AIFS ML Lecture 2: Machine Learning Basics

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Overview

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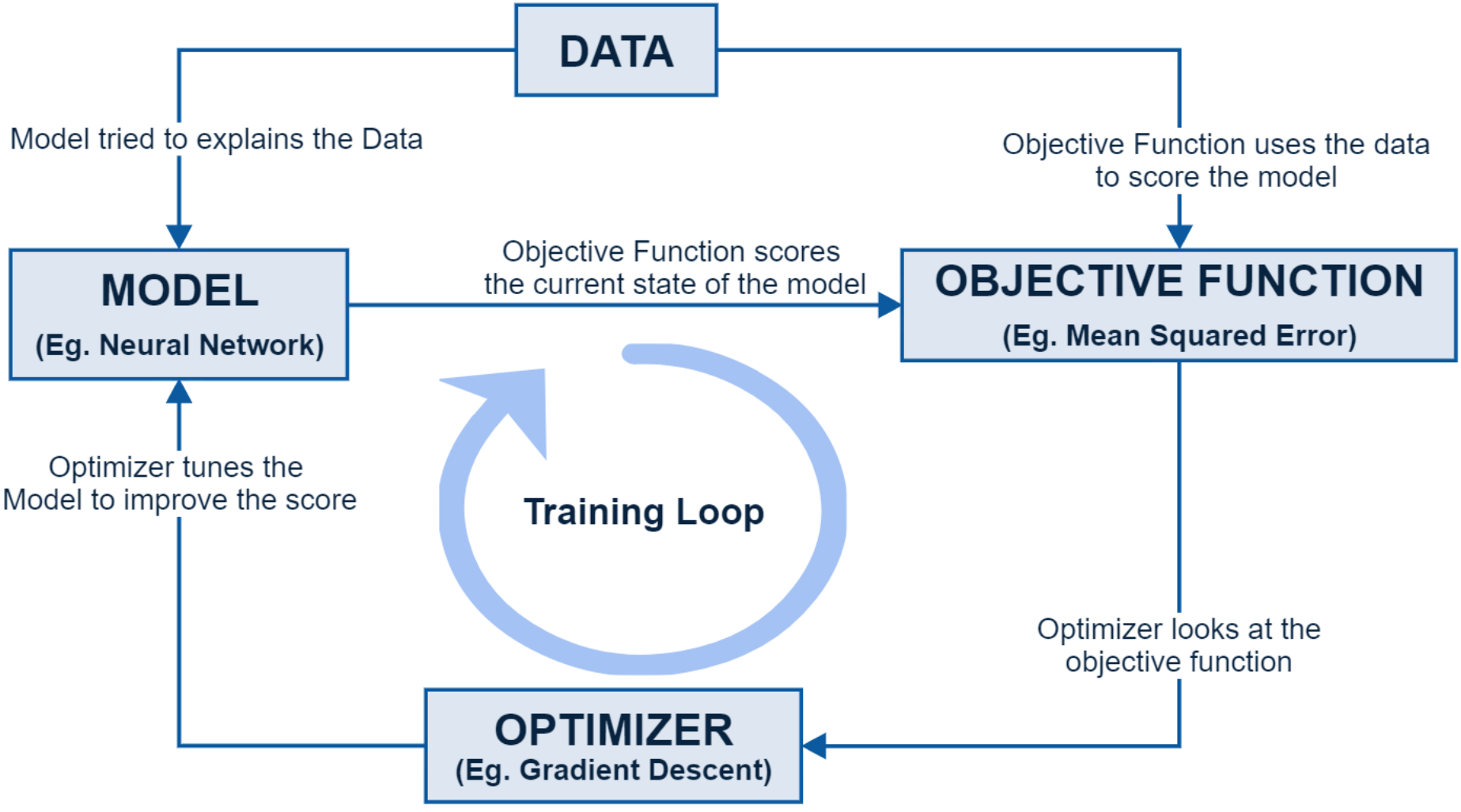
Recap

- What is a Learning Algorithm?
- Components of a Learning Algorithm
- Training Loop

Recap

- What is a Learning Algorithm?
  - An algorithms that can detect patterns in data that is relevant to some task is called a learning algorithm.
- Components of a Learning Algorithm
  - Data
  - Model
  - Objective Function
  - Optimizer

