

SECRET OF DATA

DEEP LEARNING FOR BEGINNERS

Concepts, Tools and Techniques



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Thomas Laville

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To my wife Melanie and my two children Marion and Anatole

You are my life and I love you so much!

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INTRODUCTION

Deep learning is a terminology used for a type of technological research and development that is responsible for building machines that are considered to be artificial intelligences. These are machines that are capable of completing complex functions such as speech recognition, image recognition, bioinformatics and more.

Understanding deep learning, including what it is and what makes it work, means that you will have a greater understanding of how computer scientists and researchers are developing the systems that may create a complete and pure artificial intelligence one day in the future. Until now, they have only created ones that can complete one or two functions. However, it is hoped that one day they will create something that closely resembles the human brain. Ideally, they want to create a “pure” artificial intelligence, which is one that would be created by a human but would learn and operate entirely free of human influence. In essence, it would be a “superhuman”.

“Deep Learning: Concepts, Techniques and Tools” was written to help you understand what deep learning is and why it is such a fascinating and revolutionary concept. Although it is not a new concept, it is one that is becoming more and more popular as we speed towards the possibility of having a true artificial intelligence walking amongst us. Within’ this book you will learn more about what deep learning is, what goes into developing a deep learning machine, and what can presently be done using deep learning machines. You will also learn about the future of deep learning and why scientists and many other technology fanatics are so excited about this development and where it may take us as a society.

One thing you may be fascinated to learn as you read through this book is how much we are already using deep learning technologies. Even though the idea of a complete and pure artificial intelligence walking amongst us seems to be a reality of the distant future, the amount we use the technology already is rather fascinating. Contrary to popular belief, most people interact with deep learning technologies or have the ability to on a daily basis. Furthermore, it is a large part of some of the major organizations in our society.

Deep learning is an incredible concept that is here to stay. The revolutionary science that is taking place on a daily basis and is slowly being integrated into

our society for regular consumer use is a fascinating one, and it is incredible to learn about. Understanding it may help you understand the technology you are using right now, and the future of society. You may be surprised about what you learn! Please, take your time and enjoy reading this educational book about deep learning.

CHAPTER 1: INTRODUCTION TO DEEP LEARNING

If you have ever heard of machine learning, or artificial intelligence, then you have a general understanding of what deep learning is. Essentially, deep learning is a subfield of machine learning. This particular learning system is unlike other programs where “learning” is completed using factual algorithms and set representations. Instead, the deep learning network is comprised of algorithms that have been inspired by the structure and function of the human brain. As a result, deep learning machines have the ability to learn information and use it.

The networks that deep learning is processed on are called “artificial neural networks” because of the fact that they represent true neural pathways in the human brain. This might sound confusing right now, but as we progress through this chapter and this book you will begin to understand exactly what deep learning is, how it works, and why it is an important system in today’s world. If you continue to feel confused, however, fret not. The processes of deep learning are still being studied and understood by scientists, so not everything is completely known or understood, yet. However, they have done a lot in regard to shedding light on what deep learning truly is and, so we can learn a great deal about it and how it works.

What Is Deep Learning, Exactly?

Deep learning is essentially a system neural networks that are used to help try and make learning algorithms much easier to use, as well as much better in their abilities. They are also used to make revolutionary advances in artificial intelligence, as well as machine learning, and ultimately to create what will eventually be a true and complete artificial intelligence.

In the past, computing systems were too slow, and we didn't have enough information to create the networks required in order to make a true artificial intelligence. What that means is that we were not advanced enough to create an artificial intelligence that would be able to completely act, think, and live on its own. Until now, we have only been able to create partial artificial intelligences that are able to do certain things on their own based on a set of metrics that have been programmed into their intelligence network.

With the introduction of deep learning, however, we have been able to begin developing large neural network systems that are capable of taking in information and responding to it on its own. The end goal will be to create neural networks that mimic the human brain and operate as their own intelligence, completely independent and capable of learning new things and advancing all on their own without human manipulation. Essentially, it would be an artificial species that we create and introduce into the world.

At the very foundation of all of these advances and progressions in artificial intelligence is deep learning. In the past, algorithms that were used were slow. While they could process a large amount of data, their performance was slow and limited. Deep learning combines performance with data intake and creates an optimal and advanced system that out-competes anything we have ever used before.

What Is Learned?

Right now, deep learning has been used in practice under the conditions of supervised learning. This means that the deep learning machines can only learn from labelled data that it has been exposed to. They have not been left unsupervised yet, and likely won't be for quite some time. At the very least, they won't be unsupervised until they are reliable and entirely understood.

Over time, the goal is to open up the deep learning networks and artificial intelligences to unsupervised learning, where they will be able to learn anything they want without restriction on what they can or cannot access. When they are able to access this data without restriction, artificial intelligences will then become complete and will be an artificial intelligence in the truest sense of the word.

Feature Learning

Because of deep learning being based on large neural networks, it has the ability to be scaled to incredible sizes. They can also be trained with “feature learning” however, which means that they can perform automatic features from raw data. Essentially, the artificial intelligences will be able to intake raw data and have pre-programmed feature responses which will help them respond efficiently and in a positive manner. This means that they will be able to learn data but then turn it into their own learning, growing away from human-inputted features so that they can operate entirely on their own without any human implications or manipulations.

When we learn about things as humans, we often build on concepts, allowing us to learn more and more. That is how we learn virtually everything: we start small and grow from there. The idea with artificial intelligences is to teach hierarchy feature learning, which means that the artificial intelligences will be able to take something they’ve learned, such as human-inputted information, and grow on that concept to create their own concept. They will also be able to advance similar to how humans are presently advancing: by building on concepts and moving forward through the natural learning process.

Why is it Called “Deep Learning”?

In some of the earliest papers provided on deep learning, Geoffrey Hinton was a co-publisher of the first paper written on the backpropagation algorithm. In that paper, he was said to have written the word “deep” as a representation of the development of large artificial neural networks. It is likely that he meant that they were large and went much “deeper” than the networks they were using to date in the artificial intelligence field.

Later, in 2006 he co-authored a paper where he stated: *“Using complimentary priors, we derive a fast, greedy algorithm that can learn deep, directed belief networks one layer at a time, provided the top two layers form an undirected associative memory.”*

He has also written more papers where he uses the word deep to describe the abilities of the algorithm and the learning network and how it is used to grow and advance from things it is taught in the beginning. He has been cited hundreds if not thousands of times using deep as a descriptive factor for how the network operates and its abilities. As a result, the term has been fostered into the title and the entire program is now called “deep learning” instead of “artificial neural networks”. Essentially, “Deep Learning” is the name of the system and “artificial neural networks” is what they are comprised of.

CHAPTER 2: HISTORY OF DEEP LEARNING

In 1986, Rina Dechter was a member of the machine learning community. She was the original person to introduce the concept and term of deep learning. The phrase “artificial neural networks” was introduced later in 2000 by Igor Aizenberg and his colleagues. Although it was these two individuals who brought modern deep learning into our minds, the entire concept was actually introduced much earlier in a program published by Akexey Ivakhnenko and Lapa in 1965.

At the time, the ideas of deep learning were being implemented into a computer identification system by an organization called “Alpha”. These individuals were responsible for demonstrating the learning process that was made possible through the deep learning concept.

There have been many other deep learning working architects and visionaries since the initial introduction, all of whom have contributed to deep learning getting to the spot where it is today.

Deep Learning Timeline

Below is a timeline that will help you see how deep learning has been established and the growth it has accumulated along the way. This timeline will give you insight to some of the biggest developments in deep learning technology and the people who played a key role in establishing these developments. This will help you understand how long deep learning has been around for and just how long it has come in a few short decades.

1965: Alexey Ivakhnenko and Lapa publish a working learning algorithm that uses supervised, deep, feedforward, multilayer perceptrons.

1971: A paper is published that describes the algorithm as an 8-layer deep network that is trained by the group method of data handling algorithm.

