JIMMA UNIVERSITY

INSTITUTE OF TECHNOLOGY FACULTY OF COMPUTING PROGRAM OF COMPUTER SCIENCE

Title:-Deep Learning

#	Student Name	ID	Sign
1	Aneso hasen	RU0729/08	
2	Abdo fuad	RU4184/07	
3	Bahar mohamed	RU0521/08	
4	Abdi Abrahim	Ru0526/08	

Submitted: Mr. Desalegn

Jimma, Ethiopia

Introduction

Deep learning (also known as **deep structured learning** or **hierarchical learning**) is part of a broader family of machine learning methods based on the layers used in artificial neural networks. Learning can be supervised, semi-supervised or unsupervised

Deep learning architectures such as deep neural networks, deep belief networks, recurrent neural networks and convolutional neural networks have been applied to fields including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, machine translation, bioinformatics, drug design, medical image analysis, material inspection and board game programs, where they have produced results comparable to and in some cases superior to human experts.

Neural networks were originally inspired by information processing and distributed communication nodes in biological systems synaptic structures yet have various differences from the structural and functional properties of biological brains, which make them incompatible with the neurological evidence. Specifically, neural networks tend to be static and symbolic, while the biological brain of most living organisms is dynamic (plasticity) and analog

To understand what deep learning is, we first need to understand the relationship deep learning has with machine learning, neural networks, and artificial intelligence.

Deep learning is a specific subset of Machine Learning, which is a specific subset of Artificial Intelligence. For individual definitions:

- Artificial Intelligence is the broad mandate of creating machines that can think intelligently
- Machine Learning *is one way of doing that*, by using algorithms to glean insights from data.
- Deep Learning *is one way of doing that*, using a specific algorithm called a Neural Network

Don't get lost in the taxonomy – Deep Learning is just a type of algorithm that seems to work really well for predicting things. Deep Learning and Neural Nets, for most purposes, are effectively synonymous. If people try to confuse you and argue about technical definitions, don't worry about it: like Neural Nets, labels can have many layers of meaning. Neural networks are inspired by the structure of the cerebral cortex. At the basic level is the perceptron, the mathematical representation of a biological neuron. Like in the cerebral cortex, there can be several layers of interconnected perceptron's.

- **Description basic algorithm if any area or step**

Deep learning algorithms automatically learn feature representations (usually from unlabeled data), thus avoiding a large amount of time-consuming engineering. These algorithms are dependent on developing huge artificial neural networks that were inspired loosely by brain (cortical) computations. Below are the types of deep learning algorithms:

- ✓ **Deep Belief Network(DBN)**

A Deep Belief Network is a class of deep neural network or a generative graphical model comprising numerous layers of latent variables (i.e. Hidden units) with connections in-between the layers but not units within every layer. They can be viewed as a composition of unsupervised, simple networks i.e. Sigmoid Belief Networks + Restricted Boltzmann Machines.

The major advantage of DBNs its ability of "learning features," which is attained by a 'layer-by-layer' learning strategies whereas the higher level features are learnt from preceding layers. Often, they are utilized to initialize deep discriminative neural networks (a method known as generative pre-training). They are generally used for unsupervised pre-training. In this training, the network initially trains a generative model, and utilizes it to initialize a discriminative model.

- ✓ **Generative Adversarial Network(GAN)**

Generative Adversarial Networks (GANs) are a class of Artificial Intelligence algorithms used in deep learning. They are implemented by a system of 2 neural network models that contest with each other in a zero-sum game framework. The 2 neural network models are known as the Generator and the Discriminator models. The generator model generates samples by taking noise as input.

The discriminator receives samples from both the training data and the generator and has to be able to differentiate between the two sources. A continuous game is played by these 2 networks where the generator is learning to yield more realistic samples while the discriminator is learning to get better at differentiating real data and generated data. These two networks are simultaneously trained and the competition will steer the generated samples to be indistinguishable from the real data.

GANs can generate photographs that look authentic to the observers. Take, for example, a GAN can be utilized to create a cat's synthetic photograph that deceives the discriminator into accepting it as a real photograph.

- ✓ **Backpropagation Algorithm**

Backpropagation is an algorithm that is used in artificial neural networks for calculating each neuron's error contribution after processing a batch of data (in image recognition process). The gradient descent optimization generally uses it for adjusting the weight of neurons by calculating the loss function's gradient.

The backpropagation algorithm has repeatedly been rediscovered and is equivalent to automatic differentiation in the reverse accumulation mode. For each input value, backpropagation needs a desired and known output. So, it can be stated as a supervised learning method. It can be used with any optimizer based on gradients like truncated Newton or L-BFGS. Backpropagation is generally used for training deep neural networks (neural networks containing more than one hidden layer).

