Harnessing the Collective Wisdom and Power of Smart Data, Smart People, and Smart Machines in Smart Cities: A Research Agenda

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Overview of Talk
From Smart Cities to Next-Generation Cognitive Cities

- Next generation cognitive city...“smart city of the future” Batty (2012)
- Components:
  - Smart people (and Institutions)
  - Smart Machines – AI/DL/Robotics
  - Smart Data (Big Data)
- Increasing social connectivity, information connectivity, machine connectivity – Networks! Increasing M2H and M2M interaction
- Rise of the Machines....Humans falling outside the Loop (Machine-Centric Rather than Human-Centric)
What are the Implications?

• Information Gaps and Disparities
• Information Asymmetries
• Power Imbalances
• Lack of Inclusiveness
• Implications for Resilience, Sustainability, Livability (Suboptimal Outcomes?)
Highlights of the Changing Socio-Technical Landscape
A social machine is an environment comprising humans and technology interacting and producing outputs or action which would not be possible without both parties present.

Where the human does the creative work and the machine does the administrative work.


Machines in the Mix: e.g., Bots in ...
Memory of the City

Blockchains are shared ("distributed" or "decentralized") digital ledgers which use cryptographic algorithms to verify the creation and transfer of digitally represented assets or information over a peer-to-peer network.

Record of human transactions

distributed and synchronized across networks

Immutable and Permanent

Machine validation
The Internet-of-Things (IoT) (and Internet-of-Services, and Internet of People)

Monitoring everything from the content in our refrigerators to performance of critical infrastructure

Becoming more social - crowdfunding
Complexity of the IoT Space

Functional versus Spatial Scope

Fixed versus Mobile

Increasing Fragmentation in Data ownership

(Mashadi et al., 2014)
The ‘Dataverse’ is Changing...Control Shifting to Private Sector...

The Past...

Top-Down/Bottom-Up
Collected/Managed
Private-Sector Control
Privacy an Issue
Closed and Invisible

The Present...

Top-Down
Collected/Managed
Government Control
Open and Visible
Privacy less of an Issue
(Where it is an issue, it is dealt with)
Big Data is a World Traveler...

It changes hands frequently
Gets repurposed, re-packaged, re-processed...(Schintler and Kulkarni, 2014)

It generates miles...like a used car

Makes Metadata more complicated...contributes to information asymmetries
Smart Machines Increasingly Driving the Dynamics of Systems

For better or worse? With the public in mind?
Machines are rational, Systematic.
Stifle serendipity, innovation, and creativity?
Smart Machines Increasingly in the Loop

Algorithmic Decision Making, Machine-to-Machine Collaboration
Cloud Computing...and Cloud Robotics...Autonomous Agents

M2M collaboration/Interaction/Collective Decision Making
How Can We Race with the Machines, Rather than Against Them...or Worse Yet, Behind Them?
Human-Data Interaction (HDI)

• Emerging paradigm that follows from Human-Computer Interaction (HCI)

• HCI: interaction with computers as artefacts

• “Places the human in the center of the flows of data and providing mechanisms for citizens to interact with these systems and data explicitly (Mortier et al., 2014)

• HDI is not just about analysis and sense-making of data, but also engages processes of collaboration with data, and development of communications tools that enable interaction (Kee et al., 2012)
Humans and Machines

Adapted from Mortier et al., 2014
HDI (and HMDI) Considerations

• Legibility
  • Awareness of the data that is being collected about us in the first place
  • Awareness of the implications of the data collection and use
    • Who or what is interpreting the data? Who or what has access to it (access defined broadly)?
    • Intuitive data representation key

• Agency
  • Ability to opt-in or opt-out
  • Ability for informed consent, but also revocation (flawed algorithms, biases in the data, changing context)

• Negotiability
  • Ability to re-evaluate their decisions as contexts change (e.g., people, data, or machines crossing jurisdictional boundaries)
  • Ability to provide “contextual integrity”

• Awareness: Humans to Humans, Machines to Humans, and Humans to Machines
  (Language a critical factor – Semantic and Contextual, Natural versus Machine)
Agenda for Research and Action
Better Understanding of the Dataverse

• Inventory and Typology of Big Data

• Who or what owns the data? Who or what should access it? Who or what has consent to access it?

• How do Solutions and Strategies vary depending on type of Big Data? (In terms Legibility, Agency, and Negotiability)

Mashadi et al., 2014
Dashboard Design

How do we re-design the smart city dashboard so that Legibility, Agency, and Negotiability Promoted?

Democratizing the Dashboard

Visualization as a powerful language...
Granular computing (GrC) is an emerging computing paradigm of information process. It concerns the processing of complex information entities called information granules, which arise in the process of data abstraction and derivation of knowledge from information or data. Generally speaking, information granules are collections of entities that usually originate at the numeric level and are arranged together due to their similarity, functional or physical adjacency, indistinguishability, coherency, or the like.
Hybrid Analytics and Forecasting

a dashboard that quantifies future impacts
Complex Adaptive Systems Modeling

Machines and Humans as Agents
At the end of the day...human collaboration is the key...and we need to “think outside the box.”