1980: A deep learning algorithm is published as the “Neocognitron” by Kunihiko Fukushima.

1986: Rina Dechter introduces the phrase “Deep Learning” and the concept becomes an official topic of interest for computer scientists.

1989: The standard back propagation algorithm is applied to a deep neural network by Yann LeCun who uses it as a system to read and recognize handwritten ZIP codes on pieces of mail.

1990: Igor Aizenberg coins the phrase “Artificial Neural Networks”.

1991: The same piece of machinery used to read ZIP codes on mail was advanced and developed on so that it could begin recognizing 3-D objects. This was completed by matching 2-D images with handcrafted 3-D object models.

1992: Cresceptron was introduced by Weng. This was a publication that was

used to perform 3-D recognition and could work even in a cluttered place where there wasn't a single isolated object to recognize. Similar to Neocognitron that was introduced in 1980, Cresceptron was developed using multiple layers. Unlike Neocognitron, it did not require supervision or human interaction and manipulation to complete various functions. In other words, it could perform many functions and operations on its own.

1994: A multi-layer Boolean neural network was introduced by Andre C. P. L. F. de Carvalho, Fairhurst and Bisset. The neural network module was independently trained and created a completely weightless neural network that was composed of self-organizing feature extractions.

1995: A network comprised of six fully-connected layers was trained in 2 days by Brendan Frey. The network had several hundred hidden units within' it that were each trained during this period. He proved that using the wake-sleep algorithm you could train the network to do several different functions. At the time, however, the speed was rather slow.

1997: Over the years the deep learning network has struggled with what was called the "vanishing gradient problem". This prevented machine learning systems from retaining information in gradient-based learning methods. In 1997 Hochreiter and Schmidhuber published the Long short-term memory (LSTM) network which was capable of avoiding the vanishing gradient problem. It did so by maintaining memories of events that had happened several times over. This was important in the development of speech recognition.

2006: Hinton and Salakhutdinov successfully shared how many-layer feedforward neural network systems were capable of being pre-trained one layer at a time. Each layer was treated as an unsupervised but restricted machine. Afterward, they used supervised backpropagation to fine-tune the system so that it worked the way they desired it to.

2009: Hinton and Li Deng worked together to apply deep learning algorithms to

speech recognition. Together they co-organized a workshop that took place in late 2009 called “Workshop on Deep Learning for Speech Recognition”. Here, they learned how they could deepen the generative models of speech and potentially use more capable hardware and large-scale data sets so that deep neural nets would become possible.

2010: Computer scientists and researchers extend deep learning to a larger vocabulary speech recognition.

2012: The “Merck Molecular Activity Challenge” was won by Dahl and his team when they used a multi-task deep neural network in order to predict the biomolecular target of a drug.

2014: The “Tox21 Data Challenge” was won by a team lead by Hochreiter who used deep learning as a system to detect off-target and toxic effects of environmental chemicals that can be found in nutrients, drugs, and various household products.

There have been many discoveries and advancements in deep learning over the years. The concept was originally introduced in 1965 and since then scientists and researchers have developed on it so much so that there is now a real and impending possibility that a true and complete artificial intelligence will soon exist. At this point, we are no longer concerned with “if” it will happen, rather we are wondering “when”. It is clear that the research and science has shown that deep learning has the power to complete many incredible actions, each of which will contribute to an eventual artificial intelligence that will be able to completely function, learn, and advance on its own without requiring human input, interaction, or manipulation.

CHAPTER 3: ARTIFICIAL NEURAL NETWORKS

As you learned previously, deep learning is made possible through the introduction and use of artificial neural networks. These are networks that were developed to reflect the biological neural networks that work in animal brains to make them function as independent creatures. These systems have the capability of learning on their own which grants them the ability to progressively improve their knowledge and abilities. The idea behind these systems is that they can learn to do tasks on their own without requiring special programming or interference from humans to teach them how to do so, much like true animals do.

One great example of how the artificial neural network works is examining how they respond to pictures containing dogs in them. For example, if there was programming that had pictures labeled “dog” and “no dog”, the artificial neural network would begin to identify which element in the picture was actually the dog. As a result, it would know what dogs looked like. From thereon out, it would be able to identify dogs and it would have a sound understanding of what dogs were. This is much like if you were to teach a baby how to identify a dog. At first, you must teach them how, but after they can identify dogs in any number of situations. They can also then develop information about dogs, such as how they look, what defines a dog, and what doesn’t. For example, they would be able to tell a dog apart from a cat based on appearance and, later, actions and sounds. Artificial neural networks carry this same ability, making them capable of being their own independent species.

Developing an artificial neural network requires a large series of connected units. These are called artificial neurons and they were created to resemble axons in the biological brain, which are a form of neuron. Each neuron has its own connection to other neurons, which is called a synapse. This synapse is used to transmit signals to other neurons in the artificial neural network. Much like an animal brain, the receiving neuron can then transmit that signal to other neurons in a sequence that allows the artificial neural network to operate just like an animal brain would. The result of the sequencing is that certain signals and messages are sent throughout the brain which can lead to the body that the to which the brain is attached to act, react, and respond in a variety of unique ways.

In a true animal brain, neurons are organized in a series of layers. Each one of these layers is responsible for helping brain perform different tasks, which mean

each one essentially specializes in certain information and transformations. It can take a series of transmissions from one neuron to the next in order to get the signal to transmit from the first input layer to the last output layer. Originally, the scientists responsible for working with and creating artificial neural networks were attempting to mimic the animal brain entirely, which is why it was built in such a way. Later, however, they decided to pay attention to creating specific abilities in each creation so that each one was specialized.

To date, scientists and researchers have used artificial neural networks to create systems that could accomplish a great variety of tasks. These tasks include anything from speech recognition to computer vision, computerized opponents in games, and even medical diagnosis systems. Although the artificial neural networks have become incredibly talented and have advanced far beyond what the original artificial neural networks ever were, they are still very simple in comparison to the human brain. At the time of this publication, they have been compared with worm brains. Despite only being considered at the same capacity as a worms' brain, however, they have been made capable of completing many tasks that are far more advanced than that which a worm could do.

The Challenges of Artificial Neural Networks

Despite being extremely powerful and revolutionary, artificial neural networks face many challenges that needed to be addressed by developers. They were large, slow, and could only perform minimal tasks. The computing time required for any basic function to be accomplished using artificial neural networks was incredibly long. Although it is certainly fascinating to watch a machine accomplish some of the things that have been accomplished using artificial neural networks, it also isn't very reasonable, either. Since many researchers and developers hope to see deep learning machines used as staples in society, it is important that they are actually feasible to be used as replacements for humans in regard to a various societal function. While they are still somewhat used, they are a lot less popular than they were originally. Eventually, developers decided to establish a form of "artificial neural network 2.0" if you will. That is, they created deep neural networks, which you will learn about in the next chapter.

Artificial neural networks are essentially the "how" part of the equation when it comes to deep learning. They are responsible for the process by facilitating a network that enables deep learning to take place. Without the presence of artificial neural networks, there would be no deep learning. Like our own brains, these networks are responsible for the development and growth of the artificial intelligences that are attached to the deep learning systems. If they weren't there, the systems would essentially be null and void. They would cease to exist and there would be no deep learning. The same would be true if we did not have brains of our own. As you can see, deep learning is far more than artificial neural networks, but it would be nothing without them. They are an essential component of the entire system.

CHAPTER 4: DEEP NEURAL NETWORKS

Artificial neural networks are the basis for deep learning, but the development of deep learning networks goes far beyond artificial neural networks. Since the development of artificial neural networks, scientists and researchers have been focusing on developing and using deep neural networks. These systems are extremely similar to artificial neural networks; however, they have some key differences. They are the future of deep learning, and as the deep learning system progresses it is expected that deep neural networks will eventually replace artificial neural networks entirely.

