CEE 177M - "Smarter Cities and Communities 2"

Course Outline

Over half the world's population (and growing) now live in cities; and the top 100 cities account for 25% of the world's GDP. Because they concentrate people and activity, cities concentrate the adverse impacts that mankind is having on the environment, and they also concentrate risk from climatic or seismic events. Yet paradoxically, cities are more resource-efficient and more innovative per capita, and their very concentration provides tremendous leverage if we wish to improve lives and manage our impact on the planet.

A city is essentially an organism – a complex system of systems. Smart cities leverage methodological and technical innovations to allow those systems to work efficiently and synergistically with each other, to "accentuate the positive, eliminate the negative" in urban life. The "mesh" of data and information through which we understand the world is getting smaller. There are more sensors "out there" (and probably in your pocket or your car and around your house) than ever before. They are reporting ever more frequently. Our ability to analyze the resulting flood of data is also greater than ever before, and only increasing. The result is an unprecedented opportunity to optimize the operations of cities – energy, water, transportation systems, food supply, urban design, resilience and much more; and to provide new ways to enable "the governed" to connect with their governments to a greater degree than ever before.

This course will explore the smart city, and the IT that underpins it. It will discuss what IT can and cannot do, and most importantly given the control and privacy implications of many "smart" IT systems, what the smart city *should* and *should not* do. In this context, smart cities are a deeply political and social construct, so there are rarely "right" answers – the course is designed to build awareness of the potential for IT to improve the interactions between mankind in cities and the planet, and the potential for harm. We want to encourage students to think: the course will be successful if you leave with more questions than you started with!

The course is designed to complement CEE177L which must be taken as a co-requisite. This course will provide you with a more in depth understanding of the foundational elements of a smarter city. It will cover the subset of systems not addressed in CEE177L so that the student comes away with a broad exploration of every major system that comprises a city. The two courses are organized in such a way that each week the lectures and discussion sessions complement and build on each other. This course will also feature the opportunity to meet and engage with the architects of smarter cities & communities - leaders from both the private and public sectors.
CEE177M is a 2 unit course comprised of one 1.5 hour lecture and one 1 hour discussion session per week. Please note that its co-requisite course (CEE177L) is structured the same way.

No prior knowledge of IT is required, but you will benefit from an interest in the application of information and IT to social and business issues. Classes will be a mix of lecture and group exploration. Grades will be based on written work and class participation (classroom discussions, critiques of reading assignments, identification of additional relevant case studies or reading materials).

Course Structure

Week	Format	Topic
1	Lecture	***Smarter Cities Explored:*** Panel discussion of invited experts from the public and private sector. Active dialog focused on: Who are the principal stakeholders in a smarter city? What are the challenges facing cities and infrastructures today. What can technology do and not do?
	Discussion	***Exploration:*** Round robin breakout discussions with panelists to provide opportunity for more intimate discussions with leading practitioners.
2	Lecture	***The New Informatics Toolkit (Part 1):*** the methodological and technological innovations within organization design and IT that are enabling the creation of new sensing, data aggregation, analytic/optimization and visualization technologies.
	Discussion	***Exploration:*** Current gaps in our technological capabilities and how they might be filled.
3	Lecture	***The New Informatics Toolkit (Part 2):*** (continues the discussion from Week 2).
	Discussion	***Exploration:*** Big Data Challenges – access, integration, security, ownership, standards...
4	Lecture	***Deep Dive – Energy Management:*** explores the application of the new informatics toolkit to the management of energy resources, power generation/distribution/storage infrastructure, and renewables.
	Discussion	***Exploration:*** What does smart energy need to include? How can IT help address the demand side of the issue?
5	Lecture	***Deep Dive – Smarter by Design:*** explores how experts & citizens can be engaged to design infrastructure and services for efficiency, the rise of "servitization", and the role of collaborative consumption models in cities.
	Discussion	***Exploration:*** What are the most effective ways to activate citizens to play a role in urban design? How can IT help?
6	Lecture	***Deep Dive – Buildings:*** explores the application of the new informatics toolkit specifically to making buildings and campus environments more intelligent.
	Discussion	***Exploration:*** What might a smart building consist of (that has not already been thought of) – is it just about energy savings? How do we align costs with benefits?
7	Lecture	***Deep Dive – Food production & Traceability:*** explores how the new informatics toolkit can be applied to improve urban food production and the efficiency and transparency of supply chains & distribution networks (address issues of freshness, quality, waste and safety).
	Discussion	***Exploration:*** What is the potential role of IT in food production and traceability? What can IT achieve and not achieve? What else is needed?
8	Lecture	***Architects of a Smarter City:*** a panel of technology experts from industry and the public sector who will share their perspectives and practical experience. Active dialog focused on specific technologies and implementations that illustrate the principles of the course.
	Discussion	***Exploration:*** given the caveats, and given everything you have heard on the course, what do you think about how they are evolving? Would you like to live in a smart city?

