Case Studies in Machine Learning – Fall 2023

Dr. Junfeng Jiao

(jjiao@austin.utexas.edu)

Urban Information Lab

The University of Texas at Austin

Course description:

Computers have become increasingly more powerful and capable of solving complex problems. This ability opens paths to a multitude of new tools such as machine learning methods that allow us to address complex problems. Machine learning (ML) is a fast-moving field of computer science with many recent consumer applications (e.g., Amazon Alexa, digital camera face detection, google assistance, etc.) and applications within the sciences (e.g., predicting housing prices, autonomous deliveries, traffic and pedestrian detection systems, land use classification, etc.). This course introduces graduate students to the field of machine learning and presents a broad introduction to the principles and paradigms underlying machine learning, including presentations of its main approaches, overviews of its most important research themes, and overview of new challenges faced by traditional machine learning methods. This course highlights major concepts, techniques, algorithms, and applications in machine learning, beginning with topics such as supervised and unsupervised learning and ending up with more major recent applications in housing market analysis and transportation. Through this course, students will gain experience by using machine learning methods, and by being exposed to practical case studies in which they come up with solutions for dealing with a real-world data analysis problem. Lastly, students will complete a term project through the reading of research articles, textbooks and the formulation and answering of research questions. Due to the time limitation, theoretical backgrounds behind different ML technologies will not be covered. Upon completion of this course, students will develop a good understanding of major ML methods and related applications (Figure 1).

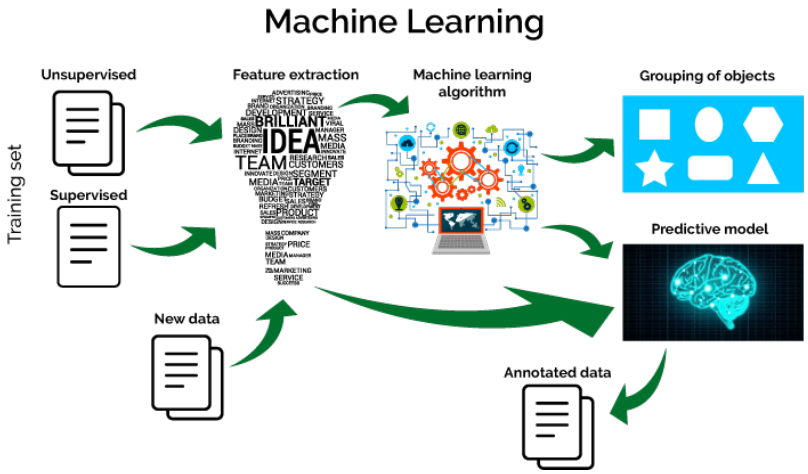

Figure 1 The Overview of Machine Learning
(Reference: https://towardsdatascience.com/machine-learning-65dbd95f1603)

Course objectives:

- Understand generic machine learning (ML) terminology.
- Understand motivation and functioning of the most common types of ML methods.
- Understand how to correctly prepare datasets for ML use.
- Understand the distinction between supervised and unsupervised learning, as well the interests and difficulties of both approaches.
- Practice script implementation (Python) of different ML concepts and algorithms covered in the course.
- Apply software, interpret results, and iteratively refine and tune supervised ML models to solve a diverse set of problems on real-world datasets.
- Understand and discuss the contents and contributions of important papers in the ML field.
- Apply ML methods to solve real world problems and present them to mini clients.
- Write reports in which results are assessed and summarized in relation to aims, methods and available data.

Programming Language: **Python** (Jupyter)

Lead Teaching Assistant**: Seung Jun Choi** (jun.choi@utexas.edu)
* We will have a total of four TAs. Contact information will be shared soon.

Final Project
Students are required to complete a class project. The choice of the topic can be very board as long as it pertains to ML and the course material. The final result will be a paper and a presentation to demonstrate your understanding of the class topics and objectives. To ensure that you are on the right track, you can submit **a one-to-two-page proposal** (optional) of your project before the project is due.

