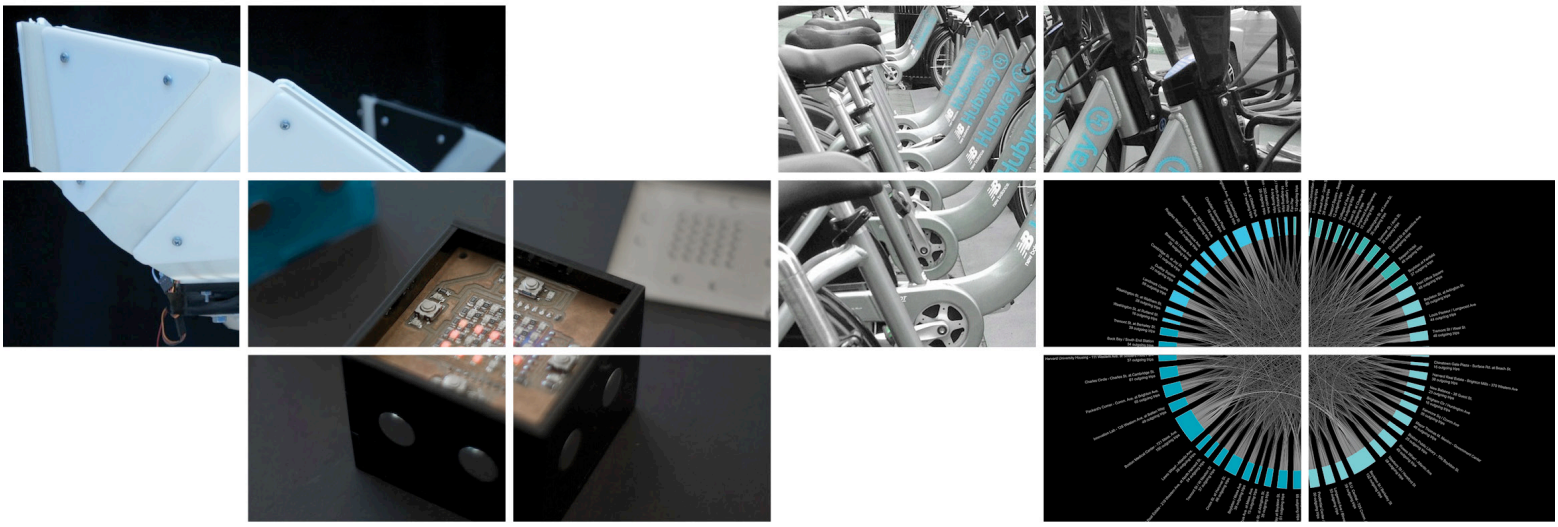
Synergetic Environments

Form, Social Behavior, and Coordination



"In the most general sense, computation is the process of storing, transmitting, and transforming information from one form to another" (Santa Fe Institute).

ARCH 6307/4050/6050, IT IS 6010, ITCS 5010
Wednesdays 6:00pm-8:45pm, Storrs 255
School of Architecture, UNC Charlotte
Prof Dr. Dimitrios Papanikolaou / dpapanik@uncc.edu
Office hours: Wednesdays 10am-12pm by appointment
Office: Storrs 146

Premise

The seminar critically reviews the evolution and design principles of systems of urban and territorial intelligence, from the ancient networks of optical telegraphy to today's internet of things. Through discussions, we will examine technologies, systems, and mechanisms for turning information into decision and action in large scales; we will question the role of the physical environment, resource scarcity, and human behavior in shaping equilibrium conditions; we will investigate the role of data, modeling, and simulation in exploring dynamics of urban systems; and we will critically speculate where the design field of urban computing might be heading in the future.

Objectives

By the end of the course, students will develop a broad yet critical understanding of what urban intelligence is, how it can be constructed, and what limits it may reach, from a sociotechnical and a systemic perspective. Topics include: Theory and technologies of computation, information, communication, and human factors in relation to the built environment; systems theory; cybernetics;

urban dynamics; ecology; social cooperation; collective intelligence; game theory; mechanism design; as well as applications in mobility, resource allocation, sustainability, and energy.

Method

The course combines discussions, lectures, and workshops. Each class covers a separate topic organized as a discussion lead by a group of students and consists of selected readings. To complete the course, students will write short weekly reaction papers (1-page max) and a final paper or project.