- ✓ **Softmax Regression Algorithm**

Generalizing logistic regression to the classification problems where we want to handle multiple classes is termed as Softmax Regression (also known as Multi-class Logistic Regression, Maximum Entropy Classifier Regression, or Multinomial Logistic Regression). The labels are binary in logistic regression. It is used for problems like MNIST digit classification where the goal is to differentiate between ten distinct numerical digits. Softmax regression enables us to handle $y(i) \in \{1,\ldots, K\}$ and K represents the number of classes.

- ✓ **Convolutional Neural Network (CNN) Algorithm**

The convolutional neural network algorithm is a multilayer perceptron that is the particular design for identifying the 2-D image formation. It has an input layer, output layer, and numerous hidden layers. The hidden layers contain normalization layers, fully connected layers, pooling layers, and convolutional layers.

The convolutional layers apply the convolution operation to the input, and they pass the result to the next layer. The individual neuron's response is emulated by the convolution to visual stimuli. The convolutional networks incorporate global or local pooling layers which combine the neuron clusters' outputs at one layer into a single neuron in the next layer.

Fully connected layers are used for connecting neurons of different layers. The benefit of CNNs is that they are quite easy to train and consist of fewer parameters when compared to fully connected networks with the same number of hidden units. Explicit feature extraction can be avoided in CNNs.

- **Application area in data mining where it can be apply and used**

Deep Learning is changing the way we look at technologies. There is a lot of excitement around Artificial Intelligence (AI) along with its branches namely Machine Learning (ML) and Deep Learning at the moment. With massive amounts of computational power, machines can now recognize objects and translate speech in real time. Artificial intelligence is finally getting smart. It's predicted that many deep learning applications will affect your life in the near future. Actually, they are already making an impact. Within the next five to 10 years, deep learning development tools, libraries, and languages will become standard components of every software development toolkit.

So, here are the TOP 15 Deep Learning applications that will rule the world in 2018 and beyond

1. Self-driving cars

Companies building these types of driver-assistance services, as well as full-blown self-driving cars like Google's, need to teach a computer how to take over key parts (or all) of driving using digital sensor systems instead of a human's senses. To do that companies generally start out by training algorithms using a large amount of data.

2. Deep Learning in Healthcare

Breast or Skin-Cancer diagnostics? Mobile and Monitoring Apps? or prediction and personalised medicine on the basis of Biobank-data? AI is completely reshaping life sciences, medicine, and healthcare as an industry. Innovations in AI are advancing the future of precision medicine and population health management in unbelievable ways. Computer-aided detection, quantitative imaging, decision support tools and computer-aided diagnosis will play a big role in years to come.

3. Voice Search & Voice-Activated Assistants

One of the most popular usage areas of deep learning is voice search & voice-activated intelligent assistants. With the big tech giants have already made significant investments in this area, voice-activated assistants can be found on nearly every smartphone. Apple's Siri is on the market since October 2011. Google Now, the voice-activated assistant for Android, was launched less than a year after Siri. The newest of the voice-activated intelligent assistants is Microsoft Cortana.

4. Automatically Adding Sounds to Silent Movies

In this task, the system must synthesize sounds to match a silent video. The system is trained using 1000 examples of video with sound of a drumstick striking different surfaces and creating different sounds. A deep learning model associates the video frames with a database of pre-rerecorded sounds in order to select a sound to play that best matches what is happening in the scene. The system was then evaluated using a Turing-test like a setup where humans had to determine which video had the real or the fake (synthesized) sounds.

This uses application of both convolutional neural networks and long short-term memory **(**LSTM) recurrent neural networks (RNN).

5. Automatic Machine Translation

This is a task where given words, phrase or sentence in one language, automatically translate it into another language.

Automatic machine translation has been around for a long time, but deep learning is achieving top results in two specific areas:

- Automatic Translation of Text

- Automatic Translation of Images

Text translation can be performed without any pre-processing of the sequence, allowing the algorithm to learn the dependencies between words and their mapping to a new language.

6. Automatic Text Generation

This is an interesting task, where a corpus of text is learned and from this model new text is generated, word-by-word or character-by-character.

The model is capable of learning how to spell, punctuate, form sentences and even capture the style of the text in the corpus. Large recurrent neural networks are used to learn the relationship between items in the sequences of input strings and then generate text.

7. Automatic Handwriting Generation

This is a task where given a corpus of handwriting examples, generate new handwriting for a given word or phrase.

The handwriting is provided as a sequence of coordinates used by a pen when the handwriting samples were created. From this corpus, the relationship between the pen movement and the letters is learned and new examples can be generated ad hoc.

8. Image Recognition

Another popular area regarding deep learning is image recognition. It aims to recognize and identify people and objects in images as well as to understand the content and context. Image recognition is already being used in several sectors like gaming, social media, retail, tourism, etc.

