribute/Label : **Continuous Variable**
Example : Number of Runs obtained in 6th Ball (6th Consecutive Ball – Continuous)
Labels : **Number of Runs in 6th Ball**

Unsupervised Learning

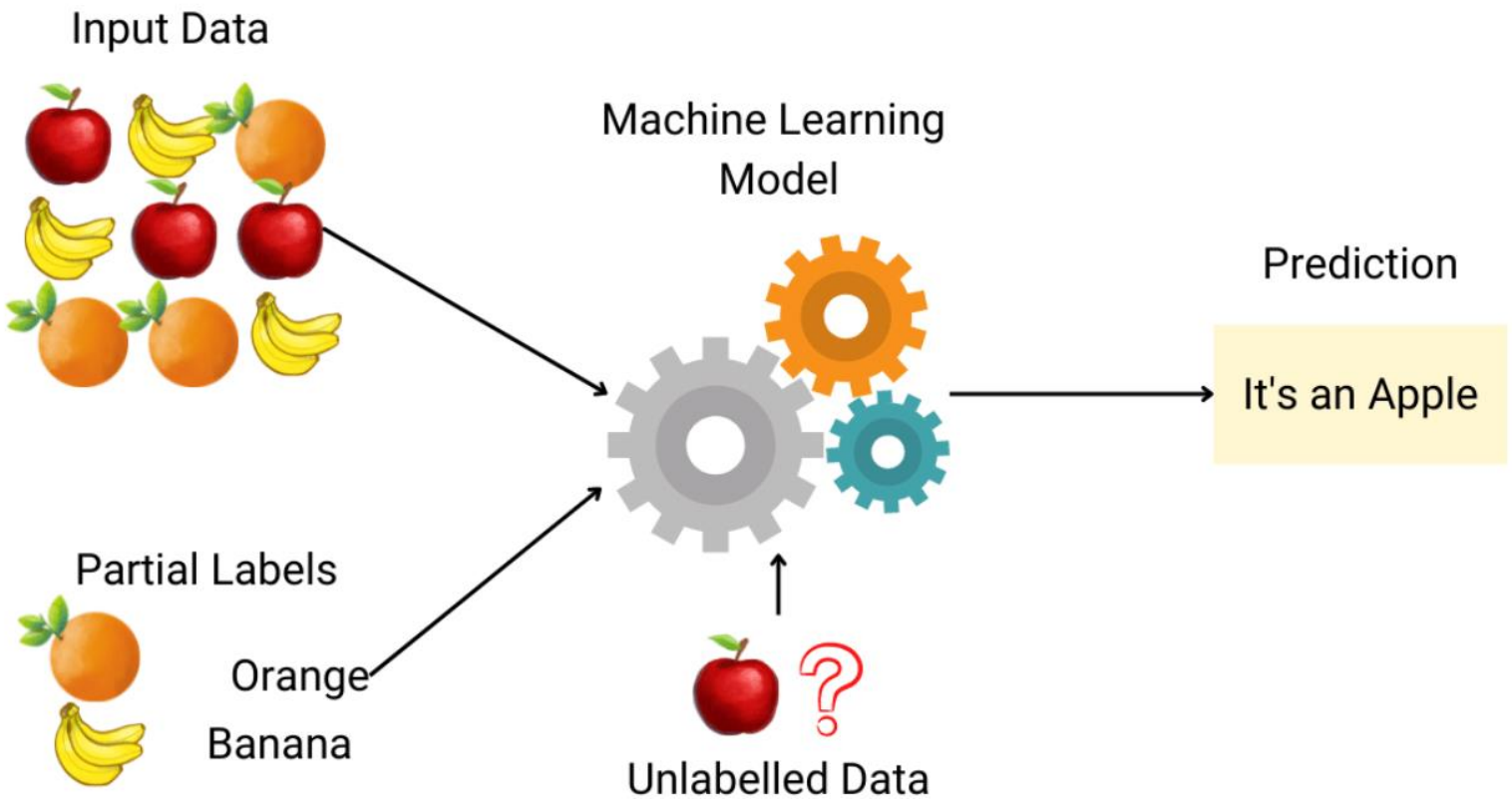
	Sepal length	Sepal width	Petal length	Petal width
1	5.1	3.5	1.4	0.2
2	4.9	3.0	1.4	0.2
3	4.7	3.2	1.3	0.2
⋮	⋮	⋮	⋮	⋮
150	5.9	3.0	5.1	1.8

Input Attributes : Independent Variables
Example : Sepal Length, Sepal Width, Petal Length, Petal Width

