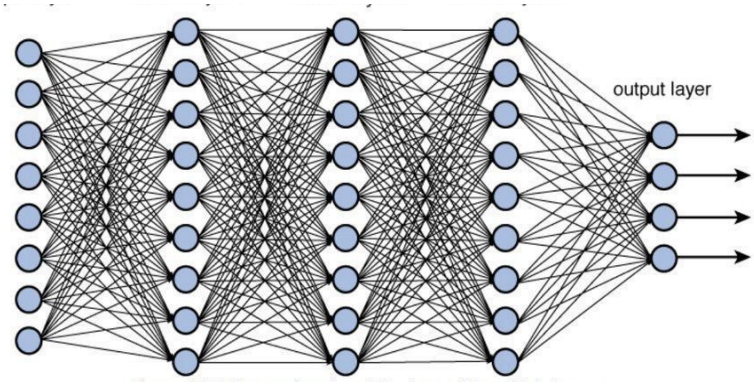
Unravelling the decision making process of black box neural networks for traffic predictions



Problem description

Given the success of deep learning models in prediction purposes, it is important to understand what these black-box methods are learning. However, it is computationally expensive and data-intensive to build and train a deep learning network. The field of transfer learning is a breakthrough in regards to this. We can use a pre-trained network for different purposes by replacing the input and output layer. While transfer learning is gaining popularity in computer science, it has not been used extensively in the transportation domain. In one of the works, we used Google's inception net, trained on millions of images, to identify different network-wide traffic congestion patterns. The objective of this thesis is to convert the deep learning neural network structure into decision trees to understand what Google's net has learned from traffic and see if the detected features have any transportation relevance.

There are multiple challenges that need to be tackled for this. The problem of estimation and prediction becomes more challenging at the network level because of the dimensionality of the traffic data, and network topology. The complexity of the input and Google's InceptionNet can lead to complex decision trees that can make it hard to explain. Thus, the student gets a unique opportunity to work at the intersection of two cutting-edge fields.

Assignment

- Review state-of-the-art in explainability of black-box methods
- Build a classification model for traffic patterns using a pre-trained model
- Convert the neural network structure to a decision tree
- Analyse the decision tree structure and relate it back to fundamental traffic characteristics

Candidate

- Should have coding skills in Python
- Should be comfortable with working with data
- Should be comfortable with learning or working with fundamental machine learning and transportation methodologies

Research group

Departments: Transport & Planning department (CEG)
Algorithms department (EEMCS)
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