Data and Society
Internet of Things Intro – Lecture 16

3/29/21
Today’s Class

• Personal Essay (Face Recognition) due on April 1 / Instructions in Lecture 1

• Last Assignment: April “Choice Assignment” next time

• Guest speaker Rich Wolski next time

• Lecture / Discussion

• Student Presentations
Op-Ed feedback

• Op-eds are **persuasive arguments**. Not the right format for a topic that most people agree with.

• **Persuasive title, and clear lede and thesis** are important to set the piece off. This is your opener and once you lose your audience, it’s hard to get them back.

• Although the piece is persuasive, the **arguments should be justified**. Anecdotes make the piece accessible to the reader but should not be the only arguments.

• **Avoid being too general or too specific.**

• Citations should be **referenced specifically in the text.**

If you didn’t quite get this, consider giving it another try (with a different topic) in April’s “**Choice Assignment**”.

Data doesn’t have to be the focus of the op-ed but could be used as part of the justification.
Read before 4/4

- From Data to Tomato, UCSB (Rich Wolski’s work)
- https://www.news.ucsb.edu/2015/015515/data-tomato
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<tr>
<th>Date</th>
<th>Topic</th>
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<tr>
<td>1-25</td>
<td>Introduction</td>
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<td>The Data-driven World</td>
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<td>2-1</td>
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<td>3-15</td>
<td>Data and Astronomy (Op-Ed due)</td>
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<td>Brett Bobley</td>
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<td>Data Stewardship and Preservation</td>
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<td>3-29</td>
<td>Data and the IoT</td>
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<td>4-1</td>
<td>Data and Smart Farms</td>
<td>Rich Wolski</td>
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<td>4-5</td>
<td>Data and Self-Driving Cars</td>
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<td>Data and Ethics 1</td>
<td>Fran</td>
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<td>4-12</td>
<td>Data and Ethics 2</td>
<td>Fran</td>
<td>4-15</td>
<td>Cybersecurity</td>
<td>Bruce Schneier</td>
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<td>4-19</td>
<td>Data and Dating</td>
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<td>Digital Rights in the EU and China</td>
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<td>4-26</td>
<td>Tech in the News</td>
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<td>NO CLASS</td>
<td>Fran</td>
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<td>5-3</td>
<td>Wrap up / Discussion</td>
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Lecture

• The Internet of Things
The Internet of Things (IoT)

• The IoT deeply interconnected ecosystem of **sensors, cameras, computers, smart systems, connected devices** and other technologies.

• IoT “things”
  • share data
  • work together to make decisions
  • often operate autonomously in the background
The IoT empowers people through technology and technology through intelligence

- Autonomous decision-making
- Optimization, customization, personalization
- Monitoring
- Efficiency
- Smart systems
IoT innovation: A perfect storm

• **Technology advances**
  - AI
  - Data science
  - Cloud computing
  - Small scale devices
  - Power solutions
  - Network innovations, etc.

• **Social drivers**
  - Growth of technology as social infrastructure
  - Competition
  - Sparse consumer protections
  - COVID pandemic

• **The “new normal”: The IoT as ubiquitous critical infrastructure**
  - Economic impact: $4-$11 trillion by 2025 (McKinsey)
  - Surveillance market: $63.2 billion by 2022 (Stratistics MRC)
  - Almost all vehicles will be self-driving by 2050 (Rand)
IoT $\rightarrow$ Internet of Everything

- IoT forms the basis for an expanded view of the world (Internet of Everything) where biological (people, plants, animals), physical (planetary, environmental) and cyber (data, devices, systems) “entities” as well as organizing structures and processes are powered by information and connected by technology.

- This larger connected world forms the basis for the future of society and the planet.
IoT systems: Smart Cities

- Use **real-time data and adaptive systems** can promote health, safety, security, and well-being of citizens.

