TABLE OF CONTENTS

WEEK 2 – INTRODUCTION TO SMART CITIES

Data

"Data is a set of values of qualitative or quantitative variables; restated, data are individual pieces of information. Data in computing (or data processing) are represented in a structure that is often tabular (represented by rows and columns), a tree (a set of nodes with parent-children relationship), or a graph (a set of connected nodes). Data are typically the results of measurements and can be visualized using graphs or images. Data as an abstract concept can be viewed as the lowest level of abstraction, from which information and then knowledge are derived.

Raw data, i.e., unprocessed data, refers to a collection of numbers, characters and is a relative term; data processing commonly occurs by stages, and the "processed data" from one stage may be considered the "raw data" of the next. Field data refers to raw data that is collected in an uncontrolled in situ environment. Experimental data refers to data that is generated within the context of a scientific investigation by observation and recording.

The word data is the traditional plural form of the now-archaic datum, neuter past participle of the Latin dare, "to give", hence "something given". In discussions of problems in geometry, mathematics, engineering, and so on, the terms givens and data are used interchangeably. This usage is the origin of data as a concept in computer science or data processing: data are accepted numbers, words, images, etc.

Data is also increasingly used in humanities (particularly in the growing digital humanities) the highly interpretive nature whereof might oppose the ethos of data as "given". Peter Checkland introduced the term capta (from the Latin capere, "to take") to distinguish between an immense number of possible data and a sub-set of them, to which attention is oriented.[1] Johanna Drucker has argued that the humanities affirm knowledge production as "situated, partial, and constitutive" and that using data may therefore introduce assumptions that are counterproductive, for example that phenomena are discrete or observer-independent.[2] The term capta, which emphasizes the act of observation as constitutive, is offered as an alternative to data for visual representations in the humanities."

Wikipedia. *Data.* [online] <http://en.wikipedia.org/wiki/Data> [Accessed 24 March 2014]

Information

“Information (shortened as info or info.) is that which informs, i.e. that from which data can be derived. Information is conveyed either as the content of a message or through direct or indirect observation of something. That which is perceived can be construed as a message in its own right, and in that sense, information is always conveyed as the content of a message. Information can be encoded into various forms for transmission and interpretation. For example, information may be encoded into signs, and transmitted via signals.

Information resolves uncertainty. The uncertainty of an event is measured by its probability of occurrence and is inversely proportional to that. The more uncertain an event, the more information is required to resolve uncertainty of that event. The ‘bit’ is a typical unit of information, but other units such as the ‘not’ may be used.

Example: information in one "fair" coin flip: log2(2/1) = 1 bit, and in two fair coin flips is log2(4/1) = 2 bits. The concept that information is the message has different meanings in different contexts. Thus the concept of information becomes closely related to notions of constraint, communication, control, data, form, instruction, knowledge, meaning, understanding, mental stimuli, pattern, perception, representation, and entropy.”

Wikipedia. *Information*. [online] Available at: < http://en.wikipedia.org/wiki/Information> [Accessed 19 September 2014].

Knowledge

“Knowledge is a familiarity, awareness or understanding of someone or something, such as facts, information, descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning. Knowledge can refer to a theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic. Knowledge acquisition involves complex cognitive processes: perception, communication, association and reasoning; while knowledge is also said to be related to the capacity of acknowledgment in human beings.”

Wikipedia. *Knowledge.* [online] <https://en.wikipedia.org/wiki/Knowledge> [Accessed 25 March 2014].

Information architecture

For physical architecture, we use physical materials. For information architecture, new types of material are needed. Data, information, and knowledge could be those materials. Abstract in nature, they need structure, space and interfaces so that we can use them for design support purposes. Other disciplines, such as medicine, are constructing their body of knowledge with the same elements to come to a better understanding of the functioning of the human system.

"Information architecture (IA) is the structural design of shared information environments; the art and science of organizing and labeling websites, intranets, online communities and software to support usability and findability; and an emerging community of practice focused on bringing principles of design and architecture to the digital landscape. Typically, it involves a model or concept of information which is used and applied to activities that require explicit details of complex information systems. These activities include library systems and database development. Historically the term "information architect" is attributed to Richard Saul Wurman. There is currently a growing network of active IA specialists who comprise the Information Architecture Institute."

Wikipedia. *Information architecture*. [online]
<https://en.wikipedia.org/wiki/Information_architecture> [Accessed 15 September 2014].

