Week 1
Lecture-3 Understanding the basics of AI in Marketing-III

Welcome to this NPTEL online certification course on artificial intelligence in marketing and now we will talk about module 3. So, this is chapter 1, and we are trying to understand the basics of artificial intelligence in marketing. This is part-3 and module 3.

In this module, we will cover the classification of AI based on different types of technologies. Then we will look at a short case on Washington Post and the third is the introduction to machine learning, deep learning, and the connection among AI, ML and DL. So, this is what, these are the three things that we will learn in this module.

Now, we will start with the classification of artificial intelligence. Artificial intelligence is not that simple to classify. As per Professor Michael Luck, Dean of Faculty, Natural and Mathematical Sciences, King's College, London, AI is not a single technology. We too often talk about it as if it is. AI is a field. It is a whole band of different technologies.

So it is a set of technologies. Some of which are really quite mature now. It is from those that we have seen some reasonable success in the media. But some techniques are not so mature. Some are new. Some still need a lot of work. So, these are at the various stages. So, one are mature, then there are new ones and then there are some that needs lots of work.

So now we will look at the AI classification that is based on different types of technologies. The categorization of AI into strong and weak AI is too narrow. Artificial intelligence should be considered as a large umbrella term under which you will find different technologies such as one, Visual recognition, voice recognition, natural language processing that is NLP, 4th is the expert system, 5th is effective computing and artificially intelligent robots. So, these are the different technologies, the set of technologies that we are talking about 1, 2, 3, 4, 5, 6. So this is how they are shown diagrammatically.

Now let us look at the first one that is visual recognition. Humans can quickly discern between places, objects and people based on images. But computers have traditionally had difficulties with understanding these images. But thanks to the new image recognition technology, we now have specific software and applications that can interpret

visual information. Visual searches uses real image, screenshots, web images or photos.

So now we are talking of real time images as an incentive to search the web. Current visual search technologies use artificial intelligence to understand the content and context of these images and return a list of related results. So, they understand the content and the context of the images and then they give a result that is a list of related items. For instance, Google Lens is an AI powered technology that uses your smartphone camera and deep machine learning to not only object, to not only detect the object in front of the camera lenses but understand the object and offer options such as scanning, translation, shopping and more. For example, if you are pointing the phone to a flower, then it will show the information about the flower and along with that where you can buy these these items and similar other flowers. So, it will not only detect the flower, but it can it will also tell you where to buy that flower and other similar flowers. Speech recognition refers to a computer interpreting the words spoken by a person and converting them to a format that is understandable by the machine. So now this computer is interpreting those words that is being spoken and then converting them to a format that the machine can understand. Depending on the end goal, it is then converted to a text or voice or any other required format.

With this technology devices, so now we have started talking about the second thing that that is a speech technology. Now with this technology, devices can interact and respond to human questions in natural language. So now I do not have to learn a computer language, the devices will interact and respond to my questions in my language. With the ability to understand the human language and communication with them, the voice AI chatbots has offered a great opportunity to businesses to serve customers. It helps speed up processes, increase productivity and scale up the operations. The voice AI assistants namely Amazon Echo, so these are the examples of AI assistants. Amazon Echo, Siri, Google Assistant, Google Home, Amazon Alexa and others are a few incredible advances that have replaced the need for touchscreen devices. Experts expect voice based shopping will reach dollar 40 billion in 2022.

The next type of technology that is covered in AI is natural language processing. Natural language processing is a division of artificial intelligence that involves analyzing natural language data and converting it into a machine-readable format. So, we are now using natural language data and then converting it into a format that is readable by the machine. Speech recognition and AI play an integral role in natural language processing models in improving the accuracy and efficiency of human language recognition. For smart home devices and appliances that take instructions and can be switched on and off remotely, digital assistant that can set reminders, schedule meetings, recognize a song playing in a pub, two search engines that respond with relevant search results to user queries. Speech recognition has become an indispensable part of our life. So that is now becoming very

important part of the life that is speech recognition. Plenty of businesses now include speeches to text software to enhance their business application and streamline the customer experience. So now even if you do not know typing, still you can write. So even if you are not, you just speak and then it will converted it into into text. Using speech recognition and natural language processing, companies can transcribe calls, meetings and even translate them. So now you record the calls, then the calls can be transcribed, meetings can be transcribed, minutes of the meeting it will be easier for everyone to make and then they can be translated to other languages also. Apple, Google, Facebook, Microsoft and Amazon are among the tech giants who continue to leverage AI-backed speech recognition applications to provide an exemplary user experience. So now this is all about providing exemplary user experience.

