Dottorato di Ricerca in Urban and Regional Development

PhD Excellence Course

Big data applications in transportation

The interdisciplinary course is addressed to provide a sound knowledge regarding different methods to analyse big data from different sources (e. g. cellular phones and GPS), which are becoming essential in transport planning and management.

Big data provides new ways of gathering novel information from passenger and vehicle movements and allows for a shift from passive approaches to active crowd-sourcing with innovative transport solutions. This course presents different methods to analyse big data from different sources (e. g. cellular phones and GPS), which are becoming essential in transport planning and management.

The course will be articulated in two parts: the first related to data science and, the second, focused on transport applications.

The introductory session will explain to the students the topic of the course, the objective and the structure, followed by introduction to Big Data and Machine Learning. Then, clustering methods and classification methods will be presented, followed by the main principles of neural networks.

Then, the diverse data collection methods in transport sector will be presented, distinguishing between passive and active travel data collection. Finally, the household surveys will be explained to compare their potential with that of the passive and active data collection.

After having given the sufficient background on the topic, two applications, related to the route choice model and origin-destination matrix construction, will be presented.

The course will be held by an outstanding scholar with high international reputation in the above field.

The description of the above sessions follows.

Scientific Coordinator: Prof. Cristina Pronello

Lecturer: Prof. Shlomo Bekhor (Technion – Israel Institute of Technology)

Formative Credit Units (CFU): 4

Calendar: 24th, 25th, 26th, 27th, 28th February 2020

Venue: Sala Vigliano – Interuniversity Department of Regional and Urban Studies and Planning - DIST
Castello del Valentino. Viale Mattioli, 30. 10125 Torino

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Course scheduling

Monday 24 February 2020

9:00 – 10:30 – Room Sala Vigliano

An Introduction to Big Data and Machine Learning

- What is Big data?
- What is Data Science?
- Main concepts of machine learning
- Overview of supervised & unsupervised learning Algorithms

10:30 – 11:00 Break

11:00 – 12:30 – Room Sala Vigliano

Clustering methods

- K-Means Algorithm
- Hierarchical Cluster Analysis
- Example

12:30 – 14:30 Lunch time

14:30 – 16:00 – Room Sala Vigliano

Classification methods

- Decision Trees
- Introduction to random forests
- Example

Tuesday 25 February 2020

9:00 – 10:30 – Room Sala Vigliano

Neural networks

- Artificial Neural Networks
- Convolutional Neural Networks
- Evaluating Classification/Predictive performance
- Classification Matrix, Accuracy Measures, ROC curve

10:30 – 11:00 Break

11:00 – 12:30 – Room Sala Vigliano

Transportation application example – road safety

- Crash data
- Data preparation
- Model estimation

12:30 – 14:30 Lunch time

14:30 – 16:00 – Room Sala Vigliano

Transportation data
- Conventional data sources
- Cellular phones
- GPS / GNSS

Wednesday 26 February 2020

9:00 – 10:30 – Room Sala Vigliano
Household surveys
- Conventional surveys
- GPS assisted surveys
- Active surveys
- Data analysis

10:30 – 11:00 Break

11:00 – 12:30 – Room Sala Vigliano
Route choice model application (part 1)
- Route choice modeling approaches
- Choice set generation methods

12:30 – 14:30 Lunch time

14:30 – 16:00 – Room Sala Vigliano
Route choice model application (part 2)
- Data collection and cleaning
- Map matching
- Model estimation

Thursday 27 February 2020

9:00 – 10:30 – Room Sala Vigliano
Origin – destination matrix application (part 1)
- Trip distribution models
- Data sources
- Data problems

11:00 – 12:30 – Room Sala Vigliano
Origin – destination matrix application (part 2)
- Cellular phone data
- On-board data
- Smart card data

14:30 – 16:00 – Room Sala Vigliano
Origin – destination matrix application (part 3)
- Data collection and cleaning
- Data analysis

Friday 28 February 2020

9:00 – 11:00 – Room Sala Vigliano
Exam / Project

The teacher

Shlomo Bekhor is Professor in the Faculty of Civil and Environmental Engineering at the Technion, and currently the Faculty Dean. He has a B.Sc. in Aeronautical Engineering from ITA – Aeronautical Institute of Technology, Sao Jose dos Campos, Brazil. His M.Sc. and Ph.D. degrees in Transportation Engineering were obtained at the Technion. He spent a two-year Post-Doc at the Massachusetts Institute of Technology. He teaches and conducts research in transportation planning and network equilibrium models, with special interest in route choice modelling. He has also participated in several consulting projects related to transportation demand forecasting. He has published 90 papers in refereed journals and 110 papers in international conferences. He has participated in several projects funded by the European Commission: CyberCars, CyberMove, CityMobil, CATS, 2MOVE2, SOLUTIONS, PETRA.
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