Deep Learning
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Module - 5.3
Lecture - 05
Contours Maps

So we look at something known as Contours.

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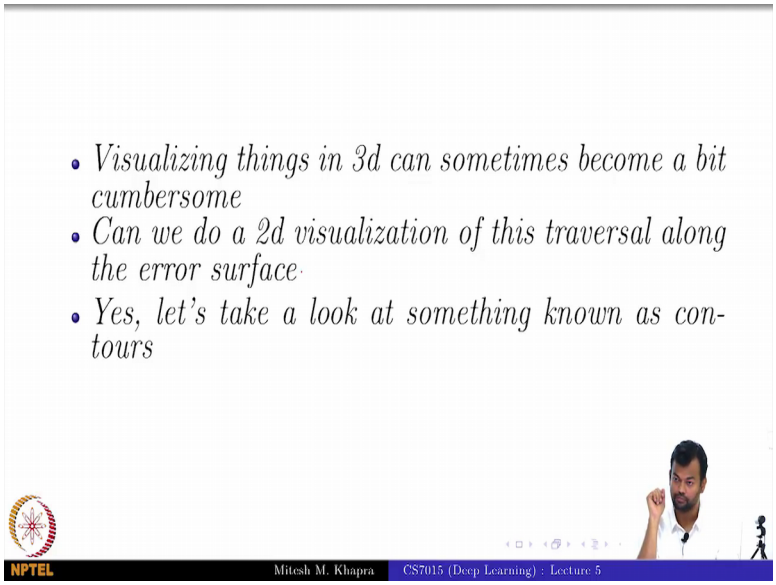

So, now visualizing things in 3d can sometimes become a bit difficult, especially for the person who is making the slides. So, we can, can we do a 2d visualization of this traversal. Have I done this in the ML course, no good? Can we do a 2d visualization of this traversal along the error surface right?

So, for that we need to understand something known as contours. How many of you have looked at contour diagrams before, how many of you know how to read them. All of you know how to read them.

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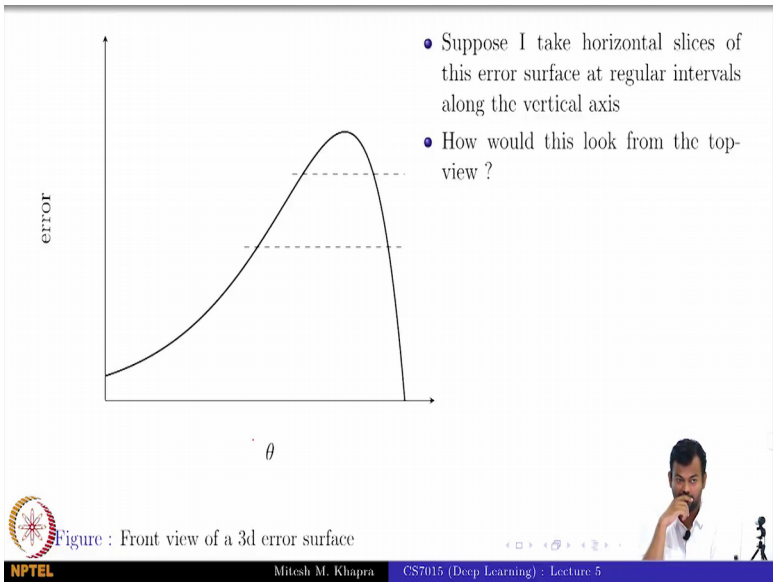

So, let us see, now suppose this is what my error surface looks like and I have a single scalar variable. So, this is just a function of w for example, and this is what my error surface looks like.

Now, what I am going to do is, I am going to take horizontal slices on this error surface fine. Now can you tell me how this is going to look from the top. Sorry let me, you should start answering before understand the question. This is this error surface is actually. So, I was wrong in saying this is theta, assume this is w comma b and you are just seeing the front view of the error surface. What you are seeing here is just the front view.

This error surface is actually like a dementors hat, so right. So, imagine that it is a hat place like this and you are just seeing the front view of this; otherwise a top view does not make sense right. So, now, I am going to slice this hat at two vertical positions, and now you are looking at it from the top, what are you going to see?

Student: Ellipsis.

Ellipsis, everyone agrees with that.

