Chapter 1: Introduction to AI and DL

Artificial Intelligence

The Artificial Intelligence (AI) tutorial provides an introduction to AI which will help you to understand the concepts behind Artificial Intelligence. In this tutorial, we have also discussed various popular topics such as History of AI, applications of AI, deep learning, machine learning, natural language processing, Reinforcement learning, Q-learning, Intelligent agents, Various search algorithms, etc.

Artificial Intelligence is composed of two words Artificial and Intelligence, where Artificial defines "man-made," and intelligence defines "thinking power", hence AI means "a man-made thinking power."

Importance of AI

- With the help of AI, you can create such software or devices which can solve real-world problems very easily and with accuracy such as health issues, marketing, traffic issues, etc.
- With the help of AI, you can create your personal virtual Assistant, such as Cortana, Google Assistant, Siri, etc.
- With the help of AI, you can build such Robots which can work in an environment where survival of humans can be at risk.
- AI opens a path for other new technologies, new devices, and new Opportunities.

Advantages of Artificial Intelligence

- ***High Accuracy with less errors*:** AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.
- ***High-Speed*:** AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.
- ***High reliability*:** AI machines are highly reliable and can perform the same action multiple times with high accuracy.
- ***Useful for risky areas*:** AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.
- ***Digital Assistant*:** AI can be very useful to provide digital assistant to the users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirement.
- ***Useful as a public utility*:** AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purpose, Natural language processing to communicate with the human in human-language, etc.

Disadvantages of Artificial Intelligence

- ***High Cost*:** The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.
- ***Can't think out of the box*:** Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.
- ***No feelings and emotions*:** AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with human, and may sometime be harmful for users if the proper care is not taken.
- ***Increase dependency on machines*:** With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.
- ***No Original Creativity*:** As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

Deep Learning (DL)

Deep learning is a branch of machine learning which is completely based on artificial neural networks, as neural network is going to mimic the human brain so deep learning is also a kind of mimic of human brain. In deep learning, we don't need to explicitly program everything. The concept of deep learning is not new. It has been around for a couple of years now. It's on hype nowadays because earlier we did not have that much processing power and a lot of data. As in the last 20 years, the processing power increases exponentially, deep learning and machine learning came in the picture.

A formal definition of deep learning is neurons.

Frequently used jargons in deep learning

- ***Perceptrons***
  A single layer neural network. Perceptron is a linear classifier. It is used in supervised learning. In this computing structures are based on the design of the human brain and algorithms takes a set of inputs and returns a set of outputs.
- ***Multilayer Perceptron (MLP)***
  A Multilayer Perceptron is a Feedforward Neural Network with multiple fully-connected layers that use nonlinear activation functions to deal with data which is not linearly separable.
- ***Deep Belief Network (DBN)***
  DBNs is a type of probabilistic graphical model that learn a hierarchical representation of the data in an unsupervised way.
- ***Deep Dream***
  A technique invented by Google that tries to distil the knowledge captured by a deep Convolutional Neural Network.

- ***Deep Reinforcement Learning (DRN)***
  This is a powerful and exciting area of AI research, with potential applicability to a variety of problem areas. Other common terms under this area are DQN, Deep Deterministic Policy Gradients (DDPG) etc.
- ***Deep Neural Network (DNN):***
  A neural network with many hidden layers. There is no hard-coded definition on how many layers least a deep neural network has to have. Usually at least 3 or more.
- ***Recurrent Neural Networks (RNN)***
  A neural network to understand the context in speech, text or music. The RNN allows information to loop through the network.
- ***Convolutional Neural Network (CNN)***
  A neural network, to do images recognition, processing and classifications. Objects detection, face recognition etc. are some CNN's ability where it is widely used.
- ***Recursive Neural Networks***
  A hierarchical kind of network where with no time aspect to the input sequence but the input has to be processed hierarchically in a tree fashion.

Applications of Deep Learning

There is massive excitement about artificial intelligence and its subsets. Here are a few Deep Learning applications that will govern the world.

1. ***Self-driving cars*****:** Companies such as Google are building driver assistance services. They are also teaching computers how to use digital sensors. In the automotive sector, researchers and developers are working diligently on deep learning-based techniques for self-driving cars.
2. ***Natural Language Processing*****:** Machines are taught to understand the complexities associated with languages and semantics. To achieve this, NLP through Deep Learning plays a significant role. NLP also catch linguistic nuances and frame appropriate responses.
3. ***Healthcare*****:** Deep Learning is completely revolutionizing the healthcare and the medical industries. AI has enabled healthcare and medical industries to advance tremendously.
   Clinical researchers use DL to find a cure for untreatable diseases. DL helps with a speedy diagnostic of dangerous conditions. Many cancer tests, such as the Pap test and Mammograms, use DL to examine cell images under a microscope.
4. ***Virtual assistants*****:** Siri and Google Assistants are approved deep learning virtual assistants. Deep Learning enables virtual assistants to learn and understand commands given by a user. Virtual assistants then execute by providing the appropriate answer naturally.
   Virtual assistants use Deep Learning to learn about the user, from what the user searches most.
5. ***Fraud detection*****:** The banking and financial sectors are benefiting from Deep Learning to detect transaction fraud. Autoencoders in TensorFlow are being used to catch credit card fraud, thus saving a lot of money from fraudsters. Fraud prevention is done by recognizing patterns in customer transactions.

6. ***Image recognition*:** Image Recognition using Deep Learning aims to recognize and learn content in images. Deep Learning also seeks to understand (gather data from) the surrounding in the image. Image Recognition is used in the gaming industry and within social media.
7. ***Entertainment*:** Entertainment companies such as Netflix recommend to their viewers what they need to watch. Deep Learning enables the entertainment industry to understand consumer's behaviors. Applying DL to the entertainment industry provides an exciting experience to clients.

Deep Learning is revolutionizing the filmmaking process. Cameras can learn body language and conduct voice synthesis. Deep Learning can also help to emulate someone's voice in virtual characters.