The next type is the expert system. An expert system is a computer program that is designed to solve complex problems and to provide decision making ability like a human expert. It performs this by extracting knowledge from its knowledge base. So it has a knowledge base using the reasoning and inference rules according to the user queries.

So user has certain queries and then it extract knowledge based on these rules. The system helps in decision making for complex problems using both facts and heuristics like a human expert. So, a human expert also uses facts and heuristics. Similarly expert systems also use facts and heuristics to solve the complex problems. It is called so because it contains the expert knowledge of a specific domain and can solve any complex problem of that particular domain. These systems are designed for a specific domain such as medicine, science, etcetera. So different domains will have different expert systems. As these systems, they provide solutions, they keep on learning and they get more knowledge stored in them and then they come up with more and more solutions, better solutions. So PXDES is an expert system that is used to determine the type and level of lung cancers. To determine the disease it takes a picture from the upper body which looks like the shadow. This shadow identifies the types and degree of harm.

The next is affective computing. Affective computing, also known as emotion AI automatically recognizes emotions. Affective computing is the study of systems that can recognize 1, interpret 2, process 3 and stimulate 4, human feelings and emotions. So now this this emotion AI is trying to trying to come up with human feelings and emotions.

Understanding emotions is critical especially for companies selling complex products. Emotions guided by subconscious mind are likely to be the decision makers in complex decisions. So now you see that in complex decisions emotions are that is guided by the subconscious mind are likely to be the decision maker. Furthermore, emotional instinct-based decisions can be better than conscious decisions when it comes to complex decisions.

Today machines can listen to voice inflection and start to recognize when those inflections correlate with stress or anger. So, these machines, they are listening to the voice inflection, and they start recognizing when this inflection correlates with stress or anger. They can analyze images and pick up subtleties in micro expressions on human faces that might happen even too fast for a person to recognize. So even if a person is not able to recognize these machines these softwares, they are able to recognize. For instance companion MX is a mental health monitoring app that listens to someone speaking into their phone and analyzes the speakers voice and phone use for signs of anxiety and mood changes. The app improves users self-awareness and can increase coping skills including steps for stress reduction. So now your mobile phone is also keeping a track of your stress.

The next type of technology that is included in artificial intelligence is artificially intelligent robots. Robotics is a branch of engineering and computer sciences where machines are built to perform programmed tasks without any further human intervention. So, these program tasks are done by these robots. Traditionally, robots are used when tasks are either too difficult for humans to perform well or extremely repetitive or both. However, AI and robotics can coexist to create artificially intelligent robots. Artificially intelligence or AI gives robots a computer vision to navigate sense and calculate their reactions accordingly. So now we are now making robots so that they can get out of this program task and then they can also be used for some unprogrammed task based on their self learning.

Robots learn to perform their task from humans through machine learning which again is a part of computer programming and AI. What makes such a robot powerful is its ability to think on its own. Companies are increasingly looking for robots to move past automation and tackle more complex and high-level tasks. So now these companies are trying to solve the next level of problems with robots. They want to use robots for more complex tasks. For instance, Hanson Robotics' most advanced human like robot SOFIA, personifies our dreams for the future of AI. As a unique engineering and artistry SOFIA is simultaneously a human crafted science fiction character depicting the future of AI and robotics and a platform for advanced robotics and AI research. So now summarizing the AI classification. One is visual recognition, for example Google Lens. Another is natural language processing so that is Google Translate. The third is affective computing that is emotional recognition. The fourth one is voice recognition. For example, Siri, Cortana, and Google Assistant. And then the fifth one is expert system CaDet and PXDEX and then comes robotics that is SOFIA.

