
CS7NS4: Urban Computing

Introduction

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Course organisation

✓ Lectures

- ~~Mon: 09:00 – 11:00~~ 10:00 -11:00
- Thu: 13:00 - 14:00

That's it in terms of contact hours..

But that means you have extra time to work!

✓ Lectures notes

- On blackboard, after the lectures

✓ No text book

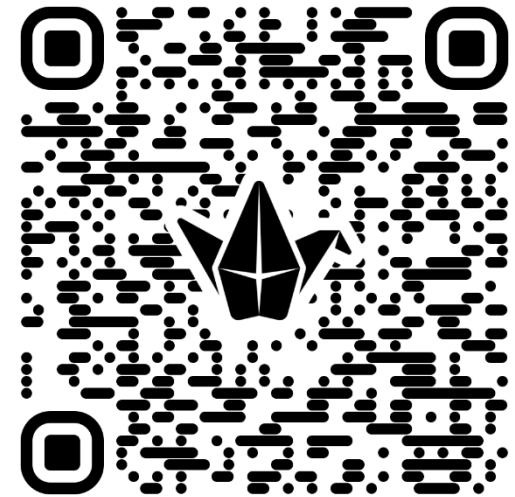
Y Zheng Urban computing, MIT Press, 2019.

Y. Zheng, L. Capra, O. Wolfson, and H. Yang. Urban computing: Concepts, methodologies, and applications. *ACM Trans. Intell. Syst. Technol.* 5, 3, 38, 2014.



Urban computing?

- ✓ What do you think?
 - Don't google!
- ✓ Discuss with your neighbours
 - Can you come up with one definition?
- ✓ Put it up on the padlet
 - <https://tinyurl.com/CS7NS4-2627>

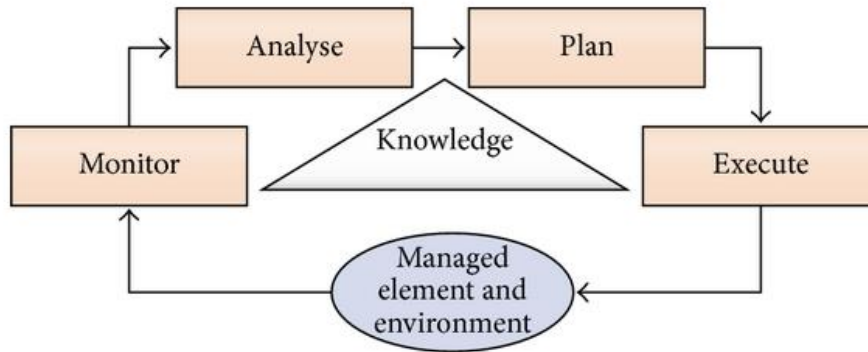


Urban computing?

- ✓ “interdisciplinary field which pertains to the study and application of computing technology in urban areas” [Wikipedia]
- ✓ “Urban computing is a process of **acquisition, integration, and analysis of big and heterogeneous data** generated by a diversity of sources in urban spaces, such as sensors, devices, vehicles, buildings, and human, to tackle the major issues that cities face. Urban computing connects **unobtrusive and ubiquitous sensing technologies, advanced data management and analytics models, and novel visualization methods**, to create win-win-win solutions that improve urban environment, human life quality, and city operation systems.”
— Yu Zheng, Urban Computing with Big Data [zheng14]

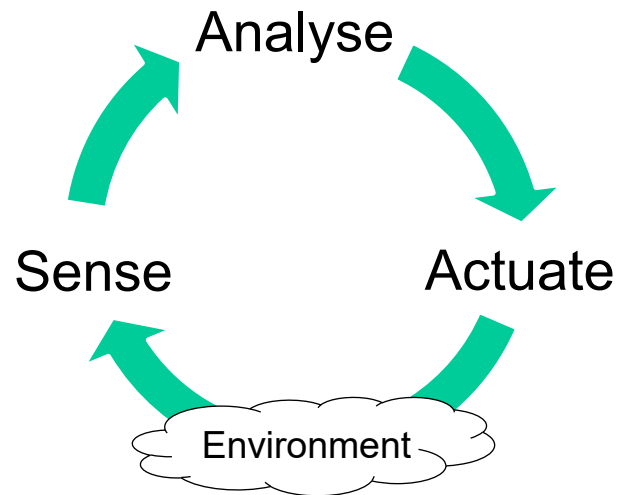
Y. Zheng, L. Capra, O. Wolfson, and H. Yang. Urban computing: Concepts, methodologies, and applications. *ACM Trans. Intell. Syst. Technol.* 5, 3, 38, 2014.

