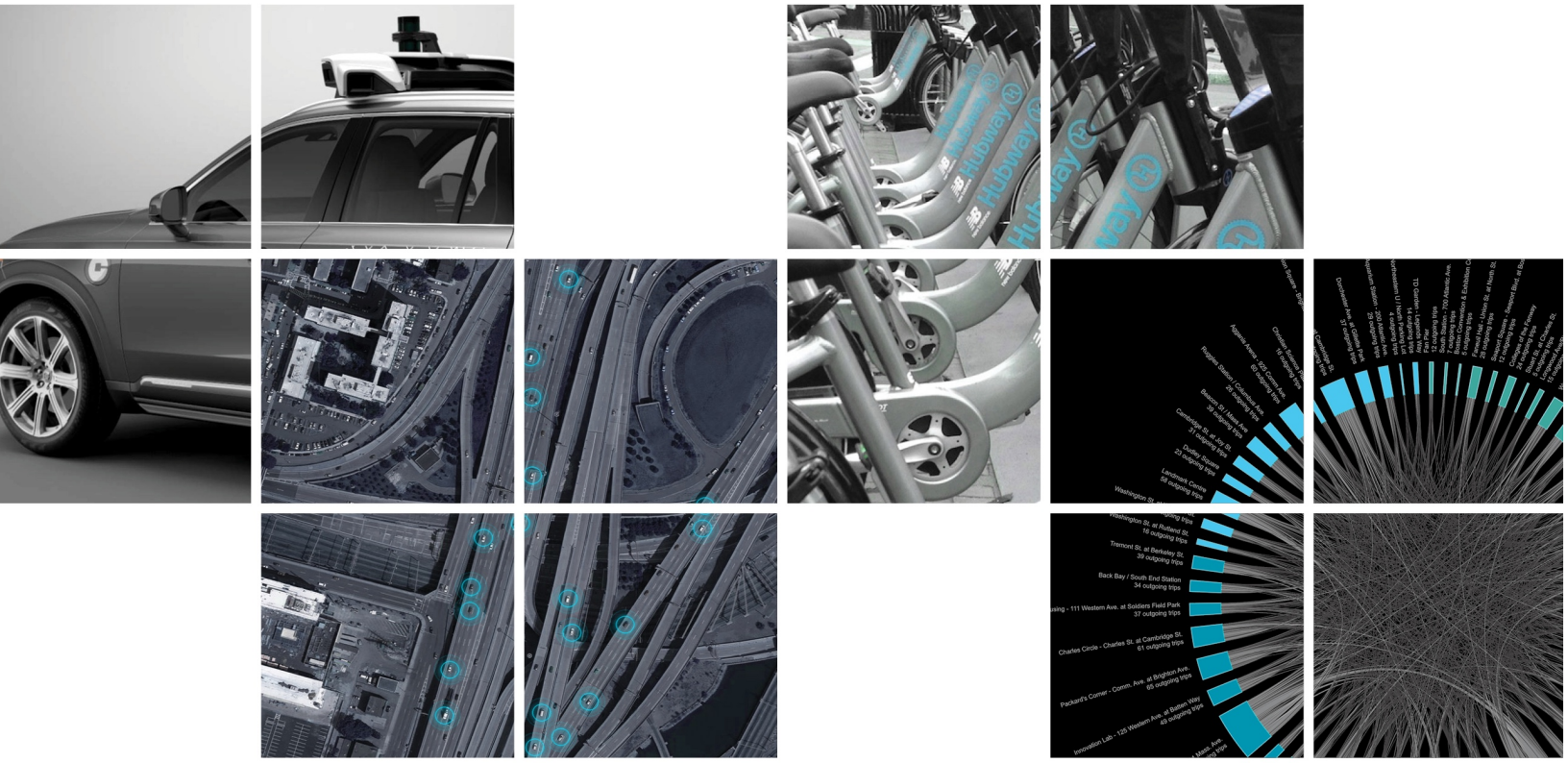
ARCH7211: CONNECTIVE ENVIRONMENTS 2

DESIGN COMPUTATION STUDIO LAB

Tue/Thu 10:00am-12:30pm DARTS and studio space.
Course Instructor: Dr. Dimitris Papanikolaou / dpapanik@uncc.edu / Urban Synergetics Lab / Office: Storrs 146
Teaching Assistant: Atefeh Mahdavi Goloujeh / amahdavi@uncc.edu
Course website: TBD
Office Hours: Wed (by appointment).



PREMISE

The deeper information technology penetrates urban life, the more pressing is the urgency for architects, engineers, and planners not only to design more intelligent and participatory systems but also to understand their complex emerging behavior. During the past decades, the design of “smart” urban environments followed a command-and-control approach in which the city is seen as a commander for serving the needs of its users. Today, widespread expansion of computing, and simultaneous sharing of resources between people, makes this approach increasingly infeasible for the simple reason that the needs and wants of one individual may often conflict those of another.

The course investigates design, engineering, and empirical assessment of participatory cyberphysical systems of common pool resources. We will look at how information, human behavior, and physical constraints, shape the capabilities of cyber-physical sociotechnical systems, and how novel interactive technologies and design strategies may enhance them. We envision a future in which coordination emerges collectively from how humans interact with data, with and through the physical environment. Towards this goal, students will prototype enabling hardware and software technologies to connect humans, objects and places; they will design control mechanisms across scales to drive human behavior towards desired collective outcomes; and they will test these ideas through strategic game experiments.

Some provocative questions we will draw inspiration from (but we will not prove) are: Can self-governed MoD systems outperform autonomous centrally-controlled MoD systems? Is it possible to have low-tech intelligent MoD systems in which information propagates physically with the vehicles? Can the built environment manifest and communicate information physically in large participatory systems?