As you know, artificial neural networks are shallow networks that have been developed to attempt to mimic the animal brain. However, they do carry many disadvantages. Part of which is that they are large and require many systems in order to work, and they can only complete a small number of specialized tasks. As far as deep learning goes, the goal is to eventually create an entirely pure artificial intelligence that requires little to no input from a human in order to function effectively and learn and grow on its own. In order to attempt to draw us closer to that, the deep neural network was created.

The deep neural network is an advanced version of the artificial neural network. It features smaller units and less “stuff”, but has the ability to perform the same complex functions that artificial neural networks create. Those who are the architects of these networks have focused on a few basic approaches as an opportunity to develop a newer and more useable program that allows the deep learning network to perform effectively and efficiently whilst taking up significantly less space.

To understand the benefit and purpose of this activity, one might consider the evolution of computers themselves. A few decades ago computers were massive machines that took up entire rooms and operated extremely slowly. Now, however, they are small and speedy devices that can fit inside of our pocket. Just like computers have evolved in this way, scientists and researchers are seeking to get artificial neural networks to be significantly smaller so that they are more useable and that they operate more efficiently. Naturally, this requires them to refine the techniques and develop new systems that will allow the device to complete the same functions with higher quality results while also taking up less space. This is why the deep neural network was created.

The Challenges of Deep Neural Networks

Just like the artificial neural network has faced challenges over the years, the deep neural network faces its own as well. The primary issues that are faced with deep neural networks are called overfitting and computation time.

Overfitting is a term used to describe the errors that are made with computing devices where the parameters and requirements in the machine are too complex. Essentially there are too many things going on at once and the device becomes “confused” per se and thus starts functioning with random errors that takes away from the machines abilities. Because there are so many layers added into the deep neural network and the layers are expected to perform many different tasks in a very specific way, deep neural networks are prone to overfitting. One way to avoid overfitting is to introduce additional tasks and requirements into the systems that teach it how to avoid the errors. However, creating a system where this works takes time since you are then introducing even more complexity into the system and if you are not careful it can lead to further overfitting. The ultimate goal is to learn how to establish systems that will be able to perform various functions without overfitting by combatting each set of overfittings with new regularization until the system is entirely free of overfitting errors and is capable of operating effectively on its own.

As for computing time, requiring a machine to perform so many different types of functions can take a while which can result in the systems not functioning quick enough. While they can still perform many incredible tasks, it’s not entirely interesting or effective if they are performing them too slowly. There are a few different ways that computing time can be minimalized such as by batching functions. This means that you teach the system to only used the relevant parts required in order to complete tasks and the rest of the system turns off in the meantime until it is needed. Having faster processors and minimizing the size of the system can also contribute to creating faster systems that have quicker computing time so that tasks are completed in a reasonable timeframe making the system worthwhile and efficient for any task that it sets out to accomplish.

In addition to being the answer to their slow and inefficient predecessors, deep neural networks are presently what is considered to be the future of deep learning. Not only have they created the opportunity to speed up computing time

and increase the capacity and functions of deep learning machines, but deep neural networks have also helped developers create machines that more closely resemble animal brains. These more advanced artificial neural networks have an incredible capacity and while they still face many challenges, it is likely that these will be sorted out and they will become even more effective and efficient.

Over time, there is the potential that we may see deep neural networks phased out as a new and even more effective system is phased in, just like we saw from artificial neural networks to deep neural networks. However, at this time there is nothing new coming in on the horizon, rather just a lot of research and development taking place on deep neural networks. Once researchers and computer scientists are capable of correcting the overfitting problems and making the computing times more efficient on deep neural networks, then we will likely see rapid advancement towards a variety of new deep learning systems being introduced to society. It is simply a matter of time and attention as they remain invested in creating the ultimate supercomputer that can complete an incredible number of tasks and functions with more accuracy and efficiency than any human ever could.

CHAPTER 5: DEEP LEARNING APPLICATIONS

Although deep learning is still being heavily researched, and we are still growing to understand how it works and how we can make it even more effective, it is actually used in many parts of modern society. In fact, you have likely interacted with a deep learning machine on a daily basis in your own life: your cell phone. There are also other systems that are using this in modern daily life, and it is not unlikely that you have crossed paths with them in your own days. In this chapter, we are going to explore where deep learning is already in use so that you can get an idea of what it is and how it is being used to help us function in society on a daily basis. This will also help you get an idea of what more we can accomplish as deep learning continues to advance and be used even more in modern technology.

Automatic Speech Recognition

If you have ever used the automatic speech recognition on your phone or on a device such as Google Home or Alexa, then you have interacted with deep learning technology.

Automatic speech recognition is one of the most successful cases of deep learning that exists in modern technology. This technology allows users to communicate certain commands and functions to their device and the device responds promptly with action that fulfills whatever command has been given to the device. For example, if you use Apple Siri on your iPhone and say something like “Siri, tell me more about dogs”, Siri is programmed to provide you with several internet resources that will give you more information about dogs.

The speech recognition programs we can communicate with on a daily basis are incredible and can perform many functions. They were developed using 630 speakers from eight major dialects in American English. Each of these speakers were required to read 10 sentences into the device which teaches it how to understand a variety of dialects. Because of how small it's size is, many different configurations can be tried using this program called TIMIT. TIMIT goes a step beyond word-sequence recognition, however. It is programmed with what is known as “phone-sequence recognition” which actually allows those who are not as fluent in English to continue using the device. In other words, it can recognize people regardless of how strong or weak their grammar skills are.

If you will recall, earlier models of speech recognition in devices were fairly weak. They were relatively incapable of understanding many commands and would frequently complete inappropriate functions have based on what was asked of it. Thanks to TIMIT's ability to use phone-sequence recognition, however, speech recognition has advanced an incredible amount. It has become more accurate than ever, and has the ability to perform a wide variety of tasks and functions without requiring very specific commands in order to do so.

Speech recognition debuted in the late 1990s under the term “speaker recognition”. It evolved to be known as speech recognition around 2009-2011 and has continued to grow ever since. Any commercial-grade speech recognition system you have ever heard of is based on deep learning processes. This includes systems such as Google Play, Amazon Alexa, Apple Siri, Skype Translator, Xbox, Cortana, iFlyTek and many others. Each one of these devices has been programmed using deep learning models and that is how you are able to use

speech recognition with these technologies. If you have ever used any of these then you have interacted with deep learning technology!

Image Recognition

Similar to speech recognition, deep learning machines are also capable of using image recognition. The image recognition used in deep learning is facilitated by a database data set called MNIST. Within' this database is over 60,000 training examples and 10,000 test examples of handwritten digits.

MNIST is similar to the speech recognition program's TIMIT because it is so small in size. As a result, just like TIMIT, it can have multiple configurations tested to ensure that it recognizes a wide variety of handwritten digits.

In addition to understanding handwritten digits, MNIST has started recognizing other things as well. For example, in 2011 there was an image recognition program where humans and artificial intelligence machines were required to recognize images and decipher what was within' them. Believe it or not, the deep learning machines performed better than actual humans did. This landed them the title of "superhuman". Image recognition deep learning machines have also been used to interpret 360-degree camera views around vehicles and to analyze malformations in facial features to help diagnose individuals with genetic syndromes.

Visual Art Processing

Visual art processing with deep learning machines are extremely similar to image recognition. By increasing the application of the techniques used in deep learning, scientists have managed to produce machines that are capable of accomplishing a series of visual art tasks.

Using deep neural networks, scientists have managed to produce deep learning technology that can accomplish tasks such as identifying the style period of paintings and what form the painting was done in. They can also “capture” the style of any given painting and create arbitrary photographs that are visually appealing, and generate incredible images based on random visual input fields. These various tasks enable deep learning machinery to be used as artists of a sort. While this isn’t necessarily a mandatory task or something that serves any particular field of “work” in the world, it certainly has the ability to portray how brilliant these machines are. They have the power to be created in such a way that they can “appreciate” and reproduce artwork, meaning that they can likely be designed very similar to an actual human one day.