Sense, Analyse, Actuate

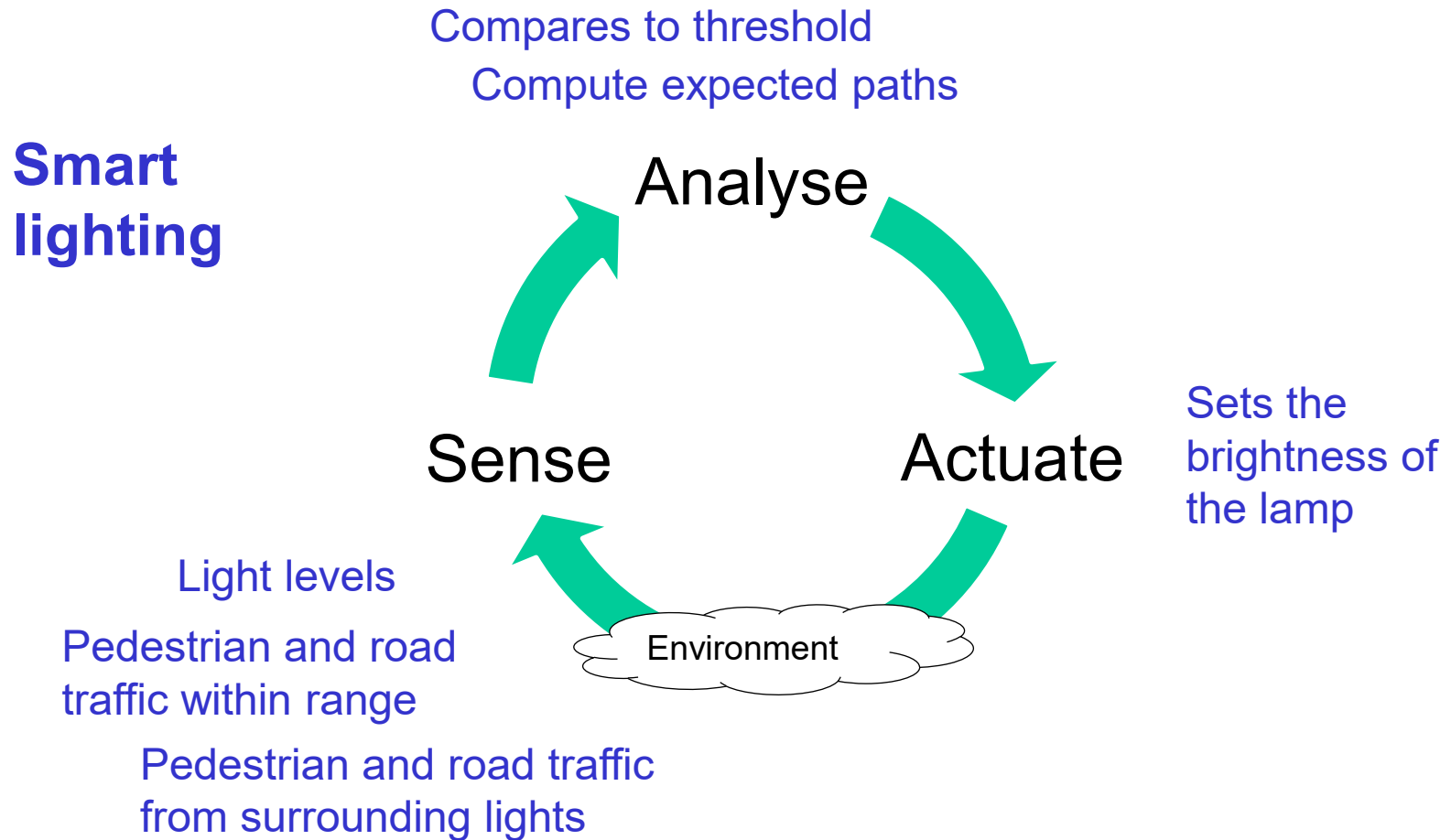


MAPE

A. Evesti and E. Ovaska, "Comparison of Adaptive Information Security Approaches," ISRN Artificial Intelligence, vol. 2013, Article ID 482949, 18 pages, 2013. doi:10.1155/2013/482949



Sense, Analyse, Actuate - Example



Urban computing ecosystem in Dublin

- ✓ Home to Google, Facebook, Microsoft, IBM, Twitter, Amazon, eBay, Paypal, Intel, HP..
 - 9 out of the 10 largest ICT companies in the world
- ✓ Particular focus on smart cities
 - IBM Smarter Cities technology centre
 - Intel Smart Sustainability Lab – IoT Ignition Lab
 - Smart Dublin initiative



Trinity's Future Cities Centre



The Future Cities Research Centre undertakes **multi-disciplinary research** that enables, promotes and **facilitates behavioural change for sustainability**.

