The basic differences between artificial intelligence, machine learning, deep learning and data science.

Probably you have heard about these terms and many people still have a confusion. What is the exact differences between them? So in this video, I'm going to cover the entire differences so that you will never have any kind of confusion. So let's begin. The first thing is that let's consider the entire universe. You know, let's say there is a universe with respect to. In this specific field. And I really want to talk about this specific universe, and let's call this universe as AI. Okay. So this universe is basically called as AI. Now if I really want to understand the definition of AI, it is basically to create an application. To create an application which can perform. Which can perform. Its own task. Its own task. Without any human intervention. Okay. Without. Without any human intervention. Any human intervention. So this is the basic definition of artificial intelligence. Okay. So the specific thing which I've actually written it over here. It is basically to create an application which can perform its own task without any human intervention. So for this specific thing we call it as artificial intelligence application. Some of the coolest example which you basically use on to day to day basis. Right. So the first example that I would like to talk about Netflix recommendation system. Now whenever I talk about Netflix recommendation system over here, you will be seeing that, you know, suppose let's say you have seen some kind of action movies, right? Now whenever you see some kind of action movies for a couple of time, then after that you get a recommendation of action movies only. Okay. You get a recommendation, movie recommendation for action movies. So this is one specific example with respect to the recommendation. You know, one super very simple example whenever we see this kind of situations. The second example and again Netflix has an AI module which will specifically do this recommendation system. And it does not require any human intervention. Human will keep on clicking different different movies automatically. Those application will be able to understand what is the next thing that we must actually recommend to the person coming to the next example? Self-Driving car. I hope many of you have actually seen this self-driving car. So in self-driving car also, there is a specific AI module, which in turn will actually help the car to be driven by itself without any human intervention. Also, over there, it will be automatically be able to detect the traffic lights. It will be able to detect the objects that is coming in front of them. How it is possible. It is basically an AI module is integrated in that specific car. So these are some of the examples even in Amazon dot in if you probably go and do some kind of shopping there also you get some kind of amazing recommendation system. Now coming to the next one, I hope we are very much clear with artificial intelligence. Now let's go ahead and let's discuss about the next one, which is basically called as machine learning. So if I talk about machine learning, I can definitely say machine learning is a subset of AI. Okay. Let me make this circle a little bit bigger. And machine learning will be falling somewhere inside this, which can be also called as it is a subset of AI. So this specific thing we basically talk about machine learning. Now what does machine learning is it provides stats tool. It provides stats tool. Stats tools. To analyze the data. Analyze, visualize. Do some kind of prediction. Our forecasting. Not say or because forecasting can also be one type of functionality within this, it can also forecast the specific data. So here, with the help of various statues, which we also say as machine learning algorithms, which we are probably going to see in this specific course. It utilizes all those things to analyze the data, visualize the data to do some kind of predictions, to do some kind of forecasting of those specific data. Right. That is what machine learning is all about. And it is a subset of AI. Right? At the end of the day, whether you work as a machine learning engineer, as a whether you work as a data scientist, at the end of the day, you will be creating an AI application. Okay. Now similarly, where does deep learning fall into it then? Right. So let's talk about deep learning. So deep learning is another specific thing which is a subset of machine learning. So this is specifically deep learning. Let's say I'm writing it out over here. Deep learning. Now in 1950s scientists thought that whether, you know we are human beings can train the machine. Like, uh, you know, the scientists were thinking something much amazing during 1950s. Can we train the machine? Also like how we human being gets trained, right? Like suppose if you are learning something, how do we learn those specific things? Right? So can we also make the machine learn in a similar way like how we human being learn. So for that in short, deep learning was basically getting implemented to mimic the human brain. Okay. And here the main aim again, let me repeat it. It was very simple. We really wanted to make the machine learn how like how we human being will, uh, usually learn things. Right. So for this, uh, the implementation deep learning was implemented and they used something called as multi-layered neural network. Okay, multi-layered neural network. And with the help of this multi-layer neural network, we were able to make the application learn like how we human being learn specific things. So deep learning is again a subset of machine learning okay. But again, at the end of the day, even though you're working as a deep learning developer, uh, at the end of the day, you try to create an AI application, and that specific application will be able to perform its own task without any human intervention. Now coming to the next one, which is data science, right? Where does data science fall into? In this specific universe, where does it fall? Right now, as a data scientist, always remember, you know, we we like I have been working for somewhere around 7 to 8 years, right. In various industries, in product based companies, service based companies, right. As a data scientist and as a data scientist, you should remember that, okay, data scientist will probably overlap each and every thing over here. Let's say they will be overlapping each and everything. Why? I'm saying overlapping each and every thing. Because tomorrow, if you're probably given a machine learning project, you really need to do, you need to know machine learning. Probably tomorrow you are given a deep learning project. You really need to know deep learning projects. At the end of the day, you should also be knowing how to create an AI application. And over here you really need to use math, statistics and many more things. That is the reason why I have actually created the circle, making sure that it overlaps each and every sector right? Even machine learning, deep learning. And finally the AI part. Right? So this part is basically the data science. In short, data science utilizes or is used in every sector of this. And over here again some more overlapping will be doing with respect to different different techniques or tools or subjects that we use like maths, linear algebra, stats, tools and all. Okay, but in short, here I have given you the basic difference between AI versus machine learning versus deep learning versus data science. I hope you have understood. In short, tomorrow, if you're working as a data scientist, you may be given a task that may be related to just EDA feature engineering. It may be related to tasks that may be related to deep learning, or it may be related to creating any kind of AI application. Okay, at the end of the day, any role that you fit in within the specific, uh, divisions that have actually made you have to really create an AI application at the end of the day. Uh, so yes, in the next video, we are going to continue and understand about what is the differences between supervised and unsupervised machine learning. Okay. Which is a very important thing in both machine learning and deep learning.