Natural Language Processing

Using artificial neural networks and deep neural networks, scientists have been able to create machinery that can assist with translations and language modeling. This program is known as LSTM and was introduced in the early 2000s.

Using LSTM, deep learning networks have the ability to understand native language in a way that enables them to have basic conversations with people. They can communicate back-and-forth in a rational method for some period of time. Because of how advanced this technology is, the deep learning machine can understand many jokes, paraphrasing, and other parts of natural language and respond as though it were an actual human sharing an intellectual conversation with you.

While the conversations they can hold are short at this time, technology is rapidly advancing towards creating deep learning network technology that can hold coherent and effective conversations with people. They are doing this by improvising technology such as Google Translate's large end-to-end long short-term memory network. This network enables the system to "learn from millions of examples" according to Google, which means that the machine can literally pick up on millions of examples and use these as an opportunity to both interpret what someone is saying to it as well as produce a response. Using this type of technology enables Google devices to remember and translate entire sentences instead of single words at a time. This means it can interpret the meaning of the entire sentence and generate a response to the entire sentence, rather than to one or two words that you have said.

In addition to being able to interpret sentences and generate responses, Google Translate can do just what the title says: translate. Using their end-to-end long short-term memory technology, Google has created a translator that can translate entire sentences rather than translating one word at a time. This means that the translation will accommodate for any grammatical changes from one language to the next and enable users to return results with translations that are correct to the native language. Rather than having an awkward sentence that isn't structured properly or written with proper native grammar, those with minimal to no language skills in another language can translate from one language to the next and speak in a way that native language speakers will understand.

Drug Discovery and Toxicology

Using deep learning machines and technology, researchers and scientists such as those at AtomNet have created machines that can help people predict how drugs are going to affect individuals. The aim is to try and predict whether or not a new drug will hit the desired biomolecular target and treat individuals with minimal side effects. They also seek to identify what the potential negative side effects would be and how they may affect individuals who are taking the drugs.

To date, an incredibly large percentage of drugs are not put through into use because they are incapable of producing the desired effects or they produce a heavy amount of undesired side effects. It is natural for drugs to have side effects, even unwanted ones or dangerous ones, but those which are known to regularly produce negative or dangerous side effects and have minimal positive effect are typically not granted regulatory approval. Instead of having to use the present methods of testing which include both research and physical testing on animals and other sometimes harsh methods, proper deep learning machinery could potentially make it significantly easier to research and approve drugs. Ideally, one would be able to put the drug into the machine and the machine would then be able to research it and identify its benefits and side effects and generate results to researchers and scientists. As a result, it would be able to bypass most testing and either make its way down the approval line or be failed before causing any harm to any animals or humans.

Customer Relationship Management

Using deep learning systems, individuals and companies have managed to produce technology that enables companies to manage their customer relationships. These systems enable businesses to understand how their direct marketing actions are affecting their business and whether or not they are generating success. Additionally, it enables them to identify the lifetime value of a customer, and how they are benefiting the business.

Technology like this enables businesses to understand where their funds are best invested and how they can contribute to retaining customers and providing greater value. Instead of relying on the research of individuals which may be slow and inaccurate, they can use a machine that directly computes the value of marketing and the amount of and value of the customers that each marketing strategy brings in. This way, companies know where to address their strengths and weaknesses and how they can invest their funds to help them generate greater success in the long run.

Recommendation Systems

If you have ever used a piece of technology that was capable of recommending anything to you, you may have been interacting with deep learning technology. There have been many recommendation systems that were built through deep learning technology to help individuals learn about things such as where to eat, where to rent a car, what to purchase, where to purchase from, and more.

These technologies work by learning user preferences based on the results, responses and reviews shown on several different domains. As a result, they are able to identify which businesses and services tend to have the highest ratings and where people should go for certain things based on these responses from real live customers who have personally experienced a company or their services.

Once again, recommendation technology is not necessarily something that is necessary in the way of helping the world “work” but it certainly generates a great convenience tool. Furthermore, it helps display the incredible talent of these technology platforms and what they can accomplish. By seeing how a deep learning network can provide recommendations on various businesses and services, we can observe it’s many abilities and how it may contribute to the overall formation of a “pure” artificial intelligence one day.

Bioinformatics

If you haven't heard of this term before, you're not alone. According to the Webster dictionary, bioinformatics is "the science of collecting and analyzing complex biological data such as genetic codes". This type of biological science enables medical scientists and doctors to discover genetic discrepancies in individuals coding that may lead to syndromes and illnesses, and it can also help them discover new illness and syndromes that may evolve in time. This is a critical element of medical science and is mandatory in helping diagnose patients and providing them with the proper care to help them treat their ailments. It is also great for preventative diagnoses and many other functions in medical science.

Using deep learning technology, medical scientists no longer have to rely strictly on their own analytical abilities to identify anything that may be going on in someone's genetics. These programs are capable of reading and understanding the coding which can help speed up the process while also making it significantly more accurate.

In one case, medical scientists used deep learning technologies to discover and predict sleep quality based on data that was collected by a wearable device worn by several patients. This data was collected and then analyzed by a deep learning machine to identify any health complications that the patient may have and how it may be contributing to their sleep quality.

While this type of technology is still very young and requires much more testing and perfecting before it can be used reliably in a lab, it is clear that this has the power to be incredibly efficient and effective when it comes to helping medical scientists excel at their jobs. In the future, deep learning technology may be the answer to helping lab technicians and other individuals in the medical profession when it comes to accurately diagnosing and treating patients.

Mobile Advertising

When it comes to advertising, particularly mobile advertising, there are many factors that need to be considered. There are various data points all contribute to the success or failure of a mobile advertising campaign, so it is important that companies understand them prior to launching a campaign. Misunderstanding the data, not reading it, or otherwise failing to interpret it effectively and use it to help them launch the campaign can result in a campaign that does not reach their target audience and fails to have any significant impact for the company.

One method is to hire a team of professional advertisers who can research these points and help them identify what would be successful in terms of launching a campaign that would provide the company with a reasonable return on their investment. However, this can be slow, and it can be inaccurate. As you are well aware, online data is rapidly changing. Manually researching the data and turning the results into a functional campaign can take a significant amount of time, so long that it can actually result in the research being null and void because the market conditions have already changed.

Using deep learning machines, however, advertising campaigns can be effectively launched with relevant data that helps the company succeed. This technology can analyze a massive amount of data rapidly, providing accurate results in a short period of time. Because of how quickly and efficiently this computing system works, advertising campaigns are much more likely to be on-target and effective because they have been launched before any of the data has had enough time to significantly change.

There are many ways that deep learning technology and machines are already used in regular application in daily life. This type of technology has the ability to be used for many incredible purposes in a variety of areas of modern life. From helping people decide where to eat to helping people determine what illness they may have and how it can be treated, the opportunities are virtually limitless.

For some, it may seem like having an artificial intelligence that can compare to a human's abilities is a dream that may never come true. However, the number of advancements that have been made in the past few decades around deep learning has proven that it is not an unlikely possibility and we should be open to the potential and opportunities presented to us by deep learning technology. By implementing the knowledge, we already know and continuing to research and

develop on deep learning, there is a potential that we could soon live in the world that once only inhabited the pages of sci-fi novels and sci-fi movie scripts.

CHAPTER 6: COMMERCIAL APPLICATION

In addition to being used in daily life by consumers and average people, there are many commercial uses for deep learning technology as well. Organizations such as Facebook and Google are developing deep learning technology to help them run their organizations. In addition to helping them run their organizations, they are providing opportunities to learn more about deep learning and what it is capable of. As a result, they are key players when it comes to the development of the programs and advancing to the next stages.

Key Players in the Commercial Field

As a consumer, people are limited to observing the development of deep learning machines and experiencing the technology as it is rolled out to consumers. Consumers are not able to play a large role in the development of deep learning technology aside from providing feedback on devices and systems that have already been introduced.