Joint Course Schedule: Lecture (Theory - Instructor) + Lab sessions (Application - TA)

Week	**Lecture Title**	**Content** *Generally will be shared earlier in the weekend.	**Note & Objective**
Week 1	Ice Breaking	Course promotion	Housekeeping session
Week 2	Introduction to Machine Learning	• Lecture 1: Introduction to machine learning and summary of AI models • Lecture 2: A brief history of AI and machine learning • Lab 1: Setting up machine learning environments and introduction to Numpy • Lab2-1: Introduction to Pandas and preprocessing data	Setting up goals, objectives and introducing working / development environment Obtain basic knowledge of machine learning Learn basic Python modules (Numpy, Pandas, Matplotlib, and Seaborn)

		• Lab 2-2: Loading modules/libraries in Python and plotting data	
Week 3	Supervised learning, Regression, and Deep Learning	• Lecture 3: Supervised learning: regression • Lecture 4: Supervised learning: classification and KNN • Lab 3: Model evaluation • Lab 4: Classification exercise: credit card fraud detection	Students will learn different regression and classification model Students will learn the process of modeling machine learning regression and classification models with evaluation technique
Week 4	ML for Shared Micro Mobility	• Lecture 5: Supervised learning: Decision tree in regression • Lecture 6: Supervised learning: decision tree in classification • Lab 5: Regression exercise: bike-sharing demand prediction • Lab 6: Decision tree & optimization • Quiz 1	Students will learn how ML to guide Shared Micro Mobility company operation (stations location, price setting, demand prediction, pick up/drop off spots identification…) Students will learn how ML methods; decision trees and how they are applied in shared micro mobility industries Understand the structure, and hyper parameters of DT
Week 5	ML for Housing Market & COVID-19	• Lecture 7: Artificial neural network: history & types of NN • Lecture 8: Artificial neural network: loss function & training NN • Lecture 9: Artificial neural network: preventing overfitting • Lecture 10: Recurrent neural network (RNN), LSTM, & GRU • Lecture 11: Machine learning and housing analysis • Lab 7: RNN & LSTM & GRU application with	Students will learn how ML can used to predict housing market movement in a given city during a period. Introducing Austin AI housing analysis and application of artificial neural networks Comparing RNN, LSTM, & GRU NN Introducing application of Pytorch in Python

		• COVID-19 prediction & Austin housing analysis • Lab 8: Deep learning with Pytorch • Lab 9-11: N/A • Quiz 2	
Week 6	ML for Urban Climate Sensing	• Lecture 12: Dimensionality reduction: PCA & T-SNE • Lecture 13: Dimensionality reduction: Linear Discriminant Analysis (LDA) • Lab 12: PCA and visual representation • Lab 13: PCA & air quality forecast using Microsoft IoT sensors • Project Proposal (Optional)	Introduce dimension reduction models (PCA, T-SNE, and LDA) Introducing air quality forecast modeling strategies and landscape decomposition process using PCA Introduce ongoing smart city planning attempts: Installation of hyperlocal IoT environment sensors
Week 7	ML for Public Health Analysis	• Lecture 14: Machine learning and public health analysis • Lab 14: Public health application: skin cancer detection & Pyhealth • Quiz 3	Students will learn how ML can be used in public health fields (e.g. predicting disease spreading or individual/neighborhood health status). Introduce machine learning application on public health fields Learn about Pyhealth module
Week 8	ML for Image Processing	• Lecture 15: Machine learning and image processing • Lab 15-1: Image processing with CNN & vehicle detection • Lab 15-2: Image processing with Keras & Tensorflow: Basics • Quiz 4	Students will Learning how ML and DL can be used to analyze traffic camera data or Drone image data Learn about image processing techniques via CNN with lab session on vehicle detection Introducing image processing basics using Keras & Tensorflow

			Future Internship/ Employment Opportunities: Transportation Agency
Week 9	ML for Shared Economy	• Lecture 16-1: Machine learning application for shared economy part 1 • Lecture 16-2: Machine learning application for shared economy part 2 • Lab 16: Analyzing & predicting AirBnB prices in NYC	Students will learn how ML methods have been used by Short-Term rental industry (e.g. Airbnb Vrbo), such as understand the Airbnb distributions in the US, predict its demand/supply in a given neighborhood, identify key factors affecting short-term rental income Future Internship/ Employment Opportunities: Airbnb, Vrbo, Homeaway
Wee 10	ML for Shared Vehicle	• Lecture 17-1: Machine learning and shared mobility part 1 • Lecture 17-2: Machine learning and shared mobility part 2 • Lab 17-1: machine learning in Uber & price forecast modeling • Lab 17-2: End to End: Uber's data analysis	Students will learn how ML methods have been used in Shared Mobility Industry. We will introduce how to use ML to predict Uber price surge, quantify the spatial and temporal patterns of Uber/lyft within cities, identify hot/cold spots for pick up drop off locations. Future Internship/ Employment Opportunities: Safegraph, Sidewalk lab or other GeoAI companies. Future Internship/ Employment Opportunities: Uber, Lyft, DiDi
Week 11	ML for Urban Informatics	• Lecture 18-1: Machine learning and urban informatics part 1 • Lecture 18-2: Machine learning and urban informatics part 2 • Lab 18: Transit Desert analysis using urban informatics data	Introducing GPS data and preprocessing steps Introducing transit desert and oasis analysis framework to apply real-time urban informatics data