Target Attribute/Label : No Label

Output : Clusters (Cluster Analysis)
Example : Cluster 1 (Iris Flower 1) , Cluster 2 (Iris flower 2)
(or)
Output : Reduced Dimensions
Example : Dimensions – 2 (Principal Components) or [Petal Length and Petal Width] - selected, [Sepal Length, Sepal Width] removed

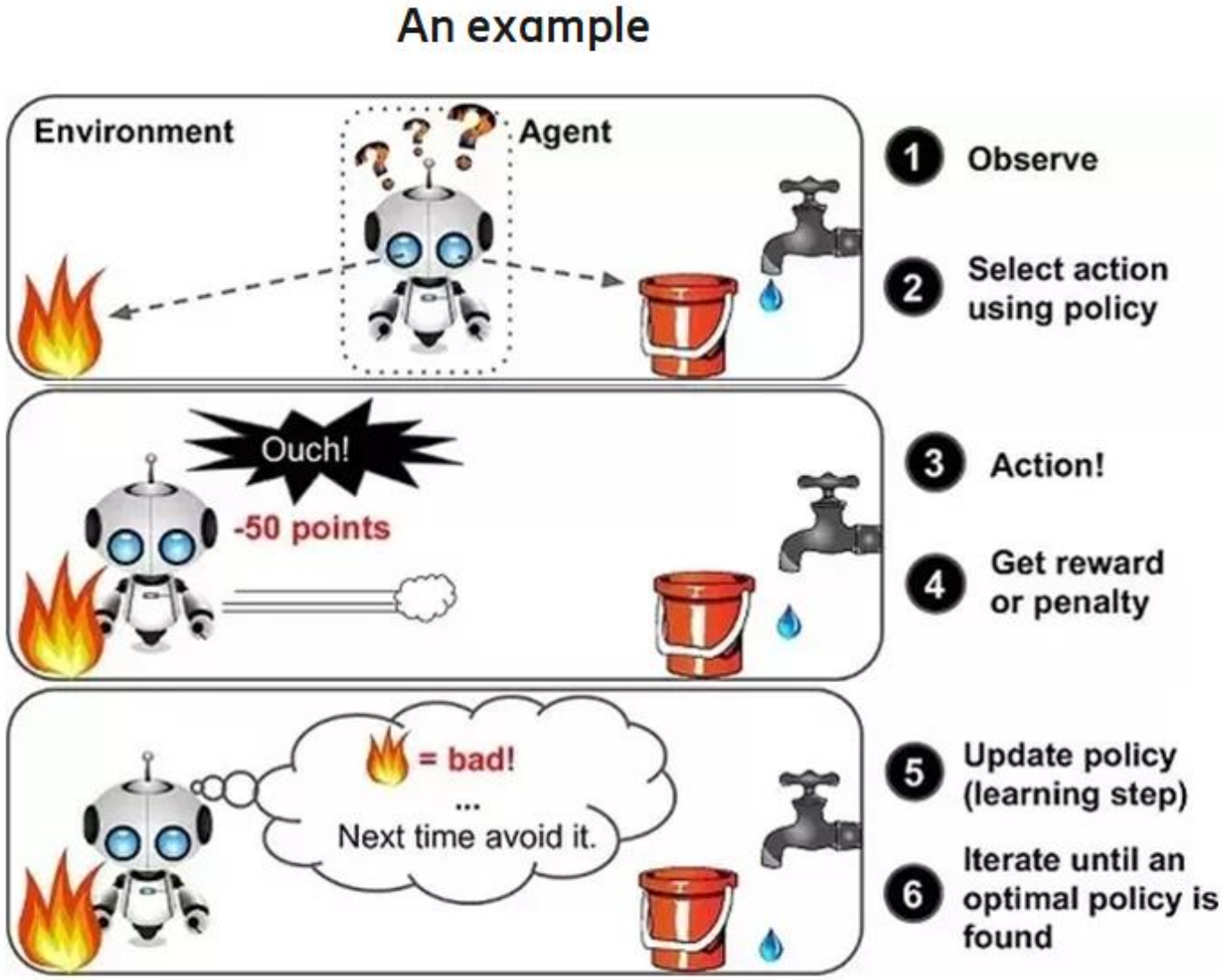
Semi-Supervised Learning



Dataset consists of

Unlabeled data > Labeled data

Reinforcement Learning



Step 1 : Observe (Actions – To Touch fire, Touch water)

Step 2 : Selects Action Policy

Step 3 : Does that Action (Example : Touches Fire)

Step 4 : Gets Penalty (-50)

Step 5 : Updates the policy :

Touches Fire	-50 Points

Step 6 : Iterates until optimal policy is found

Apply Question

Create an Example for Learning Problem with **Task (T), Performance (P) and Training Experience (E).**

For the Created Learning Problem what type of learning can be applied? Create an appropriate dataset.