Recap - Training Loop



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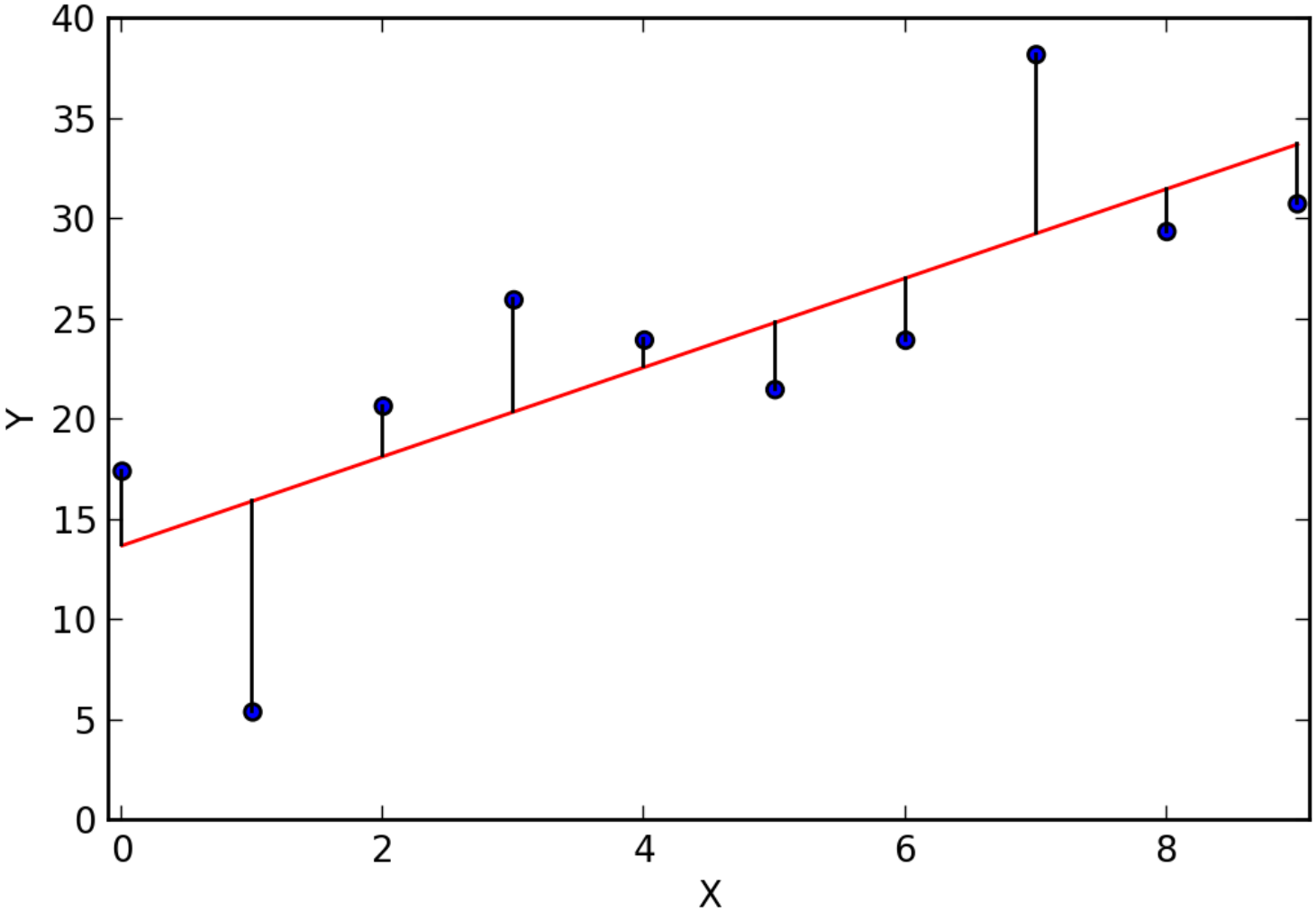
Learning Styles in Machine Learning

- Based on degree of supervision
- Based on the mode of consuming the data
- Based on model type

