

# 1 General concepts of Machine Learning

## 1.1 Supervised Learning

Supervised Learning is a Statistical Learning technique in which for each observation of the predictor measurement  $x_i$  there is an associated response measurement  $y_i$ . [1, p. 26] The target is to fit a model that related the relation between the predictor and the response for prediction or inference.

## 1.2 Unsupervised Learning

In contrary to Supervised Learning, Unsupervised learning there is no associated response to every observation [1, p. 27]. Because of the lack of appropriate response,

## 1.3 Reinforcement Learning

Definition of training/validation/testing sets.

Definition of loss function.

Algorithm Online/offline

Incremental Learning.

# 2 Inertia in weight updating

For weights updating problem, it is important to maintain accuracy for previous training while incorporating new data. We can consider this as inertia

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For a stochastic algorithm such as gradient descent and its derivation (Back-propagation etc.), the inertia of the system is archived through

- Previous state/weights of the system: The new weights is calculated base on the current weights as  $\beta_i = \beta(i-1) + \delta_\beta$  where  $\delta_\beta$  is a weights adjust vector calculated base on the error between the desired output and the actual output; or the propagated error signal for each layer of a multilayer network.
- A constant  $\alpha$ , also known as "learning rate" which contribute to  $\delta_\beta$

Linear Model

Solution of Normal equations

Geometrical Interpretation

### **3 Neural Networks**

General motivation (brief biological description, etc).

Learning the weights.

Backpropagation

Problems of backpropagation

### **4 Swarm Intelligence**

#### **4.1 PSO**

### **5 A new hybrid technique ELM+PSO a new technique**

### **References**

- [1] Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. *An Introduction to Statistical Learning*, volume 103 of *Springer Texts in Statistics*. Springer New York. DOI: 10.1007/978-1-4614-7138-7.