The studio lab will reimagine the future of shared urban mobility through the context of autonomous vehicles, complex human-in-the-loop systems, self-organization, social cooperation, and how in general, the design of urban form affects design and performance of the next generation of shared mobility systems. Moreover, we will brainstorm ideas for how shared mobility networks can be designed and used for other functions in cities, in addition to transporting people, to transporting goods.

This course is interdisciplinary. We will cover topics on information and communication technology, data visualization, systems theory, game theory, behavioral economics and mechanism design, ecology, and interaction design. You are expected to be highly motivated and find resources online on your own. We will not have the time to cover in depth all topics, tools and resources in class.

PREREQUISETS

Connective Environments 1 or prior experience with physical computing, sensors, and basics of server programming. If all these are new to you, you must team up with a student whose experience meets these requirements.

METHOD

The course combines lectures, discussions, lab assignments, readings, and student presentations, and is organized into four projects and one final paper. Each student will develop a website to document projects and weekly progress. Class meets twice per week and has one lab session (TBD). Lab assignments introduce core technologies. Final project integrates skills critically in a real architectural context that engages one or more individuals to interact with/through it. Final paper will be of publishable quality at the level of the ACM SIGCHI conferences.

TENTATIVE SCHEDULE

Weeks 01-02: Smart Cities, Mobile devices, User Interfaces, and Real Time Mapping
Weeks 03-05: Linking people, objects, and places: Creating a cyberphysical ecosystem
Weeks 06-09: Orchestrating Collective Behavior: Strategic Games, Game Theory, and Mechanism Design
Weeks 10-16: Project Development, Deployment, Experiment, and Analysis.

ASSIGNMENTS

Assignment 1 (5 days): Find and present a large-scale cyber physical participatory system. What are the components, who are the stakeholders, what are their interests, what is the feedback loop?
Assignment 2 (1 week): Create a real time map of UNCC campus or of Charlotte using real geolocation data from bikes.

Assignment 3 (3 weeks): Extend the provided network-based application platform and develop a human-device network that can exchange messages in any possible way (device-to-device, device-to-human, human-to-human, human-to-device). Implement a simple function in the microcontroller so that it updates a map and also informs users accordingly.
Assignment 4 (4 weeks): Design a participatory strategic game that involves people and places (such as a market mechanism) and its rules, such that once played iteratively by selfish individuals (each one unaware of the presence of the others), it converges to an equilibrium that you have already predefined.
Assignment 5 (8 weeks): Design, develop, implement, and test, a large scale multi-user cyberphysical participatory urban system. This can be a technology/system that helps people achieve something, a landscape-scale art installation, or anything you can imagine that connects humans, objects, landscapes, into an iterative feedback loop.

TOPICS

- Intelligent Shared Mobility Systems
- Intelligent Freight Transportation Systems
- Increasing awareness

LEARNING OBJECTIVES

By the end of the course you should:

- Practical knowledge of how to design, deploy, large-scale cyber-physical participatory network-based applications.
- Basic skills on urban sensing and urban computing
- Basic understanding of Game Theory and Mechanism Design
- Create online real-time maps
- Critically assess not only benefits but also limitations of intelligent systems

Also:

- Develop a strong thesis statement and be able to position it critically within the architecture/technology discourse
- Work independently by cultivating a learning-through-making approach to design
- Become comfortable working within unknown fields of knowledge
- Think out of the box and challenge pre-established notions about design and technology

Course Overview and Approach

The course combines lectures, discussions, and technical skill workshops. The course is organized into four thematic parts: The first part is a critical introduction to smart cities. The second part is a hands-on approach on developing networked technologies for connecting people, objects, and places. The third part introduces game theory and mechanism design (also called social engineering). The fourth part is the development of final projects.

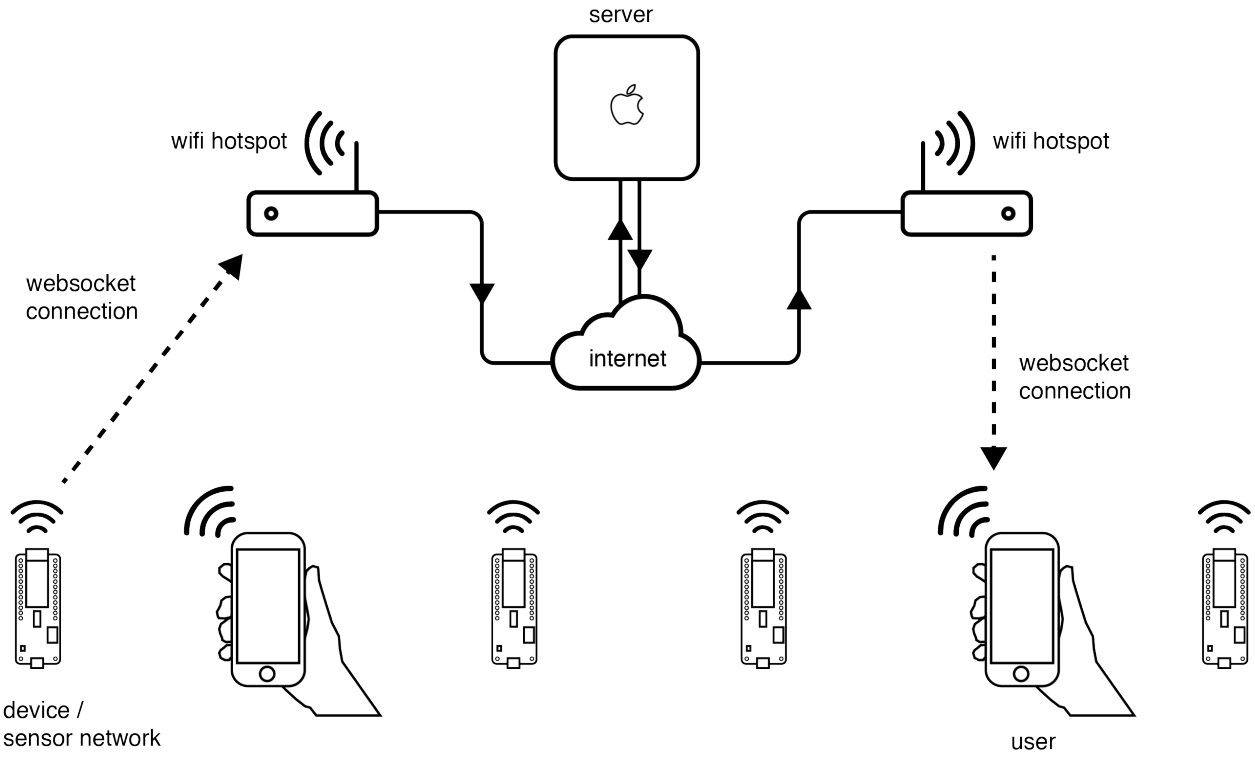
Readings
All weekly assignments are due the beginning of next class.