Calendar

Week / Date	Topic
01 / Aug 23	*The Anatomy of a Smart City: People, Things, and Bits* Introduction
02 / Aug 30	*Real Time Cities: Sensing, Data, and Information Transparency*
03 / Sep 06	*On-Demand Sharing: Doing More with Less*
04 / Sep 13	*Feedback, Control, and Self-Regulation*
05 / Sep 20	*Information is Physical*
06 / Sep 27	*Computation is Physical* Midterm Assignments Due
07 / Oct 04	*The Environment as an Agency: Things that Think* Midterm Reviews
08 / Oct 11	*The Environment as an Interface: Tangible Bits, Radical Atoms*
09 / Oct 18	*Networks, Complexity, and Connectedness*
10 / Oct 25	*Emergence: from Individuals to Masses*
11 / Nov 01	*Game Theory: Scarcity, Individualism, and Collective Outcome*
12 / Nov 08	*Mechanism Design and Cooperation*
13 / Nov 15	*Dynamics and Limits of Urban Systems*
14 / Nov 22	Thanks Giving – No Class
15 / Nov 29	*Intelligence as a Synergy*
16 / Dec 06	Final Reviews
Dec 13	Final papers due
Dec 18	Final grades due

Weekly Assignments

Each week, a team of students will lead a discussion focusing on the topic of the week. The team will open the discussion with a brief presentation focusing on open yet critical questions. In addition, each student must submit a 500-word (max) reaction paper on the readings/topic of each class two days before each class (e.g. Mondays if class meets Wednesdays) by 11:59pm, and read the reaction papers of the other students before each class. The reflection may be a position, and argument, or a series of open questions. It should not be a summary of the readings. The presentations and the submitted reaction papers will structure each discussion. Unless otherwise stated, papers must be emailed to dpapanik@uncc.edu.

General Required Readings and Software

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.

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.

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.

Software

In several class meetings we will be using NetLogo, a multi-agent programmable modeling environment, to demonstrate some ideas about complex systems and emergence. Download and install NetLogo from here: http://ccl.northwestern.edu/netlogo/download.shtml

Tentative Schedule and Weekly Readings

Each week contains required and optional readings. All students must come in class prepared to discuss the required readings assigned for the particular week. The following schedule is tentative. Modifications or additions in readings or assignments may occur depending on students' interests and/or level of experience, at the discretion of the instructor. Updated versions of the syllabus will be

available as PDF in advance and with file names including the date of the update.

Link to Google Drive folder: https://drive.google.com/open?id=0BwGs8nJot-Y0VmFBRDI5ODRVQms

Week 1 / Aug 23

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

This week overviews 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/

In-class Assignment

Introductions and Team Formations.

Week 2 / Aug 30

Real Time Cities: Urban Sensing, Data, and Information Transparency

This week explores the role of information transparency and real time feedback. Come prepared to discuss 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.

Optional Readings

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. 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.

Week 3 / Sep 06

Moving and Sharing: Doing More with Less

This week 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 the following:

Required Readings

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.

Papanikolaou, D. Revisiting the Automobile: Lessons from Bikes, 6 Years Later. Responsive Cities, Symposium Institute of Advanced Architecture of Catalonia (IAAC), Sep 16 2016

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

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.

Week 4 / Sep 13

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 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.

In-class Workshop/Assignment: TBD

Week 5 / Sep 20

Information is Physical

This week explores the nature of information, as a configuration of form, and of communication as a process of encoding, transporting, and decoding information with inherent limitations. Come prepared to discuss the following:

Required Readings

Papanikolaou, D., "Choreographies of Information: Communication through Architectural Form in the Early Napoleonic Internet of Optical Telegraphy" in *New Geographies 07: Geographies of Information,* ed. Ali Fard and Taraneh Meshkani (Harvard Graduate School of Design Press, 2015).

Gleick, James. 2011. The Information : A History, a Theory, a Flood. 1st ed. ed. New York:. Chapters 1, 4, 5, 9, 13.