Goals & Assignments

Class assignments are based predominantly on written essays, to test your ability to explore, adapt and critique the ideas behind smart cities. Assignments will be required as follows:

- Two essays of 2,500 words each
- 10% awarded for contribution, orally in class; or if you prefer via a short critique (250 words) of at least two of the eight sessions.

With the essays, we will provide a list of possible topics, but subject to instructor approval you may also develop your own topics, whether about other aspects of smart cities that interest you, or critiquing the reading either from the list in this document or some other source that caught your eye. If you prefer you may also, subject to instructor approval:

- substitute presentations or posters for essays.
- substitute published blog posts totaling 2,500 words for one essay.

Note that neither of these options is an "easy way out". Blog posts will need to demonstrate intellectual weight as well as newsworthiness!

Course Methods and Logistics

Classes will take place in Y2E2 Room 111. Discussion sessions will take place in Y2E2 Room 111 with the exception of

This is a 2 unit course and requires concurrent registration in CEE177L. It is graded by Letter or Credit/No Credit.

Where letter-graded, papers/posters/blogs will be graded as follows:

A. Adds insight – or even just questions and open issues - to the existing "state of the art"

B. Demonstrates understanding and insight on a par with the "state of the art".

C. Not wrong, but not earthshaking either!

D. Either trivial or demonstrates a specific lack of understanding.

Extensive time will be allowed for discussion. Some pre-reading will be set for some modules (see below); and students will be asked to think in advance about issues to be discussed. At all times, students will be encouraged to supply examples of their own of the issues and solutions being discussed on the course.

Students will be expected to actively participate in the course and the level of participation will impact final grades. Contributions can take many forms including: participation in classroom discussions, responding to blog posts by fellow students, or finding & posting relevant articles/stories to the class reading list.

Pre-reading

This is a very wide-ranging overview type of course that synthesizes multiple sources and ideas: there are no references that cover all of it. Here is a selection of some pre-course reading. The items in bold will deliver most value for time spent. ☺

Browse http://smartcitiescouncil.com/smart-cities-information-center/information-center (free registration required)

Browse the many articles at http://cadillacaimhigh.economist.com/old-cities-new-big-data/ (this is sponsored content from Cadillac, but prepared by The Economist to a high standard of quality).

"Informed and Interconnected: A Manifesto for Smarter Cities" "R Moss Kanter, S. Litow, Harvard Working Paper 09-141, 2009. Available from http://www.hbs.edu/research/pdf/09-141.pdf

"Thinking in Systems: A Primer" by Donella H. Meadows, Chelsea Green, 2008

Google "citizen sensing" and "crowd-sourcing data" and follow wherever the trails lead…

Google "servitization" and "collaborative consumption" and follow wherever the trail leads…

GreenBiz: State of Green Business Report 2015 , https://www.greenbiz.com/report/state-green-business-report-2015

"Smart Cities and the Quality of Life: A Point of View based on the Urban Systems Collaborative meeting, London, 10-11 September 2013", *http://urbansystemscollaborative.org/wp-content/uploads/2014/04/Smart-Cities-and-the-Quality-of-Life.pdf*

"Against the Smart City", A Greenfield, Verso, 2013.

"Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia", A Townsend, Norton, 2013.

"Business Dynamics: Systems Thinking and Modeling for a Complex World," Sterman, J, Irwin/McGraw-Hill, 2000.

"Pricing the Planet", P Bisson, E Stephenson & P Viguerie, McKinsey Quarterly, June 2010.

