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PROJECT TITLE: Using ArcGIS for Moving Point Object

INTRODUCTION

Our current state of technology allows us to collect far more data than we are able to immediately analyze and act upon. Many events can be missed because of the large amount of information streaming at us from all angles. Teaching machines to interpret this stream of data for us is a smarter way to sift through, and give meaning to this information.

For our research project, we propose to design a system that will help us interpret the intent of an abstract entity, the Moving Point Object or MPO. For our purposes, a MPO can represent a person via a GPS tracking device on a vehicle or a cellular telephone, though it could represent any moving object.

RESEARCH QUESTION

There are two questions we hope to answer with our research. The first is: Can we determine anomalous behavior by studying patterns made by movement? If someone’s daily movement patterns were known, could we detect if they strayed from their normal routine? The second question comes from successfully answering the first: Can we algorithmically predict intent by studying movement patterns of people?

Answering these questions would increase the autonomy of the machines that assist us in our work. Machines have the potential to analyze and interpret the vast amount of data we are now capable of generating with a lower error rate than a human. To assist us in our task, we will use a collection of software libraries and the Python programming language.

METHODOLOGY

We will use a mixture of software and algorithmic tools to attempt to answer our research question. The software that will be used is as follows:

1. NetLogo: A.I. agent simulation software, source of movement data. Using this software, we will simulate MPOs, and we will be able to curate labeled data to use with our Machine Learning techniques.
2. ArcGIS: provides tools for maps and manipulating geographical data.
3. Scikit-learn: Machine Learning library, also incorporates numpy and scipy, two Python libraries for manipulating numbers, and scientific computation tasks.

Two major algorithmic tools that will be utilized are the Support Vector Machine or SVM, and HMM or the Hidden Markov Model. The SVM is a linear classifier that can be trained to recognize known patterns in new data. We will use this to compare an instance of a movement data model with a known movement pattern to determine anomalous behavior, e.g. outside of pattern behavior. The HMM is a statistical model that will help us determine the intent of MPOs by studying the data, and by performing temporal pattern recognition.

CONCLUSION

Using ArcGIS along with Machine Learning techniques will allow us to predict the intent of people or objects that are represented by data. We will be able to detect when an object is moving in an anomalous way automatically. These techniques could be used to classify behavior made by individuals, or net movement centered on a location, such as a school.