Reddy, M.J. (1979). The conduit metaphor -- a case of frame conflict in our language about language. In A. Ortony (Ed.), Metaphor and thought (p. 284-297 only). Cambridge: Cambridge University Press. Link: https://msu.edu/~orourk51/800-Phil/Handouts/Readings/Linguistics/Reddy-TheConduitMetaphor-1979.pdf

Weller, Toni and David Bawden. 2005. "The Social and Technological Origins of the Information Society." *Journal of Documentation* 61 (6): 777-802.

Pierce, John R. 2012. *Introduction to Information Theory: Symbols, Signals and Noise*. Chapters 1-5.

Stone, James V. 2015. Information Theory : A Tutorial Introduction. First Edition. ed. Sheffield, United Kingdom]:. Chapters 1-3

Optional Readings

Shannon, Claude Elwood, Warren Weaver, Richard E Blahut, and Hajek. *The Mathematical Theory of Communication*. Urbana: University of Illinois Press, 1998.

Holzmann, Gerard J. and Björn Pehrson. "The First Data Networks." Scientific American 270, no. 1 (1994): 124.

Holzmann, Gerard J. The Early History of Data Networks, edited by Pehrson, Björn. Los Alamitos, CA.: IEEE Computer Society Press, 1995.

Standage, Tom. 2007. The Victorian Internet: The Remarkable Story of the Telegraph and the Nineteenth Century's On-line Pioneers. 1st ed. Walker & Company.

Saltzer, J., D. Reed, and D. Clark. 1984. "End-to- End Arguments in System Design." ACM Transactions on Computer Systems (TOCS) 2 (4): 277-288.

Pierce, John R. (John Robinson). 1990. *Signals: The Science of Telecommunications*, edited by A. Michael Noll. New York:.

In-class Workshop/Assignment: TBD

Week 6 / Sep 27

Computation is Physical

This week explores the nature of computation as a process of transforming information from one form to another. If information is physical, is it possible to imagine physical or architecturall forms of computation? Come prepared to discuss the following:

Required Readings

Knight, Terry and George Stiny. 2001. "Classical and Non- Classical Computation." Arq: Architectural Research Quarterly; Arq 5 (4): 355-372.

Mitchell, William J. (William John). 1989. “Languages of Architectural Form” in: The Logic of Architecture : Design, Computation, and Cognition. Cambridge, Mass.:.

Cheung, K. C., E. D. Demaine, J. R. Bachrach, and S. Griffith. 2011. "Programmable Assembly with Universally Foldable Strings (Moteins)." Robotics, IEEE Transactions on 27 (4): 718-729.

Aaronson, Scott. “The Power of the Digi-Comp II: My First Conscious Paperlet.” Link: http://www.scottaaronson.com/blog/?p=1902

Dewdney, A. K. 1989. "A Tinkertoy Computer that Plays Tic- Tac- Toe. (Computer Recreations) (Column)." Scientific American 261 (4): 120.

Optional Readings

Wolfram, Stephen. 2002. ***A New Kind of Science***, edited by Robert D. Graff. 1st ed. ed. Champaign, IL:.

Petzold, Charles. 2000. Code : The Hidden Language of Computer Hardware and Software. Redmond, Wash.:.

Stiny, G. "New Ways to Look at Things." Environment and Planning B: Planning and Design (1998): 68-75. (Anniversary Issue)

Petzold, Charles. 2008. The Annotated Turing : A Guided Tour through Alan Turing's Historic Paper on Computability and the Turing Machine. Indianapolis, IN:.

Shannon, Claude Elwood. “A symbolic analysis of relay and switching circuits.” Thesis, Massachusetts Institute of Technology, 1940. http://dspace.mit.edu/handle/1721.1/11173.

Turing, Alan M. The Essential Turing: Seminal Writings in Computing, Logic, Philosophy, Artificial Intelligence, and Artificial Life Plus The Secrets of Enigma. Edited by B. Jack Copeland. Oxford University Press, USA, 2004.

Simon, Herbert A., 0262691914, and 978-0262691918. 1996. The Sciences of the Artificial - 3rd Edition. third edition edition. The MIT Press.

Wolfram, Stephen. 1984. "Computation Theory of Cellular Automata." Communications in Mathematical Physics 96 (1): 15-57.

Minsky, Marvin and Seymour Papert. 1988. Perceptrons : An Introduction to Computational Geometry, Expanded Edition. Cambridge, MA: MIT Press.