CYBER PHYSICAL PARTICIPATORY SYSTEMS

A cyberphysical system (CPS) is a cybernetic system that links the physical and digital worlds. Cybernetic systems are feedback systems (e.g. systems that contain at least one control loop) that link information from past actions to drive decisions for future actions. A cyber physical participatory system (CPPS) is a CPS that involves participation of multiple humans.

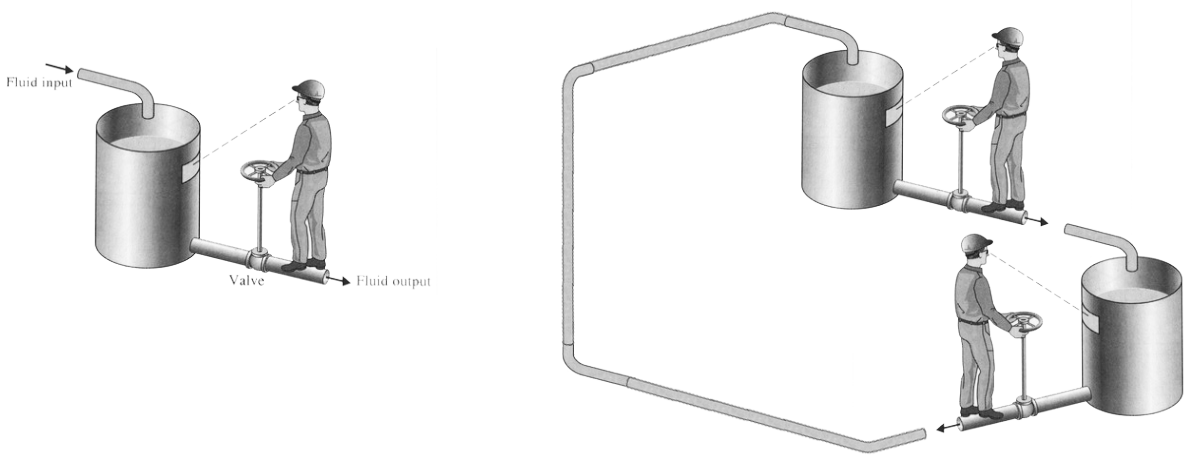
NETWORK-BASED APPLICATION

Dynamic networked applications allow connected users to exchange information in real time. Working in teams you will learn, adopt, and extend, an online multi-user participatory cyber physical platform consisting of a server that can connect users and devices in a peer-to-peer manner. The platform will be provided by the Urban Synergetics Lab, and students are expected to expand it and adjust it according to their projects. The platform is based on web technologies Node.JS/Express.JS and Socket.IO. Node.JS and Express.JS is a No-SQL JavaScript-based template to build asynchronous servers. One of its benefits compared to SQL servers, besides the fact that is asynchronous, is that it uses the same programming language as the front-end side. This allows a developer (you) to use the same programming language for all components of a dynamic network application. In its simplest form, a cyberphysical participatory platform consists of a number of microcontrollers and a number of users that are all networked through a server and can exchange messages. From the point of view of the server, a client can be a human or a device with no difference between the two.



GAME THEORY AND MECHANISM DESIGN

Game Theory studies strategic situations between two or more individuals in which the decisions of one individual affect the options (and thus decisions) of the others. Game Theory asks the question: if all individuals involved in the strategic situation act selfishly, in what state will the system reach during equilibrium? Mechanism Design (or Inverse Game Theory) studies the opposite question: if we want a group of individuals to reach a predefined state of equilibrium, how should we design the rules or policies that affect their decisions and interactions?



Consider the two individuals in the above figure. Assume that each of them wants his tank to contain as much water as possible. Each individual can control only the outflow but not the inflow. Suppose initially, that each of them is unaware of the presence of the other; what will they do? Suppose next that each of them is aware of the presence of the other. What will they do now?

CONTEXT/SITE/AREA OF STUDY

The studio lab will use Charlotte's North End Smart District (NESD) as an area of study. This will provide the context for your project. You are free to design any system within this area as long as it is a **closed system**. A closed system is a system whose components do not increase or increase, over time, within its boundary. You are responsible to find the necessary data, drawings, any other contextual information for your site.

GUEST TALKS (TBD)

COST

You will be building in teams an interactive system consisting of Arduinos, RFID sensors, or other means of interaction. The cost of your project will depend on your decisions and the technical means you will choose.

DOCUMENTATION

You are expected to document your progress in the class's blog and participate in the discussions. Make sure you cite the sources of your code, ideas, inspirations and techniques. Other people must be able to read your posts and find your resources.