		• Quiz 5	
Week 12	Natural language processing & social media	• Lecture 19: Natural language processing • Lecture 20: Social media application • Lab 19: Mercari price suggestion with text analysis • Lab 20: Tweet analytics using natural language processing	Students will learn basic NLP methods and how ML can be used to monitor social media and guide companies' business decisions. Future Internship/ Employment Opportunities: Business Intelligence or Social Media Companies
Week 13	ML for Recommendation System	• Lecture 21: Movie recommendation & YouTube • Lecture 22: Online dating app • Lab 21: Engineering movie recommendation system with filtering • Lab 22: Application of Surprise module • Quiz 6	Student will learn filtering means using ML and use Surprise ML modules to build movie recommendation filtering system Future Internship/ Employment Opportunities: YouTube, Tinder, Bumble
Week 14	Course Review	• Lecture 23: Grades & course review	Course overview before final
Week 15	Final Week	• No class / Work on final report • Final Report: Submission through UT Canvas (link will be provided in edx)	Students will submit their final projects.

Grades:

- **60% Quiz – 6 Quizzes**
- **40% Final Project Report**

Assignments:

Final Paper: Your paper must be complete, coherent, and easy to read. **Your final project is expected to be an individual work by default and should be original. You are not allowed to reuse the report that you have previously submitted in this course or in any other course. Plagiarism is strictly prohibited, and any evidence of it will result in failing the project and the course. You are encouraged to use the course materials, including the lectures and labs, to develop your ideas, but the final project should be your own work.**

Please make sure to proofread your paper thoroughly prior to submission. The final paper should be 3,000-5,000 words. You must cite at least 30 sources, including at least 15 outside scholarly readings, and all citations must follow APA Style. Research paper rough drafts will be graded according to the following criteria: suitability of the writing, creativity of the writing, and overall coherence and clarity of writing.

Quiz:

Throughout this course, you will be required to complete 6 quizzes, which will count for 60% of your final grade (10% each). These quizzes are open-book, and will include true/false, multiple-choice, and text-typed questions, as well as several math questions. Some questions are coding questions.

You'll be given ample time to prepare, and we highly recommend that you print out the slides or review them before taking the exam. You'll normally have 7-10 days to review your materials before taking each quiz. Some questions will require you to review lab materials, but the majority of the exam will be based on lecture slides. However, there's no partial grading for the quiz.

Please read through the question & instruction carefully.

Quiz Instructions:

General Announcement

Please maintain academic honesty and submit only one attempt. The instructors have reviewed the quiz content and will provide clarification, but do not request a solution until the deadline has passed.

Grading Policy

Please note that partial grading is not allowed in this course. Once you submit your quiz, it will be automatically graded and the correct answer choices will be revealed after all students have submitted their quizzes. If you think that your answer was correct but was marked wrong, please reach out to the instructors via private post or email. They will review your response and make any necessary adjustments to your score.

Q & A

Please post any questions or technical support inquiries on Piazza as a private post or email us.

Personal Extensions
If you require an extension, please contact us via private post or email with your EID. After the deadline, instructors will manually grade any outdated content.

Others
You are responsible for submitting materials on time and keeping up with the Piazza conversation.

Late submission:
Students are expected to turn in required assignments when it is due. Without early notice in very extraordinary circumstances, submission after the due dates will not be accepted. Failure to submit the final report will be graded as a failing the course.

Final Project Instruction:
Topic: Use of machine learning techniques on various fields (**Choose your own**)
Final Project should be individual work in default.
Ex. Micro-mobility / Housing / Climate / Image / Health / Shared Economy / Shared Vehicle / Urban Planning / etc.

