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SPEAKERS

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Welcome. In this lecture, I'm just going to go through some of the very basics of like kind of the notation and how we talk about vectors, because we're going to need them for gradients, which are going to kind of give us like, like the direction that a function is changing the fastest. I know this is a little bit like, it's just notation, you can do it. I know it's a little notation always feels a little overwhelming and confusing at first. This is true even for, you know, advanced mathematicians of every level and so on. So don't get intimidated, you can do it. It's just like, like it always does takes a little bit of practice, and, you know, a few deep breaths and kind of, you know, just sorting things out. So here we go. So let's first look at in two dimensions. So in two dimensions.

What's the, you know, how do we talk about vectors. So a vector is going to have, you know, you've got to figure out just like a point in R2, you need to figure out, you know, how far you go in the horizontal direction, and then how far you go in the vertical direction. And this really is going to correspond exactly to that. I'll even kind of show you. In fact, actually, maybe I'll show you this part first, which is that we break it into, we do this by breaking it into adding together two kind of vectors, little vectors, so we have this vector here. Okay, which ends at 1, okay, so this is the vector, we write this vector as I equals 1, 0, okay? And then we have this other vector, that's going to end at one in this direction, and this is going to be J. Okay, so this is going to be j equals 0, 1. And then all I need to know if I want to be able to add these together to get to anywhere in here, is I need to know like how big I'm going to scale them. And then whether maybe I'm flipping it on the other side or something. Okay? So we have V1. So that's kind of that's the scalar that's telling me how big I'm going to scale this by, or multiply it by, and then that vector I, okay? So this gives me the distance in the X direction. So this is the distance in the X direction, and you wouldn't be surprised that, like, it goes backwards, if sign negative, so backward, like it points in that direction instead if, you know, there's a minus in front of it. Okay, so that's kind of the first piece of that. And then we're going to add that together with, we're going to have how far we go in the second direction. Oops this should be a 2.

So we have V2, oops, that's not what I wanted at all there. I'm not sure why I did that. These things happen. Okay. So then we put, this is what I wanted to put was a J like that, right? Because I'm multiplying this direction by J. Okay? So this is going to tell me the distance in, in the Y direction. And again, not surprising at all, then I'm going down if there's a minus in front of it, okay. Great. So let's kind of look at with these these pieces put together, I can get, so I get my vector V, I can break it into the two parts. So I have this one. Right, so I have this is a V1 I, and then I add to it, right, we always add to them by putting them like nose to tail or whatever, that I start the next one here and I go up and this is how I add vectors, right? Like I add them like that. And then this is getting me V to J. Okay, so here's some kind of other notation. Just good to know. So let's put our other notation here.

Which is, is is just another way we like to write it. We sometimes like to write our vectors like this, where I put the V1 in here, and the V2 in here. And then the last thing that it's good to know is what is the length of this vector that I've been drawing here? So this length is going to be, so this length of this vector is equal to the square root of, so we're going to have a V1 here, and we're going to have the V2 here, and we're going to square them and add them together. And if you think about this, this is exactly the Pythagorean Theorem, right? I'm taking this length squared plus this length squared equals this length squared. The square root is because I said this length squared. Okay, so you can almost guess what's going to happen in three dimensions now. It's kind of based on what happens in two dimensions. So let's go through that really quickly. So in three dimensions.

So we're going to have a vector, now we're going to want to write it. So let's, let's first draw, I think it helped a little bit to actually draw the picture first, before we write it like that. So we've got, we've got an X direction, a Y direction, and a Z direction. And then I've got, right, if I go, and then now I want to be able to go 1 in each direction. I usually tell people that think of this, like you're in the corner of a room. And you know, you've got, you know, going one direction in the room or the other direction in the room and then going up. But if you look in the corner of the room, you can almost like use it to say, well, I start in the corner of the room, and then I take three steps in this direction. And then I take three steps in or four steps in that direction. And then I go two up, right, and this is how I, it can help to think about this. So the one that goes in the X direction here is I. So this is I, which now has to have three coordinates. So it looks like this. And then my J like this. So this is J equals 0, 1, 0. And then I have my K. I should put down this rag, my cleaning device when I make mistakes. Okay, and then my K is going to be, K equals, where do I want to put it? I'll put it over here, it's an okay place to put K equals 0, 0, 1. Okay, so now I want to talk about how far I can go in each of those directions. So I get V is going to equal, and then I want to take so from this direction, right, I need to figure out how to scale that one and then go V1 times I, I was checking whether I made mistake over there didn't okay job surprisingly. And then V2 times J, it was only the V2 that I, you know the J there that I messed up, not the I. And then I have V3 times K. So those are kind of how far do I go in the X direction, the Y direction and the J direction, I'm not going to draw the picture of trying to add these together. Because I've tried to do it before and I think it's a little hard on a surface like this, but you can imagine that it's kind of like you, you, you do them nose to tail, nose to tail, and then you've got to have another one that's sticking straight out at you, maybe. And then then you have to get to the endpoint of that. And that one sticking out is your V3 times K. Okay, so our other notation we'll put here, so our other notation.

Here it's going to be, so now it's just this vector where I go like this. So I have V1, V2, and V3. And then I have, the last part that I want to do, just like I want to do over there is to do the length. And so my length is going to equal, so the length of this vector like this, it's exactly the same except I add the third component also. So I'm adding together the three components and squaring each of them. So I add together in my V1, my V2 and my V3. Okay? So this is just a little bit, I know this is like a little bit of notation. It's ways to kind of break apart these factors, it ends up being useful. It's just another thing to get useful. It's like one of these things, you get used to it and then it turns out to be really useful and helpful. So it's worth getting used to, but not getting intimidated by at the start. Okay, so I hope that made sense, and I will see you in the next lecture.