Prakash, Manu and Neil Gershenfeld. 2007. "Microfluidic Bubble Logic." Science (New York, N.Y.) 315 (5813): 832.

Minsky, Marvin. 1967. Computation: Finite and Infinite Machines. Englewood Cliffs, N.J. Link:
http://www.cba.mit.edu/events/03.11.ASE/docs/Minsky.pdf

In-class Workshop/Assignment

Break up in teams; explore, play with, and discuss the following links and videos:

Links

Turing Machine
http://www.alanturing.net/turing_archive/pages/reference%20articles/what%20is%20a%20turing%20machine.html#states

Online Turing Machine Simulator: https://turingmachinesimulator.com/

Online Logic Circuit Simulators: https://simulator.io/

https://en.wikipedia.org/wiki/Logic_simulation

https://en.wikipedia.org/wiki/Logic_synthesis

Videos

Skylar Tibbits TED's talk

https://www.ted.com/talks/skylar_tibbits_the_emergence_of_4d_printing

Saul Griffith's TED talk

https://www.ted.com/talks/saul_griffith_on_everyday_inventions

Neil Gershenfeld's TED talk

https://www.youtube.com/watch?v=EA-wcFtUBE4 https://www.youtube.com/watch?v=aNhXjXYLLvc

1. https://www.youtube.com/watch?v=BvmSYN8tLW0
2. https://www.youtube.com/watch?v=3Med34kodqA
3. https://www.youtube.com/watch?v=rdT1YT9AOPA
4. https://www.youtube.com/watch?v=aDN4s8ElxqE
5. https://www.youtube.com/watch?v=QKnSRw_X2w4
6. https://www.youtube.com/watch?v=6hs6eqSdbGc
7. https://www.youtube.com/watch?v=GcDshWmhF4A
8. https://www.youtube.com/watch?v=md0TlSjIags

Assignment

Midterm Assignments Due Wednesday Oct 04 at 11:59pm.

Week 7 / Oct 04

The Built Environment as an Agency: Things that Think

This week explores the concepts of ubiquitous computing and the internet of things. How can the physical environment become an ecology of self-aware interacting components by embedding physical objects with sensing and computing capabilities? How do humans interact with such intelligent objects?

Required Readings

Weiser, Mark. 1993. "Some Computer Science Issues in Ubiquitous Computing." Communications of the ACM 36 (7): 75-84.

Weiser, Mark. 1991. "The Computer for the 21st Century." Scientific American 265 (3): ec.

Weiser, Mark. 2001. "Whatever Happened to the Next- Generation Internet?" Communications of the ACM 44 (9): 61-69.

Anderson, David and John Kubiatowicz. 2002. "The Worldwide Computer." Scientific American 286 (3): 40.

Gershenfeld, Neil, 1999. *When Things Start to Think*. 1st edition. Henry Holt and Co.

Optional Readings

Dourish, Paul. 2001. Where the Action is: The Foundations of Embodied Interaction. Cambridge, Mass.:.

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

Bush, Vannevar. 1996. "As we may Think." Interactions 3 (2): 35-46.

Sutherland, Ivan E. and Jo Ebergen. 2002. "Computers without Clocks." Scientific American 287 (2): 62.

Midterm Reviews

Students present their project/paper proposals.

Week 8 / Oct 11

The Built Environment as a Medium: Tangible Bits, Radical Atoms

This week explores the ability of the physical environment to become a medium for information, communication, and computation. If information and computation are physical, to what extent can architecture become a configurable computing environment? How can novel human-computer interfaces, sensing technologies, smart building systems, and embedded/distributed systems close the loop between information and action in more intuitive ways? Come prepared to discuss the following:

Required Readings

Ishii, Hiroshi. 2008. Tangible Bits: Beyond Pixels.

Ishii, Hiroshi, Dá Lakatos, Leonardo Bonanni, and Jean-Baptiste Labrune. 2012. "Radical Atoms: Beyond Tangible Bits, Toward Transformable Materials." Interactions 19 (1): 38-51.

McLuhan, M., & Lapham, L. H. (1994). *Understanding Media: The Extensions of Man* (Reprint.). The MIT Press.