- Times new Roman – 12 fts
- Formatted minimum 10 pages **without** title/cover page, table of contents, and references (1.5 spacing)
- Elaborate 1) introduction and research background, 2) research and methods, 3) materials and data sources, 4) results, 5) discussion or conclusions.
- Citation should be included in all referenced materials ex) (Jiao, 2022)
- Submission through edx Platform

Please note that the final report you submit will be checked for plagiarism and reviewed by OpenAI to ensure that you have not used ChatGPT to write the report. Any instance of plagiarism will result in failing the course, as we have zero tolerance for such behavior. While you can use ChatGPT to develop your ideas, please be aware that the contents created by ChatGPT may not always be correct. Please note that graders and instructors can easily identify whether the paragraphs are written by you or generated by ChatGPT.

Grading Criteria – Final Project Report

Criteria	Ratings				Pts
Suitability of the Writing	40 pts Rough draft aligns with the focus of the class and is responsive to assignment guidelines	35 pts Rough draft aligns fairly well with the focus of the class and the assignment guidelines but has some areas for improvement	30 pts Rough draft aligns with the focus of the class and is responsive to the assignment guidelines to some degree but has some very significant areas for improvement	0 pts Rough draft is not aligned with the focus of the class or responsive to the assignment guidelines	40 pts
Creativity of the Writing	30 pts Original writing, very creative	25 pts Creative but some concerns about overuse of a small number of specific references (should expand net more broadly and better integrate sources)	20 pts Writing is too derivative of existing work and does not add enough insight beyond just repeating long passages from existing sources	0 pts Assignment is not creative or significant accidental or intentional plagiarism is detected (if severe, may result in a 0 for the assignment and/or referral)	30 pts
Overall Coherence and Clarity of the Main Body	20 pts Writing is clear and compelling with no or few errors	15 pts Writing has some significant errors; please make sure to proofread carefully	10 pts Writing is problematic enough that its meaning is frequently unclear	0 pts Writing is not clear or compelling	20 pts
Overall Coherence and Clarity of the References	10 pts Cites at least 20 references including at least 10 outside scholarly readings and correctly applies APA format	8 pts Cites at least 20 references including at least 10 scholarly readings but has significant errors in use of APA format	5 pts Cites fewer than 20 references OR fewer than 10 are scholarly outside readings	0 pts No references cited	10 pts
					Total Points: 100

Final Grade (available in Canvas):

Letter grades will be assigned based on the points that students will have received by the end of the semester:

A	94-100	B+	87-89	C+	77-79	D+	67-69	F	0-60
A-	90-93	B	84-86	C	74-76	D	64-66		
		B-	80-83	C-	70-73	D-	60-63		

Edx Grade (for your certificate):

Please note that the Edx grade cannot be broken down into more than five. Your final grade will be displayed in UT Canvas and not on Edx's grade report.

ACADEMIC DISHONESTY: It is expected and desirable that we use others' findings to inform our own work for a given assignment or task. This means knowledge is being shared and applied. However, a bright line separates the appropriate use and acknowledgement of another's work from plagiarism, the inappropriate presentation of another's work or ideas as one's own. With full text reports, articles, and presentations available on the internet, it is easy to borrow another's words and ideas inappropriately, whether inadvertently or deliberately. Technology makes plagiarism easy to do and easy to detect.

Please familiarize yourself with The University Honor Code and its provisions. This link is a place to start: http://deanofstudents.utexas.edu/conduct/academicintegrity.php

It is your responsibility to know what "scholastic dishonesty" is and to take steps to avoid it. Examples include: submission of similar written assignment for two classes without the prior permission of the instructor; copying from another student's test, paper, project, or other assignment; and, plagiarism. ***Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University.***

Failure to meet academic dishonesty would be given more than scholastic penalties.

ACADEMIC HONESTY STATEMENT
The online course format allows for multiple methods of identity verification, collusion, collaboration and plagiarism monitoring and detection. A violation of the course policy may include (but is not limited to) the following:

- Providing your UT EID to any other person
- Collaborating or sharing information with another person regarding the material on any quiz, assessment or assignment, before, during and/or after any quiz, assessment or assignment
- Recording any quiz, assessment or assignment material in any format
- Posting any quiz, assessment or assignment material in any format to a public forum.
- Failing to properly cite language, ideas, data, or arguments that are not originally yours
- The public (such that it can be viewed by more than one person) posting of any form of a test bank or group of questions from any assignment
- **Consulting forbidden materials or sources of information.**
- **The University of Texas at Austin Academic Integrity Principles call for students to avoid engaging in any form of academic dishonesty on behalf of yourself or another student. Grade-related penalties are routinely assessed ("F" in the course is not uncommon), but students can also be suspended or even permanently expelled from the University for scholastic dishonesty.**

If you have any questions about what constitutes academic dishonesty, please refer to the Dean of Students website or contact the instructor for this course.