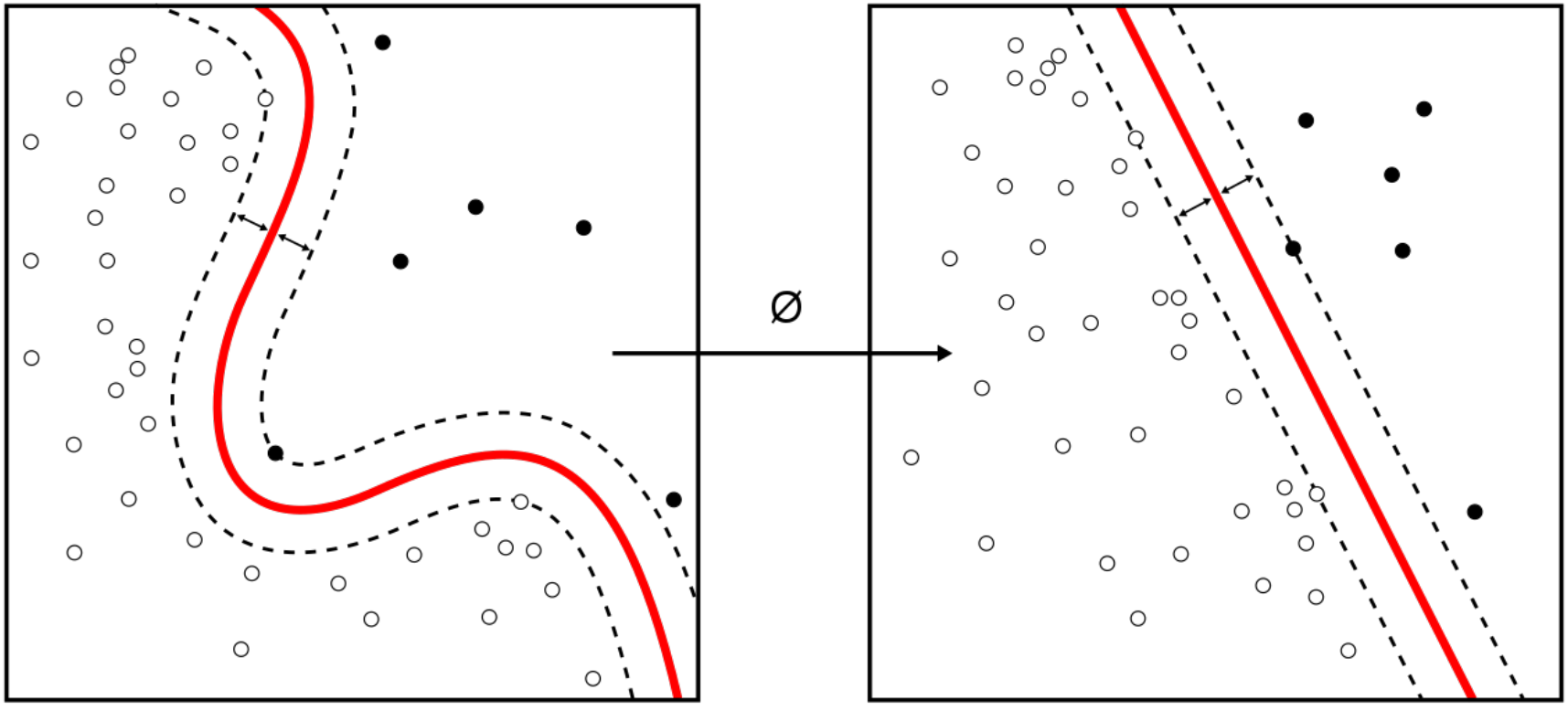
Based on Degree of Supervision

- **Supervised Learning:** Each record in the dataset contains a *label* (a.k.a. *target*). The task for the model is to predict the labels for new unseen data.
- It is called supervised because during training, the label acts as a supervisory signal to tell the model what the true prediction should have been.
- Typically there are two kinds of Supervised Learning tasks:
  - **Classification:** The model has to predict the category a data-point belongs to. When the number of category is two, we call it *binary classification*. When it is more than two, we call it *multi-class classification*.
    Eg. Task: Classify between abnormal/normal ECGs.
    Eg. Algorithm: Logistic Regression, Support Vector Machines
  - **Regression:** The model has to predict a numerical value (real-valued number).
    Eg. Task: Predict hospital length of stay, Predict time to recur in cancer diagnosis.
    Eg. Algorithm: Linear Regression, Support Vector Regression