"Foundations for Smarter Cities", C. Harrison, B. Eckman, R. Hamilton, P. Hartswick, J. Kalagnanam, J. Paraszczak and P. Williams, IBM Journal of Research and Development, Vol 54, No 4, July/August 2010. Available from http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5512826 (There is an outragous charge of $31 for this article, so don't feel you have to read it).

"Smart Cities": Transforming the 21st century city via the creative use of technology", V Buscher, L Doody, D Hill; Arup, 2010

About Us

Dr. Peter Williams

I am the Chief Technology Officer for IBM's "Big Green Innovations", and in 2009 had the honor of being appointed an IBM Distinguished Engineer. I have been heavily involved with the creation of IBM's product and service offerings in greenhouse gas management, water management, resilience and the company's activities in the area of "smarter cities". By background, I am a management consultant with 25 years' experience of applying IT to leading edge business and social issues. My PhD was in Management but focused on politics, gained from the University of Bath, England. Although I work for IBM, I will draw on the activities of multiple vendors for the course.

Rich Lechner

I held a number of senior leadership positions at IBM in business development, marketing, sales, and product development across the hardware, software, and services organizations.   As vice president of Energy & Environment at IBM, I was responsible for launching a business segment with revenues in excess of $4B across IBM's broad sustainability portfolio including energy efficient IT, intelligent buildings, smart urban infrastructure, and optimization of operations for energy, carbon, water, and waste. My responsibilities included strategy, marketing, portfolio management, ecosystem development, and sales enablement. In this role, I had the privilege of working with hundreds of organizations around the world to help them address the issues and opportunities around energy, the environment, and sustainability.

We look forward to meeting you on the Smarter Cities and Communities course!

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Goals & Assignments

Week	Topic	Goals	Reading
1	Smart Cities Explored	Critically assess the aspects of cities that can be made intelligent, the attributes and potential benefits of a smarter city. Initiate thinking about what smart cities should or should not attempt to be. Add depth and nuance to the understanding from hearing different expert opinions and challenging these.	• •
2	Informatics Toolkit 1	Establish a framework for understanding the enabling technologies and critically assess the gaps and potential issues.	• •
3	Informatics Toolkit 2	Complete the framework for understanding the enabling technologies. Develop deeper understanding of the tools that comprise the Informatics Toolkit, explore real world applications.	• •
4	Deep Dive: Energy	Develop a systems view of energy from generation through distribution to consumption. Critically assess demand management programs and the role of technology as well as behavioral science. How do these integrate with other aspects of smart cities, such as building management (6B, below)?	• •
5	Deep Dive: Design	Critically assess the role of citizen engagement in designing sustainable, smart cities. Explore the potential impacts of collaborative consumption models.	• •
6	Deep Dive: Buildings	Develop a holistic view of intelligent buildings that encompasses the structure, the occupants, the processes, as well as all of the external systems.	• •
7	Deep Dive: Food/Traceability	Critical analysis of the role of IT in the food supply chain, including the issue of traceability and how IT can increase transparency and efficiency.	• •
8	Architects of a Smarter City	Challenge public & private sector experts with the benefit of the perspective of what has been learned in the class. As before – add depth and nuance to the "taught understanding".	• •

Student Engagement Hours

Week	Topic	Lecture	Discussion	Reading	Writing	Totals
1	Smart Cities Explored	1.5	1	2	2 Essays @10 hours each Participation ~4 hours	
2	Informatics Toolkit 1	1.5	1	2		
3	Informatics Toolkit 2	1.5	1	2		
4	Deep Dive: Energy	1.5	1	2		
5	Deep Dive: Design	1.5	1	2		
6	Deep Dive: Buildings	1.5	1	2		
7	Deep Dive: Food/Traceability	1.5	1	2		
8	Architects of a Smarter City	1.5	1	2		
Total		12	8	16	24	60

Accessibility

Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk; phone: 723-1066; web site: http://studentaffairs.stanford.edu/oae.

Honor Code

The Honor Code applies to both instructors and students. The text is reproduced below; for more information, see http://studentaffairs.stanford.edu/communitystandards/policy/honor-code. Violations of the Honor Code will be taken extremely seriously in this class.

1. The Honor Code is an undertaking of the students, individually and collectively:

   a. that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;

   b. that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.

2. The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.

3. While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work.