1. TITLE

A Survey in Applications of Machine & Deep Learning in GIS – Spatiotemporal data  
mining and forecasting

2. STATEMENT OF THE PROBLEM

Spatiotemporal data is a dataset collected in the space domain (a.k.a. a map over a location), and the time domain (a.k.a. the time series). The need to S.T.-Data mining rises with the emerging use of intelligent transport system (ITS, i.e. automatic guidance, self driving cars, traffic prediction, etc.). Several models based on both machine learning have been deployed, but ML models need a human to extract the features. Deep learning models, capable of self-feature extraction, usually outperform regular ML ones. However, DL models have drawbacks, a CNN/GCN can only extract and learn only the space domain, while an RNN/LSTM can only do these on the temporal domain of the S.T. data.

3. BACKGROUND AND HISTORY

Spatiotemporal data is a dataset collected in the space domain (a.k.a. a map over a location), and the time domain (a.k.a. the time series) My thesis is focused on paper survey of overhead imagery processing & recognition using machine and deep learning algorithms and models, such as CNN (Convolutional Neural Network) for static images, and LSTM-RNN (Long Short-Term Memory RNN) for videos and time series data. With the AI, there are some uses in Spatiotemporal data mining:

* CNN-GCN is used to extract features in the spatial domain.
* LSTM-RNN is used to extract features in the temporal domain.
* In survey engineering, some researchers use CNN observe changes in land use, crop growth, and construction progresses.
* In ITS, ST-Data mining is extremely useful in traffic prediction, guidance systems, route planning, and self-driving cars.
* To make GPS based pathfinding more accurate, Spatiotemporal Data Mining is often utilized in several papers to train the pathfinding ML/DL-architectures.
* All the papers to be referred below, may be added & updated in the future, involve GIS, Computer Vision (CV), and spatiotemporal data mining.

Spatiotemporal data mining is a form of GIS data analysis done in both the spatial and the temporal domains. A CNN learns the spatial graph input, while and LSTM/RNN learns the temporal domain of the input data. With both DNN working together, we can forecast a spatiotemporal data (such as traffic, train ridership, etc.) not only the time series (time domain), but also the heatmap (space domain).

## JUSTIFICATION OF THE PROBLEM

In stating the problem, it is also necessary to specify why it is important and what new insights may be found. What would be its net contribution to the body of knowledge in the field(s), and/or towards solving the problems for humanity at large?