Linear Regression



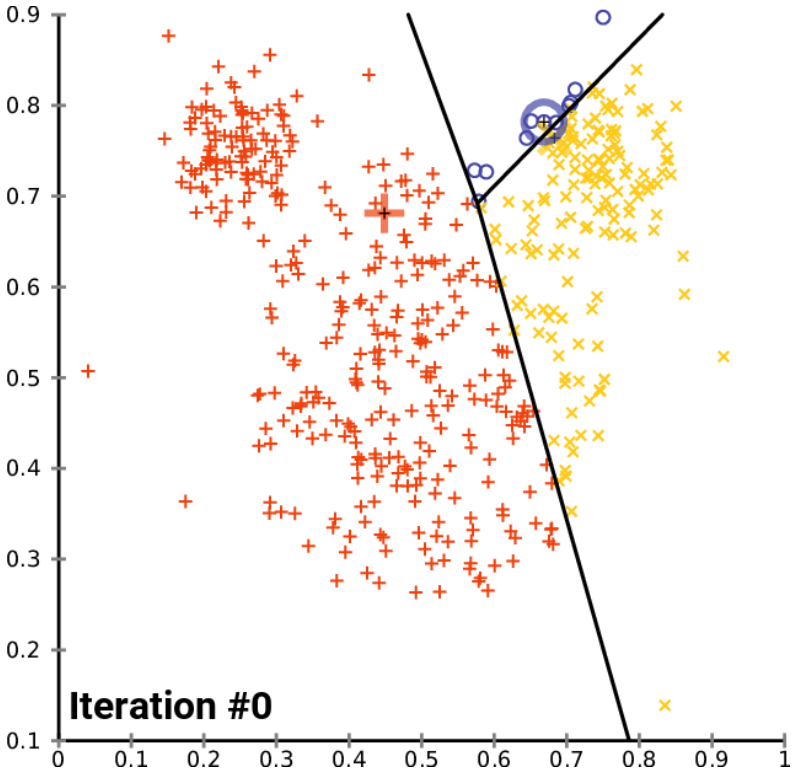
SVM classification

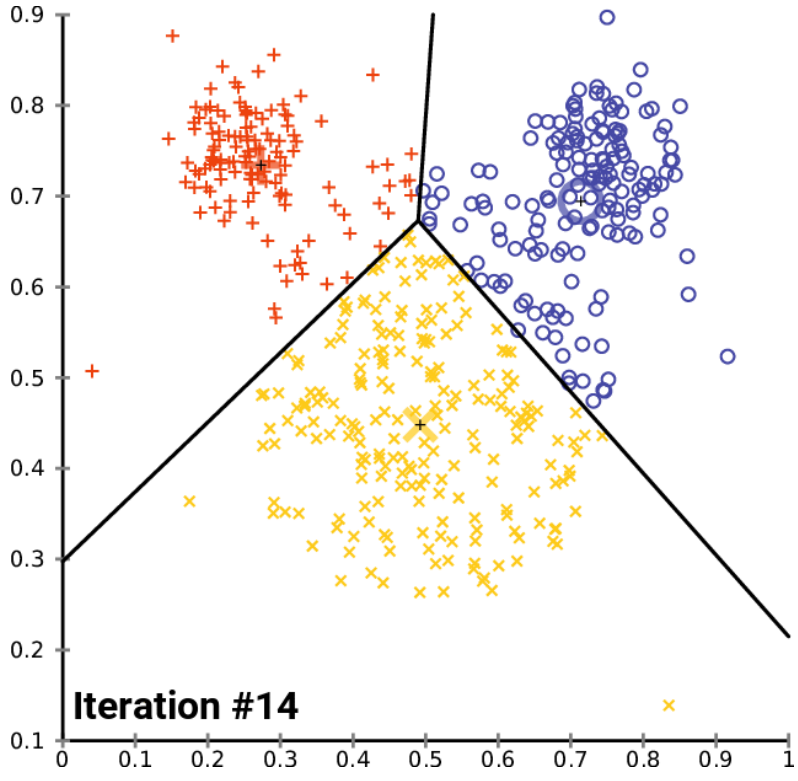


Based on Degree of Supervision

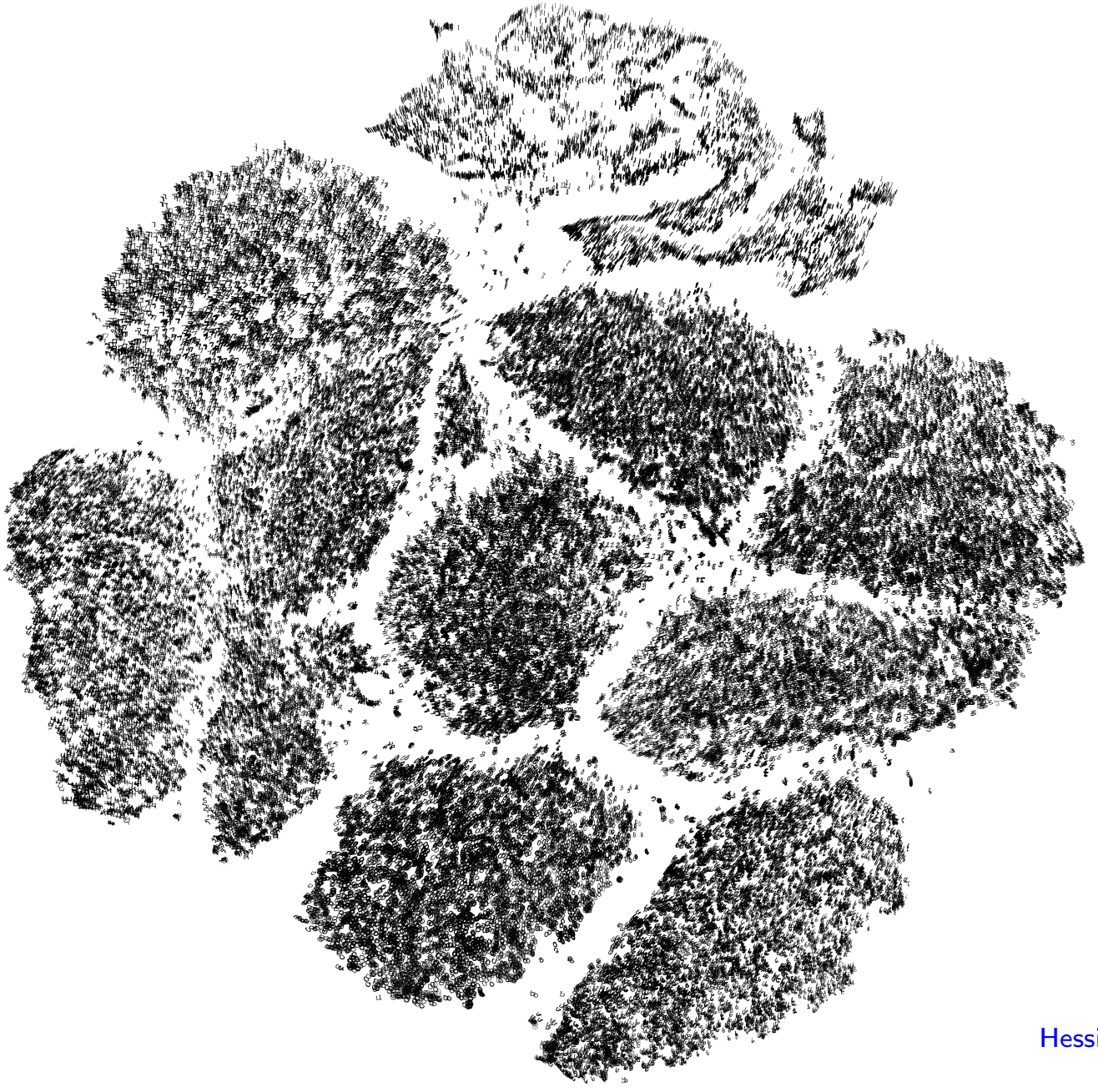
- **Unsupervised Learning:** The dataset does not have a label. The goal of the learning algorithm is to extract useful knowledge from the dataset.
- There are many unsupervised tasks possible, two of the important tasks and their corresponding algorithms are listed below:
  - **Clustering:** Detect groups of similar data-points within the dataset.
    Eg. Task: using medical history to shed light on the likelihood of conversion from mild cognitive impairment (MCI) to Alzheimer's Disease
    Eg. Algorithm: k-Means, Hierarchical Cluster Analysis
  - **Dimensionality Reduction:** Most real world datasets have multiple features that capture various aspects of the system. In this task the goal is to maximally compress/transform the dataset, and at the same time minimize information loss.
    Eg. Task: Distinguish cancer versus normal patterns from mass-spectrometric data. Dataset contains 10000 features.
    Eg. Algorithm: Principle Component Analysis, Autoencoders

Clustering





Clustering



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- *RL is not supervised.* There is a supervisory signal in the form of a reward, but the agent does not know if the reward was for the current action or some action in the past. Sometimes the environment can have some inherent randomness to it so the same action could lead to different rewards. So the reward signal is not a true supervisory signal.

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- *RL is not unsupervised.* The future actions of the agent is guided by the reward it gets, so because of the existence of a partially supervisory signal it cannot be considered as unsupervised.

Reinforcement Learning