TEXTBOOK & ONLINE RESOURCES

There is no required textbook. Most readings will come from the books "Networks, Crowds, and Markets: Reasoning about a Highly Connected World", "Reinventing the Automobile", and "ME++". A list of individual readings and links is provided in the syllabus. Additional readings and links to online resources will be provided before each class.

OFFICE HOURS

By appointment, Wednesdays.

CALENDAR

WEEK	Theme	Date	Discussion	Lab	Notes
1	Synergetic Cities				
		Thu Jan 10	Course Introduction From Smart Cities to Cybernetic Cities		Assignment 1 Out
2	Synergetic Cities	Tue Jan 15	Cybernetics Feedback Centralized and distributed systems	Collecting & cleaning data Visualizing data on maps	Assignment 1 Presentations Assignment 2 Out
		Thu Jan 17	Moving and Sharing Intelligent mobility systems	Visualizing data on maps	
3	Connecting people, objects, and places	Tue Jan 22	Cyberphysical systems Human-in-the-Loop systems Anatomy of a cyberphysical system	Designing a Front-End User Interface	Assignment 2 Presentations Assignment 3 Out
		Thu Jan 24		Building a server in Node.JS	
4	Connecting people, objects, and places	Tue Jan 29		Interacting with a Database in MongoDB	
		Thu Jan 31		Chat Room Application using Socket.IO	
5	Connecting people, objects, and places	Tue Feb 05		Sending/Receiving Socket Messages with a Microcontroller	
		Thu Feb 07			
6	Orchestrating Collective Behavior	Tue Feb 12	Social Networks Cellular Automata Self Organization Common Pool Resources Causal Loop Analysis	Emergent patterns in multi-agent systems Representing Social Networks	Assignment 3 Presentations Assignment 4 Out
		Thu Feb 14	Game Theory Strategic Games Prisoner's Dilemma The Tragedy of the Commons	Examples in NetLogo	First Course Evaluation
7	Orchestrating Collective Behavior	Tue Feb 19	Game Theory Zero Sum Games Market Equilibrium	Market Lab in class	
		Thu Feb 21	Mechanism Design (Inverse Game Theory)	Examples in NetLogo	
8	Orchestrating Collective Behavior	Tue Feb 26	Mechanism Design (Inverse Game Theory)	Examples in NetLogo	
		Thu Feb 28	Mechanism Design (Inverse Game Theory)	Examples in NetLogo	Assignment 4 Presentations Assignment 5 Out
9	Spring Break	Tue Mar 05			No Class
		Thu Mar 07			No Class
10	Project Development	Tue Mar 12			Field Trip NESD
		Thu Mar 14			Final Project Proposal Presentations

11	Project Development	Tue Mar 19		Desk Crits	
		Thu Mar 21		Desk Crits	
12	Project Development	Tue Mar 26		Desk Crits	
		Thu Mar 28		Desk Crits	
13	Project Development	Tue Apr 02		Desk Crits	
		Thu Apr 04		Desk Crits	
14	Project Deployment	Tue Apr 09		Desk Crits	
		Thu Apr 11		Project Deployment	
15	Project Development	Tue Apr 16		Project Deployment	
		Thu Apr 18		Experiment	
16	Project Development	Tue Apr 23		Experiment	
		Thu Apr 25			
17		Tue Apr 30			Final Reviews
		Thu May 02			Final Papers

General Required Readings

Readings

Mitchell, William J., Casalegno, Federico. Connected Sustainable Cities. MIT Mobile Experience Lab Publishing, 2008. Link: http://www.connectedurbandevelopment.org/pdf/connected_sustainable_cities.pdf.

Mitchell, William J. Me++: The Cyborg Self and the Networked City. Cambridge, MA: MIT Press, 2003.

Mitchell, William J., Chris E. Borroni-Bird, and Lawrence D. Burns. Reinventing the Automobile: Personal Urban Mobility for the 21st Century. New ed. The MIT Press, 2010. Chapters 1, 3, 8, 9, 10.

David Easley and Jon Kleinberg: Networks, Crowds, and Markets: Reasoning about a Highly Connected World. Cambridge University Press, 2010.

Ascher, Kate. 2007. The Works: Anatomy of a City, edited by Wendy Marech. New York, N.Y., U.S.A.:.

Meadows, Donella, Jorgen Randers, and Dennis Meadows. Limits to Growth: The 30-Year Update. Chelsea Green, 2004.

Minsky, Marvin. The Society of Mind. Simon & Schuster, 1988. Chapters 1,2.

Paul Dourish and Genevieve Bell. 2011. Divining a Digital Future. Mess and Mythology in Ubiquitous Computing. Cambridge: MIT Press.

Arindam Dutta. A Second Modernism: MIT, Architecture, and the "Techno-Social" Moment by Arindam Dutta. MIT Press, 1616.

Carpo, Mario. *The Second Digital Turn: Design Beyond Intelligence*. 1 edition. Cambridge, Massachusetts: The MIT Press, 2017.

Carpo, Mario. *The Alphabet and the Algorithm*. Book, Whole. Cambridge, Mass., 2011.

Greeneld, A. (2013) Against the Smart City (The City Is Here for You to Use). 1.3 edn. Amazon Digital Services, Inc.: Do Projects. Link: https://www.wired.com/2013/02/adam-greenfield-the-city-is-here-for-you-to-use-one-hundred-easy-pieces/

Weekly Readings

WEEK 1

The Anatomy of a Smart City: People, Things, and Bits

The first 3 weeks overview predominant definitions of 'smart cities' in academia and industry focusing on the question: what is intelligent behavior in an architectural/urban context, what components constitute an intelligent system and how does the role of organization, structure, and stakeholder interests affect behavior?

Required Readings

Mitchell, William J., Casalegno, Federico. Connected Sustainable Cities. MIT Mobile Experience Lab Publishing, 2008. Link: http://www.connectedurbandevelopment.org/pdf/connected_sustainable_cities.pdf.

