CEE 177K/CEE 277K: "Environmental Information Engineering"

Applying IT to Save the Planet

Course Outline

Humankind is faced with climate change with all its implications, and a population that is expected to increase to 9 billion by 2050 – over half in cities - just as environmental degradation and resource shortages in multiple areas start to manifest themselves. For better or worse, we are at what may come to be seen, looking back, as a pivotal moment in our history as a species.

Information technology may point to some of the answers we need. The "mesh" of data and information through which we understand the world is getting smaller. There are more sensors "out there" (and quite possibly in your pocket and around your house too) than ever before. They are reporting ever more frequently. Our ability to analyze this flood of data is also greater than ever before – and only increasing. The result is an unprecedented opportunity to understand the operation of planetary and human systems, and to manage the interactions between the two.

That understanding and management capability could enable us to save our quality of life, and very possibly in the longer run, the planet itself as a habitable place. For this reason, the application of information and IT to the management of the environment and to enabling us to live in more sustainable ways is set to become *the* defining information technology trend of our time.

This course will explore the application of IT to the management and understanding of planetary systems, human systems and the interaction between them. It is structured as 7 x 2.5 hour modules:

1) June 27th: *Challenges Meet Capabilities:* reviews the "megatrends" of climate change, resource scarcity and urbanization; these are set against the IT capabilities that are becoming, or have already become, available and the issues that will attend their deployment. The module exemplifies the specific opportunities and challenges for IT that arise.

2) July 11th: *The New Informatics Toolkit (Part 1):* discusses 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. This module also discusses current gaps in our technological capabilities and how they might be filled.

3) July 18th: *The New Informatics Toolkit (Part 2):* (continues the discussion in Module 2).

4) July 25th: *Deep Dive – Water Management:* explores the application of the new informatics toolkit specifically to the management of water resources, and water and waste-water infrastructures.

5) August 1st: *Deep Dive – Transportation:* explores the application of the new informatics toolkit specifically to transportation systems.

6) August 8th: *Deep Dive – Urban Design:* explores the application of the new informatics toolkit specifically to urban design and the creation of livable, sustainable cities.

7) August 15th: *"Yes, but…":* the application of IT in the areas described presents challenging issues of technology risk management, citizen acceptance, privacy and security. This module explores those issues and summarizes the rest of the course.

Course Methods and Logistics

This is a 2 unit course, graded by Letter or Credit/No Credit.

We will require the submission of two papers or posters (your choice), on topics to be determined. Papers/posters 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.

Students will not be required to have a technical knowledge of IT but they will benefit from an interest in the application of information to social and business issues. 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.

The course will run every Wednesday on the dates above, from 5.15 pm - 7.45pm. Classes will take place in Y2E2 Room 111.

Module 5 will be delivered by an external speaker.

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. ☺

"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.

"The Value of the world's ecosystem services and natural capital", Costanza et al, Nature, 387, 253-260, 15 May 1997.

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

"Sensor Technologies for a Smart Transmission System" – EPRI white paper, December 2009. Available from:
http://www.smartgridnews.com/artman/uploads/1/1020619SensorsSmartTransmission1-2010_1_.pdf

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

"A Strategy For Federal Science And Technology To Support Water Availability And Quality In The United States, - Report Of The National Science And Technology Council Committee On Environment And Natural Resources Subcommittee on Water Availability and Quality", NSTC, September 2007.

"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

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

"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

About Me

I am the Chief Technology Officer of IBM's environmental business incubator, "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 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 intend to draw on the activities of multiple vendors for the course.

I look forward to meeting you on the Environmental Information Engineering course!

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