ARTIFICIAL INTELLIGENCE AND DEEP LEARNING

WEEK 5
2021 SPRING

Contents

1)What is Deep Learning?

- Is a sub division of machine learning.
- Is the set of algorithms and models that work on «ANNs» that are multilayer network structures inspired from the structural and operational properties of the brain.
- "Deep" expresses multiple hidden layers.

1)What is Deep Learning?

- Deep learning uses many nonlinear process element layers for feature extraction and transformation. Each consecutive layer accepts the output of the previous layer as its input.

- Algorithms can be supervised (classification) or unsupervised (pattern analysis).

1)What is Deep Learning?

- In deep learning it is present that there is a structure that relies on the learning of multiple feature levels or representations of the data.

- High level features are formed from low level features to form a hierarchical representations. This representation learns multiple levels of representation corresponding to different levels of abstraction.

1)What is Deep Learning?

- Deep learning basically relies on learning from the representation of the data.

- Representation for an image stands for; a vector of density per pixel or side sets, special shapes.

1)What is Deep Learning?

- Some of these features represent the data better.

- At this stage, as another advantage, deep learning methods employ efficient algorithms for hierarchical feature extraction that represents the data best instead of handcrafted features.

What are the differences between deep learning models and classical artificial neural networks (ANNs)?

- There are many more hidden (deep) layers in deep learning models when compared to classical artificial neural networks.
- The differences of deep learning than classical ANNs are as follows:

- More data, more processing power
- Nonlinear activation functions
- New initialization methods
- New regularization methods

Why can deep learning be present in many different problems?

- Because it provides (much) higher accuracy in many problems when compared to conventional machine learning methods.
- This level of accuracy enables commercial applications.
- It enables new applications.

4) Deep Learning Libraries

- There are many libraries developed for deep learning.

Library	Language	Developer	Main Features
Theano	Python	MILA Lab	-Effective Tutorials -GPU support
Caffe	Python	BVLC	-Presence of pretrained networks -GPU support
Torch	Lua	Ronan Collobert et. al.	-Maximum flexibility and speed in algorithm formation -GPU Support -User Friendly Interface
Digits	C++	NVIDIA	-NN design and traning over multiple GPU systems -Improved Visualization
TensorFlow	Python	Google	-Using a single API
DeepLearning	Java	Adam Gibson	-Based on JVM
KNET	Julia	Deniz Yuret	-Easy to understand, short coding -GPU Support

- NOTE: The details of these libraries will be discussed in the lecture of week 6.

5) Deep Learning models

- Commonly used deep learning models are as given below:

- CNN Convolutional neural networks
- Auto-encoder neural networks
- RNN recurrent neural networks
- Deep belief networks

Convolutional Neural Networks

- Known as convolutional neural networks or CNN (Lecun, 1989) is a special type of neural networks that are used to process the data with a topology similar to grill
- Samples include the image data that can be thought as a one dimensional grill that samples regularly time array data and two dimensional pixel grill.
- Convolutional neural networks performed magnificently well in practical applications.
- «Convolutional neural network» name symbolizes that the network uses a mathematical operation called convolution.
- convolution is a special linear operation.
- Convolutional networks are basically, the neural networks that utilize convolution instead of general matrix multiplication in at least one of their layers.

* NOTE: The details of CNN will be explained in lectures of weeks 7 and 8.

Autoencoder

- an autoencoder is a neural network that is trained to copy its input to its output kendi girdisini çıktısına kopyalamak üzere eğitilmiştir sinir ağıdır.
- Autoencoders generally perform the copying process approximately and they are trained to copy only the inputs that are similar to the training set.
- Autoencoders conventionally were employed in dimensionality reduction and feature learning.
- Autoencoders could be thought as a special type of feedforward networks and they can be trained by techniques that follows the gradients calculated by backpropagation such as minibatch gradient exit.
- Unlike feedforward networks, autoencoders can also be trained with Recurcilation learning algorithm.

* NOTE: The details of Autoencoder will be discussed in the lecture of week 9.

Recurrent Neural Networks(RNN)

- Recurrent neural networks (RNN) are a class of neural networks in which the connections between nodes form a directed cycle. This, enables dynamic temporary behavior.
- Unlike feedforward neural networks, RNNs can use their input memory to process the random orders of inputs. Recurrent neural networks' main aim is to use consecutive information.
- In a conventional neural network, we assumed that all inputs (and outputs) are independent of each other. RNNs are named as recurrent since they do the same job for each element of the sequence, the output depends on the earlier calculations.
- In classical ANNs no associations between previous states or inputs are made. However, in RNNs, which is a deep learning algorithm, an associations with previous inputs or states are carried out.

NOTE: The details of RNN will be explained in the week 10 lecture.

Deep Belief Network(DBN)

- In machine learning, Deep Belief Network (DBN) is a generative graphical model.
- The Deep Belief Network is a class of deep neural networks made up of multiple layers of hidden nodes, with connections between layers but not between nodes.
- Deep Belief Networks is a deep neural network consisting of a multi-layered graphical pattern that has both directed and unverified edges.
- It consists of multiple hidden unit layers, with each layer interconnected but without units.
- DBN today; It is applied in major areas such as Clustering, Classification, Dimension reduction, Anomaly detection and Natural language processing.

- NOTE: Details of DBN will be explained in the lecture in the 11th week.