This task requires the classification of objects within a photograph as one of a set of previously known objects. A more complex variation of this task called object detection involves specifically identifying one or more objects within the scene of the photograph and drawing a box around them.

9. Automatic Image Caption Generation

Automatic image captioning is the task where given an image the system must generate a caption that describes the contents of the image.

In 2014, there was an explosion of deep learning algorithms achieving very impressive results on this problem, leveraging the work from top models for object classification and object detection in photographs.

Once you can detect objects in photographs and generate labels for those objects, you can see that the next step is to turn those labels into a coherent sentence description.

Generally, the systems involve the use of very large convolutional neural networks for the object detection in the photographs and then a recurrent neural network (RNN) like an Long short-term memory **(**LSTM) to turn the labels into a coherent sentence.

10. Automatic Colorization

Image colorization is the problem of adding color to black and white photographs. Deep learning can be used to use the objects and their context within the photograph to color the image, much like a human operator might approach the problem. This capability leverage the high quality and very large convolutional neural networks trained for ImageNet and co-opted for the problem of image colorization. Generally, the approach involves the use of very large convolutional neural networks and supervised layers that recreate the image with the addition of color.

11. Advertising

Advertising is another key area that has been transformed by deep learning. It has been used by both publishers and advertisers to increase the relevancy of their ads and boost the return on investment of their advertising campaigns. For instance, deep learning makes it possible for ad networks and publishers to leverage their content in order to create **data-driven predictive advertising**, **real-time bidding (RTB) for their ads**, **precisely targeted display advertising** and more.

12. Predicting Earthquakes

Harvard scientists used Deep Learning to teach a computer to perform viscoelastic computations, these are the computations used in predictions of earthquakes. Until their paper, such computations were very computer intensive, but this application of Deep Learning improved calculation time by 50,000%. When it comes to earthquake calculation, timing is important and this improvement can be vital in saving a life.

13. Neural Networks for Brain Cancer Detection

A team of French researchers noted that spotting invasive brain cancer cells during surgery is difficult, in part because of the effects of lighting in operating rooms. They found that using neural networks in conjunction with Raman spectroscopy during operations allows them to detect the cancerous cells easier and reduce residual cancer post-operation. In fact, this piece is one of many over the last few weeks that match advanced image recognition and classification with various types of cancer and screening apparatus–more in the short list below.

14. Neural Networks in Finance

Futures markets have seen a phenomenal success since their inception both in developed and developing countries during the last four decades. This success is attributable to the tremendous leverage the futures provide to market participants. This study analyzes a trading strategy which benefits from this leverage by using the **Capital Asset Pricing Model (CAPM)** and cost-of-carry relationship. The team applies the technical trading rules developed from spot market

prices, on futures market prices using a CAPM based hedge ratio. Historical daily prices of twenty stocks from each of the ten markets (five developed markets and five emerging markets) are used for the analysis.

15. Energy Market Price Forecasting

Researchers in Spain and Portugal have applied artificial neural networks to the energy grid in an effort to predict price and usage fluctuations. The daily and intraday markets for the region are organized in a daily session where next-day sale and electricity purchase transactions are carried out and in six intraday sessions that consider energy offer and demand, which may arise in the hours following the daily viability schedule fixed after the daily session. In short, being able to make adequate predictions based on the patterns of consumption and availability yields to far higher efficiency and cost savings.

- **What can be done your suggestion?**

Many organizations employ deep learning for particular applications. Facebook's AI lab performs tasks such as automatically tagging uploaded pictures with the names of the people in them. Google's DeepMind Technologies developed a system capable of learning how to play Atari video games using only pixels as data input. In 2015 they demonstrated their AlphaGo system, which learned the game of Go well enough to beat a professional Go player. Google Translate uses an LSTM to translate between more than. And also

Deep Learning with a focus on:

- ***Neural Networks and Machine Learning.***
- ***Convolutional Neural Networks (CNNs).***
- ***Object detection/localization with Deep Learning.***
- ***Training large-scale (ImageNet-level) networks.***
- ***Hands-on implementation using the Python programming language and the Keras +mxnet libraries.***

Conclusion

Deep learning architectures like recurrent neural networks, deep belief networks, and deep neural networks have been applied to fields such as natural language processing, machine translation, speech recognition, computer vision, and so on. These architectures have generated results in such a way that they were superior to human experts in some cases.

Deep learning is taking machine learning very much closer to its original goal; artificial intelligence. Deep learning algorithms learn high-level features from data and this is a major step ahead of conventional machine learning. To get an insight on deep learning algorithms, there are various sources available on the internet such as e-books, websites, and so on. They provide the information related to deep learning methodology and the latest advancements in this field.