Three types of machine learning techniques.

Usually all these machine learning techniques are related to some kind of problem statement. First of all, let me just call out all the names. So the first kind is something called as supervised machine learning technique. And the second type is something called as unsupervised machine learning technique. And the third type is called as reinforcement machine learning technique. And all these techniques that we will probably be discussing will be with respect to some specific problem statement. Okay. So let me go one by one and let me explain you. So first of all I'm just going to consider supervised ML okay. Supervised machine learning technique. Supervised ML technique. Nine supervised ML technique. What happens is that let me give you a very basic example. Suppose my task is to predict the house price. Okay. So I really want to predict the house price. And let's say I have a specific data set. Okay. In this particular data set I have some features. Let's say I have features like the size of the house. Okay. Number of rooms in the house. Number of rooms in the house. And then I have my third feature, which basically indicates the price of the house. Usually in a supervised machine learning technique, you get this kind of features and you divide the features into two different categories. The first category is something called as independent features. Okay. So this both the features are basically called as independent features. Okay. And one more feature that you see over here is something called as price. This price is basically called as your dependent feature. Or your output feature. Okay. Similarly, when I say independent feature these are also my input features. Now let me give you some of the data points. As an example. Let's say that the size of the house is $5000ft^2$ and number of rooms are five. So the price of the house will be $450. Okay. Similarly, let's say your size of the house is $6000ft^2$. Number of rooms are six. Then this will become 500 K dollars. Like this. You will be having lot of data points and this will basically be your data set okay. In short over here why this feature is called as dependent or output feature. Because this value keeps on changing as the input value changes or as your independent feature changes. One more very important thing to understand about supervised machine learning technique is that there are two types of problem statement that we usually get to solve. One is regression problem statement and the other one is something called as classification problem statement. Now, what is the basic difference between regression and classification? Problem statement. Okay, in regression problem statement, whatever dependent or the output feature will you will be having all those feature values will be continuous okay. It will be continuous. Okay. So two important thing with respect to supervised machine learning technique is that first of all, you will be having a specific output or dependent feature. Okay. So first point is that in supervised machine learning technique you will definitely be having a dependent or output feature. Okay. The second point is that if it is a regression problem statement, then your output feature will be continuous. If it is continuous, you can directly consider that this will be a regression problem statement. Okay. But if this is not continuous and if this is categorical, then what kind of problem statement this will become? This will become a classification problem statement. Let's say I'll give you a basic example okay. I have one classification problem statement as an example. So here is my classification problem statement. And let's consider I have features like number of study hours. Number of play hours. And here with respect to this specific output, let's say the person is either passing or failing. So let's say I have a data set which has this features here. My input features are number of study hours, number of play hours. And based on that we really need to determine whether the person is going to pass or fail. So this becomes my dependent feature. Dependent feature. Okay. And this all becomes my independent feature. So here let's say if the person is studying for seven hours, if he's playing for three hours, that basically means he's going to pass. Okay. If the person is probably studying for only two hours, he's playing for six hours. He may probably fail. Okay, so this kind of features now here the output feature is fixed number of categories. If there are only two categories we basically say it as binary classification. Okay, if there are only two categories, then we specifically say it as binary classification or if there are multiple categories. Suppose let's say there are also one more category like maybe, maybe he may pass or fail. He or she may pass or fail. Then this becomes a multi-class classification. Okay. So usually we get two types of problem statement. Even in classification it can be a binary classification or multi-class classification. The basic difference between binary and multi-class classification is that in binary classification you just have two fixed categories that is, either pass or fail. That is binary, right? Two right. In the case of multi-class, you may have more than two categories, and you really need to train the model with respect to the specific input. And you need to probably predict it whether the person is going to pass or fail. Right. So this is the basic difference. Uh, or this is the types, uh, with respect to the supervised machine learning. Again, let me revise it. In supervised machine learning you basically see two types of problem statement regression and classification. And why do we say supervised. Because here specifically you have a dependent feature okay. Dependent feature should be there. Then only we will be able to say it as supervised. Then only we will be able to train our model with this specific data set. And later on, whenever we give a new input data to that specific model, it will be able to predict okay. So this is with respect to supervised machine learning. Now let's go ahead and let's try to talk about unsupervised machine learning. So the second type is something called as unsupervised machine learning. Now what is the basic difference between supervised and unsupervised. Okay. Let me again give you a basic example. So this example is related to something called as customer segmentation. Okay. Whenever we work with respect to unsupervised machine learning, one very important thing that you should note that we do not know the output feature. Over there, we don't need to predict anything. Instead we need to find out similar clusters or groups. So if I take an example with respect to customer segmentation and I have a specific data set, let's say this data set is something like salary or this, uh, I have a feature like salary. Then I have something called as spending score. Okay. Spending score. Let's say I have these two specific feature. The spending score is given between 1 to 10. That basically means how much the person is spending. The more the value towards ten, the