However, there are some organizations that are heavily invested in the creation of deep learning machinery. For example, Facebook, Google, and Amazon are all heavily invested in creating devices that are based in deep learning. Each of these three major organizations are invested in the research and development of deep learning technology as each of them are interested in using the automated devices for both personal use and for their organizations. They are also hoping to make this technology available to the public once it is ready for such an introduction.

In addition to these three major players, there are several other companies that have experience with deep learning technology. Apple, IBM, Microsoft, Baidu, Deepmind, and OpenAI are all major companies that are involved in researching and using deep learning technology in their company platform in one way or another, in addition to Facebook, Google, and Amazon. Each of these unique companies are also heavily invested in the research and development process as they are interested in learning more about how this technology can advance their own devices and platforms and help them offer revolutionary and advanced devices that will take them to the next level. Everyone is seeking to discover new ways to offer this incredible technology to their consumers in a way that will take us all to the next level with them.

Applications to Date

Some of the activities deep learning performs in commercial applications includes activities such as Facebook's feature where photos that are uploaded are automatically tagged with the people in them. While this isn't a prominent feature used by daily users, it is one that is presently being developed. The idea is that each time you upload a picture those who are in it will automatically be tagged. In addition to being used on Facebook, this type of technology is used on many smartphones. You may have noticed that in the camera's album on your smartphone there is a "faces" feature where your phone identifies unique faces and categorizes them each into their own subcategory within' an album. Essentially, each one of your friends and family members who are a part of your pictures will have their own "album" where you can find pictures that have that particular person in them. This is a demonstration of the image recognition abilities of deep learning technology.

Another use is Google's DeepMind Technologies systems. They have developed many deep learning technologies that are capable of playing games on their own and winning the games. For example, they can play Atari games with minimal input from a human. Instead, they learn to play and then play the game all on their own. They have perfected this particular deep learning technology so well, in fact, that it is capable of beating professional players.

As you learned in a previous chapter, Google also uses deep learning as a part of their translation technology. Google Translate is a deep learning technology that is capable of translating between more than 100 different languages. Furthermore, as you know, it is capable of translating complete sentences with proper grammar to the native language instead of translating word for word.

Although deep learning is primarily used by the same corporations and organizations who are responsible for the research and development of the technology at this time, it is clear that there is a large future for it in corporations and commercial use. Those who are developing it are hoping that one day we can see it in virtually every corporation, government facility, medical facility, and other major facility as an opportunity to perfect the tasks being done and create a higher level of accuracy, security, and efficiency within' corporations and organizations. However, we still have a long way to go before that happens!

CHAPTER 7: CONNECTION TO HUMAN DEVELOPMENT

As you have already learned artificial neural networks and deep neural networks are influenced by the human brain. Naturally, the development of them closely relates to the development of the human brain. The way that deep learning is developed and created mocks the human brain and human development because scientists and researchers are seeking to develop an artificial intelligence that can operate entirely on its own and they want it to have advanced capabilities such as a human would.

What Does Deep Learning Copy Exactly?

Understandably, deep learning is not copying the development of the human body in particular. Rather, it is closely related to the development of the human brain. In particular, it copies the neocortical development which is a part of cognitive sciences. This is the part of the brain that is responsible for the interpretation and understanding of thoughts, experiences, and anything felt by the senses. By allowing deep learning to mimic and develop alongside the understanding of cognition, scientists are able to begin making an artificial brain that could potentially work exactly like the human brain one day. The more we learn about cognitive science and cognition in the brain, the more we understand and are able to strive towards developing in the deep learning networks.

It is through the development and understanding of cognition that scientists were able to mock up the models for the earliest deep learning networks in the first place. By generating an understanding of how the human brain works and the many layers of the brain that are responsible for its successful operation, scientists were able to generate ideas to create machines that would be as capable as we are, if not more. Therefore, the more we understand our own brains, the more the deep learning development progresses.

The more we progress with our understandings of our own brains, the deeper learning networks are going to develop. This is because scientists will have a clearer idea of what can be added in order to make the deep learning network more closely related to the human brain. After all, the more they learn about how our brains work, the more they will be able to ultimately mimic one and recreate a brain entirely that will be able to work on its own and will be born from technology instead of biology.

CHAPTER 8: CONTRADICTIONS AND CRITICISMS

As with any major creation and advancement, there are several contradictions and criticisms that come along with deep learning. There are many reasons why deep learning may never get as advanced as people hope, as well as many reasons why people are afraid of deep learning. While most are excited about this concept, the reasons as to why it is considered to be a threat or something to be concerned about make complete and total sense. In this chapter we are going to explore where deep learning is weakest, and why some people are afraid of the concept altogether.

Theory

One of the reasons why scientists themselves are unsure about deep learning is because they don't have an extremely clear understanding of how the machine works. While they understand what they are required to do in order to make the machine operate as desired, they are not one hundred percent clear on why it operates this way or everything else that is going on while it operates this way. There are many variables that are presently unknown to scientists which means that the understanding of how deep learning machines operate is presently a theory and not finite knowledge. As a result, there are many who are concerned that they may never fully understand this part of it and therefore they may never be able to advance it to where it needs to be in order to fulfill the ideology and dreams of those who have spent many years on developing the technology.

Unique Approaches

Another reason why artificial intelligences and deep learning may not be advancing as quickly as it potentially could be because many of those who are involved in the development are advancing it from different angles. Some, for example, want to develop a complete artificial intelligence whereas others simply want to design machines that are capable of fulfilling one or two functions that a human would have traditionally done. These would be highly specialized machines that have greater accuracy and abilities than humans might, therefore making them more reliable and accurate than humans could ever be. Many of those who are focusing on merely advancing artificial intelligences enough to have them capable of being specialized machines that can successfully perform one or two functions do not believe that there is enough knowledge around what would truly be required to create an artificial intelligence for it to happen. These individuals believe deep learning is merely one of the many parts of what would be required in order to generate a true artificial intelligence.

If everyone were on the same page and working towards the same goal, we may see even greater advancements in deep learning. However, with so many different individuals and organizations working towards a variety of different goals, we are seeing a potentially slower advancement across a number of different areas. Still, it is incredible to see how far it has come and where it has yet to go.

Errors

One reason why deep learning machines are not necessarily admired by everyone at this point is because they are not more accurate or reliable than a human's abilities. While that is the goal and they certainly have the potential to one day get there, many display regular problematic behaviors that make it clear that they are not the solution to completely override manual human effort. For example, some machines confidently categorize unrecognizable images as particular things when said thing is not in fact present in the image. Although this seems irrelevant or seemingly small, it does provide evidence that it is not a good idea to rely entirely on deep learning machines to complete tasks that would normally be completed by humans. They still have a long way to go before they can be routinely used in every day jobs with the amount of reliability that would be required in order for them to take over human interference or analysis. Deep learning machines face many restrictions that the human brain doesn't necessarily experience, therefore it may be extremely limited and restricted in what it can do. We have currently seen these restrictions in existing machines and there is no way of knowing for sure that they will ever be completely fixed so that the machines can reliably be used in important activities.

Cyber Threat

Artificial intelligences and deep learning machines are at risk for cyber threats. Because deep learning machines are a form of technology, they do have the ability to be hacked which means that any number of things could go wrong. They could begin performing the wrong functions, producing several errors, creating fabricated results, or compromising sensitive information. To the human eye, it may be difficult to identify what is going on with the system, but a subtle change could alter the entire system and complicate things to a severe degree, potentially even deeming the system irreparable.

Lack of Understanding

One reason why we may never have a true artificial intelligence is because we don't have enough comprehension of the human brain to truly recreate one. While we may be able to recreate versions of a more primitive brain, unless we fully understand our own there may be no opportunity for us to recreate it entirely. After all, if we don't fully comprehend what makes our brain work the way it does it would be hard to create one that works just like it.

