

*Carnegie Mellon University*

**Fall 2023 Mini II: 94-845/12-645**

Smart Cities: Growth with **Intelligent Transportation Systems**

**Lecture:** Thursdays, 6:40pm–9:30pm, HbH 2008, In-Person meetings

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**Instructor:**

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**Sean Qian**

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Office hours: Thursdays, 12-1 (starting from Nov 2) or by appointment

**Zulqarnain Khattak**

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**TA:**

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**Lindsay Graff**

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TA office hours will be announced later on Canvas

**Canvas**

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Canvas organizes this course. All course materials will be posted to Canvas ([www.cmu.edu/canvas](http://www.cmu.edu/canvas))

**Office Hours:**

Prof. Sean Qian holds weekly Office Hours: Thursdays 12-1, from Nov 2, 2023 to Dec 7, 2023. Office hours will be held in person, and Zoom meetings can be also available during the office hours upon request. **If you plan to come to the office hours, please email Prof. Qian to confirm in advance.**

## **Student well-being:**

Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website <http://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

## **Diversity and Inclusion:**

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment. Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

- Center for Student Diversity and Inclusion: [csdi@andrew.cmu.edu](mailto:csdi@andrew.cmu.edu), (412) 268-2150
- Report-It online anonymous reporting platform: [reportit.net](http://reportit.net) username: tartans password: Plaid

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.

## **Course Context**

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Cities all around the world are being built and re-invented as smart cities utilizing information systems and innovative applications of data analytics. One major smart cities component is

transportation. The Intelligent Transportation Systems (ITS) industry is expected to grow at a rate of 4% per year and reach \$37 Billion in annual investment by 2027 (Reportlinker, 2021). This shifting dynamic provides great opportunity for improved transportation safety and efficiency but also poses challenging information systems and public policy challenges. Furthermore, there are new opportunities for professional-school graduates outside of engineering schools for employment in transportation planning and policy.

This course is supported by CMU's Traffic21 Institute and Safety21 National University Transportation Center. Classes will feature guest lectures provided by Traffic21/Safety21 faculty and industry and government ITS professionals.

## Course Objectives

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- Develop an understanding of the underlying dynamics of the smart cities trend and how ITS is integrated. Smart Cities components in addition to transportation include; energy systems, health and human services, water and sewer infrastructure, public safety, etc.
- Develop an understanding of the various components of ITS. Examples of ITS components included; autonomous and connected vehicle technology in vehicles and between infrastructure and vehicles, real-time sensing of infrastructure, artificial intelligence to analyze data, information dissemination, shared mobility services, etc.
- Develop an understanding of the various applications/systems of ITS on the local, state, national and international levels. Examples of ITS applications include: advanced traffic control system, automatic road enforcement (variable speed limits, electric toll collection), intelligent public transportation system, transportation demand management, intelligent parking management system, multi-modal traveler information systems, etc.
- Synthesize and analyze ITS policy and understand the technology challenges. Examples of current technology challenges include inadequacy of GPS positioning distribution of safety certificates. Policy challenges include; privacy, liability, tax equity, social acceptance of technology, etc.
- Develop hands on experience of ITS concepts by applying them to scenarios such as the City of Pittsburgh's smart transportation plans.

## Course Format

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Each of the class meetings will focus on a particular topic of ITS. To pursue the course objectives most effectively you will be asked to accomplish the following:

- 1) Read the assigned article(s) or technical report(s) in advance,
- 2) Attend guest lectures provided by the instructors, industry and government ITS professionals,
- 3) Participate in the discussion for ITS issues and case studies,

- 4) Prepare weekly reflections after each class and turn in by Wednesday midnight,
- 5) Hand in a final project report and present your project in the end of the course.

## Grading:

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Your course grade will be based on the following team and individual activities and weights:

### Team:

Final Project (proposal due 11/20 accounts for 10%)	50%
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### Individual:

Four Weekly Reflections (Due on Wednesdays by Midnight)	40%
Class Participation	10%
Total:	100%

## Textbook

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There is no textbook for this course. Materials will be posted on Canvas as needed.