more that specific person is basically spending. Okay, so let's say this salary is ₹20,000 okay. ₹20,000 INR $20,000. And let's say the spending score is somewhere around nine. That basically means this person spends more, right? Suppose if I say the salary is 45,000 okay, it can be in dollars or INR or anything as such. Okay. Uh, then let's say that spending score is two. What does this basically indicate is that obviously the person is earning more when compared to this person, but his spending is less, so he does not like to spend much. Similarly, I may have lot of data like this. Okay, now in this particular data set, I just have my features here. We don't say that, okay. This is my output feature, okay? I don't have to predict that based on the salary. What will be my spending score? No, that is not the aim. Tomorrow let's say I want to launch a product. I am an e-commerce company. I'm running an e-commerce company. And this e-commerce company. I've launched a product and I want to send a mail with some discount coupon mail with some discount coupon. Some discount coupon. To this people based on the spending score. So how do I send it? What I do is that with the help of unsupervised machine learning, we create clusters. You know, we create clusters. Now let me give you an example of clusters, how it will be. So let's say that. Okay. What we do is that we create similar clusters. So let's say this group basically is the group which has higher salary and which are spending more. Okay. Let's say I have one more group. These are basically having less salary and they are spending. See if I probably say salary over here and spending over here. Right. So these are the people who have median salary and they spend more. Right. These are the people who have less salary and they spend less. Right. So these are the people. And so we are going to make this kind of clusters or groups over here. Right. Let's say this is another group which has huge salary and spending is median right in the median like in in the mid right. If I have one more cluster I can have one more cluster which is somewhere here. And probably this people are having the highest salary and the spending score is also high. So if why we do this specific thing is that tomorrow, let's say that if I'm launching any product, I would definitely give this people, you know, this people some discount so that they will be able to buy my product because their spending score is obviously high and the salary is also high. So in short, in unsupervised machine learning we create something called as clusters okay, clusters. And they have various kind of algorithms that we specifically use. Uh, I'll talk about different kind of algorithms, uh, as we go ahead. Okay. Now let me talk about all the algorithms that we are going to learn in supervised machine learning. And in unsupervised machine learning. Okay. So in supervised machine learning we will start with something called as linear regression. As I said, two types of problem statement we will be solving. One is regression and one classification. So first we'll start with linear regression. Then we will go with the ridge and lasso lasso regression. Again this is basically to solve a regression problem statement. Then we will be learning about elastic net. This is also used for solving regression problem statement. And then we will move towards classification. So classification we will be seeing something called as logistic regression okay. So this is basically my classification okay. Then uh we will go with some algorithms. And this algorithm can actually help us to solve both the regression and classification problems. So here we will be learning about Decision tree okay. We'll be learning about uh something called as Random Forest and Forest AdaBoost. Sorry AdaBoost right. We'll be learning all these algorithms slowly. We'll also be understanding how to implement it practically. Then, uh, we will be seeing something called as XGBoost or Random Forest. These are something called as bagging and boosting. And with the help of this kind of algorithms. Right. We can solve both. Both. Classification. And regression. Okay. And regression problem statement. We can solve both of them okay. And AdaBoost XGBoost Catboost is also there. So we'll try to solve all this thing in unsupervised machine learning. We will try to learn about algorithms like k means or hierarchical mean okay. Hierarchical mean algorithm. Then I also have something called as DB scan. You know DB scan me DB scan clustering. Okay so these are all clustering algorithms okay. Specifically we'll be using something called as unsupervised machine learning technique so that we can create some amazing clusters and groups. Right. So this is with respect to supervised machine learning and supervised machine learning okay. And let's go ahead and let's talk about something called as uh you know what about the third one which is called as a reinforcement learning. So in reinforcement learning this is also an amazing module altogether. And it is completely different when we compare it with supervised or unsupervised machine learning, because here the application will learn things by itself, you know, by getting some amazing rewards. You know, the best example that I can probably take with respect to reinforcement learning is that just for right now, because we'll be having a separate module for this also, is that whenever we consider a baby, right. You have seen a baby, right? When it is very small, it will not know anything. But as it keeps on growing right, it learns new, new things, you know? So let's say it is trying to walk for the first time. So when it is walking for the first time, he or she may fall down. And when he may, or she she may fall down. At that time, what happens? She he or she may cry, right? Because, uh, some, uh, you know, when she or he is actually falling down, you know, they may get some kind of, uh, sore in their leg and all, and they may get hurt right later on. What they do is that they make sure that they slowly learn things so that they should not get hurt. So that basically means they will try to do things by getting some amazing rewards. Right? And using children right. If they bring good marks, good marks in their high school or college, you know, the parents gives them some kind of rewards, right? So based on that, that specific action is actually done. Right. So similarly reinforcement learning also works in that way. Don't worry about it right now because we'll be having this module as we go ahead okay. So these were the basic difference in making you understand between the three types of machine learning. We'll start with uh we'll start with supervised machine learning technique. Uh probably our first algorithm is linear regression, which we specifically say it as simple linear regression, where we'll be learning what exactly how this algorithm works. And we'll be learning about Ridge Lasso and all. And we'll go in this specific order and we'll cover first supervised machine learning. Then we'll go with unsupervised machine learning. And then we'll be learning all these things.