Greeneld, A. (2013) Against the Smart City (The City Is Here for You to Use). 1.3 edn. Amazon Digital Services, Inc.: Do Projects. Link: https://www.wired.com/2013/02/adam-greenfield-the-city-is-here-for-you-to-use-one-hundred-easy-pieces/

Case studies / videos

"Loon." n.d. Loon. Accessed January 9, 2019. https://loon.co/.

"Unparking :: MIT Senseable City Lab." n.d. Unparking :: MIT Senseable City Lab. Accessed January 9, 2019. http://senseable.mit.edu/shareable-parking.

"Roboat:: MIT AMS." n.d. Roboat:: MIT Senseable City Lab AMS. Accessed January 9, 2019. http://roboat.org.

"City Scanner." n.d. Accessed January 9, 2019. http://senseable.mit.edu/cityscanner/.

"Monitour / MIT Senseable City Lab." n.d. Monitour / MIT Senseable City Lab. Accessed January 9, 2019. http://senseable.mit.edu/monitour.

"WaterFly by MIT SENSEable City Lab." n.d. Accessed January 9, 2019. http://senseable.mit.edu/waterfly/.

"Trash | Track." n.d. Accessed January 9, 2019. http://senseable.mit.edu/trashtrack/.

Tech Insider. n.d. *Inside A Warehouse Where Thousands Of Robots Pack Groceries*. Accessed January 9, 2019. https://www.youtube.com/watch?v=4DKrcpa8Z_E&feature=youtu.be.

Business Insider. n.d. *Inside Alibaba's Smart Warehouse Staffed by Robots*. Accessed January 9, 2019. https://www.youtube.com/watch?v=FBl4Y55V2Z4.

Assignment 1

Find and present a network participatory project. What does the system do? How does it do it? Who are the key participants and what are their motivations? What is the conflict about? What is a possible solution to the problem?

WEEK 2

Real Time Cities / Moving and Sharing

This week explores the role of information transparency and real time feedback. This week also explores the concept of resource sharing, the evolution of on-demand mobility, its challenges, and how novel autonomous technologies and design strategies may help overcome them. Come prepared to discuss at least one of the following:

Required Readings

Calabrese, F., M. Colonna, P. Lovisolo, D. Parata, and C. Ratti. 2011. "Real- Time Urban Monitoring using Cell Phones: A Case Study in Rome." Intelligent Transportation Systems, IEEE Transactions on 12 (1): 141-151.

Sevtsuk, A.; Huang, S.; Calabrese, F.; Ratti, C. (2008).Mapping the MIT Campus in Real Time Using WiFi. Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City, 326-338. Hershey, PA: IGI Global

Mitchell, William J. "Intelligent Cities". Inaugural lecture of the UOC's 2007-2008 academic year. Link: http://www.uoc.edu/uocpapers/5/dt/eng/mitchell.html.

Goodspeed, Robert. 2015. "Smart Cities: Moving Beyond Urban Cybernetics to Tackle Wicked Problems." *Cambridge* Journal *of Regions, Economy and Society* 8 (1): 79-92.

Mitchell, William J., Chris E. Borroni-Bird, and Lawrence D. Burns. Reinventing the Automobile: Personal Urban Mobility for the 21st Century. New ed. The MIT Press, 2010. Chapters 1, 3, 8, 9, 10.

Ratti, C. and Biderman, A. (2017). From Parking Lot to Paradise. Scientific American, July 2017.

Spieser, Kevin; Treleaven, Kyle; Zhang, Rick; Frazzoli, Emilio; Morton, Daniel; Pavone, Marco. *Toward a Systematic Approach to the Design and Evaluation of Automated Mobility-on-Demand Systems: A Case Study in Singapore*. Link: http://dspace.mit.edu/handle/1721.1/82904#files-area

Optional Readings

Anderson, James M., Nidhi Kalra, Karlyn D. Stanley, Paul Sorensen, Constantine Samaras, and Tobi A. Oluwatola. 2016. "Autonomous Vehicle Technology." Product Page. 2016. https://www.rand.org/pubs/research_reports/RR443-2.html.

Edwina. 2018. "(Un)Certain Skies? Drones in the World of Tomorrow." Text. ITF. May 18, 2018. https://www.itf-oecd.org/uncertain-skies-drones.

Edwina. 2018. "Blockchain and Beyond: Encoding 21st Century Transport." Text. ITF. May 17, 2018. https://www.itf-oecd.org/blockchain-and-beyond.

"The New Automobility: Lyft, Uber and the Future of American Cities." n.d. Accessed January 9, 2019. http://www.schallerconsult.com/rideservices/automobility.htm.

Ascher, Kate. 2007. The Works: Anatomy of a City, edited by Wendy Marech. New York, N.Y., U.S.A.:.

Mitchell, William J. Me++: The Cyborg Self and the Networked City. Cambridge, MA: MIT Press, 2003.

Shepard, Mark, ed. Sentient City: Ubiquitous Computing, Architecture, and the Future of Urban Space. The MIT Press, 2011.

Green eld, A. (2013) Against the Smart City (The City Is Here for You to Use). 1.3 edn. Amazon Digital Services, Inc.: Do Projects.

Townsend, A. M. (2013) Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia. New York, NY: W.W. Norton & Company.

Lindsay,G.(2011) IBM partners with Portland to play SimCity for real. Fast Company. Available online at: http://www.fastcompany.com/1772083/ibm- partners-portland-play-simcity-real

Castells, M. (1989) The Informational City: Information Technology, Economic Restructuring, and the Urban-Regional Process. Cambridge, MA: Blackwell.

Batty, M., Axhausen, K., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., Portugali, Y. (2012) Smart cities of the future. The European Physical Journal Special Topics, 214: 481–518.