The next technology is an umbrella term for a number of technologies that are being actively used by marketers today. AI and natural language processing, sensors, robotics, augmented reality, virtual reality, mixed reality, Internet of Things and blockchain. So, this next technology consists of 1, 2, 3, 4, 5, 6, 7 and 8. So this IoT is Internet of Things.

By replicating human capabilities these technologies can empower the next generation marketing. Out of these technologies artificial intelligence is one of the most popular buzzwords in business today. But that is for a very good reason. AI has shown to be a very powerful tool for many marketing applications. And that is where our interest lies. Artificial intelligence is a powerful technology that can further enhance the emerging field of other technologies such as sensors technology, robotics, mixed reality, Internet of Things and blockchain. AI has been around for decades, but it is, but its recent popularity is due to 3 major factors. The first is the growth of big data. The second is the availability of cheap, scalable computational power. And the third is the development of new AI techniques. So that has increased the recent popularity of AI.

So how do they replicate humans? So, on the left hand side you have humans, on the right hand side we have machines. Here you see the person is thinking, here it is artificial intelligence. Then he is communicating this is natural language processing. He is sensing this is sensor technology, moving - robotics, imagining - mixed reality, connecting is Internet of Things and blockchains. So, this is how these machines are used to replicate a human.

Now the next thing on the agenda today is about the story of the Washington Post. How AI has changed Washington Post? Washington Post was founded in 1877 in Washington DC, USA. Most circulated paper in Washington DC metro area. They published Pentagon Papers, Watergate Scandal. They made huge losses in 2010s. Then it was acquired by Nash Holdings backed by Jeff Bezos for $250 million. Then they started implementation of AI and ML in news reporting and writing. AI and ML used to predict the popularity of articles. AI driven system called; Zeus Insights act as personalization engine. AI driven come in moderation system. Heliograph AI powered story writing system produced better stories. Now AI field has developed in two dimensions. The first is the human centered that is hypothesis and experimental validation. The second is rationalistic approach that is engineering and mathematics.

Now we are looking at the AI dimensions. A human centered approach is based on empirical science traditions involving hypothesis and after that their experimental confirmation. Human centered AI learns from human inputs and collaborations, focusing on algorithms that is part of a broader human based system. It is characterized by systems that are continuously improving because of human input while providing an effective human robot experience. So that is human centered. Now by developing machine intelligence with the goal of understanding human language, emotions and behavior, human centered AI bridges the gap between machine and human beings. For a business standpoint, human centered AI solutions leverage human science and qualitatively thick data to understand the underlying needs, aspirations and drivers of customer behavior in your market. So that is human centered. Advanced contextual analytics combine data and human science to deliver specific behavioral information. When analytics are

applied to human behavior and choices, the patterns will emerge. These contextual analytics combine data and human science to produce dramatically improved personalized customer experience. Now let us look at the rationalist approach.

It involves a combination of mathematics and engineering. So now we are in rationalist approach we are we are looking at a combination of mathematics and engineering. Although AI incorporates ideas, views and techniques from other fields also, it is a discipline dedicated to developing software and hardware capable of performing activities that require the use of cognition. So that is important about all this. Therefore, from the racialist perspective, the field of AI encompasses any technique which enables machines to act by simulating the human behavior to achieve the best result or in uncertain scenarios the best result expected. In the early days of AI, the major challenge was to perform tasks that are easily solved by a human being, but hard to describe formally in terms of mathematical rules. The difficulty of rules for this type of task indicated that AI techniques needed the capability to extract pattern from data and acquire their own knowledge. So first they extracted patterns from data and then they started acquiring their own language. This ability is known as machine learning which enables computer-based applications to automatically detect patterns in data and to act without explicitly being programmed. Thus the field of AI has advanced not just in the direction of process rules previously defined by human beings for simulating human behavior to make decisions as in classical AI algorithms but also aims to mimic human learning. So that is what is the goal, the end goal.