The equation of a straight line and understand about 3D plane and hyper plane.

Now this is a super important topic. Before we start any machine learning algorithm like logistic regression or support vector machine, let us consider over here an example. Suppose if I have two axes, one is x and y, and if I probably try to create a straight line we can represent or we can provide a equation for this particular straight line, which is called as y is equal to m x plus c. Right. And I hope you have seen this formula probably in your 10th standard eight nine standard. Similarly, I can also give some different kind of notation like y is equal to beta zero plus beta one into x. Or I can also give some other notations like this which is a x plus b y plus c is equal to zero. Okay. This both the equation are almost same. First of all let's go and understand what this equation basically specifies. Over here there are two things. One is the x and y coordinate. Obviously you can definitely see this x x and y axis. Here you have first component which is called as m m is nothing but it is called as slope. Now over here what the slope denote is that in the unit movement in the x axis, what is the movement with respect to the y axis. So with respect to this, if I try to try to see what is the unit movement in y axis, this will basically be giving me the slope value. Okay. This is basically giving me the slope value right now. This is with respect to slope. What about C. C is basically called as intercept okay intercept. Now when I talk about c let's consider that in this equation if my x value is zero. So suppose if my x value is zero where does this particular straight line meet the y axis. So if I probably draw this it meets it meets somewhere here right. So this point is basically my C or intercept okay. Very simple. Slope basically says that with the unit movement in the x axis, how much movement is there with respect to the y axis? The second thing is that when my x value is zero, then obviously you can see y is equal to c, right. Because if this is becoming zero. So this basically indicates that at x is equal to zero where does the straight line meet the y axis. Okay. Now you may be thinking how this and this particular equation are one and the same. Let's consider over here guys. Let's say that this is my equation. And now I can basically write something like this right. So let's consider this I will write b y plus c is equal to minus x. Then b y is equal to minus a x minus c. And finally y is equal to minus a by b. This is one component multiplied by x minus c by b. Now over here you know that this also follows the same equation which is like y is equal to mx plus c right y is equal to mx plus c. Now when I say this is basically my m value and this is basically my c value right. The slope and the intercept. So almost both this equation also represents the same thing okay.

Now just for the ease easiness what we can also do is that let's let's provide one more equation over here. And it is almost similar okay. Let's say that I have my x axis x one and x two. The reason why I'm writing x one and x two because if I have multiple axis like say if I have multiple dimension over here, I just have two dimension right now in this particular two dimension I can represent it by x and y. But if I have many dimensions. So I'm writing it as X1X2, something like that. Okay. Now in this particular case, let's say I can also give the equation of a straight line which looks something like this. So here I'm going to mention it as W1X1 plus W2X2 plus b is equal to zero. Now this equation also matches this specific equation. Here you can see instead of a I'm writing W1X instead of x, I'm writing x one. Similarly, over here instead of b, I'm writing w two instead of x two. Sorry, instead of y I'm writing x two plus b is equal to zero. B basically becomes the intercept okay. Now in this particular case you can see I have two important things. One is W1W2W1W2 is basically my coefficients. So I can also give this representation as w transpose x plus b is equal to zero right. So in the upcoming any algorithms we will probably discuss I will be using this particular equation regularly. Like w transpose x plus b is equal to zero. And this is nothing. But this is a equation of a straight line. So equation of a straight line. Super important. And understand this representation. This representation are almost one and the same. Now this is fine. What happens if I have three dimensions or three axis. So here let's say I have X1I. X2 and I have x3. Now, in this particular case, we don't draw a straight line here. Specifically, we draw a 3D plane. Okay. So let's say we are drawing a 3D plane and this plane will look something like this. Okay, so this is how a plane will look like. The plane can be here. It can also be here or it can also be here. Now in with respect to this the equation will again change a little bit okay. Now with respect to a 3D plane this equation will become W1X1 plus W2X2 plus W3X3 plus b b is basically my intercept is equal to zero right. So here I have three axes X1X2X3. With respect to that I have basically three uh coefficients W1W2W3. And again as usual I can also represent this as w x plus b is equal to zero right. The same thing right here W will nothing be it will be. W1W2W3. And obviously you know that when we do matrix multiplication with w and x one of the matrix, we have to basically transpose it. Okay. And similarly x will be nothing but x one comma x two comma x three. So when I probably. Sorry just a second, let me write this in another way that it will look like x one transpose. Right. So this is my w and this is my x. So if I really want to do this a dot product over here. So here you will be able to see that I have to do the transpose of one of the matrix. Similarly. Now this is with respect to a 3D plane right. And 3D plane we basically create a 3D plane like this. What about an n dimensional plane? N dimensional plane. Now in this particular case I can again give a better representation, which looks like this W1X1 plus W2X2 plus W3X3. Like this up to w n x n is equal to zero. So here you will be able to see again I can represent