Singer, N. (2012) Mission control, built for cities. The New York Times. Section BU1, 4 March.

Hall, R. E. (2000) The vision of a smart city. Presented at the 2nd International Life Extension Technology Workshop, Paris, France.

Picon, Antoine. 2015. "The Limits of Intelligence: On the Challenges Faced by Smart Cities." In *Geographies of Information*, 77–83. New Geographies 7. Cambridge, MA: Harvard Graduate School of Design.

Picon, Antoine. 2015. Smart Cities : A Spatialised Intelligence. Chichester, West Sussex:.

Batty, Michael. 2013. The New Science of Cities. Cambridge, MA.

Offenhuber, Dietmar and Katja Schechtner, eds. 2013. Accountability Technologies: Tools for Asking Hard Questions: Ambra.

Hall, R. E. (2000) The vision of a smart city. Presented at the 2nd International Life Extension Technology Workshop, Paris, France.

Arindam Dutta. A Second Modernism: MIT, Architecture, and the "Techno-Social" Moment by Arindam Dutta. MIT Press, 1616.

Carpo, Mario. *The Second Digital Turn: Design Beyond Intelligence*. 1 edition. Cambridge, Massachusetts: The MIT Press, 2017.

Ratti, C. and Claudel, M. (2014). *The Driverless City*. Link: http://senseable.mit.edu/papers/pdf/201401-Ratti-Driverless.pdf

Batty, M., Axhausen, K., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., Portugali, Y. (2012) Smart cities of the future. The European Physical Journal Special Topics, 214: 481–518.

Papanikolaou, D., "The Potential of On-demand Urban Mobility: Lessons from System Theory and Data Visualization" (Doctoral Dissertation, Harvard GSD, Cambridge, MA, 2016). Chapter 1: Introduction

Fagnant, Daniel J. and Kara M. Kockelman. 2014. "The Travel and Environmental Implications of Shared Autonomous Vehicles, using Agent- Based Model Scenarios." Transportation Research Part C 40: 1-13.

Singer, N. (2012) Mission control, built for cities. The New York Times. Section BU1, 4 March.

Arindam Dutta. A Second Modernism: MIT, Architecture, and the "Techno-Social" Moment by Arindam Dutta. MIT Press, 1616.

Carpo, Mario. *The Second Digital Turn: Design Beyond Intelligence*. 1 edition. Cambridge, Massachusetts: The MIT Press, 2017.

Lab

- Maps, latitude, longitude coordinates
- Leaflet.JS
- MapBox.JS

Assignment 2

Create a real-time map visualization of Charlotte or UNCC on a topic of your choice

WEEK 3

Closing the Loop: Feedback, Control, and Self-Regulation

This week explores the concept of information feedback in cybernetic systems and its role in creating self-regulating behavior. Every self-regulating system contains a control feedback loop. Understanding the components of the loop is important for understanding the behavior of the system: how does the loop close? Who makes the decisions and who takes the actions? Come prepared to discuss at least one of the following:

Required Readings

Mindell, David. 2000. Cybernetics: Knowledge Domains in Engineering Systems.

Braitenberg, Valentino. 1984. Vehicles, Experiments in Synthetic Psychology. Cambridge, Mass. Chapters 1-6.

Richards, Whitman. 2015. Anigrafs : Experiments in Cooperative Cognitive Architecture. Cambridge, Massachusetts. Read part 1.

J.C.R. Licklider, "Man-Computer-Symbiosis" from IRE Transactions on Human Factors and Electronics (March, 1960) 4-11.

Pickering, Andrew. 2010. The Cybernetic Brain : Sketches of another Future. Chicago. Chapters 1-2.

Pickering, Andrew. Cybernetics and the Politics of the Dark Universe.

Minsky, Marvin. The Society of Mind. Pages Bent. Simon & Schuster, 1988. Chapters 1,2.

Optional Readings

Wiener, Norbert. 1948. Cybernetics: Or the Control and Communication in the Animal and the Machine. Cambridge, MA: MIT Press. "Introduction"

Ashby, W. R. 1956. An Introduction to Cybernetics. New York:. Available online from: http://dspace.utalca.cl/bitstream/1950/6344/2/IntroCyb.pdf

Mindell, David A. Between Human and Machine: Feedback, Control, and Computing before Cybernetics. The Johns Hopkins University Press, 2004.

Richardson, George P. 1991. Feedback Thought in Social Science and Systems Theory. Philadelphia:.

Schirner, G., D. Erdogmus, K. Chowdhury, and T. Padir. 2013. "The Future of Human-in-the- Loop Cyber- Physical Systems." Computer 46 (1): 36-45.

Lee, D. B. (1973) Requiem for large-scale models. Journal of the American Planning Association, 39: 163–178.

Heims, Steve Joshua. The Cybernetics Group. The MIT Press, 1991.

Hughes, Agatha C., and Thomas P. Hughes, eds. Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After. 1st ed. The MIT Press, 2000.

Light, J. S. (2003) From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America. Baltimore, MD: Johns Hopkins University Press.

Savas, E. (1970) Cybernetics in city hall. Science, 168: 1066.

Arindam Dutta. A Second Modernism: MIT, Architecture, and the "Techno-Social" Moment by Arindam Dutta. MIT Press, 1616.

Carpo, Mario. *The Second Digital Turn: Design Beyond Intelligence*. 1 edition. Cambridge, Massachusetts: The MIT Press, 2017.

WEEKS 4-5

Lab sessions. No reading assignments other than necessary tutorials.

WEEK 6

Crowds and Emergence: From individuals to Masses

This week focuses on the topic of modeling and simulation of complex urban systems, asking the question: how can we study emergence of systems by replicating their behavior through computer simulations? how does macro-behavior of large ecosystems depend on micro-behavior of individuals? Come prepared to discuss at least one of the following:

Required Readings

Coleman, James S. 1966. "Foundations for a Theory of Collective Decisions." American Journal of Sociology 71 (6): 615-627.

