Arizona State University
CEE 598: Transportation Modeling and Simulation, 2018
Tuesday, Thursday, 07:30 PM-08:45 PM, CAVC455

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Co-Instructor: Jiangtao (Tony) Liu, jiangtao.liu@asu.edu Office: CAVC 321: Office Hours: T, TH 11AM -12PM noon
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Course Overview

Students will develop a deep understanding on the major topics of network modeling and optimization, stochastic system analysis, transportation simulation. Students will be able to apply stochastic, simulation and optimization models to analyze and improve the performance of dynamic transportation systems with multiple origin-destination pairs, a large number of agents (travelers, pedestrian, vehicles and service providers) on congested corridors and networks. The simulation tools to be used in this class include (1) models that the students develop in the class, (2) DTALite, and (3) VISSIM.

Reference books

(1) Urban Operations Research Hardcover – by Richard C. Larson and Amedeo R. Odoni
http://web.mit.edu/urban_or_book/www/book/
(2) Tentative book: Transportation Modeling and Simulation: Theory and Applications
(3) Multi-agent transportation simulation by Kai Nagel (2004)

Software Packages
GAMS: https://www.gams.com/; DTALite/NeXTA: https://github.com/xzhou99/dtalite_software_release
VISSIM: http://www.vissim.com/

Selected research papers and handouts will be distributed in class, such as reference manual for VISSIM

Course Requirements/Evaluation/Grading

7 weekly homework assignments	70 %
Mid-term (open-book, in person with professor)	10%
Final examination (open-book, in person with professor)	15%
Group presentation and paper	5%

Grading

A	A-	B+	B	B-	C+	C	C-
92	90	85	80	77	75	67	65
100	92	90	85	80	77	75	67

Topic No.	**Specific Topics**	**C++ implementation (advanced programming)**	**Homework: Model, pseudo code for algorithms, implementation (e.g., in Excel, GAMS, and Visual C++), test cases and report**
1. Introduction to Optimization Models	Linear programming 1: Linear programming 2: Excel and Integer programming, GAMS software package	Read and display network, OD matrix, path, and flow assignment Input_node, input_link, input demand, input_agent	**HW 1: DTALite and NEXTA** **HW 2: Transportation Optimization models** Transportation problem, Assignment problem, Shortest path problem

		(familiar with NEXTA visualization) DTALite introduction	If-then constraints in location applications Implemented in both GAMS and Excel
2. Network algorithms and applications	Shortest path applications Label correction Algorithm Vehicle Routing Problem 1 (introduction) Vehicle Routing Problem 2 (insertion algorithm and swapping algorithm) (Ch 6 of Urban Operations Research)	Label correcting algorithm for large scale network Lagrangian relaxation (Advanced) Vehicle routing in dynamic programming framework	**HW 3:** Shortest path formation Implemented in Matlab or C++ Vehicle routing formulation Solved in GAMS (read the sample code in C++)
3. Probability and queuing theory	Review of probability and statistics Random distributions Queuing theory and M/M/1 queues Queuing theory and cumulative flow counts	Bottleneck simulation Implement a single deterministic queueing model in C++	**HW 4:** Mean and Variance Arrival and departure as Poisson and exponential distributions Queue model (workzone or toll plaza) Queue implement in Excel
4. From discrete event simulation to agent-based traffic simulation	Introduction for simulation Discrete-event simulation Random number generation, Queueing related performance evaluation	Discrete event simulation Random number generation, Stochastic queueing related performance evaluation Vehicle generation in DTALite	**HW 5:** Random number generation and statistics testing (uniform) in Excel Random number generation (Normal and Lognormal) in Excel Queue implement in Matlab or C++
5. World for agents: Spatial and temporal representation for transportation systems	Car following model VISSIM 1 VISSIM 2 Traffic network assignment	Static Traffic Assignment in Excel, in GAMS, and in C++	**HW 6:** Car following summary Car following in Excel VISSIM test networks Traffic Assignment in GAMS
6. Network Simulation and route assignment and routing applications	Workzone applications Signal application Tolling and traveler information provision application Vehicle routing for mobility as services Mobility as service simulation	Scenario testing Calibration and Validation OD demand estimation Vehicle routing in C++	**HW 7:** (In DTALite) Workzone applications Signal application Tolling and traveler information provision application Vehicle routing for mobility as services

	August 2018							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	**Weekend teaching Video**
		13	14	15	16 Introduction	17 **Release HW1**	18	**DTALite and Nexta**
1		20	21 Linear programming 1	22	23 Linear programming 2	24 **Release HW2**	25	

					HW 1			
2		27	28 Excel and Integer programming	29	30 GAMS software package	31 **Release HW3**		**C, python for transportation optimization,** **Reading and display network**
	September 2018							
	Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	
							1	**Label correcting algorithm**
1		3	4 Shortest path applications	5	6 Label correction Algorithm **HW 2**	7	8	**Lagrangian relaxation (advanced)**
2		10	11 Vehicle Routing Problem	12	13 Vehicle Routing Problem 2	14 **Release HW4**	15	**Vehicle routing algorithm**
1		17	18 Review of probability and statistics	19	20 Random distributions **HW 3**	21	22	**Bottleneck simulation**
2		24	25 Queuing theory and M/M/1 queues	26	27 Cumulative flow counts	28 **Release HW5**	29	**Single deterministic queueing**
	October 2018							
	Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	
1		1	2 Introduction for simulation	3	4 Discrete-event simulation **HW 4**	5	6	**Discrete event simulation**
2		8	9 Fall break	10	11 **In-class midterm exam**	12	13	**Random number generation**

3		15	16 Random number generation	17	18 Queueing related performance evaluation **HW 5**	19 **Release HW6**	20	**Vehicle generation in DTALite**
1		22	23 Car following model	24	25 VISSIM 1	26	27	**Static Traffic Assignment in Excel**
		29	30 VISSIM 2	31				
	November 2018							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
					1 Traffic network assignment **HW6**	2	4	**Static Traffic Assignment in GAMS**
		5	6 Workzone applications	7	8 Signal application	9	11	**Static Traffic Assignment in C++**
	Release HW7	12	13 Tolling and traveler information	14	15 Vehicle routing for mobility as services **HW7**	16	17	**OD demand estimation**
	Release HW8	19	20 **Mobility as service simulation**	21	22 Thanksgiving	23	24	**Scenario Testing**
Final week Literature review paper		26	27 Student presentation	28	29 Student presentation	30		