As cognitive sciences and other neurological sciences advance, we learn more about more about our own brains and how they work. As you have already learned, these sciences are closely followed by those who are attempting to create a true artificial intelligence because these are the sciences that help them understand what it is that they need to recreate exactly. However, there is no proof that we will ever fully comprehend our own brains, which means we may never understand them enough to create a new artificial one entirely. Without having all of the operating functions that our brains have, it would be virtually impossible to completely recreate a superhuman that had all of our abilities to a "perfect" degree.

Skeptics

There is a large community that is very skeptical about deep learning and its abilities. These are the scientists who believe that it either isn't worth getting too deep into, or it will never advance to the place where many people want it to go. These are the ones who don't believe we will ever produce a full artificial intelligence and that deep learning will only ever be good for producing specialized machinery that can produce high quality and accurate results that may not be achievable by a human.

Additionally, there are many people in society in general who are in disbelief about the abilities of deep learning. These individuals often have no idea that they interact with devices that are using deep learning technologies on a daily basis. They are also unclear as to what deep learning is exactly, and how it can be used to help us design a more advanced version of society that can perform various functions and tasks with higher accuracy and greater convenience. Although they may be right, and we may never produce that true artificial intelligence that, so many people are interested in, it is still clear that deep learning is a technology that is here to stay and will continue to be implemented into every day society until its abilities have been maxed out. Since it has many abilities and can be used in such a wide variety of areas within' society, it is unlikely that this will be the last time you hear about deep learning. In fact, we will likely continue to see growth and development within' that technology for many years to come. As more developments are made, we will continue seeing the impact they have as they are integrated into our society and used by everyday consumers, corporations and organizations, and society as a whole.

Fear

Aside from scientists, researchers, and those related to professions that are responsible for the development of deep learning technologies and artificial intelligences, there are those within the community who believe that deep learning should not be further researched. These individuals are afraid of what deep learning could lead to and what an artificial intelligence may mean for the future of our society.

When these people think about artificial intelligence, they do not tend to think about the advantages of having deep learning networks in our community. Instead, they are afraid that these machines could become much stronger and more advanced than humans and lead to the destruction of life as we know it. They are afraid of these intelligences forming their own colonies or alliances and destructing society one by one. If you think about it, a single superhuman artificial intelligence built with the right materials could lead to a great deal of destruction within the human species. Since it would take a lot to destroy it, a significant amount of damage could be accomplished before anyone could effectively stop the machine.

There are many thoughts, theories, opinions, contradictions and comments that come along with the concept of deep learning and artificial intelligences. From an uncertainty about how far it could truly go to a genuine disbelief in it ever going anywhere, and even to skepticism and fear, there are many different approaches to the idea of deep learning. While some hold very valid reasoning, others are not necessarily set in stone. For example, we don't have any evidence that we will ever fully comprehend the human brain or be able to recreate it, however we also don't have any evidence that we *won't* be able to do this. As a result, this is a valid theory and belief but also one that doesn't necessarily create enough reasoning for us to stop researching and exploring this theory entirely. Only time will tell!

CHAPTER 9: THE LONG-TERM VISION OF DEEP LEARNING

Depending on who you ask, there are many long-term visions for deep learning machines, technologies, and advancements. Several different people have different desires for where they want to see deep learning go and what they want to see coming from it. However, there are some fairly common core concepts and beliefs held by those who are interested in or involved in the advancement of deep learning. This chapter will help you get an idea of where the technology itself is aiming to go in the coming years.

Smaller and More Efficient

One common goal of people who are studying and developing deep learning machines is that they want to establish a system that enables them to have all of the same, if not better, outcomes while using much less space. Similar to how computing devices have gotten smaller over time, developers are seeking to make deep neural networks and artificial neural networks that are significantly smaller than the ones that presently exist. By making them smaller they become more manageable and more likely to be used in everyday life in one way or another.

Another thing that developers are seeking to accomplish is to create a system that enables the deep learning machines to work more efficiently and quickly. At this time, the computing speed of artificial neural networks is rather slow, making them almost pointless in the way of regular use. While certain functions such as speech recognition and image recognition are quick, other functions are extremely slow and this makes them irrelevant in most business places. If a human can complete the same task quicker and with more accuracy, there is virtually no point in replacing them with an artificial intelligence. However, if they were able to create deep learning machines that were capable of automatically accomplishing all of the same tasks only quicker and more accurately, then it would make sense to replace humans with these machines as they would be more efficient and successful with the task at hand.

The future of deep learning machines is similar to the future of computing machines. Just as computing machines continue to get smaller and more advanced, developers are attempting to do the same with deep learning machines. The coolest part is that the two are already entwined and may continue to be further entwined as they go along. The idea of having a device that fits in your pocket and can do almost everything for you may not be just an idea in the not-so-far off future.

More Automation

Although the systems are already incredibly talented, developers are seeking to make them even more automated. Essentially, they want to add more capabilities to the deep learning machines, as well as teach them how to do things with less human interaction. This is the reason why they are heavily invested in learning about the different layers of the neural networks and how they can establish machines that have many capabilities as it is. The more they research and develop these parts of the deep learning machines, the more automated these systems will become and the more tasks they will be able to successfully complete without having to be driven or guided by a human. Instead, one day they may be able to make choices on their own without requiring a human to intervene and give the machine direction on what to do in every situation.

Perfected Specialized Abilities

Before they ever create a fully artificial intelligence, researchers and developers are likely going to continue creating machines that are highly specialized in different fields. For example, personalized devices that can help you manage your life, and medical devices that can help diagnose and treat illnesses. The two are very different, but both require highly specialized requirements from the machine operating them. Ideally, researchers and developers are going to find ways to perfect the operations of the machines and make them even more capable of helping with a variety of different tasks in real life. Instead of merely demonstrating that they can do so, they will be actually used in practice to help people perform various functions in life including day-to-day activities and different tasks within' unique professions.

Given the incredible and vast abilities of deep learning machines already, it is not unlikely that we will start seeing new machines and technology being introduced that can help us accomplish various tasks in society. Slowly, we may see people being replaced with machines that are more efficient and accurate. These machines will be highly specialized at performing many different functions in society. Truly, the potential and opportunities are limitless. The only thing standing between us and that next step of advanced deep learning machinery is time. Researchers are rapidly advancing towards creating machines that can be used for virtually everything in society.

Full Artificial Intelligence

Following the creation of unique specialized machines that can help us with many different aspects of running our society is the goal of creating a fully artificial intelligence. This would essentially be one machine that could do it all. Every task that was previously run by specialized machinery would be condensed into one single machine. This would enable a single machine to be capable of doing virtually anything a human could do, only better. This would essentially be the “perfect human” or “superhuman” that everyone talks about when they discuss artificial intelligences. It would be a robotic species entirely capable of doing virtually everything on its own from learning to taking actions and fulfilling various tasks in society.

Many people who are on board with developing an artificial intelligence are interested in creating the ultimate superhuman that can do everything. This is the next step for them after creating specialized machines using deep learning abilities. After they perfect each unique element of those machines, they hope to start working towards creating a single machine that can do it all. With the knowledge they gain from each independent machine they will be able to program one that can do everything from help recommend where to eat and what to do, to help identify what you are sick with and how to treat it, and even help you cook your dinner. It would be able to do literally everything a human could, which is why they model robots after humans. This would be an entirely robotic species that would live simultaneously amongst humans. The species would be capable of doing virtually anything on its own and wouldn't require human interaction at all, though they would hope that it would interact with humans and integrate with our society to help us fulfill many tasks that exist within' modern society.

Despite there being some clear visions for the future of deep learning, the true future is entirely unknown. To date, it is likely that many of the researchers that were on board with learning about and developing deep learning machinery were unaware of just how far it would go and how much they would be able to accomplish. The technology is truly incredible and revolutionary, and it is capable of doing things that we aren't even fully aware of at this time. Since we are not entirely clear on what the full capabilities of this technology are, it is really hard to pinpoint exactly where the future will go with deep learning. Furthermore, it is hard to say whether or not government officials or other

authorities would even allow the creation of a pure artificial intelligence given the potential that it could jeopardize our own existence here on Earth.