The research is supported by the application of **sensor, communication and analytical technological solutions to sustainability concerns** in urban infrastructure such as energy, water, waste management and transportation systems.

What do you expect from the module?

Learning Outcomes

- NS4LO1 Describe the **purpose, scope, and challenges** associated with urban computing
- NS4LO2 Describe and reason about **cyber-physical systems**, including closing the feedback loop
- NS4LO3 Describe, compare and contrast existing approaches and associated challenges to **data collection and management**, including **participatory and opportunistic sensing**
- NS4LO4 Contrast, select and apply state of the art city-scale **intelligent optimization techniques**
- NS4LO5 **Analyse, specify, design, implement and test** a complete smart city application

Module Pre-requisites

- ✓ Students must be able to program a front and back end application
 - Independently
 - Using any technology that you want

Assessment

- ✓ Exam 40%
 - 5h take home exam
- ✓ Assignments 60%

Assignments

- ✓ Assignment 1 – Smart city case study (group) 15%
 - Due week 4
- ✓ Assignment 2 – Sensor data collection (individual) 10%
 - Due week 6
- ✓ Assignment 3 – Sensor data gathering (individual) 10%
 - Due week 8
- ✓ Assignment 4 – Smart city application (individual) 25%
 - Due week 11 – demos week 11 too

Questions?

Smart cities

- ✓ What is it?
- ✓ Using ICT to manage resources efficiently and improve citizens' quality of life
- ✓ Link with urban computing?
- ✓ Why do we need them?

Urban Population Growth



By 2050, ~70% of population will live in cities

Urban Sprawl



Negative impact on transportation and CO₂ emissions
Negative impact on cost of public services

Congestion



In 2007, congestion induced economic losses in Dublin were 4.1% of GDP

Air Pollution



Premature Deaths: from ~150 per million (2000) to ~390 per million (2030)