Papanikolaou, D. A.J. Bernheim Brush, and Asta Roseway. BodyPods: Designing Posture Sensing Chairs for Capturing and Sharing Implicit Interactions. In Proceedings of the 9th International Conference on Tangible, Embedded and Embodied Interaction – TEI'15 (Stanford University, Stanford, CA, 15-19 January 2015)

Aleksakova, Olga, and Andreas Huhn. Pier 11 NYC: New York Ferry Terminals Competition. Graduation project Architectural Design, TU Delft, 2001.

Optional Readings

Negroponte, Nicholas. The Architecture Machine: Toward a More Human Environment. The MIT Press, 1973.

Bruce Sterling. 2005. *Shaping Things*. Cambridge: MIT Press.

Guest Talk: Daniel Leithinger, PhD

Week 9 / Oct 18

Networks, Complexity, and Connectedness

This week explores the concepts of connectedness and network complexity, asking the question: how does network architecture affects connectedness and accessibility? Come prepared to discuss the following:

Required Readings

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

Barabási, Albert-László. 2003. Linked: How Everything is Connected to Everything Else and what it Means for Business, Science, and Everyday Life. New York:.

Optional Readings

Watts, Duncan J., and Steven H. Strogatz. "Collective dynamics of /`small-world/' networks." Nature 393, no. 6684 (June 4, 1998): 440-442.

Castells, Manuel, ed. The Network Society: A Cross-Cultural Perspective. Edward Elgar Pub, 2005.

Castells, Manuel. The Information Age, Volumes 1-3: Economy, Society and Culture (Information Age Series). Wiley-Blackwell, 1999.

West, Geoffrey B. 2017. Scale : The Universal Laws of Growth, Innovation, Sustainability, and the Pace of Life in Organisms, Cities, Economies, and Companies. New York:.

Week 10 / Oct 25

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 macrobehavior of large exosystems depend on microbehavior of individuals? Come prepared to discuss 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 11 / Nov 01

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 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 12 / Nov 08

Mechanism Design (Reverse Game Theory): Institutions and Cooperation

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 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 13 / Nov 15

Dynamics and Limits of Urban Systems

This week explores dynamics and limits of urban systems and how these depend on physical and spatial

constraints. How do human, physical, and information resources move in cities, and how do their movements and concentrations affect performance of urban cyber-physical systems? Prepare to discuss the following:

Required Readings

Forrester, Jay Wright. 1969. Urban Dynamics. Cambridge, Mass.: M.I.T. Press.

Sterman, John. 2002. "All Models are Wrong: Reflections on Becoming a Systems Scientist." System Dynamics Review 18 (4): 501.

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

Optional Readings

Alfeld, Louis Edward, and Graham Alan. Introduction to Urban Dynamics. Productivity Pr, n.d.

Forrester, Jay Wright. 1961. Industrial Dynamics, edited by Georges F. (Georges Frederic) Doriot. Cambridge, Mass.: M.I.T. Press.

Forrester, Jay Wright. 1971. Systems Analysis as a Tool for Urban Planning.

Featherston, Charles and Matthew Doolan. "A Critical Review of the Criticisms of System Dynamics."The 30th International Conference of the System Dynamics Society.

Lane, David C. 2000. "Should System Dynamics be Described as a ‘ Hard’ Or ‘ Deterministic’ Systems Approach?" Systems Research and Behavioral Science 17 (1): 3-22.

Batty, Michael. 1971. "Modelling Cities as Dynamic Systems." Nature 231 (5303): 425.

Phillips, A. W. H. "Mechanical Models in Economic Dynamics." Economica 17, no. 67 (1950): 283-305.

Week 14 / Nov 22

Landscapes

Thanks Giving. No class. Prepare for final reviews.

Optional Readings

Cantrell, Bradley E., and Justine Holzman. Responsive Landscapes: Strategies for Responsive Technologies in Landscape Architecture. 1 edition. New York, NY: Routledge, 2015.

Mostafavi, Mohsen. *Cartographic Grounds: Projecting the Landscape Imaginary*. Edited by Jill Desimini and Charles Waldheim. New York: Princeton Architectural Press, 2016.

Week 15 / Nov 29

Urban Synergies: Rethinking Intelligence

Final Reviews

Students present their final project/paper results in front of guest critics.