Machine learning is a part of artificial intelligence and is a study of computer algorithms that can improve automatically through experience and using data. The algorithms try to imitate the way that humans learn, gradually improving their efficiency and accuracy. So, we are looking at this gradual improvement of accuracy. Examples from the real world where machine learning is used include one, spam email detection that is used by Gmail. The second is speech recognition like Siri, Cortana and Google Assistant. The third is computer vision, augmented reality, virtual reality tools and estimated time of arrival, Zomato and Uber. So that is ETA. Machine learning algorithms build a model based on sample data in order to make some kind of predictions. So, 10 samples, 0 data. Now we used 80 training data, 20 tested data and then came up with a model. So one is, one way was to get a model here, another was to get a model from here.

So basic approach to machine learning that is supervised learning. So, data contained input and desired output. Example of that is visual recognition. The second is unsupervised learning that is data contained input only. Models find the structure. That is for example, COVID clustering that was used. The third is reinforcement learning. Model interacts with the dynamic environment. For example, self-driving cars.

Now let us look at what is supervised learning. Supervised machine learning requires labeled input and output data during the training phase of the machine learning lifecycle. This training data is often labeled by the data scientist in the preparation phase before being used to train and test the model. Once the model has learned the relationship between the input and the output data, it can be used to classify new and unseen data sets and then predict the outcomes. Basically, supervised learning is where we teach or train the machine using data that is well labeled. So here now we are teaching and training the machine using data that is well labeled. Which means some data is already tagged with the correct answer. After that the machine is provided with a new set of examples. For example, data so that supervised learning algorithm analyze the training data, set of training examples and produce a correct outcome from labeled data.

For instance, suppose you are given a basket filled with different kinds of fruits. Now the first step is to train the machine with all the different fruits one by one like this. First is if the shape of the object is round and has a depression at the top, is red in color then it will be labeled as apple. If the shape of the object is long, curving, surrender having green, yellow color then it is labeled as banana. So, we are now creating, so these are the creating of rules. Now suppose after training the data you have given a new separate fruit say banana from the basket and ask to identify it. Since the machine has already learned the things from previous data and this time has to use it wisely. It will first specify the fruit with its shape and color and would confirm the fruit name as banana and put it in the banana category. Thus, the machine learns the things from training data that is basket containing fruits and then applies the knowledge to test data that is new fruit. So supervised learning and the next is, so this is how what is how it happens in supervised learning. So, this picture, this picture and this picture it goes to the model and then it says that it is a mango. So, this supervised learning is based on classification and regression, voice recognition.

So, it is classified into two categories of algorithms. The first is classification. A classification problem is when the output variable is a category such as red, blue or disease and no disease. Regression or regression problem is when the output variable is a real value such as dollars or weight.

The next is unsupervised learning. Unsupervised learning is the training of a machine using information that is neither classified nor labeled and allowing the algorithm to act on that information without guidance. Here the task of the machine is to group unsorted information according to similarities, patterns, and differences without any prior training of data. Unlike supervised learning, no teacher is provided. That means no training will be given to the machine. Therefore, the machine is restricted to find the hidden structure in unlabeled data by itself. For instance, suppose the machine is given the images of apple, banana, and mango which it has never seen. Thus, the machine has no idea about the features of all the fruits. So, we cannot categorize it as apple, banana, and mango.

But it can categorize them according to the similarities, patterns, and differences and then categorize them into different parts. The first part may contain all pics having an apple in them. The second part may contain all pics having a banana in them. And finally, the third may contain all the pictures that have a mango. But it does not learn anything before which means no training data or examples. It allows the model to work on its own to discover patterns and information that was previously undetected. It mainly deals with unlabeled data. So, the basic approach to machine learning is unsupervised learning and then all these pictures are sent to it and then that makes the clusters. Cluster 1, cluster 2, cluster 3. So, it is not identifying what is what, but it has clustered on the basis of with how similar they look. So that happened in COVID clustering.

So unsupervised learning is classified into two categories of algorithms. Clustering is one. A clustering problem is where you want to discover the inherent groupings in the data. Such as grouping customers by their purchasing behavior which can then be used for segmenting. An association rule learning problem is where you want to discover rules that describe large portion of your data. Such as people that buy X also tend to buy Y. So now we are associating X and Y. So, there will be 10% people who buy who are buying X and they will also buy Y.

