A Brief Introduction on DNN based Methods

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Trajectory Estimation of Mobile Users/Devices based on Wi-Fi Fingerprinting and Deep Neural Networks

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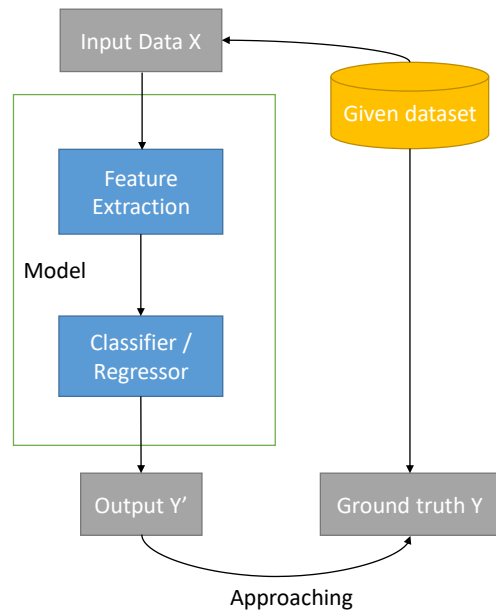- Convolutional Neural Networks (CNNs)
- Summary

From a view of model

- Basic elements of a model:
  Input and Output

- In our case:
  RSSI → Location lables

- Our objective:
  A mapping from input to desired output

| Input Data |
| Feature Extraction |
| Model |
| Classifier / Regressor |
| Output |
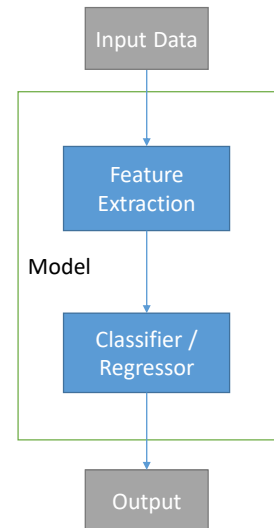
# Model Training

- What we have:
  Pairs of input and output (X, Y)
  Y is called ground truth

- What model tells:
  Y' = f(X, w) is called hypothesis
  where w are parameters inside model

- How to get desire mapping:
  Minimize the difference between Y and Y'

| Input Data X |
| Given dataset |
| Feature Extraction |
| Model |
| Classifier / Regressor |
| Output Y' |
| Ground truth Y |
| Approaching |

Loss and Gradient Descent

- Loss function:
  Measures such a difference
  A function of weights L(w)

- Update weights to make Y' approaches Y

- Main method: Gradient Descent
 Learning rate is important !
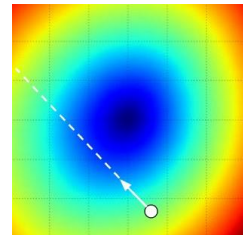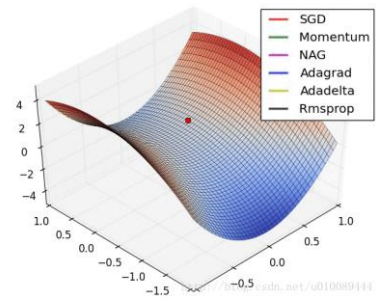
Deep Neural Networks (DNNs)

- Simulation of neural system

- Consist of multiple hidden layers

- Neuron influenced by output from previous ones

- Activation provide Non-linearity:
 Selection based on experiments
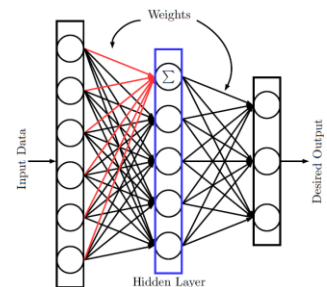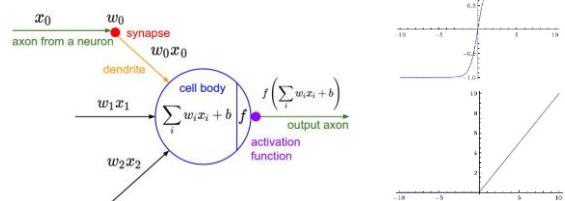
Stack Auto Encoder (SAE)

• Fully connected layers

• Compress high-dimensional data to lower ones

• Dimensional reduction and feature extraction

• Firstly train encoder and decoder classifier to have an identical output
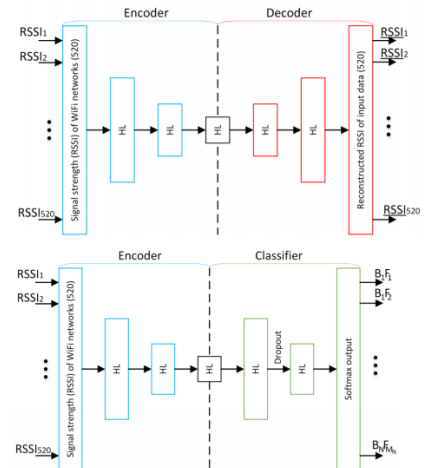
Convolutional Neural Networks (CNNs)

• Employ convolution
• Take spatial relation into account
• Successful in vision tasks

• Share parameters
• Automatically extract rich features
• Robust to spatial variation
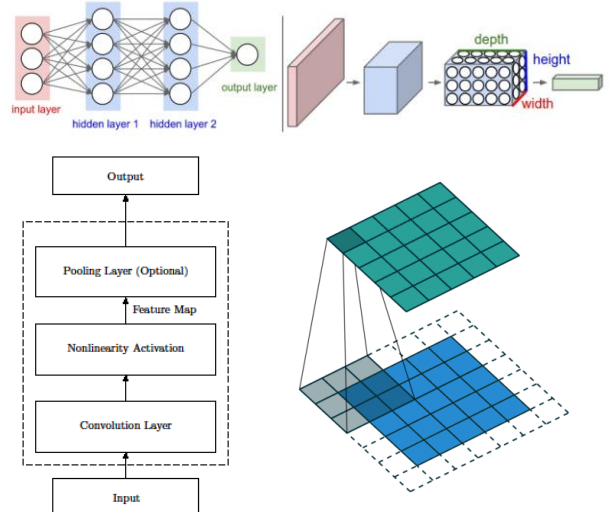
Feature Map

- Output of convolution

- Relatively Low-level features:
  Edges, color and texture

- High-level features:
  More abstract, more semantic information
  Easier classification
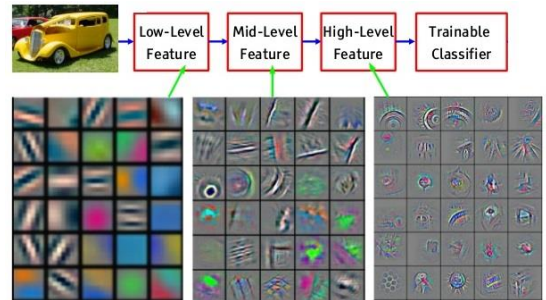
Summary

- The training of model is data driven
- Aims to minimize the loss value
- Many training settings need consideration
- DNNs have powerful mapping ability
- SAE mainly performs dimensional reduction
- CNNs can consider spatial relation and extract rich features

Thanks for listening !

Questions ?