I am really excited for today’s lecture as I used Oracle Spatial on a project when I worked for Oracle corporation. I am interested in knowing what exactly spatial AI is. (Aside: I like the fact that Bob the dog is helping to summarize the presentation, nice hook!) I have never considered the fact that location is the key which links various types of data and this makes me wonder if spatial AI is underused by different companies. OSM data has inconsistencies since sources and projections are created at different times and from different projections. For applications that have a modifiable area unit problem I would think there would be a mathematical way to convert data with one type of spatial units to be consistent with data that has a different type of data units. Finally, I am amazed at the diversity of real world problems and data which spatial AI can handle.

The first topic in the presentation is spatiotemporal predictive learning. In this type of learning, knowing what has happened, along with where and when, and how it has changed over space and time is the key to modeling complex spatiotemporal phenomena (from presentation slide). Basically, given a sequence of frames (images) we are trying to predict what the future frames (images) will be. One existing approach is using a data-driven method with the main challenge being that a spatiotemporal model created in this method can violate basic rules of physics. Thus, to solve this we have to add a physics component into the model which means we have to understand physics. From the lecture it seems that what we really need to understand is not physics but mathematics and PDEs. Physics guided methods that use known PDEs seem fairly straightforward. However, if you do not know the governing PDE we can approximate the underlying physics using data. I wonder if there are similarities here between deriving a probability distribution using monte carlo methods and the approximation of the PDE in this model?

One issue with physics guided methods is how to handle the estimation noise. For DeepLATTE: SVPNet I could follow some of what Dr. Chiang was explaining but it would have been nice to follow a simple specific example at a high level through the process. Although, given the time constraints of the presentation this may have not been possible. I might add that there may be no such simple use case to step the audience through. From what I remember about PDEs the solutions were significantly more complex than ODEs. It was interesting to look at how DeepLATTE performed across the three different problem domains of natural processes, human activities, and synthetic datasets. In addition, the future work of adding interpretability to the formation to the governing PDEs is very intriguing.

The second topic is about SpaBERT, a pretrained language model from geographic data for geo-entity representation (from presentation slide). Basically, the idea is that spatial neighbors characterize geo-entities. So, if we look at what is around an entity we should be able to determine what the type of the entity is. Isn’t this simply a classification problem? Seeing that existing PLMs do not capture spatial relations makes me wonder how many other areas would benefit from a spatial relations component. It seems to me that this research area, spatial AI, is just scratching the surface of possible applications.

SpaBERT’s general idea is that we know the characteristics of a geo-entity by looking at its surrounding entities (from presentation slide). I struggled to follow Dr. Chiang through his description of embedding modules. It could be that I do not have the background yet to follow the lecture and/or it could be that my math and computer science background is getting in the way. That is, I have an idea of what an embedding is in mathematical terms and I have an idea of what a token is when we speak of compilers. Here it seems that a token is the name of a geo entity, but I am still struggling with what he means by an embedding (I think I ended up figuring this out see the third to last paragraph in this essay). One slide states that the token and sequence position embedding are the same as BERT which makes me wonder if I am missing a lecture on BERT and that this is the follow-on lecture. The second application is around geo-entity linking. We are going to link geo-entities in USGS maps to Wikidata. In other words, this is a mapping from pixel coordinates to geo-coordinates. Incorporating lines and polygons seems like a natural extension of what SpaBERT does.

The third topic is digital map processing. The mapKurator system converts historical maps into searchable content (speaker’s words). I do not have much to say about this topic except that being able to search historical map data in this way is pretty fascinating. I wonder if you could apply this same technique to maps produced by authors in works of fiction like Tolkien, Wheel of Time, Winnie the Pooh, etc.

The last topic was capturing locality characteristics form online text (from presentation slide). It was interesting from the standpoint that the example he used was from a review of an AirBnB and I just spent a week at an AirBnB in Duluth. I picked AirBnB by reading the reviews. Oh, by looking at the slide here I see that an embedding looks like putting a spot or point on a map. i.e. I think the points of interest on google maps are what is considered an embedding.

Dr. Chiang sped through the last several slides which was tough to follow simply because of how fast he was going.

In summary, we can use spatial data to create contextual data which allows us to provide analytics in regard to spatial data.