Traffic4cast competition reveals novel way to predict traffic flow using AI

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NeurIPS, Vancouver – The Institute for Advanced Research in Artificial Intelligence (IARAI), an independent global machine-learning research institute established by HERE Technologies, today announced the results and winners of its traffic prediction competition, which aimed to solve mobility challenges using artificial intelligence (AI). Traffic4cast, a unique competition merging movie-prediction machine learning with traffic research, challenged competitors to understand complex traffic systems and make predictions about how they would flow in the future.

The results show how AI can effectively uncover insights to solve traffic gridlock through trial and error of industrial geospatial data from HERE, a leader in mapping and location-based services. Traffic comes about when drivers make simple decisions that lead to complex behavior patterns. These patterns depend on various factors, such as time of day, the road network, congestion situations, holidays, weather conditions and day of the week. Effectively identifying and analyzing traffic patterns lead to more accurate predictions of how traffic would move on given roads at given times of day.

AI, and more specifically neural networks—computer systems modeled on the human brain and nervous system—can help to solve this problem because they are very good at spotting patterns. Neural networks "learn" to do tasks by considering examples, such as datasets, usually without being programmed with task-specific rules. This ability to learn without being programmed means that although neural networks are good at identifying patterns, why they are good at it is unclear. Their inner workings are one of the mysteries of machine learning, the so-called "black box" AI, meaning that the processes cannot be easily understood or tested by programmers.

The Traffic4cast results show that neural networks were the most effective method used at predicting traffic and came closest to simulating the exact traffic flow. All the top entrants used neural networks instead of "non-black box" solutions, such as support vector machines, Bayesian networks and other fixed algorithms. Winners from South Korea, Oxford/Zurich and Toronto were among more than 40 teams from around the world who submitted over 4,000 entries.

Working with HERE, IARAI provided participants with traffic movie clips based on a year's worth of industrial-scale, real-world data for three diverse cities: Berlin, Istanbul and Moscow. The clips were created using data based on an unprecedented number of over 100 billion probe points from positions reported by a large fleet of probe vehicles. They captured morning, evening and rush-hour traffic. Each movie frame summarized GPS trajectories mapped to spatio-temporal cells. The movies showed multiple color channels characterizing traffic volume, speed and direction.

"This competition is special alone because of the sheer scope and size of the data," said Sepp

Hochreiter, a founding co-director of IARAI and an artificial intelligence pioneer (he invented the long short-term memory (LSTM) neural network framework).

Entrants had to forecast the traffic by completing the next part of each movie clip for all three cities. Contestants were given 285 full training days (full movie for the entire day) and 72 testing days (containing five blocks of 12 consecutive images with at least 30 frames between each such block); the rest were marked out validation sets. Each contestant then had to produce the three consecutive images following each given block of 12 images in each movie file for each day in the test set for each city.

“This competition brought together diverse groups to tackle a fundamental problem—predicting geospatial processes—that lies at the heart of sustainable mass mobility,” said Michael Kopp, head of research at HERE and founding co-director of IARAI. “Guiding the AI revolution to this problem using an interdisciplinary approach via billions of real-life data points is both novel and a paradigm shift that will be reflected in many applied scientific disciplines. The results seem to prove that ‘black box’ machine learning is most effective at solving predictive problems. This gives us a jumping-off point for further research into how AI learns.”

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