The future of deep learning is an expansive one that truly could go in any direction. We may simply end up with highly specialized machines that are capable of fulfilling roles in society better than any human could, or we may end up with completely artificial intelligences that walk amongst us and interact with our society as their own independent species. The only way we will ever find out what is actually going to happen is to wait and watch. Every day we are learning more and more about this revolutionary technology, its capabilities, and what our future may look like with the existence and integration of deep learning networks.

CHAPTER 10: OUR FUTURE WITH DEEP LEARNING APPLIED

While the future of deep learning itself is rather incredible, it may be beneficial to further look at what our future could look like with the integration of deep learning machines. Deep learning technology has already been integrated into our world to a degree, and it is rapidly growing. As a result, we can expect to continue seeing the integration of deep learning-based technologies in our society. In this chapter we are going to explore some of those technologies that could eventually exist in our society and what they may look like given what we already know about deep learning and deep neural networks.

Medical Technology

As you learned, deep learning technology has the power to perform many incredible tasks in the medical community. The more they explore deep learning machinery, the further these technologies will go. There is the potential that we could end up seeing every lab in the world being outfitted with advanced machines that are capable of performing many functions that humans are presently performing, only better. For example, we may see the introduction of machines that are capable of reading blood tests and DNA samples to help doctors provide more accurate diagnoses regarding patient's medical concerns. We may also be able to choose more effective drugs for each unique patient as the machine can factor in many pieces of data such as the individual's DNA sequencing, the illness, and the parameters of unique drugs. The machines may be able to predict negative or severe reactions in unique individuals to certain drugs meaning that they can choose more effective ones that will treat the illness with less negative or harsh side effects for the patient.

Another type of machine that may be developed is one that can help with the development of new drugs. Drugs are constantly being created to help treat existing illnesses more efficiently and to treat new illnesses as they come up. If it were created properly, a deep learning machine could potentially have the ability to provide new ideas for drug creations and provide predictions as to what the effects and adverse reactions could or would be to these new drugs. In essence, it could play a key role in the development of new medications helping to cure patients.

Biomechanics

Elaborating further on the medical industry we can address the idea of biomechanics. Already, there are many incredible biomechanical limbs and parts that are being tested and used on patients who are in need. As we continue to explore the capabilities of deep learning, however, we may be able to discover how to create biomechanical organs and limbs that essentially learn to function exactly as they should in order for the person to operate as though they had never lost a limb or an organ in the first place. These biomechanical pieces could be taught to not only help the individual accomplish basic tasks but also relearn how to accomplish fine-motor-skills they may have once had or been interested in developing prior to the loss of their limb.

Fully Automated Smart Homes

Smart homes are already in existence, but as deep learning machines and systems are developed upon we learn about more and more that can be done within' the home. Already we can accomplish tasks such as turning on lights, turning on or changing music or channels on the TV, ordering clothes from websites, ordering food from the store, and more. There are many incredible tasks that can be accomplished with smart homes.

However, there is a lot more than could be done using deep learning technology. Many developers from large organizations such as Facebook are already attempting to create a fully automated smart home that could literally do everything for you. It would essentially become a self-sustaining smart-home that could do everything for itself. You would never have to cook, clean, pick up groceries, or do virtually anything else with a fully automated smart home. Furthermore, they are attempting to create one that can not only do all of this and take commands, but also one that can carry an intelligent conversation and essentially build a "relationship" with the people who live in the home. It would be able to recall important information about you and do things such as wish you a happy birthday, ask how your day was and interact back with you based on your response, and otherwise hold intelligent and unique conversations that were not facilitated by pre-recorded responses on the device.

Having a smart home could be incredible in that you would no longer have to do much in order to manage your home. Instead, you could cast aside tasks such as cleaning and cooking and spend more time enjoying your company and family that visits your home. This particular level of smart home is likely not going to be introduced for quite some time, and will only be available to those who are wealthy to begin with, but it is not unlikely that we may eventually have smart homes like this that are built as an average everyday home for consumers.

Advanced Mobile Technology

If you have watched the evolution of cell phones, then you have seen them go from simple phones in your pocket that could be used to call people you needed to communicate with to mini-computers that are capable of performing many incredible functions. Social media, texting, managing your calendar, taking high quality photos, and many other things can be completed using smart phones the way they are in their current state.

As they continue developing deep learning technology and refining deep neural networks, it is likely that we will continue to see the smart phone become even smarter. Over time, these devices may be capable of being personal managers that we carry around in our pockets. We would be able to accomplish many of the same things we already complete without having to take them out or interact with them in any way beyond speaking. We would be able to communicate with the device and it would do everything from make or cancel dinner reservations to order new outfits or products straight to our homes. They could communicate with our friends for us to establish plans or help us communicate with clients if it were to be used as a business device.

Essentially, anything that is typically done by a personal manager could be done by your phone one day in the not-so-distant future. Having a personal manager would no longer be reserved for those who are rich and famous as we would all have a personal manager that we carried around in the form of a mobile device. We would get to experience all of the same luxuries as those who have an assistant or manager to oversee their everyday life, and we wouldn't even have to be rich or famous to do so. Instead, it would be a piece of technology that is made available to everyday people in the form of either a smart phone or something similar.

Automated Commercial Use Programs

In addition to managing our personal lives, deep learning machines could be used to manage businesses and organizations as well. These could be used to manage everything not unlike the personal management devices. They could organize and arrange business meetings, reserve tables or spaces for the meetings to be held, and send out automated reminders to everyone who is required to show up without anyone ever having to be present for the arranging. One person could communicate something with the device and every other person would have that information and would be able to automatically perform any activities that were needed to be accomplished in advance.

In addition to managing meetings, these devices could be used to manage advertisements. They could be responsible for collecting data and creating advertisement campaigns for various products or businesses based on what was presently taking place in the company. For example, they could discover who the target audience was, how to target them, what parameters would be set in the campaign to ensure that they were reached, and what graphics should be used in order to appeal to the consumer. They would also be able to measure any metrics and data that was returned by the campaign, including how well it performed, how much money each lead costed, the value of each lead and what could be done to make the campaigns even more effective going forward. Everything would be entirely done by a device and nothing would ever have to be done by an individual person, as the device would be more effective and productive anyway.

There are many other ways that deep learning machines could be great for businesses as well. They could be used to oversee the payments made to and from companies, order products or services, schedule employees, hire and fire employees, and more. There are truly limitless opportunities when it comes to learning about what could be done in a corporate or commercial world using deep learning machinery.

Partial Artificial Intelligence s

Although the focus often remains on completely artificial intelligences, it is worth paying attention to the idea of partial artificial intelligences as well. This would be a system that is more advanced than specialized machines but not quite a complete artificial intelligence. For example, it could be a human-sized and shaped figure that was your personal manager and was capable of taking commands and completing many functions but was not entirely independent. Instead, it still relied somewhat on human interaction to complete many functions. This device could be responsible for helping you plan your days, schedule commitments, order stuff for your house or yourself, and otherwise perform daily activities. It could also help you manage other partial artificial intelligences you may have.

Yes, in addition to a personal manager-style artificial intelligence, you could have one that was responsible for physically taking care of your house, one that was responsible for managing your employees, one that was responsible for driving your car, and other such things. These would be partial robots that were capable of doing complex and advanced tasks but that were not completely capable of operating on their own with zero assistance from a human. They would be an incredible addition to help people perform daily activities without having to do them on their own, but they would be manageable and programmable by humans.