Final and MidTerm Project/Paper

There are two options for a final deliverable. The first is to write a publishable position paper (4,000 words max) on the future of urban or architectural intelligence. This may be a critique on existing approaches to urban intelligence, a speculative investigation of future directions, or a well-supported manifesto. The second option is to design and prototype a project based on one or more topics that have been covered during the class. The project may be a physical prototype or a digital visualization, simulation, etc., and must be accompanied by a short (500 words max) description paper. The second option must be a team project. Midterm deliverable consists of a 1-page (~500words) description of yout final project or paper (due Wednesday Oct 04 at 11:59pm) and an in-class presentation.

Course Requirements and Grading

Students are expected to participate in class discussions, present/lead weekly topics, and write a final paper or a project with a project description. Grading: class participation (1/3); presentations and reaction papers (1/3); final paper/project (1/3).

General Information & Policies

RESOURCES

For most required readings, PDF links or printouts will be available. Otherwise, books will be reserved in the library. If books are not available in the library, those specific readings will be excluded or replaced by others.

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.

POLICIES

Readings and assignments: This course requires a significant amount of reading and critical reflection. The readings and assignments in the present syllabus may change during the course depending on students level of experience and preferences.

Academic Integrity: All written and graphic submittals, in-class presentations, and other academic tasks

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: http://integrity.uncc.edu/. Violations of the Code of Student Academic Integrity will result in disciplinary action. Faculty may ask students to produce identification at examinations and may require students to demonstrate that graded assignments completed outside of class are their own work.

Disability: If you have a diagnosed disability which influences your ability to learn or have your work assessed in the classroom, all efforts will be made to meet your needs. Please provide a copy of your Letter of Accommodation from the UNC Charlotte Office of Disability Services by the end of the second week of classes. Their office is located in 230 Fretwell and more information is available online at: http://www.ds.uncc.edu/. All information about your disability and accommodations will remain confidential. Please see the instructor if you are interested in being an official scribe (note taker) for this course. Your notes will be made available to others in the class with special needs.

Attendance: In order to fully benefit from and participate in this course, attendance is required. 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. When possible, notify your instructor as early as possible in advance of a potential absence.

Workload: This 3-credit course requires 3 hours of classroom or direct faculty instruction and 6 hours of out-of-class student work each week for approximately 15 weeks.

Late Work: Late work will not be accepted, and will not receive credit. A printed hard copy of each submittal is due at the beginning of the class period on the due date indicated in the class schedule. If you are unable to complete an assignment due to an excused absence, notify the professor on the due date and turn in the assignment at the next class meeting. Failure to turn in two assignments on their due dates is grounds for automatic failure of the course.

Religious Holy Days: Students whose religious beliefs prohibit class attendance or the completion of specific assignments on designated dates may request an excused absence. If the student notifies the instructor of the classes to be missed due to religious holy days by the end of the second week of classes, the student will be excused. (Eligible religions are those whose places of worship are exempt from property taxation.)

Diversity and Respectful Interaction: All perspectives and opinions are welcomed and will be respected in this classroom or studio, as long as they are presented in manner that is respectful. Intolerance will not be tolerated. Be mindful of your conduct when engaged in experiences and discourses with those who differ from you in appearance, race, ethnicity, beliefs, gender, sexuality, style, politics or intellectual position. If you feel personally uncomfortable or alienated, or that diversity in general is any way stifled in this class, please let the instructor know so that the situation can be remedied.

All students are required to abide by the sprit and the specifics of the UNC Charlotte Sexual Harassment Policy, which can be found online at: http://legal.uncc.edu/policies/up-502.

Culture: Students and instructors alike share responsibility for the collective culture of all SoA courses,

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: https://coaa.uncc.edu/academics/school-of-architecture/about-the-school-of-architecture/studio-culture-policy

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 Standard for Responsible Use: http://itservices.uncc.edu/iso/standard-responsible-use. Remember that harassment, as defined in the UNC Charlotte Sexual Harassment Policy, is prohibited, even when carried out through computers or other electronic communications systems, including course-based chat rooms or message boards.

GRADING

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.provost.uncc.edu/catalogs/2007%2D2009/ (undergrad) and http://www.uncc.edu/gradmiss/gs_catalog.html (grad). Grading conforms to the following grading scales and values:

Undergraduate Scale & Values

A	90-100	Excellent
B	80-89	Good
C	70-79	Fair
D	60-69	Passing
F	59 & Below	Failing

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.

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.

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.