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SUMMARY KEYWORDS

instantaneous velocity, equals, interval, change, slope, limit, derivative, picture, zooming, smaller, approximated, lecture, slightly reduced, looked, tiny little, instant, average velocity, instantaneous rate, closer, side

SPEAKERS

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Welcome. So if you recall in the last time, in the last lecture, we looked at kind of zooming in at the time T equals 5 in order to kind of change from looking at an average velocity to an instantaneous velocity. In this lecture, we want to kind of shift that into what does that mean in terms of a limit? So, last time, right, we approximated the instantaneous velocity. So we approximated the instantaneous velocity, we approximated the instantaneous velocity, instant, instantaneous, that's a funny word, velocity at this time T equals 5. Okay? And what do we do so this kind of process of repeatedly zooming in that we talked about doing, so this process of repeatedly zooming in.

Right, where we went, so first, we looked at the inner, so we could look at the interval 4.9 to 5. And then maybe next we looked at, so we went from there, to looking at, and we also looked at the interval from 5 to 5.1, but we're just going to simplify to kind of talking about one side of it. And then we could go from 4.99 to 5, and then we could keep going right, to 4.999 to 5. Okay, this process of looking at these kind of smaller and smaller intervals that are closer and closer to 5, okay, and what this is doing is amounting to taking a limit. And what limit in particular is this? So this is the limit, and then we're having as H goes to zero, okay, and what is this H going to be? So this is going to be H equals 0.1, this is H equals 0.01. So we're looking at kind of the width of this interval. And what we're doing is we're taking, so I'm taking the difference in the output values, right, or these distance, these positions. So I would take the input value of 5 plus H, and 5 here, so I'm looking at some tiny little interval because this H is really, really small. And I'm dividing by this change in time. Okay, so I'm taking 5 plus H minus this time here, 5. Okay, so I'm looking at the change of distance over change of time of a tiny, tiny little interval, okay? And so if you kind of picture this, on before I kind of write this in a slightly reduced form, let's just kind of picture what I'm a little bit, right, if all these are on the number line, right, and I have, so I could be taking 5, right, and maybe 4.9 is here. And then 4.99 is already getting so much closer. And 4.999 is even closer yet.

And then maybe so 5 plus H, H could be kind of negative here, which it is in these circumstances. Or it could be kind of over on this side, so that this little length is H, okay? Or right, so this is where we have H equals minus, minus point one and so on. So I guess I wrote point one and point 001, and point 001 when really I kind of minus those, but you can see what I mean there. And then this is going to equal the limit as H goes to zero, of and then this is just kind of reducing this down here. So I have this P and I still have this 5 plus H minus P of 5, and then you can just kind of reduce this down and get H on the bottom. Okay, and this H here, right, this is what you're taking the limit with respect to. Okay, so let's kind of draw this as a picture over here. I have T equals, right, this is my T equals time, and then I have my position.

I have my position. And maybe my P of 5 is here, who knows, maybe my P of 5 plus H is actually lower. And so I would have here, and then on here I have, if I have my 5, and then I have my 5 plus, and then I have this H. So this like here is H, okay? And then if these are the two values there, so maybe, right, so my 5, this is like here. And this is here. And each of these steps, I'm actually kind of looking at this slope. Right? This slope is what I'm looking at. Okay, as I, right, this is the, this is the point, what are these points here, let's just kind of be specific. This is the point five P of 5. This is the point 5 plus H, P of 5 plus H. So just like in the other picture, we're looking at the slope, we're looking at the slope each time as we're getting this interval being smaller and smaller. And so the slope kind of at that instant, is actually going to give you the instantaneous velocity. And as you'll see, going through this will be the derivative in this formula here will look really familiar. Okay? So kind of what we talked about this time was the fact this process of zooming in is the same thing as getting these intervals really small. So that when you're looking at the slope, you're still looking at that slope as kind of average change over that interval. But as you get smaller and smaller, as these intervals get smaller and smaller, what you're really looking at is the instantaneous rate of change, which is just going to be the derivative. Okay, so I hope that made some sense, and I'll see you in the next lecture.