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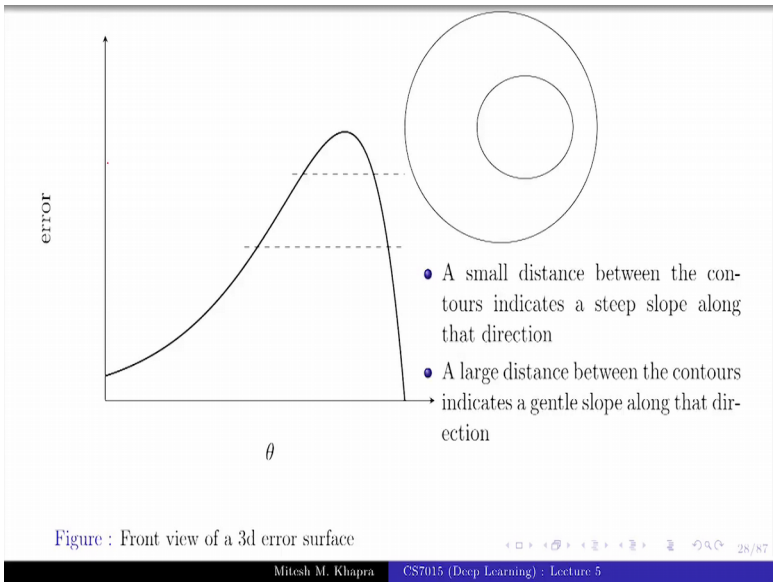

So, we will see something like this. do you see something peculiar about this. Is this a contour map. This is no ok, and all of you raise your hands when I asked do you know contour. So, do you see something peculiar about this, what is it, how many if you get that. So, what you are seeing here is, this portion right where the slope was very steep, the difference between the two circles or the two ellipses is small and you can visualize it if you try to look at it from the top, this distance is actually going to be small right, and in the areas where the slope was gentle, relatively gentle the distance is more and you can again visualize it right, from if you look at from the top this is the distance that you are going to see. And what do you say about these guys, what does that indicate. They are the same.

Student (Refer Time: 02:46).

Value, across that entire region the value is same, because you have taken a verticals, you have taken a horizontal slice at a particular vertical position right. So, you have taken a horizontal slice at this position; that means, the error is going to remain the same throughout that rim. Is this clear to everyone, it is very important that you understand this ok

So, there are only two things that you need, to understand if you want to read contour maps; one is a small distance between the contours indicates that the steep slope exists along that direction, and a large distance between the contours indicates that a gentle

slope exists along the direction. So, everything today is going to be about steep and gentle slopes. And the other thing that you know need to know is that whenever you see one circle, the error is the same along that circle or ellipse, whatever you boundary that you see, the error is the same, because you are taking these vertical slices. So, we are ready with this rule, everyone understands this perfectly.

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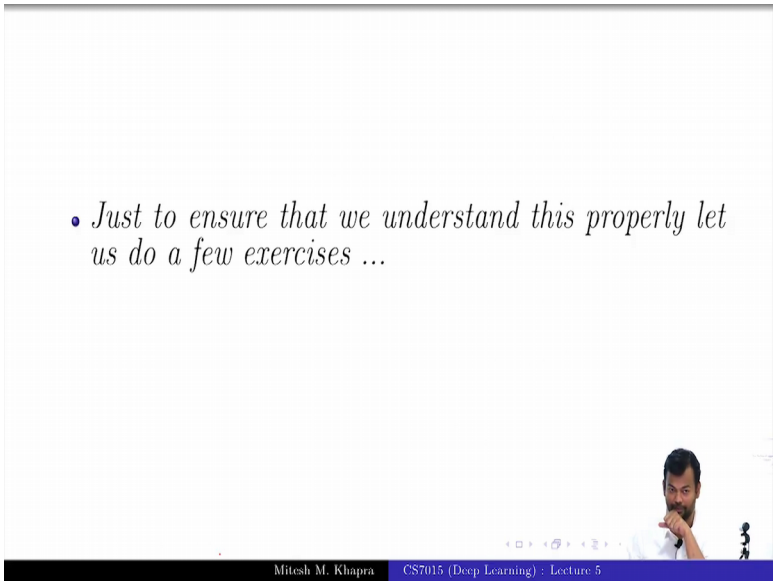

So, I will just give you a couple of exercises and you have to tell me whether you understand this or not ok.