You must agree to abide by the Honor Code of the University of Texas. You will not work with or collaborate with others in any way while completing any of the graded course assignments, unless the course or assignment makes specific allowances for group work. **You will be signing a form in week1.**

ETIQUETTE STATEMENT
When corresponding any method used in this course, be mindful that your comments remain respectful of others and relevant to the course content. We don't want to discourage students from posting any comments that are related to this course, even if not directly covered in the course materials. **We do, however, expect that your comments will be respectful and considerate of others.**

To this end, we require that when students communicate in this class, they do so in a way that clearly identifies them to the instructor and, ideally, to other students.

The course discussion forum is not a place for secondary discussions about culture, politics, sports, etc. It is also not appropriate to use the discussion forum as a place to post personal attacks on fellow classmates or the instructional team, profanity, or other individual complaints about the course, including grading issues. If you have a specific issue with the course or a grade you received, you are free to discuss it privately with the instructor or a teaching assistant.

If you post something that the instructor determines to be either disrespectful or off-topic, your post may be removed. If you continue to post inappropriate content, you may be banned from the platform and/or subject to other disciplinary action(s).

Students are expected to abide by a code of collegial respect and sensitivity towards their classmates and the instructional team. Please respect the right of everyone in this class to ask questions and discuss their thoughts about the subject matter of our course without fear or concern. **You will be signing a form in week1.**

Q Drop Policy

If you want to drop a class after the 12th class day, you'll need to execute a Q drop before the Q-drop deadline, which typically occurs near the middle of the semester. **We do not allow Q drop after the 12th class day.** Under Texas law, you are only allowed six Q drops while you are in college at any public Texas institution. For more information, see: http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop

Title IX Reporting

Title IX is a federal law that protects against sex and gender based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When sexual misconduct occurs in our community, the university can:

1. Intervene to prevent harmful behavior from continuing or escalating.
2. Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
3. Investigate and discipline violations of the university's relevant policies.

Faculty members and certain staff members are considered "Responsible Employees" or "Mandatory Reporters," which means that they are required to report violations of Title IX to the Title IX Coordinator. I am a Responsible Employee and must report any Title IX related incidents that are disclosed in writing, discussion, or one-on-one. Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you want to speak with someone for support or remedies without making an official report to the university, email advocate@austin.utexas.edu For more information about reporting options and resources, visit titleix.utexas.edu or contact the Title IX Office at titleix@austin.utexas.edu.

The following recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767, http://www.utexas.edu/safety/

This course does have a textbook titled "Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow"; however, it is not required for the course and you do not need to purchase it. All necessary materials will be provided in the course lectures and labs.

Readings:

- **Books**:
  1. Mathur, Puneet. Machine Learning Applications Using Python: Cases Studies from Healthcare, Retail, and Finance. Apress, 2018.

  2. Zheng, Yu. *Urban computing*. MIT Press, 2019.

  3. Bandyopadhyay, M., Rout, M. and Satapathy, S.C., Machine Learning Approaches for Urban Computing.

  4. Hastie, T., Tibshirani, R. and Friedman, J., 2009. *The elements of statistical learning: data mining, inference, and prediction*. Springer Science & Business Media.

  5. Zin, T.T. and Lin, J.C.W., 2018. Big Data Analysis and Deep Learning Applications. In *Conference proceedings ICBDL* (p. 12).

  6. Yamagata, Y. and Seya, H. eds., 2019. *Spatial analysis using big data: Methods and urban applications*. Academic Press.

  7. Kirwan, C.G. and Fu, Z., 2020. *Smart Cities and Artificial Intelligence: Convergent Systems for Planning, Design, and Operations*. Elsevier.