From http://postscapes.com/internet-of-things-examples/
IoT Systems: Smart Homes

IoT-focused products

- Remotely monitor and manage your home / physical environments
- Promote efficient and cost-effective resource usage

From http://postscapes.com/inter
net-of-things-examples/

HEAT YOUR HOME EFFICIENTLY
Smart thermostats like the Nest use sensors, real-time weather forecasts, and the actual activity in your home during the day to reduce your monthly energy usage by up to 30%, keeping you more comfortable, and offering to save you money on your utility bills. // Visit

MAKE SURE THE OVEN IS OFF
Smart outlets like the WeMo allow you to instantly turn on and off any plugged in device from across the world or just your living room. Save money and conserve energy over time by eliminating standby power, measure and record the power usage of any device, and increase its operating lifespan through more efficient use and scheduling. // Visit

TRACK DOWN THOSE LOST KEYS
You can easily track down those lost keys or cell phone in your house using Bluetooth and other wireless technology devices like the Cobra Tag. // Visit

LIGHT YOUR HOME IN NEW WAYS
Web enabled lights like the Phillips Hue can be used as an ambient data displays (Glows red when my bus is 5 minutes away). These multi-functional lights can also help you to reduce electricity use (automatically turn off the lights when no one is in a room) or help to secure your home while you are away by turning your lights on and off. // Visit

AVOID DISASTERS
Using a device like the Ninja Block and its range of add-on sensors you can track if a water pipe has burst in your basement, if there is motion inside your home while you are away, and have it automatically send you a notification by email or text message when it happens. // Visit

KEEP YOUR PLANTS ALIVE
Whether taking care of a small hydroponic system or a large backyard lawn, systems like HarvestGeek with their suite of sensors and web connectivity help save you time and resources by keeping plants fed based on their actual growing needs and conditions while automating much of the labor processes. // Visit
IoT systems: Environmental monitoring and management

IoT-focused products

• Use real-time data and predictive analysis to better understand and manage ecosystems and natural resources

From http://postscapes.com/internet-of-things-examples/
Many benefits of the IoT

Robotic Surgery

Disaster Response

Autonomous Vehicles
Risks of the IoT

A couple says that Amazon's Alexa recorded a private conversation and randomly sent it to a friend.

FDA warns users of cyber vulnerability in pacemaker programmers.

Contact tracing by app: life-saving or invasion of privacy?
Mitigating risk through social oversight: The IoT’s “cultural lag” [Ogburn]

- Disruptive technologies can have broad societal effects, transforming
  - Work opportunities and workforce needs
  - National and international priorities
  - Economic, cultural, social, and political structures
  - Leading sectors and new areas for innovation and impact. Broad ripple effect from both.
Disruptive technologies -- How did the Industrial Revolution transform the World?

• Transition to new manufacturing processes in late 18th / early 19th century.
  • Hand production \(\rightarrow\) machines, new chemical manufacturing, new iron production processes
  • Improved efficiency of water power and the increased use of steam power
  • Wood and bio-fuels \(\rightarrow\) coal
  • England \(\rightarrow\) Western Europe, US

• Major turning point, almost every aspect of daily life influenced in some way

Iron Bridge, Shropshire. First bridge constructed from iron. Opened 1781.

Technological Innovation transformed society during the Industrial Revolution, social oversight followed innovation

- **Economic transformation**
  - Better standard of living
  - Better agricultural practices, housing, food supplies
  - Less expensive clothing and consumer goods

- **Urbanization and life-style changes**
  - Rise of factories and modern cities (and pollution)
  - Change in employment options; over-employment of children

- **Social policy**
  - Child Labor laws
  - Environmental laws
  - Growth in trade unions

*Manchester* is a name given to the city of Manchester, in England. It denotes a metropolis of cotton and cotton mills, as inspired by Manchester's status as the international centre of the cotton and textile processing industries during this time.

Engraving by Edward Goodall (1795-1870), original title *Manchester, from Kersal Moor* after a painting of W. Wylde. Wikipedia (cropped from original)
Fast forward to the present

• IoT devices everywhere and increasingly used for everything

• Opportunities for technological innovation, social controls, new approaches to business, entertainment, communication, research, governance, manufacturing, management, etc. etc.
How we build and manage the IoT matters

- Technical architectures have societal implications
- Social controls must be embedded in technology
- Many trade-offs to consider – promoting the common good is a holistic exercise
Researchers / Developers: Many challenges / opportunities in developing the IoT

• **Infrastructure challenges:**
  - How do we operate IoT devices in environments where there is no / limited power, or no / limited bandwidth?
  - How do we determine which devices / systems should have the greatest priority? What about emergency situations?
  - How much of the IoT can we run using renewable energy?