this as sorry I missed out b x plus b is equal to zero. Plus b is equal to zero. So this again becomes the same equation. Now let me do let me consider 111 case. Okay. One case over here. Let's say I just have two axes x one and x two. And obviously in this case I can represent my equation as W1X1 plus W2X2 plus b is equal to zero. Write the equation of a straight line. What if my equation passes through origin? Okay, now when my equation passes through origin over here, you can see that obviously we can find out coefficient. That is not a problem. But with respect to B that is our intercept B basically means in this case if my x one and x two are zero over here, let's say in this particular case both are zero. Right now. In this case what will happen if it is basically this line is passing through the origin now. In short B will also be equal to zero right. So whenever there is a straight line that passes through origin I can also represent this as W1X1 plus W2X2 is equal to zero which is nothing but w transpose x is equal to zero. So equation of a straight line passing through the origin will have this particular equation. So equation of a straight line passing through an origin. Passing through and. Origin. Is nothing, but it is given by. W transpose x is equal to zero. Okay. This is nothing but the equation of a straight line. So let's consider now the equation of a plane that we have basically got over here. Equation of a plane is usually given by a notation which is pi. And this is not the 3.142. We're just seeing it as pi in n dimension. And this is represented as w transpose. X is nothing, but it is equal to zero. Since we have considered that our intercept is basically our line is passing through the origin. And in this particular case, obviously my w value you know it will be what W1W2W3 like this up to w n. And my x value will similarly be X1X2X3 up to x n. Right. And specifically when we do the dot operation we are going to get this specific equation. That is w transpose x is equal to zero. Now forget about the equation of a plane. Now in this particular case let's consider w multiplied by x this w and x. Let's consider that these are my two vectors. Let's say this is my w and x okay. And if this w and x are there. And because over here obviously we have we have we have considered some values over here. Right here we are basically doing some matrix multiplication by w transpose x is equal to zero. But if I just talk in terms of linear algebra, and if we try to see how this dot operation can be specified mathematically, here I will specifically write w transpose x. It is nothing but magnitude. Magnitude of W multiplied by magnitude of x multiplied by cos theta. And this cos theta will basically be giving my angle between them right w and x vectors. If I'm specifically talking about this as vectors right. This in turn will be equal to zero okay. Because my w transpose x is equal to zero initially. And my w transpose x is equal to zero through linear algebra. We can definitely represent this equation as something like this, where we are considering magnitude of w multiplied by magnitude of x multiplied by cos theta. Now you need to understand when will cos theta be equal to zero. Obviously when theta is equal to 90. Suppose if theta is equal to 90 then my cos theta will be equal to zero right. So in this particular case we can definitely make a conclusion like like something like this. Like this. Let's see this conclusion okay. So if suppose I have an hyperplane let's say this is my plane which is mentioned as pi. Then geometrically I can definitely mention w as that it will be a vector that will be parallel to this specific plane. Okay. So this is basically my W, right. Uh, this is my w and x coordinates that you can see over here. It can be this point. It can be that point. It can be any points in this particular plane. Now this is with respect to a 2D line. Now similarly with respect to a 3D line, how does it 3D line look like or how does a 3D plane look like. So my let's say consider that this is my 3D plane. Okay. Let's consider that this is my 3D plane. Now, in this particular point, if I probably try to create a straight line, this is basically my W. And this will be always, you know, perpendicular to every points that I see. Probably over here in X1X2X3X4X5. Whatever plane we are basically creating this will always be perpendicular, right? So mathematically we can definitely mention uh that w will always be perpendicular to my plane. Right. And this is what is the equation that we basically use to represent this. Uh, and this basically shows that at every point of time, whenever we are considering w, it is going to be always perpendicular to plane. And this w can also be represented because see, understand in this equation it also follows this right w transpose x plus b is equal to zero at this point. At this point this is basically part passing through origin zero comma zero. This point is again passing through zero comma zero. Now suppose if my coordinates are. If my if this line is not passing through zero comma zero, or if this plane is basically why I'm using zero comma zero because my intercept is equal to zero, right. So if I specifically say that if my intercept is not equal to zero, then it is not need to have that. It needs to always pass through the origin right now this is with respect to a 2D line 2D plane. Right. This this is with respect to a 2D line. Sorry not I'll not say 2D plane because I'll say plane with respect to a 3D. Right. So here definitely origin. It is passing. Let's say this is my 3D plane here the origin is zero comma zero. Then w is always going to be perpendicular to every points that we see with respect to X1X2X3. Anything as such. Right. So this is how we represent the equation of a line 3D plane and hyperplane. I hope you have understood this. If you have not, please do make sure that you revise and yes in the. This topics will be super important when we are discussing about logistic uh logistic regression we. We'll be discussing about, uh, uh, you know, support vector machines and all.

Understand this linear algebra topic, like how to find out a distance of a point from a plane.

