

CP-module2_lecture9_editedShayon

📅 Mon, 12/27 2:59PM ⌚ 8:29

SUMMARY KEYWORDS

points, region, distances, closer, euclidean plane, voronoi, sports, analytics, geography, talk, approximate, p2, application, p1, soccer, p3, voronoi diagram, computing, area, business

SPEAKERS

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Welcome. In this lecture, I kinda want to go through a fun example of these distances in the Euclidean plane that we've been talking about. This is a example close to my heart, because I'm very interested in soccer analytics. So here's some, this is kind of an early form, which is it's really nice. This is actually an interesting fact of sports analytics, that soccer is one of the sports that has the most geometric analytics involved. There's a range within it. Some sports it's far more statistical. So, one, so, so we're going to talk about Voronoi diagrams and explain what they are. But I first wanted to say so yeah, they're an application in sports analytics, which is actually where I first learned about them. But they actually show up in all different kinds of areas. So you could be thinking about areas served by some kind of business, or services. And then one that I'm going to not write down but talk about, where so there's some geography examples, actually. So you could imagine, so one of the things that Voronoi diagrams really do is they kind of tell you, where all the points like, if you're looking at all the points on, on the plane, they tell you, where they're closest to. So which business are you closest to, or, you know, which energy source or whatever. So you can kind of imagine already that there can be geography examples, but there are even more complicated ones, because they can also be used, you can transform them into something called the Lonnig triangulations that you can then use to kind of approximate different kinds of objects and so on. So there's a lot of different interesting examples of how Voronoi diagrams are used. But you can look at also so in sports. And I mentioned soccer, but this could also be done in basketball or other sports, this is area controlled by a player. So what is a Voronoi diagram, I've told you what all these applications are, they show up everywhere, I haven't really told you what they are. So what's a Voronoi diagram?

It's kind of cool application. So for our input, you can imagine that you've got some set of points and maybe the locations of the businesses or the soccer players or whatever you'd like. So you have some kind of set of points in $\mathbb{R}^2$, right, so a field or a court is a natural example of $\mathbb{R}^2$, or some portion of $\mathbb{R}^2$, but so is also you know, yes the Earth is round. But for all our purposes, when you know, if you're close enough, if your distances are small enough, you think it's flat. So it looks like $\mathbb{R}^2$, that's an entire more advanced area of mathematics. But we often think of, you know, we look at the world is basically flat for a lot of purposes. So the set of points in $\mathbb{R}^2$. And so here's my set. So I have each one of these is a point that's going to live inside of $\mathbb{R}^2$, so maybe we'll kind of, even so

over here is going to be R two. So you can imagine, I'm going to have some kind of point P one over here, we can have a lot more than this, but it's easiest to draw if I only have three, but you can keep going. Maybe even I will. Let's put another one down here.

Okay, and then my output is going to be the Voronoi, so the Voronoi region DK so I'm going to have one of these for each of, oh I used a K here. So let's do this as DJ, okay. Is all points in R two that are closer to PJ than to any other of these. Okay, so looking over here, so here's an example. So we're going to look at P1. And this is going to be approximate. So I apologize if this is, is approximate, but I can more or less approximate this. So if I want to look at all the points that are closer to P1 than to any of these other points, this probably actually will take a turn at some point over here. I'm going to get some region like this. So as long as I'm in this region, so this is D1. So all points in this region are closer to P1 than to any of the others, okay. So all points in D1 are closer to P1 than to any other P I, okay. So any of these others than to P2 or p3 or P4, okay. And then you can do a similar thing with the other ones. So here's my region P2 or D2, right? Everything in here is closer to P2 than to any of the others. And they can keep going.

There's actually a trick to computing these, I made a silly video on YouTube kind of showing it. But here, this would be D3. So this is everything closer to P3 than to any of the other regions. And then the last one, I'm going to reuse this color even though it's not exactly this, even though it's not the same region is that just because they're not touching, so I think it'll be hopefully clear to you that this is the region that's going to go for this point here. So this is D4. So this is just kind of a fun example. But it's actually also a very useful example where when you understand the distances in R two, you can kind of understand things like how do you create these regions that can be useful whether you're interested in soccer, or you're interested in businesses, or you're interested in geography, any of these kinds of things. They kind of map out the regions where something you know, you're closest to that, right? So we still are actually looking at like these, these distances, right, I'm looking at each point in here, I'm looking at this distance, just like we were just computing. What is the distance between these points? Or what is the distance from here to here? Or what is the distance from here to here, or from here to here, and this is the distances as smaller. So this really is an application of knowing how to compute distances in Euclidean plane. So I hope that made some sense, and I'll see you in the next lecture.