Revision For Mid-Sem Test

Covered Topics

- Textbook "*Dive into Deep Learning*": Chapter 1 - Chapter 6

- Tutorials: 1-4

- Lecture Notes: Lecture 1 - Lecture 5, and Lecture 6 Part 1 (i.e., CNN-Part 2.jpynb)

Machine Learning Problem Formulation

- Four major components:
    - Data
    - Model
    - Objective function
    - Optimization algorithm
- Biggest challenge
    - Overfitting
    - Generalization

Data

- Training data, Validation data,Test data
- Gap between training and testing performance
- Data preprocessing
- Data augmentation (to reduce risk of overfitting)
- Implemetation: split data into batches for training

Models-Linear

➢ What is a linear model?
➢ Limitations
➢ Implementation

Models-MLP

- Multilayer perception
  - What is a neuron?
    - Activation function
  - How neurons are organised in neural networks
    - Hidden layer
  - Forward/backward propagation, computational graph
  - Universal approximation power
    - The activation function is not a polynomial
  - Implementations
  - Neurons, layers, blocks, entire network
  - Initialization
  - Parameter management
  - Implementation of a neural network model

Models-CNN

- What is convolution?
  - Kernel, stride, padding, channnels
  - Receptive field
- Why we need convolution for image classification?
  - Compare with MLP: advantages and disadvantages
- Use convolution to build convolution layers and convolution neural networks
- Regularization: Batch normalization
- Implementations
  - layers, blocks, entire network
  - Initialization
  - Parameter management

Objective functions

- **Mean Squared Error**
    - Connection to maximum likelihood estimation
- **Cross-entropy loss**
- **Regularization**
    - Weight decay

Optimisation (Training)

- Parameters and Hyper-parameters
- Stochastic Gradient Descent method
- Regularization methods
  - Dropout

Model Selection

- Hyper-parameter search
- Use validation data
- Cross-validation
- Overfitting, underfitting