• **What protections should be implemented?**
  - How do we architect systems to support public protections

• **Which ethics?**
  - How do we promote ethical decision-making in autonomous systems?

• **Who is liable?**
  - Who is responsible when IoT systems have negative outcomes?
  - Who is liable?
  - What legal framework do we need to assign blame or determine causality?

• **Whose data?**
  - Who has the right to access, share, use, control data collected from IoT devices and systems?
  - How do we handle data curation, metadata, interoperability, workflows, retention?

• **Research implications**
  - How do we study the IoT?
  - How do we do open science on the IoT?
  - How do we do reproducible research on the IoT?
IoT Governance – who makes the rules?

IoT is largely decentralized and without a global governing authority, what is needed to ensure that the IoT promotes the common good?

According to the World Governance Index (based on the UN Millennium Declaration), critical themes for governance span key areas.

<table>
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<tr>
<th>WGI Theme</th>
<th>IoT Areas Where Governance Structures Needed</th>
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<tr>
<td>Peace and Security</td>
<td>IoT Security, Trust, Safety, Crime prevention</td>
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<tr>
<td>Democracy and Rule of Law</td>
<td>Legal framework for determining appropriate and inappropriate behavior, liability, accountability, responsibility</td>
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<tr>
<td>Human Rights and Participation</td>
<td>IoT “Bill of Rights”? Framework for promoting equality, penalizing discrimination, and reducing the digital divide</td>
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<td>Human development</td>
<td>Digital ethics, use of technology to advance / actualize its participants and contribute to common good</td>
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<tr>
<td>Sustainable development</td>
<td>Architectures, standards, policy, infrastructure, etc. to promote minimize environmental risks and promote sustainable growth</td>
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Francine Berman
IoT Players – promoting the public interest in the IoT requires action from every sector

**Government should** take the lead in protecting the public

- **Regulation of the private sector** with respect to consumer protections, personal data protections, safety and security standards, ethical guidelines
- **Clarity** on responsibility, liability, accountability

**Businesses should**

- **Focus on responsible design**
  - Public interest-focused design – architected to support public protections
  - Environmentally-focused design – longer lifespans, SW vs. hardware upgrades, sustainable materials
- **Focus on responsible practice**
  - Development of sustainable supply chains and sources
  - Explainability, risk mitigation
- **Provide transparency about the risks and benefits** of products, what constitutes safe use, what happens to personal data

**Citizens should**

- **Ask before you buy** (privacy, security, safety, protections)
- **Provide feedback** (respond to requests for comment on policy)
- Ask public officials, candidates what their stand on technology are and **vote your preferences**

**Higher education should**

- Develop **Public Interest Technology courses, internships and programs** in higher ed to increase technology literacy and societal strategies that promote the common good
Presentations
Upcoming Presentations

April 1


April 5


April 8


• “’This is bigger than just Tinmit’: How Google tried to silence a critic and ignited a movement”. Fast Company, https://www.fastcompany.com/90608471/timnit-gebru-google-ai-ethics-equitable-tech-movement
• “What a gambling app knows about you”, New York Times, 

• “Can computer algorithms learn to fight wars ethically?”, 
Washington Post, 
https://www.washingtonpost.com/magazine/2021/02/17/pentagon-funds-killer-robots-but-ethics-are-under-debate/?no-nav=true&tid=a_classic-iphone (Jin H.)
Today’s Presentations

March 29

• “Animal Planet”, New York Times,  

• “Ring and Nest helped normalize American surveillance and turned us into a nation of voyeurs”, Washington Post, (Hannah L.)  
  https://www.washingtonpost.com/technology/2020/02/18/ring-nest-surveillance-doorbell-camera/?utm_campaign=wp_post_most&utm_medium=email&utm_source=newsletter&wpsrc=nl_most