So let's consider that I have a plane over here and this is specified by pi okay. Now with respect to this, and you know that if this particular plane passes through the origin, we can definitely use a equation which is like w transpose x is equal to zero. We just discussed this in our previous video right. Now when w transpose x is equal to zero what is w over here? We can definitely say w is a vector that is perpendicular to this x axis. That is this plane okay. Or this this plane specifically. Okay. Now let's say if I have a point okay. And let's say this point is specifically specified by x and this has some coordinates like X1X2X3 like this up to x n. Let's consider that this is a n dimensional plane okay. Now how do I try to find out the distance between this particular point to this particular plane. And this is super important because in some of the algorithms like logistic regression and SVM, we are going to use this because in logistic regression we usually solve a classification problem. Classification problem basically means I have some coordinates like some classes over here, some classes over here. And our main aim is to basically find out a best fit line such that it should be able to split this two points very easily, so that if. Suppose my new point come over here, it should be able to categorize in this particular group. Okay. That will probably be seeing as we go ahead. Now our main thing is that how do I find out this distance of this point S with respect to this particular plane. And let's say there is one more point which is over here. And let's say this is mentioned as s dash and this is mentioned as X2X3 till x n considering n dimensional plane. So I also want to find out the distance between this particular point to this particular plane. And here you should note that w is perpendicular to this plane in this direction okay. So when I say perpendicular it is 90 degree right now. Usually in this particular scenario, if I really want to find out the distance again I'm not going to prove you the formula. Uh that is basically used to calculate the distance. But in short I'll try to write down the formula. So this d distance is basically calculated by w transpose s s is basically my point. This point that is x one comma x two comma x n. Like this. Up till x n divided by the magnitude of w. Okay. So this is the equation that is basically used. Again proof. You can definitely refer some of the topics related to this. Even in Google you'll be able to find out the proof. Like if I really want to compute the distance considering my w vector, uh, and the x vector which is again perpendicular to this particular plane, and w is in this direction, it is basically given by this particular equation. And obviously from this you know that if I try to calculate w transpose x this is nothing but magnitude of w magnitude of x multiplied by cos theta. So in short, if I really want to find out, uh, the distance of this point from the plane, I may also consider this w and x, right. So in short I'm going to use this right. And whatever angle is basically getting formed. And obviously this angle that you, you will be seeing that is getting formed is less than 90. So if it is less than 90, that basically means I'm going to get a value between 0 to 1. So it is always going to be positive. So if I do this entire computation this is going to be positive. You can see this angle between this w and x vector. It is always less than 90 right in this particular case. So if I'm trying to calculate the distance with respect to this right I'm also always going to get a positive number. So that basically indicates that. Suppose if I have any other points and if I try to calculate the distance between from this particular point to this particular plane on top of this plane, I'm always going to get a positive number. Okay. That is the indication that we can come up with. Now. Similarly what will happen about this D dash that is below this plane? There is another point which is called as s dash. And we really need to find out what is the distance between this particular point to this. And you know that w vector is in the opposite direction. So in this particular case my d will be w transpose S dash divided by w right magnitude of w. And this in turn if I just take w transpose z dash, it is nothing but magnitude of w multiplied by magnitude of s dash cos theta. Now you know that over here in. In the above case my theta was between between 0 and 90 degree. Right. It will always be less than 90 degree because it is above this particular coordinate. But what about in this particular case. If I try to contact this W, and if I try to connect this w and s dash here, the type of angle that we are going to get is always greater than 90, and whenever we have any angle that is greater than 90 and less than 270 or less than 180, you know that we are going to. So here we are going to get greater than 90 and less than or I can just consider greater than 90. And it can also be less than 270 here all the time with respect to any angle that I get greater than 90 here, I am going to get a negative number. Right. So this indicates that any point that are below this hyperplane. Right. And if we try to calculate the distance this is always going to be negative okay. Super super important point. Any point that are above this plane. And if you are trying to calculate the distance by using this particular formula which is basically my distance formula, in short all the time. And why this is happening. Because above this plane my cos theta theta value will be between 0 to 90. Here it will be always greater than 90 okay. So in this particular case always this is going to be positive. The distance above this particular plane is going to be positive. And similarly distance below this particular plane is going to be negative. This is a super super important point. In order to calculate the distance of a point from a plane. Uh, and two important points that yes, anything above this particular plane, which is in the same direction as the W vector, will be seeing that all will be having a positive value or positive distance. This will basically be having a negative distance. Why we are saying negative distance is just that. It's not like negative distance literally means something like negative distance, but instead it is just saying that it is in the opposite side of the plane. Okay, so this is how we basically indicate and the same concepts we are going to use it in Support Vector Machine. So I hope you got this particular idea with respect to the equation of a straight line. Uh, sorry, distance of a point from a plane equation of a straight line was already covered in our previous video.

Instance based learning versus model based learning.