## Final Project

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All students will be expected to complete a semester project on a topic of their choice in transportation systems. Because I am convinced that you can learn a great deal in this course by working with your fellow students, you are encouraged to work in teams of three or four. Each group would need at least one engineer (or computer scientist) and one policy analyst (or social scientist). For those of you that have trouble selecting a topic, we will brainstorm some ideas in class. In the meantime, you might begin to consider potential topics and groups. Expectations on the project work will change based on the number of group members. Groups will present oral summaries of their work during the last class session and will submit written reports. Each group member will need to present his/her work as part of the group presentation.

Your group may choose to do an in-depth project on any of the above applications. Your group may also develop your own project. A project report is to be submitted by Dec 09. The project must include both technology and policy components. Please work closely with the instructors and the TA to develop your project ideas if needed.

**Your project needs to address a real-world challenge.** Possible project topics include, but are not limited to:

- A critical review of an ITS application with proposed future research framework
- Cost/benefit analysis of an ITS component or application

- A state-of-the-art review of an ITS component or application, and its future development
- How can an ITS component or application be implemented to achieve sustainable mobility?
- How can an ITS component or application help to manage transportation demand efficiently (e.g., congestion pricing, parking pricing)?
- How does an ITS component or application affect the long-term land-use development, urbanization or transit-oriented development?
- Data Analytics and its applications in an ITS to address a specific real-world problem.

Appearing below is the grade sheet that will be completed for each project. Make sure your project has all the elements listed.

Item	Possible	Score
Oral Presentation	10	
Statement of Problem/Goal/Background	4	
Literature Review	4	
Research Approach	2	
Analysis	7	
Results	7	
Conclusions	4	
Limitation and Future Work	2	
Total	40	

A one-pager project proposal is due Nov 18 5pm. The proposal accounts for 20% of the final project, namely 10% of the course grade. The proposal should have the following elements:

Item	Possible	Score
Statement of Problem/Goal/Background	2	
Expected Research Approach	2	
Expected Results/Outcomes	2	
A list of potential readings and/or data sets	2	
Task description for each group member	2	
Total	10	

## COURSE CALENDAR

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### MODULE 1: Why Smart Cities, Why ITS, Why Now?

- 10/26 Course overview, Smart Cities overview (6:40-7:10)  
Guest lecture and Q&A (7:15- 8:15)  
Lecture and discussions: Smart cities; ROW permitting and EV charging (8:25-9:20)  
Introduction to intelligent sensing (9:20-9:30)
- Guest Speaker: Chase Klingensmith (City of Pittsburgh Department of Innovation and Performance)

### MODULE 2: Technology in ITS

- 11/02 Intelligent sensing
- Guest lecture and Q&A (6:40- 7:40)  
Lecture: Intelligent sensing (7:50-8:50)  
Discussions: Opportunities and challenges of smart sensing (8:50-9:20)  
Introduction to connected vehicles (9:20-9:30)
- Guest Speaker: Christoph Mertz (RoadBotics by Michelin)
- 11/09 Autonomous and Connected Vehicles, applications of V2I and V2V
- Lecture: Connected automated vehicles: basics (6:40- 7:40)  
Lecture: Connected automated vehicles: applications and policies (7:50-8:50)  
Discussions: The future of autonomous vehicles (8:50-9:20)  
Introduction to demand management (9:20-9:30)
- Guest Speaker: Zulqarnain Khattak (CMU, Former DOE R&D staff scientist)

### MODULE 3: Applications of ITS that bring intelligence to the travelers and managers

- 11/16 Travel Demand Management and Traveler Information Systems
- Guest lecture and Q&A (6:40- 7:40)  
Lecture: Travel demand management (7:50-8:50)  
Discussions: ITS and demand management; TDM for Philadelphia downtown (8:50-9:20)  
Introduction to transportation data analytics (9:20-9:30)

- Guest Speaker: Naveen Lamba (Guidehouse)

**11/20 Term project one pager proposal due 5pm**

11/30 Data Analytics, System Modeling; Shared Mobility Services

Guest lecture and Q&A (6:40- 7:40)

Lecture: Transportation system modeling and data analytics (7:50-8:50)

Discussions: Shared mobility and data; Transportation solutions for CMU (8:50-9:20)

Introduction to traffic control systems (9:20-9:30)

- Guest Speaker: Rylan Seifert (City of Pittsburgh Department of Mobility and Infrastructure)

#### **MODULE 4: Project presentations**

12/07 Term project presentations (6:40-9:30) **(may be extended depending on the number of teams)**

12/10 Term project report due midnight