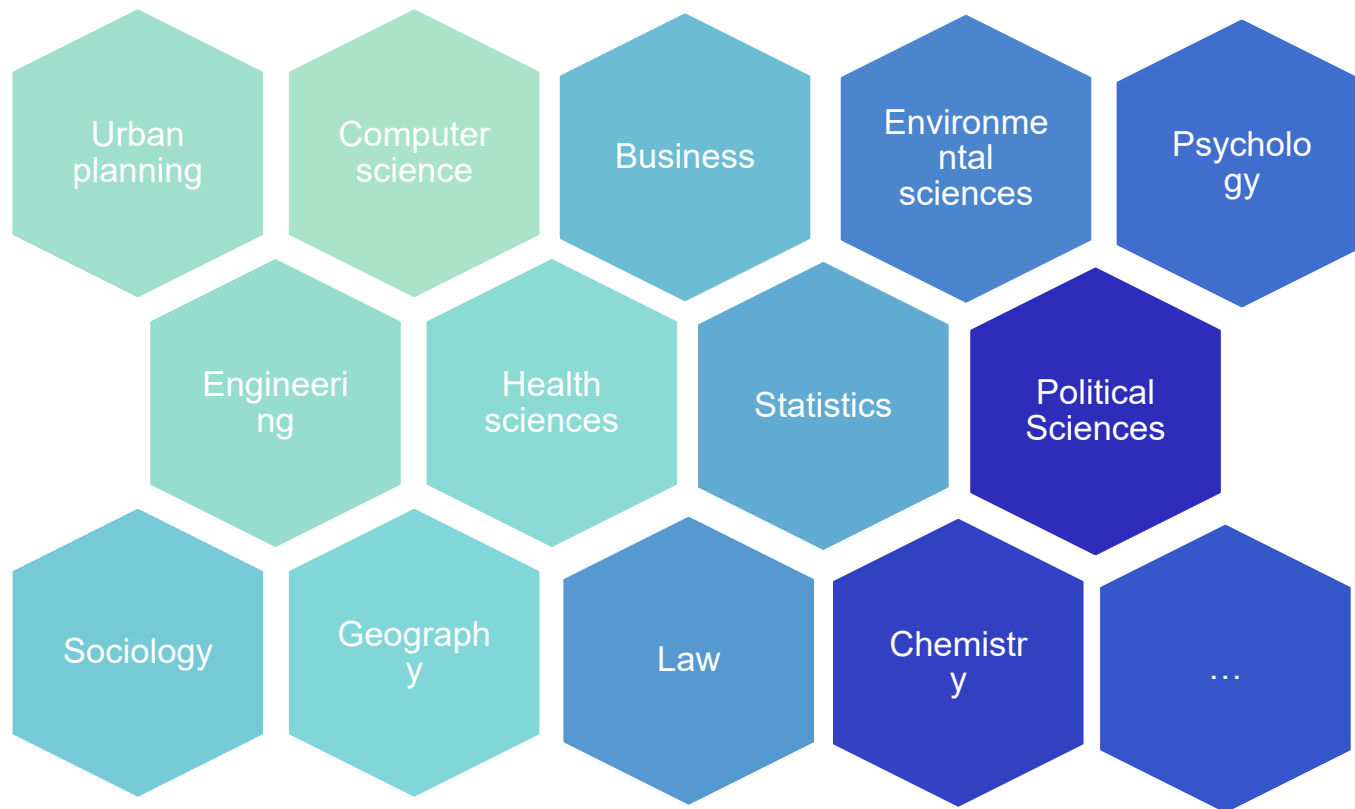
Ecological Footprint



World uses 50% more resources than can be sustainably produced

Disciplines

Disciplines



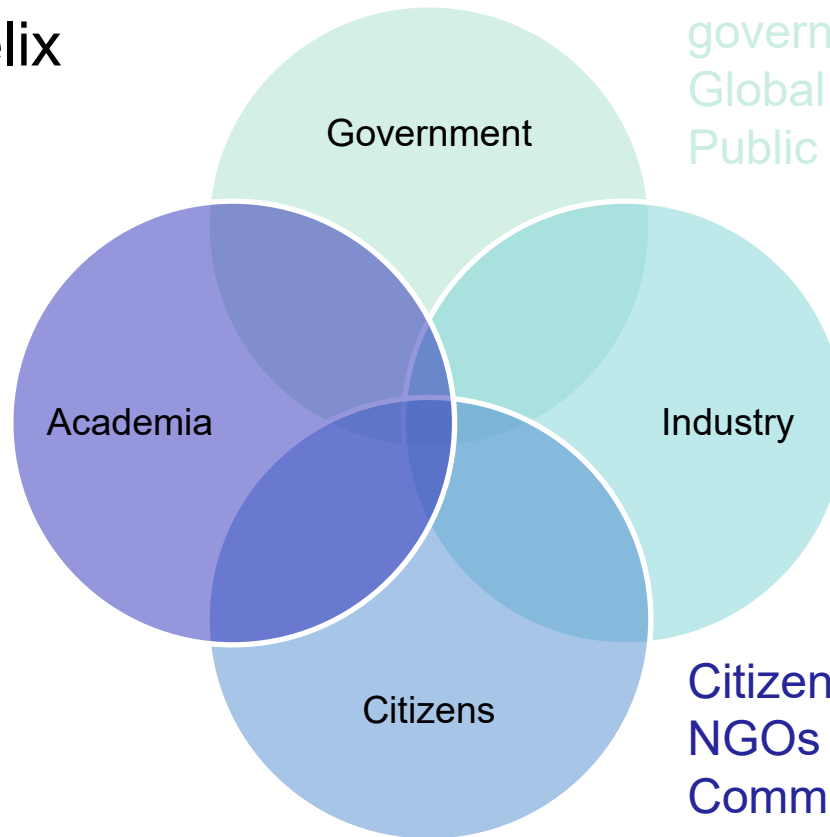
Actors?

- ✓ Discuss in groups
 - Which are they?
 - See if you can group them

Actors?