One reason why a partial intelligence like this, even one that could perform all the aforementioned tasks without having to have multiple, is because it helps reduce or even eliminate the fear of having a complete artificial intelligence that could overrule the world. These ones would be manageable and could be stopped in the instance that they attempted to cause any harm to anyone or anything. They would not be completely independent and therefore they could be prevented from wreaking havoc on society the way a completely artificial intelligence might be able to. It would help to reduce many of the fears that several people have around having a complete artificial intelligence while still giving all of the effect and convenience of an artificial intelligence that was capable of performing complex tasks for its owners.

Complete Artificial Intelligences

Once again, we discuss the potential of creating a completely artificial intelligence. Complete artificial intelligences would be literal superhumans. They would be capable of doing anything a human could do. They could fulfill and execute complex actions and functions, carry intelligent conversations, learn, grow, and do virtually anything a human could.

While the idea of creating an entirely complete artificial intelligence is phenomenal, this is one aspect that needs to be further considered by developers before it was ever to be created. A completely artificial intelligence may be cool, but it could also pose many threats and dangers to society. For example, they could create their own completely artificial intelligent replicas and develop their own society with as many or as few as they wanted. They would be able to create armies, potentially destroy society, and even wipe humans out entirely. If we were to have complete artificial intelligences, even one that were hacked or otherwise turned “evil” could create a large amount of damage in society. Since they would be created to be strong and virtually perfect it would be hard for an imperfect human to be capable of stopping them. They would have to outsmart them, and since the intelligence would be created to be smarter than us, that would be virtually impossible. We would not have the strength to stop them and would require the involvement of other artificial intelligences which could ultimately lead to a psychotic war between superhuman machines and humans.

Although the idea of creating a completely artificial intelligence is incredible, it is also highly unlikely. At least, not at any time in the near future. Having a completely artificial intelligence would require us to know basically everything there is to know about the human brain in body in order to recreate it in a machine form. We would also have to know how to recreate in machine form to not only function like our own but to function *better*. This is all highly unlikely, or potentially impossible. If it were to happen, it’s likely that it wouldn’t happen for another few generations at least. And when it did, these machines would have to be created in such a way that they could be outsmarted, which would then take away from them being entirely complete artificial intelligences. So, unless developers and the government are willing to jeopardize society as a whole, it is extremely unlikely that we will ever see a true and complete artificial intelligence.

The future of deep learning is vast and incredible. There are so many things that could take place that it is hard to dream up every single one. There are truly so many routes that this technology could go and the only way we will ever know where it ends up is by watching and waiting. Deep learning networks are essentially our key into creating the sci-fi world that we have all dreamt about at one time or another, or watched or read about in pop culture. There are so many potentially incredible, and devastating, things that could happen as a result of deep learning. In order for us to continue advancing as a society without having a heavily negative impact from deep learning machines, we must take our time and roll things out slowly.

Additionally, major developments must be monitored and thoroughly understood before they are ever exposed to the general public. If something were not fully comprehended and were to be released too soon, it could wreak serious havoc on society. The reality is, even a human with bad intentions could use basic deep learning against society. It is important that we take our time and really investigate each part of the process and continue learning more and more about deep learning and deep neural networks before we ever plan on using them as a large and primary part of society.

Still, it is extremely fun to dream about where we may end up with the inventions that are based in deep learning. There are so many possibilities and the idea of having machines that are capable of fulfilling many of the functions that deep learning machines could potentially fulfill one day is incredible. Could you imagine coming home, asking your kitchen to cook you lobster and steak for dinner and then sitting on your couch and having a conversation with your home while it helps you pick out a show on TV? For some it may seem over the top, but for others it sounds like a great piece of luxury and perhaps the best relationship yet.

CONCLUSION

Thank you for reading “*Deep Learning: Concepts, Techniques and Tools.*” Deep learning is an incredible technological advancement that has been in development since the mid-1960s. This technology is the one that is responsible for building machines that are considered to be basic artificial intelligences, and it is also responsible for the future of these machines which will hopefully one day be their own complete artificial intelligences.

As you have learned, deep learning machines have a powerful ability to contribute to society in a number of ways. Presently they have proven their ability to help with their perfected techniques such as image recognition, speech recognition, and bioinformatics abilities. There are so many things that deep learning machines can accomplish, it is fascinating to watch as their abilities continue to be discovered and we continue learning about how they can help us advance as a society.

I hope that this book was able to assist you in understanding what deep learning is and how it works. Understanding these concepts will give you a greater understanding of things such as the technologies you use every day, and the technologies that are presently being studied and developed by some of the world’s largest organizations. The idea is that one day they will create their own complete artificial intelligence so that we can have an entirely new and completely manufactured “species” walking amongst us. A “superhuman” species of sorts.

This book was written to help you understand this revolutionary topic and gain insight as to how it can change the face of life as we know it. From helping us with medical practices such as diagnosing and treating illnesses to helping us decide which restaurant to eat at or which clothing store to shop at, deep learning has the power to help us with an incredible amount of daily activities. Although some may seem more important than others, virtually everything we learn about deep learning technologies at this point should be seen as equally important as they all help us gain a greater understanding to how the technology can be developed to mimic the human brain. The more we learn about the technology, the more we truly understand just how revolutionary this technology truly is.

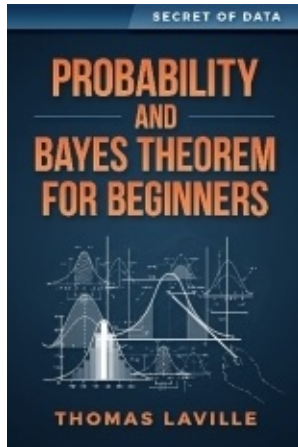
The next step is to continue learning more about deep learning and following the advancements that scientists are making. Google, Facebook and Amazon are

three of the largest key players right now and all three have a huge involvement in the advancement of the technology as they all seek to use this technology to revolutionize and advance their own organizations. Watching these three organizations and their advancements is a great way to stay up to date on the developments of deep learning.

Thank you !

Thank you for buying this book! It is intended to help you understanding Deep Learning Concepts and Tools. If you enjoyed this book and felt that it added value to your life, I ask that you please take the time to review it. Your honest feedback would be greatly appreciated. It really does make a difference.

IN THE SAME SERIES: SECRET OF DATA



[Do you want to understand Bayes' Theorem and Probability?](#)

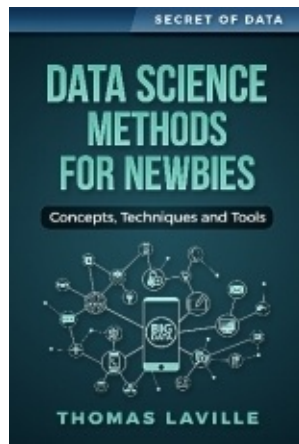
You must first master the concept of probability. Probability is the likelihood that something will happen, describing such things as the chances of you drawing a specific card, say an ace, from a deck of playing cards. There are a simple ways to calculate such probabilities using the information you have in front of you, however Bayesian probability takes this one step further by incorporating previously known information to inform these calculations.

Bayes' theorem is present everywhere in many of the different things that we carry out throughout the day, such as Googling the internet, applying spam filters, machine learning, and so much more.

This book first aims to help build a foundation for the understanding of Bayes' theorem using a step-by-step method that introduces the various elements of probability before approaching the theorem itself. Understanding these sometimes rather complex concepts is made very easy with the use of several examples and everyday applications of probability.

You will find that being in possession of a solid understanding of the ideas related to and applications of both probability and Bayes' theorem in particular will assist you in comprehending and indeed engaging with some of the ways that these concepts are used today, including practical examples like "We want to go for a picnic but it is cloudy. Is it likely to rain on our picnic?" or "What are the chances that someone has an allergy?" or even "In a zombie apocalypse, how likely is my test kit to determine whether someone is really infected?".

So what are you waiting for, let us start delving into the fascinating and useful world of probabilities!



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Up until now, there are only a few data science wizards who dominate. So what are you waiting for, let us start delving into the fascinating and useful world of probabilities!