Now guys, whenever we solve any specific use case.Right.And let's say that for this particular use case I really want to create a model.And this specific model will be let's say I'm creating a machine learning model.And this machine learning model will actually help us to solve some problems.You know, let's say regression or classification problem.Right?Let's say I am trying to solve a regression or classification problem right now in this.If I really want to find out what is the exact differences between instance based and model based learning,usually this machine learning model learns about the data in various ways, right?The first way is basically through that instance based techniques.And the second way is basically through the model based techniques.Right now when I am actually dividing this to.I would also like to probably, you know, and this this entire differences is based on the learningpatterns of the model, learning patterns of the model.That basically is how the model are able to understand the data.If my model is completely dependent on my training data, let's say if it is completely dependent onmy data.And for doing every prediction, you know, for doing every prediction, it will be dependent on thisspecific data.So based how the data actually exists over here.Based on that we will be getting some specific output.But in the case of model based technique whatever data we use over here.You know, whatever data we use over here, what this model based technique does is that it tries tounderstand the pattern within the specific data.Okay pattern within the specific data.And once it's understands the pattern with respect to the specific data, it creates a generalizationmethod.To make the prediction for new data.Right.And this generalization method is far more better when compared to this instance based techniques.Because in instance based technique, the model is just dependent on the data that it has currently.And whenever a new data basically comes based on this particular data only, it tries to predict theoutput.It's just like a domain expert kind of thing.Let me give you an example.Okay.So that it will help you to understand.Now let's say that you have features.And this specific features are like number of play hours okay.Let's say I have I'm using this features number of play hours.Number of study hours.Number of study hours.And, uh, the last column is the whether the person is going to pass or not.Okay.Or pass or fail.Now, let's say that if I have this three specific features.Okay.And, uh, this these are the features with respect to whether, uh, for a student.Right.How many number of hours he's playing, he or she is playing, how many number of hours he or she isstudying.Right.And then we need to predict whether the person is going to pass or not.Now, if I probably take this particular data points.Right.And, uh, if I just try to plot this particular data points over here.Okay.So let's say this is, uh, play hours.This is study hours.Okay.And you know that, uh, this will be inversely proportional, right?If a person is playing more.Right, and if he's studying or if a person is studying, if if the person is playing more and he'sstudying less, then I can suggest that he may probably not pass.Right.So I may have different different data points over here.Let's say these are some of the data points.Okay.Let's say these are some of the data points.Right.And let's say there are other data points where the person is studying more.And based on that, uh, this red mark that you'll be seeing, it is basically saying pass.And this yellow mark is basically saying fail, right?Now in this particular scenario, obviously there will be some kind of outliers also.Okay.Like even though the person is playing more, he may uh, his study hours may also be more and becauseof that he may pass.Right.So they may be obviously some data points from this particular data points.Even though he's studying less, he's able to pass that specific exam right now in this particular usecase, what happens is that in the case of instance based learning.Instance based learning.Okay.This will be just like a domain expert.Just imagine this, okay?This will just be like a domain expert.Like how this specific model works.Now in this, just imagine that.Suppose a new query point comes.Let's say the new query point is somewhere here, right?It's somewhere here.Now what happens in instance based learning?The model knows the training data what it is going to do.It is not going to understand the pattern within this data.It is just going to see the surrounding data around it.Let's say if this particular data point is coming, it will see that how surrounding is basically behaving.If the surrounding is behaving in a way that most of the points are passed at that point of time, thiswill actually become pass.Otherwise, if most of the data points are fail, then this will probably be fail.Now here you can see within this circle most of the data points are fail.So this will actually behave in that specific way.And this will the new test data will actually show it as fail as an output.Right.So here specifically it is focusing more on the training data.Or you can just say that it is learning religiously from this particular training data okay.Religiously.Right now.This is what basically happens in instance based learning right here.You'll not be getting any patterns right.The model will not learn based on some specific patterns.Here you just have a training data.And based on this particular train data you will try to learn it and you'll try to find out, uh, thedifferent kind of outputs.Now this instance based learning, there are a lot of there are a lot of different, different techniques.Right.One of the technique that I would like to talk about is can write k nearest neighbor is one of the algorithmwhich uses this instance based learning.Right.And we will discuss about this okay.And there are some kernels also which we are going to discuss about instance based learning.But if I probably consider the same problem statement with respect to model based learning.Now let's say if if I had a specific model based learning okay.And if I probably if my machine learning model learns based on this model based learning.And let's say if I have some of the data points over here, here, what will happen is that my modelwill understand the pattern in this data.Right.So it's basically understands the math intuition behind this.So it it is able to create a generalized model.Or a generalized model basically means that it will be able to perform well, uh, even for any kindof data.It may probably come in the future.So generalized model basically means it is trying to understand the pattern.Uh, what pattern is basically used in this and how it is basically behaving?Let's say these are all my data points.Now in this particular case, what will happen is that my machine learning model will probably try to,you know, create this kind of line.Let's say it will try to create this curve.Let's say this curve is basically called as decision function or decision boundary, right.That basically means anything that comes below this particular decision boundary.We are going to consider it as fail.Fail and anything that comes above this decision boundary, we are basically going to consider it aspass, right?So this is the basic difference between instance based and model based learning.Here you create a generalized format to learn the data.Generalized format to learn the data.Right.To learn the data.That basically means this model is going to behave based on this decision boundary, because it hasunderstood the pattern.Okay.And this pattern it is going to.Basically be used for any future new data to predict whether the person is passing or failing.But here it is completely