Schmitt, G. Information Architecture. *Information Cities*. Zürich-Singapore: ETH-Zürich *, pp. 11-12*

Information city

Information city describes the extension of information architecture to the urban scale. In analogy to information architecture, information city has two main meanings: (1) making the invisible visible on the scale of a city and thus helping to understand the functioning of an interaction between components of the city, and to design new cities; (2) information city might become a metaphor for the structuring and ordering of vast amounts of data, created increasingly by the city's inhabitants and its infrastructure. With information city we do not mean the various Info Cities projects that focus on the seamless integration of information and communication technologies. We also do not mean completely virtual cities.

Schmitt, G. Information Architecture. *Information Cities*. Zürich-Singapore: ETH-Zürich

Modelling

"Scientific modelling is a scientific activity, the aim of which is to make a particular part or feature of the world easier to understand, define, quantify, visualize, or simulate. It requires selecting and identifying relevant aspects of a situation in the real world and then using different types of models for different aims, such as conceptual models to better understand, operational models to operationalize, mathematical models to quantify, and graphical models to visualize the subject. Modelling is an essential and inseparable part of scientific activity, and many scientific disciplines have their own ideas about specific types of modelling. There is also an increasing attention to scientific modelling in fields such as philosophy of science, systems theory, and knowledge visualization. There is growing collection of methods, techniques and meta-theory about all kinds of specialized scientific modelling."

Wikipedia. *Scientific modelling.* [online] <http://en.wikipedia.org/wiki/Scientific_modelling> [Accessed 16 September 2014].

Simulation

Simulation in the sciences is becoming an important method in addition to theory and experiment. In architecture, simulation has been used for decades, mainly to predict structural behavior, energy consumption or life cycle cost. In urban design, simulation is gaining importance in exploring future scenarios in pedestrian movements, vehicle mobility, or land use alternatives. And in territorial planning, simulation helps to predict the functioning of large-scale operations in transportation or energy supply. "Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics or behaviours/functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time.

Simulation is used in many contexts, such as simulation of technology for performance optimization, safety engineering, testing, training, education, and video games. Often, computer experiments are used to study simulation models. Simulation is also used with scientific modelling of natural systems or human systems to gain insight into their functioning. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist.

Key issues in simulation include acquisition of valid source information about the relevant selection of key characteristics and behaviors, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes."

Wikipedia. *Simulation.* [online] <http://en.wikipedia.org/wiki/Simulation> [accessed 16 September 2014].

Big Data

Big data is a term for data sets that are so large or complex that traditional data processing applications are inadequate. Challenges include analysis, capture, data curation, search, sharing, storage, transfer, visualization, querying, updating and information privacy. The term often refers simply to the use of predictive analytics or certain other advanced methods to extract value from data, and seldom to a particular size of data set. Accuracy in big data may lead to more confident decision making, and better decisions can result in greater operational efficiency, cost reduction and reduced risk.

Wikipedia. *Big Data.* [online] < https://en.wikipedia.org/wiki/Big_data> [accessed 18 June 2015]

Citizen Science

Citizen science (CS) (also known as crowd science, crowd-sourced science, civic science, volunteer monitoring or networked science) is scientific research conducted, in whole or in part, by amateur or nonprofessional scientists. Citizen science is sometimes described as "public participation in scientific research", participatory monitoring and participatory action research.
Citizen Science is defined also as: "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions"

Wikipedia. *Citizen Science.* [online] < https://en.wikipedia.org/wiki/Citizen_science> [accessed 18 June 2015]

Responsive Cities

Responsive Cities allow the direct engagement of citizens in the planning and management of their present and future environment, enabled by the advancement of good governance and progress in information and communication technology. We present examples of cities from the US, Asia and Europe that are on the verge to become responsive. We show similarities and differences between their starting positions and their approaches.

Dynamic planning and citizen integration differentiate the Responsive City from the Smart City: cities become first smart and then responsive. The ICT industry developed the Smart Cities concept as an opportunity to contribute to the improvement of city safety and management. Data for the Responsive City come from smart buildings, smart infrastructure and other smart environments. Those are human made structures that are monitored, metered, networked and controlled in areas of interest to the owners, builders and managers.

A symposium presented by ETH Zurich, Gerhard Schmitt "From Smart Cities to Responsive Cities”