Resnick, Mitchel. Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Microworlds. A Bradford Book, 1997. Chapter 01.

Miller, John H., and Scott E. Page. Complex Adaptive Systems: An Introduction to Computational Models of Social Life. Princeton University Press, 2007. Chapters 1-6.

Uri Wilensky. Networked Gridlock: Students Enacting Complex Dynamic Phenomena with the HubNet Architecture in the Proceedings of The Fourth Annual International Conference of the Learning Sciences, Ann Arbor, MI, June 14 - 17, 2000. http://ccl.northwestern.edu/papers/gridlock/Wilensky-Stroup.html

Papanikolaou, D. Cloudcommuting: Games, Interaction, and Learning. In Proceedings of the 12th International Conference on Interaction Design and Children - IDC13 (New York, NY, 24-27 June 2013)

Optional Readings

De Landa, Manuel. 2011. Philosophy and Simulation: The Emergence of Synthetic Reason. London ; New York, NY:.

Epstein, Joshua M., and Robert L. Axtell. Growing Artificial Societies: Social Science from the Bottom Up. First Edition. A Bradford Book, 1996.

Kagel, John H., and Alvin E. Roth, ed. 1997. The Handbook of Experimental Economics. Princeton University Press.

Batty, Michael. 2005. Cities and Complexity: Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals. Cambridge, MA; London

Coleman, James S. 1973. The Mathematics of Collective Action. [1st U.S. ed.] ed. Chicago:.

Workshop

Agent based simulations with NetLogo

WEEK 7

Game Theory: Scarcity, Individualism, and Collective Outcome

This week explores the concept of equilibrium in strategic situations, asking the question: if every individual acts selfishly, where will the system go? What happens when goals and interests of some individuals conflict those of other individuals? Come prepared to discuss at least one of the following:

Required Readings

Hardin, Garrett James, 1915. The Tragedy of the Commons.

Fadul, Rafid. 2009. "The Tragedy of the Commons Revisited." The New England Journal of Medicine 361 (11).

Adar, Eytan and Bernardo A. Huberman. 2000. "Free Riding on Gnutella." First Monday 5 (10).

David Easley and Jon Kleinberg: Networks, Crowds, and Markets: Reasoning about a Highly Connected World. Cambridge University Press, 2010.

Optional Readings

J. F. Nash. The bargaining problem. Econometrica, 18:155–162, 1950.

Dixit, Avinash K., David H. Reiley Jr, and Susan Skeath. Games of Strategy. Third Edition. W. W. Norton & Company, 2009.

Venttsel, E.S. An introduction to the theory of games. Heath, 1963.

Kagel, John H., and Alvin E. Roth, ed. 1997. The Handbook of Experimental Economics. Princeton University Press.

Campbell, Richmond, and Lanning Sowden. Paradoxes of Rationality and Cooperation: Prisoner's Dilemma and Newcomb's Problem. First edition. Univ of British Columbia Pr, 1985.

Simmel, Georg, David Frisby, Charles Lemert, 0415610117, and 978-0415610117. The Philosophy of Money (Routledge Classics). Reprint edition. Routledge, 2011.

Guest Talk: TBD

WEEK 8

Mechanism Design (Inverse Game Theory)

This week explores the concept of mechanism design, asking the question: how should we determine rules, payoffs, and platforms if we want a group of selfish individuals converge to a desired outcome? Come prepared to discuss at least one of the following:

Required Readings

Maskin, Eric S. "Mechanism Design: How to Implement Social Goals." *American Economic Review* 98, no. 3 (May 2008): 567–76.

Ostrom, Elinor. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge; New York:.

David Easley and Jon Kleinberg: Networks, Crowds, and Markets: Reasoning about a Highly Connected World. Cambridge University Press, 2010.

Pickard, Galen, Wei Pan, Iyad Rahwan, Manuel Cebrian, Riley Crane, Anmol Madan, and Alex Pentland. 2011. "Time- Critical Social Mobilization: The DARPA Network Challenge Winning Strategy" Science 334 (6055): 509-512.

Pentland, Alex (Sandy). 2010. "To Signal is Human." American Scientist 98 (3): 204-211.

Papanikolaou, D. and Larson K. *Constructing Intelligence in Point-to-Point Mobility Systems*. In Proceedings of the 9h International Conference of Intelligent Environments (Athens, Greece, 18-19 July 2013)

Optional Readings

Ostrom, Elinor. 1994. Rules, Games, and Common-Pool Resources, edited by Roy Gardner, James Walker. Ann Arbor:.

Axelrod, Robert M. 2006. *The Evolution of Cooperation*. Rev. ed. ed. New York:.

Olson, Mancur. The Logic of Collective Action: Public Goods and the Theory of Groups, Second Printing with a New Preface and Appendix. Revised edition. Cambridge, Mass.: Harvard University Press, 1971.

Pentland, Alex: Society's Nervous System: Building Effective Government, Energy, and Public Health Systems. In Computer, Jan. 2012, Vol.45(1), pp.31-38. PDF Link

Tang, John, Manuel Cebrian, Nicklaus Giacobe, Hyun-Woo Kim, Taemie Kim, and Douglas Wickert. 2011. "Reflecting on the DARPA Red Balloon Challenge." Communications of the ACM 54 (4): 78-85.

David Easley and Jon Kleinberg: Networks, Crowds, and Markets: Reasoning about a Highly Connected World. Cambridge University Press, 2010: Sections II (Game Theory), III (Markets and Strategic Interaction in Networks), VII (Institutions and Aggregate Behavior). https://www.cs.cornell.edu/home/kleinber/networks-book/networks-book.pdf

T. Mullen and M. P. Wellman. Some issues in the design of market- oriented agents. In W. et al., editor, Intelligent Agents: Theories, Architectures and Languages, volume 2. Springer-Verlag, 1996.