- **Scientific Papers**:

  1. Jiao, J., *Azimian, A.,* (2021).Measuring Accessibility to Grocery Stores Using Radiation Model and Survival Analysis. *Journal of Transport Geography.* *https://www.sciencedirect.com/science/article/pii/S0966692321001605*

  2. Jiao, J., *Azimian, A.,* (2021). Who Are Teleworking During the COVID-19 Pandemic. *Transport Findings*. https://findingspress.org/article/23573-socio-economic-factors-and-telework-status-in-the-us-during-the-covid-19-pandemic

  3. *Bai, S.,* Jiao, J., *Chen, Y., Guo, J.,* (2021). The Relationship Between E-scooter Travels and Daily Leisure Activities in Austin, Texas. *Transportation Research Part D*. https://www.researchgate.net/publication/351172020_The_relationship_between_E-scooter_travels_and_daily_leisure_activities_in_Austin_Texas

4. Jiao, J., *Azimian, A.*, (2021). Exploring the Factors Affecting Travel Behaviors During the Second Phase of the COVID-19 Pandemic in the United States. *Transportation Letters: the International Journal of Transportation Research.*

5. Jiao, J., *Hansen, K., Azimian, A.*, (2021). Land Value Impacts of Airbnb Listings on Single-Family Homes in Austin, Texas, USA. *International Journal of Housing Markets and Analysis.*

6. Jiao, J., *Bhat, M., Azimian, A.*, (2021). Measuring Travel Behavior in Houston, Texas with Mobility Data During the 2020 COVID-19 Outbreak. *Transportation Letters: the International Journal of Transportation Research.*

7. *Bai, S.*, & Jiao, J. (2021). Mining Heterogeneous Impact of Destination Attributes in Travel Demand Forecast for Different Urban Districts: A Deep Learning Approach. *Transportation Research Record: Journal of Transportation Research Board.*

8. *Feng, C.*, & Jiao, J. (2021). Predicting and mapping neighborhood-scale health outcomes: A machine learning approach. *Computers, Environment and Urban Systems*. https://doi.org/10.1016/j.compenvurbsys.2020.101562

9. *Feng, C.*, Jiao, J. and Wang, H. (2020).Estimating e-scooter traffic flow using big data to support planning for micromobility. *Journal of Urban Technology.* https://doi.org/10.1080/10630732.2020.1843384

10. Jiao, J. & Wang, F. (2020).Shared Mobility and Transit-dependent Population: A New Equity Opportunity or Issue? *International Journal of Sustainable Transportation*. https://doi.org/10.1080/15568318.2020.1747578

11. Jiao, J., & *Bai, S.,* (2020). Understanding the Shared E-scooter Travels in Austin, TX. *ISPRS International Journal of Geo-Information. 9*(2), 135; https://doi.org/10.3390/ijgi9020135

12. Boeing, G., Wegmann, J., & Jiao, J., (2020). Rental Housing Spot Markets: How Online Information Exchanges Can Supplement Transacted-Rents Data. *Journal of Planning and Education Research.* https://doi.org/10.1177/0739456X20904435

13. Jiao, J., & *Bai, S.*, (2020). An Empirical Analysis of Airbnb Listings in Forty Major American Cities, *Cities.* https://doi.org/10.1016/j.cities.2020.102618

14. Jiao, J., *Bischak, C., Hyden, S.,* (2020). The Impact of Shared Mobility on Trip Generation Behavior in the US: Findings from the 2017 National Household Travel Survey. *Travel Behaviour and Society.* 19, 1-7. https://www.sciencedirect.com/science/article/abs/pii/S2214367X19300687

15. Jiao, J., Holmes, M., & Griffin, G. (2017). Revisiting Images of the City in Cyberspace: Analysis of Spatial Twitter Messages During a Special Event. J*ournal of Urban Technology*. DOI:10.1080/10630732.2017.1348881.

16. Berkhahn, S., Fuchs, L., & Neuweiler, I. (2019). An ensemble neural network model for real-time prediction of urban floods. Journal of hydrology, 575, 743-754. https://www.sciencedirect.com/science/article/pii/S0022169419305116

17. Huang, B., Zhao, B., & Song, Y. (2018). Urban land-use mapping using a deep convolutional neural network with high spatial resolution multispectral remote sensing imagery. Remote Sensing of Environment, 214, 73-86. https://www.sciencedirect.com/science/article/pii/S0034425718302074

18. Liu, Z., Li, Z., Wu, K., & Li, M. (2018). Urban traffic prediction from mobility data using deep learning. IEEE Network, 32(4), 40-46.

19. Maharana, A., & Nsoesie, E. O. (2018). Use of deep learning to examine the association of the built environment with prevalence of neighborhood adult obesity. JAMA network open, 1(4), e181535-e181535.

20. Song, C., Kwan, M. P., Song, W., & Zhu, J. (2017). A comparison between spatial econometric models and random forest for modeling fire occurrence. Sustainability, 9(5), 819. https://www.mdpi.com/2071-1050/9/5/819