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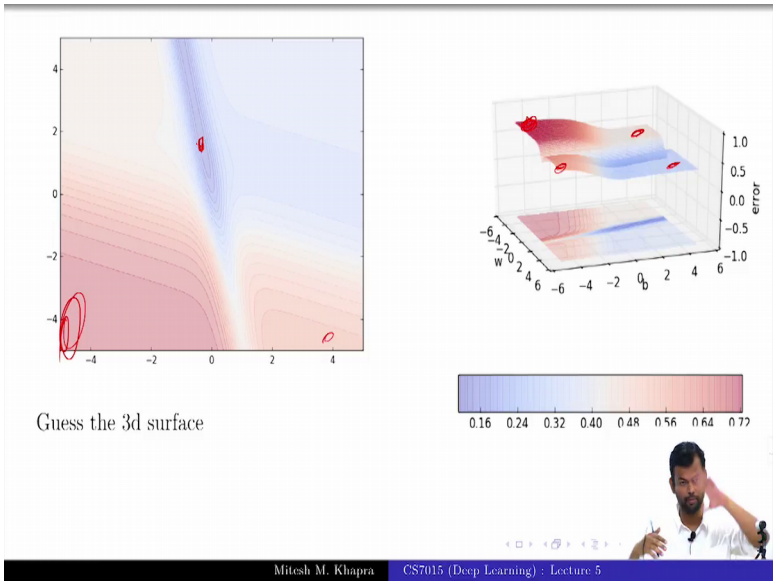

So, I have plotted a 3 d surface or 2 d, I have, what is this.

Student: (Refer Time: 03:54).

No.

Student: there is a contour.

There is a contour; everything is not going to look like clean circles always right ok. So, this is a contour, every line that you see here represents one cut along the vertical axis right; that means, the error is the same there. Now what you are seeing is a contour, I want you to guess the 3 d surface from this, you just guess it, I mean just keep it to yourself fine. The color is the same right blue is good, red is bad.

So, blue means the darker, the shade of blue the lesser the value of the error, the darker the shade of red the higher the value of the error ok. I want you to imagine the 3 d surface, if you can do that then I will be sure that you understand what how to read a contour. How many if we can imagine this? You can just say yes right I can never figure out whether you actually speak it.

So, let me help you with the first one and then we will do a few more. So, let us start with the extremes right. So, let me see how to do this; so this portion. I also need to do it for the video ok. So, let me just do it here. So, this portion, what do you think about the slope there, very flattish why, because this is the line that you see and the other line is not even in the figure right. So, it is basically very flat, the slope is very gentle. Is it a low region or a high region, high region fine ok. Now what is actually happening here, what is the slope here

Student: High.

Very high; that is why these two regions are very close to each other. So, from this high region what is happening, suddenly there is a slope and you are going down and you know you are going down, because you are reaching a blue region right ok. Now what is happening here?

Student: Very flat.

Very flat, and this also flat, but slightly upper than the lower guy; is that fine? Now can you all imagine this ok, and is this what you thought it is? Perfectly yes right, is exactly what you thought ok. Just a minute. So, the orientation here has been changed a bit right. So, this portion actually corresponds to this portion. Are the two this is clear, this portion corresponds to this portion right the just orientated fine?

So, you start off this high plateau region which is here, then you start going down go down and then you see a fold here right; that is this fold. So, you went to a darker shade and then you came up to a slightly lighter shade. The shades are ok. Everyone gets this. You all understand this ok.

Guess the 3 d surfaces. How many if you want to play this forever now. Start with the extremes the bad guys the good guys the plateaus and the valleys and then see how do you go from the plateau to the valley ok. Tell me the corners first, this plateau or valley.

Student: Plateau.

Plateau. This plateau, higher than this or lower than this.

Student: Lower than this.

Lower than this. This?

Student: Valley.

This, towards the valley, it is still between red and blue right, it is not like right down there and what happens to all these guys, all are very steep slows, all converging down into the valley. So, can you perfectly imagine this?

And you will tell, yes when I say when I show you the 3 d surface right, again you need to reorient yourself. So, this corner here is this corner, this corner here is this corner. So, we had these two plateaus at the top, we had this slightly higher valley slightly lower valley and then all of them going into a very deep valley. You see that. Everyone gets this. How many? If you have a problem with this if you have a problem with this, you will just sleep off in the rest of the lecture. So, I want you all to understand this very carefully I do not mind repeating it. How many of you understand this. You understand the regions with gentle slope

Student: Yes.

The regions where you have a steep slope and you end up into that valley, which is the valley here can you point it out, fine ok. So, we will move ahead.