Quadruple helix innovation

Universities,
Research
labs,
Public
incubators

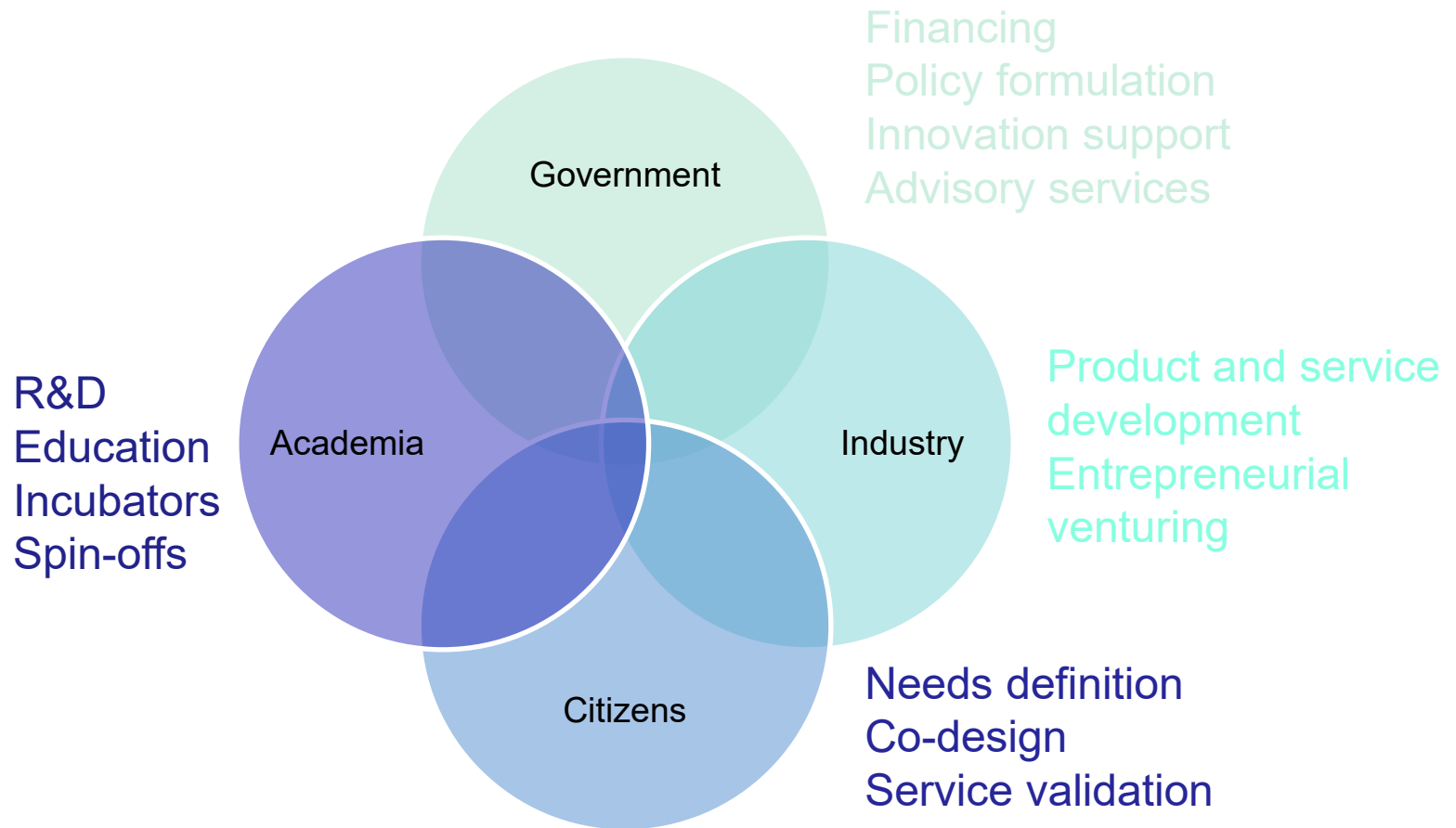


National and local
governments
Global organisations
Public transport operators...

Private transport
operators
Data centres
Utility companies
...

Citizens
NGOs
Communities...

Quadruple helix innovation 2



Adapted from M. Lindberg, M. Lindgren & J. Packendorff, Johann. (2014). Quadruple Helix as a Way to Bridge the Gender Gap in Entrepreneurship: The Case of an Innovation System Project in the Baltic Sea Region. *Journal of the Knowledge Economy*. 5. 94-113.

Domains

- ✓ Mobility
- ✓ Energy
- ✓ Water
- ✓ Pollution/ environment
- ✓ Waste
- ✓ Health
- ✓ ...