dependent on the current data that it has.You know, based on this data, let's say if you probably get another point, another new query point,again, it will try to see the surroundings.And based on that, it will try to take a decision whether it should be pass or fail.So this is what is instance based learning is and generalize based model in terms of a student.Just imagine this is more like by hearting the data, right by hearting the data.That basically means memorizing the data, okay.Memorizing the data.Okay by heart basically means, uh, we usually say, right again, I should not use this word, buthere, focus that the, uh, the, the model is trying to memorize the data here.The model is trying to learn the data.Okay.Here.Learn the data.The model is trying to learn the data so that from this learning it is being able to create a decisionboundary.Or I can also say learn the pattern of the data okay.Just not learn.Otherwise it will be uh a wrong word to basically use.So here I can definitely say learn pattern of the data.Loan pattern of the data.So this is the basic differences between instance based learning and model based learning.And I hope you have got an idea about it.Now let's go ahead and understand some of the differences.Here are some of the differences.So usual convention machine learning model basically means this is a model based learning right.This is model based.This is instance based okay.So first of all prepare the data for model training.Obviously you'll require the data over here.Also here also you'll be requiring no difference over here.Then the second point is train the model from training data to estimate the model parameters like discoverpatterns.So here as I said this here you're trying to do the generalization.Here you are trying to learn the decision boundaries right.And this is only possible when you will be learning the parameters uh, or when you'll be learning themodel parameters within that.And from that training data, it is being able to identify that this is a super important one, whichis basically discover patterns.Okay, here.Do not train the model pattern discovery postponed until squaring query received.So that basically means whenever you get a new data point, then only we will try to square this righthere.No pattern recognition is there in the instance based learning right?Whenever new data comes, then only we'll be able to identify based on the surrounding data, whetherit is yes or no, or whether the person is going to pass or fail.Okay.Store the model in suitable format.So in most of the models that we'll be using, you know, we will be able to save them in some pickleformat file.So this will be able to store it in the hard drive or will be able to store it in any folder locationor any cloud location.There are different types of file format like pickle, Hdf5, H5 format, and many other formats.Okay, we also say it as H5 format, right?So uh, definitely we store the model in some suitable format.And whenever we store this particular model in this format, it is basically stored it in a serializedformat, serialized format that basically see internally some math equation is there within this particularmodel.So whenever any data comes to this model right.So let's say if this is my model which is in the pickle format of serialized format, whenever we giveour input over here, we will be getting some kind of output.So internally here you'll be having lot of mathematical equations that will be serialized.The serialized format.Okay.So there is no model to store.Generalize the rules in the form of model even before scoring instance is seen.This is super important because since we have a decision boundaries, it will generalize the entirerule.No generalization before scoring.Obviously we have seen the difference between them predict for unseen scoring instance use models.Right?We'll be able to even predict completely new data because since we have created a decision boundaryso that it gives us result in a generalized manner, both for the training data set or for any new kindof data that we are going to get.Predict for unseen scoring instance using training data directly.Okay.So here you'll be able to see here we are specifically only using training data.Okay.To do even the prediction of the new data.Can't throw away any input or training data after model training.So here you can throw the input and the training data even.Okay.Once the model is trained you can just throw it completely.You don't require it.Why?Because now you have a specific model.And this model is in some format.It is in the serialized format.And it has all the decision boundaries and pattern recognition within them.So whenever a new data comes, it will just be able to predict the output.But in the case of instance based learning you always require the input of training data.Okay, so let's say after I get my input data and if I train my model using, um, this model basedlearning and what will happen, I will be able to get my score the accuracy.Okay.Just don't understand.Don't worry that what are all these things we will learn as we go ahead.Right now, after training our model, we can remove this input data because everything is stored insidethis, right?The decision boundaries and all.So any prediction that we give with respect to our new data it will be able to do it.But in the case of instance based learning we always require the input of the training data.Okay.Requires a known model form may not have explicit model form.This is a basic difference.Storing model generally requires less storage because this model pickle file that it is created, itwill either be created in KBS or MB BS.Right?Since we even don't store any training data, so we just create the serialized format of this picklefile.And inside this you know that it is being able to recognize patterns and decision boundaries.It is able to create.Right.So this are usually stored in KBS or Ms., whereas in the case of storing training data generally requiresmore storage.Obviously in the instance based learning, just imagine in your training data you have 10,001 millionrecords.So it is obviously going to take more storage space.And scoring for a new instance is generally faster.Scoring for new instance may be slow.The reason I tell you the reason this particular point is mentioned that scoring for a new instanceis generally fast because our model is in a serialized format.So whenever we get any kind of input internally, all the mathematical equations will quickly get triggeredand automatically we will be able to get the output.But in the case of instance based learning, it will go and first of all see the surrounding data points.And then it will use some parameters like Euclidean distance some distance parameters.And then it will be able to finally tell you the output.So obviously the model based learning is faster than the instance based learning.That is, what is the outcome that you can actually get from here.So I hope you have understood this.The basic differences between instance based learning and model based learning.And the main thing is that from the instance based learning, you are just learning from the data,you're just memorizing the data.So here I want to make one point that the learning of the model usually happens by two way.One is memorizing.One is generalizing, right?And generalizing is a better way when compared to memorizing.But yes, for some of the use cases you can use memorizing techniques.So memorizing technique is basically my instance based learning.Instance based learning and generalizing is basically a technique with respect to model based learning.Okay.So this is are the basic differences between memorizing and generalizing. understand what is the basic difference between instance based and model based learning