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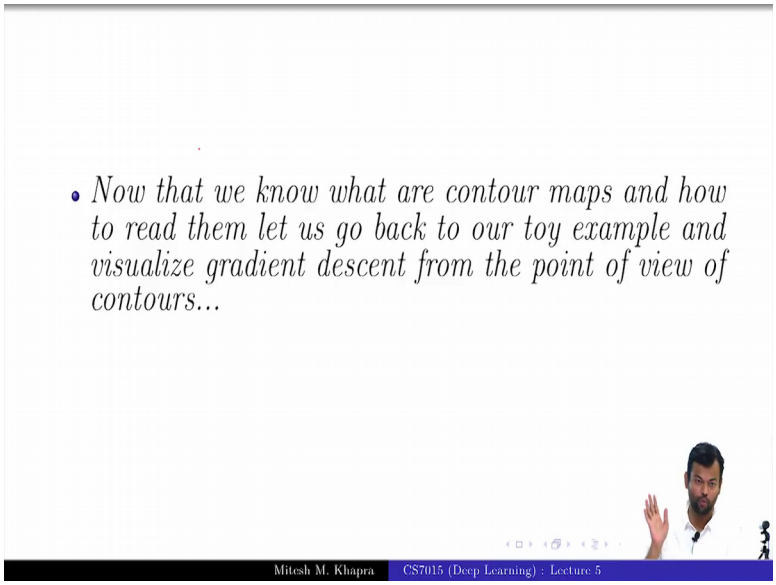

So, now, we know what contour maps are and how to visualize them and so on right. So, now, we will try to see the gradient a descent algorithm. Instead of running it on the 3 d error surface, we will try to run on this 2 d contour map ok.

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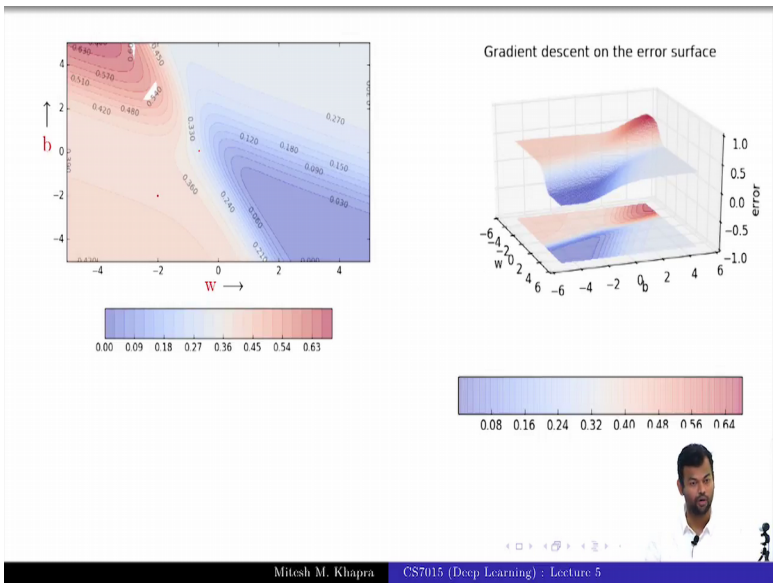

So, this is what I already showed you right. I started from here and I showed you how it comes here or something like this. That was the gradient descent, let me just erase this ok, that is something like what the gradient descent algorithm right.

Now, again you just need to reorient yourself. So, let us see, this corner is this corner, this corner is this corner and so on right. So, you get the reorientation right, it just shifted. Now I am going to start my gradient descent algorithm from here, from this point ok, everyone see is that ok. I am going to start from there and you have to help me and I am not going to just keep clicking, you have to tell me what is going to happen. So, what will happen initially, fast movement slow movement?

Student: Slow movement.

Slow movement right. So, I am running it 1 2 3 4 5 6 7 8, it just keeps running very slowly very very slowly. Now what will happen?

Student: Fast.

Fast ok; now you see actually you can see the arrows these arrows are the quantity, the magnitude of the movement right. So, earlier this movement was so small that you could not even see the arrows, I have been drawing arrows right from the beginning, but you could not see them at the beginning, now you can see them right. Now what will happen?

Student: Slow.

Slow right; so, you see the exact same movement that I did on the 3 d surface, now you can visualize it on the 2 d surface right and you can easily tell me where it will go fast, where it will go slow right and where it will just keep moving very very drag its feet and so on ok. So, this is where it starts dragging its feet, and the same thing happened when we were in this region right. So, just, you just make the connection that we are in the corresponding 3 d region there, fine. So, we are moving very very slow and it just keeps running.

So, that is where we lend this module. So, we just revised gradient descent. We saw that things are proportional to the gradient that is why gradient descent, and the smaller the gradient the slower the movement, the larger the gradient higher the movement, gentle the slope.

Student: Smaller.

Smaller the gradient, steeper the slope larger the gradient.