Machine Learning Quiz1 (Range From Lab1-6)

Lab1: Introduction

1.1 Machine Learning Defination

learn and explore the patterns from data itself

1.2 Difference Between ML & Traditional one

- ML
    - dont need to write **rule**, cuz the Machine Learning Algorithm can learn the pattern or rule from the data itself
    - **Data + Label**
    - **Data-Driven**
- Traditional One
    - need to write **rule**, we need to write a program to set rules
    - **Data + Program**
    - **Program-Rule Driven**

1.3 Types of Machine Learning

- **Supervised Learning**: data + label, learning from the data and minimize the loss between prediction and label's value.
- **Unsupervised Learning**: No label, find and explore the data's rule & find the pattern of data itself.
- **Reinforcement Learning**: Agent has an interaction with the environment and try to maximize the reward function by optimizing the Agent's strategy

1.4 Application of Different Types of Machine Learning Above

- **Supervised Learning**: Regression + Classification
- **Unsupervised Leaning**: Clustering + Generation (generate the new data sample with the help of known data training)
- **Reinforcement Learning**: complex decision-making, like AI player.

1.5 Machine Learning Workflow

- Data Preparation
- Data Pre-processing
- Model Setting
- Model Training
- Model Evaluation

- Fine Tuning For Parameters
- Deployment

Lab2 Linear Regression

2.1 Types of Linear Regression

Types: Simple / Multi (the bias term is the only one! for the whole total bias term as the whole formula, not) Linear Regression

2.2 Assumption

Linearity Assumption for Model: the relationship between Features & Target is Linear

2.3 Cost Function Overview

- (1) MSE: **avg of the square** of **difference between** predicted & real one

> for Linear Regression is used for Regression task, it can predict the continous numeric value.

- (2) R^2: the formula is

$$1 - sum(y_{pred} - y_{real})/sum(y_{pred} - y_{avg})$$

  , the larger R^2, the better (attn for Over-fitting problem with high R^2)

- (3) **Normal Equation**: that's the Ordinary Least Square. (**but Linear-Regression only**)

2.4 Difference Between Cost Function mentioned above

- (1) MSE: **iteractive update** the parameter

- (2) Normal Equation: **NOT iteractive update**

- (3) R^2: over-fitting problem

Lab3 Logistic Regression

Classification types:

- Bi-Classification
- Multi-Classification (**one-vs-rest**)

3.1 Model Evaluation

- (1) ACC:

$$TP + TN/(TP + TN + FP + FN)$$

- (2) Precision:

$$TP/(TP+FP)$$

- (3) Recall (**double-inverse**):

$$TP/(TP+FN)$$

- (4) F-Score: the balance between Precision & Recall

$$2pr/(p+r)$$

- (5) ROC: the **balance between TPR & (1-FPR) => balance between sensitivity & specificity**
    - **TPR:**

$$TP/(TP+FN)$$

    - **FPR:**

$$FP/(FP+TN)$$

    - **Trade off TPR & (1-FPR)**
    - **AUC**

Lab 4-5-6 Neural Network

> Computation Model: **Mapping from input to output through Hidden Layers**

(1) Perceptron

Bi-Classifier (fail in XOR)

(2) MLPs

Stucture: Input -> Hidden -> Output

Activation Functions of MLPs

- Sigmoid: vanishing gradient
- Tanh: better than Sigmoid, but still vanishing gradient
- ReLU: dead Neural Nodes