Next is reinforced learning. Reinforced learning is an area of machine learning. It is about taking suitable action to maximize rewards in a particular situation. It is employed by various software and machines to find the best possible behavior or path it should take in a specific situation. Therefore, reinforcement learning differs from supervised learning in a way that is supervised learning the training data has the answer key with it.

So the model is trained with the correct answer itself. Whereas in the reinforcement learning there is no answer. But the reinforcement agent decides what to do to perform the given task. In the absence of a training data set it is bound to learn from its experience. So deep learning is a broader family of machine learning. Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans that is learn by example. Deep learning is a key technology behind driverless cars enabling them to recognize a stop sign and to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TV, and hand-free speakers. So, this is Tesla model 3 voice control devices Alexa.

So, deep learning is getting lots of attention lately and for good reason, it is achieving results that were not possible before. In deep learning a computer model learns to perform classification tasks directly from images, text, and sounds. Deep learning models can achieve state of art accuracy sometimes exceeding human level performance. Models are trained by using a large set of labeled data and neural network architectures that contain many layers.

So now what are the ways deep learning is used in practice? The first is for customer experience. So, machine learning is already used by many businesses to enhance the customer experience. Just a couple of examples include online self-service solutions and to create reliable workflows. There are already deep learning models being used for chatbots and as deep learning continues to mature, we can expect this to be an area deep learning will be used for many businesses. The next is translation. Although automatic machine translation isn't new, deep learning is helping enhance automatic translation of text by using stacked networks of neural networks and allowing translations from images.

Language recognition. Deep learning machines are beginning to differentiate dialects of a language. A machine decides that someone is speaking English and then engages an AI that is learning to tell the difference between dialects. Once the dialect is determined, another AI will step in that specializes in that particular dialect. All of this happens without involvement from a human.

So now let us look at the connection between AI, ML and DL. So deep learning is a specialized subset of machine learning which in turn is a subset of artificial intelligence. The main difference among AI, ML and DL is the dependence of the human being on establishing rules or defining features to represent a problem. From the AI layer, human dependence on the learning process decreases as one moves towards inner layers. So, the figure will show how deep learning is a kind of representation learning which is used for many but not all approaches of machine learning which in turn is considered a kind of AI. So, this is the figure that, so this is artificial intelligence, inside is machine learning. So deep learning is a specialized subset of machine learning which in turn is a subset of artificial intelligence. To exemplify these differences, consider the problem of recommending products to a customer on an e-commerce platform. An example of classic AI algorithm would be to implement a program based on the rule. If a customer has already made a purchase, then recommend the products most purchased by him. Classic AI algorithms are built using hand-designed programs containing rules defined by domain expert human.

Now consider a customer that has never bought on the platform. The defined rule will fail. A solution would be to use the age of the customer to perform recommendations based on the product category. In this case, the age and product category are features defined by a human being. From these features, more rules could be established by a human specialist based on historical purchase data. But if the platform has diverse products and many customers, the definition of these rules becomes more difficult. Thus, a machine learning model could be trained from the historical data based on these features. Besides the customer age, more features of customers can be important in real world scenarios. An approach generally used in this kind of problem is clustering the customers using representation learning algorithms.

Representation learning algorithms are a kind of machine learning, but they start the learning process one step ahead of the classical machine learning algorithms. Representation learning methods have the capacity to learn from features input by a human and they are able to perform a mapping from features. In the case of clustering the customers, representation learning models can decide the cluster of a client without the human being previously knowing about it. However, due to number of features that exist in real world context, the accuracy of the model could be improved if the features initially defined by the human being are used for the algorithm to map more abstract features.

This is the capability of deep learning algorithm. Deep learning algorithms are a type of representation learning and they need the human being to define just simple features. From these simple features, they can define more abstract features in additional layers of learning and then perform a mapping from features. The term deep comes from these additional layers of learning.

So, to conclude, in this module we have discussed the classification of AI on various technologies. Then we have discussed the short case study on how Washington Post is using artificial intelligence. We have also given a brief introduction to machine learning, its type and deep learning. Finally, we have discussed the connection of AI, ML and DL. These are the references from which the material for this module was taken. Thank you.