M. P. Wellman. Market-oriented programming: Some early lessons. In S. Clearwater, editor, Market-Based Control: A Paradigm for Dis- tributed Resource Allocation. World Scientific, 1996.

WEEK 9

Spring break: No class

WEEKS 10-16

Project development. No reading assignments other than necessary tutorials.

PRESENTATION FORMAT

All printed project presentations will follow specific guidelines regarding style, layout, and dimensions. These guidelines will be announced ahead of time.

STUDIO LAB CULTURE & ATTENDANCE

The course combines studio culture with research lab culture and seminar culture. It consists of desk crits and lectures, discussions, presentations, demos, workshops, and reading assignments. Attendance and participation is required. You are expected to be in the studio at your desk before class begins. Two (2) unexcused absences automatically lower your final grade one letter grade. More than two (2) unexcused absences will constitute grounds for automatic failure of this course. Documentation of excused absences must be submitted in writing and show evidence of the medical or family emergency. If you must be late or absent, notify me as early as possible in advance. The workload expected to be invested in the course is significantly high. If you took Connective Environments 1, expect this course to have more workload.

ACADEMIC INTEGRITY

As a UNC Charlotte student, each of you have the responsibility to be familiar with and observe the requirements of the UNC Code of Student Academic Integrity. This code and policies will be strictly followed. All written and graphic materials, in-class presentations, and other academic tasks should be your individual and original work unless specifically noted as group work. The studio is a public space. Please be sensitive to images and other materials around your desk, including your computer, which might be offensive to others. In addition, all students are required to abide by the spirit and letter of the UNC Charlotte Sexual Harassment Policy, which can be found online at: http://www.legal.uncc.edu/policies/ps-61.html

GRADING (TBD)

~~First review 25%~~
~~Second review 25%~~
~~Final review 30%~~
~~Weekly deliverables 10%~~
~~Attendance and participation 10%~~

Late weekly submissions as well as poor attendance will count negatively towards your grade. All courses in the SoA are governed by the rules and regulations of UNC Charlotte as stated in the University Undergraduate and Graduate Catalogs. For more information about these polices, please refer to the appropriate catalog, which can be found online at: http://www.uncc.edu/gradmiss/gs_catalog.html (grad). Grading of courses conform to the following grading scales and values:

Graduate Scale & Values

A	90-100	Commendable
B	80-89	Satisfactory
C	70-79	Marginal
U	69 & Below	Unsatisfactory

These grades are determined according to the following criteria:
A (Excellent / Commendable): Meets or exceeds stated requirements of the course; exhibits significant improvement, development, and/or intellectual growth over the course of the term; exhibits research efforts from which both the instructor and students may learn; all work turned in on time and presented in a professional manner.
B (Good / Satisfactory): Meets the stated requirements of the course; exhibits good improvement, development, and/or intellectual growth over the semester; provides a measure for student emulation; and all work is turned in on time and well presented.
Grad C (Marginal): Fails to meet most requirements of the course (the work is incomplete to a significant degree); exhibits little or no improvement, development, and/or intellectual growth over the semester; and/or work is of a caliber only marginally acceptable at the graduate level.
Grad U (Unsatisfactory): Fails to meet the requirements of the course; and/or the work is incomplete or of a caliber unacceptable at the graduate level. A grade of U will affect eligibility for continued enrollment and will not apply towards degree requirements.

RESOURCES

For information about writing style, use the UNCC standard guide for student research, writing, and citation style: Kate Turabian, et al. *A Manual for writers of Research Papers, Theses, and Dissertations,* 7th ed (Chicago: University of Chicago Press, 2007)
For assistance with research, students are encouraged to contact Art and Architectural Research Librarian, Jenna Rinalducci. You can also contact her via email at jrinaldu@uncc.eduto ask questions or make an appointment to talk in person.
For assistance with writing, students are encouraged to contact the UNC Charlotte Writing Resource Center for free, individual consultations on all stages of the research paper and presentation process. You can reach them by email at wrchelp@uncc.edu. Additional information about the WRC can be found online at http://writing.uncc.edu/writing-resources-center.

SOA POLICIES

Academic Integrity: All written and graphic submittals, in-class presentation, and other academic Trasks should be your individual and original work unless specifically noted as group projects. No cheating. No plagiarism. It is assumed that you are aware of and will comply with the spirit and specifics of the UNC Charlotte Code of Student Academic Integrity, which is available online at: http://legal.uncc.edu/policies/ps-105.html.
Disability: If you have a diagnosed disability which influences your ability to learn or have your work assessed in the classroom, please provide a copy of the Letter of Accommodation from the UNC Charlotte Office of Disability Services by the end of the second week of classes. All efforts will be made to accommodate your needs and this information will remain confidential.
Inclusiveness: All perspectives and opinions are welcomed and will be respected in this university classroom as long as they are presented in manner that is respectful. Intolerance will not be tolerated. If you feel personally uncomfortable or alienated, or that diversity in general is any way stifled in this class, please let the professor know so that the situation can be remedied.
Culture: Students and instructors alike share responsibility for collective culture of all SoA course, all participants are expected to enhance its intellectual life by being present, pro-active, and respectful. All courses actively comply with and promote the SoA and CoAA culture policies with which it is assumed you are aware. The SoA culture policy is available online at http://www.coaa.uncc.edu/Academics/School-of-architecure/About.
Electronics: At all time during class cell phones, computers and other devices should be switched off and put away, unless permission to use those devices has been explicitly given by the instructor. All students are required to abide by the UNC Charlotte policy on responsible Use of University Computing and Electronic Communication Resources, which can be found online at http://www.legal.uncc.edu/policies/ps-66.html.