



CSCE 580: Introduction to AI

Weeks 14 - Lectures 26 and 26:
Graduate Presentation; Putting AI Together for Real World

PROF. BIPLAV SRIVASTAVA, AI INSTITUTE

18TH AND 20TH NOV 2025

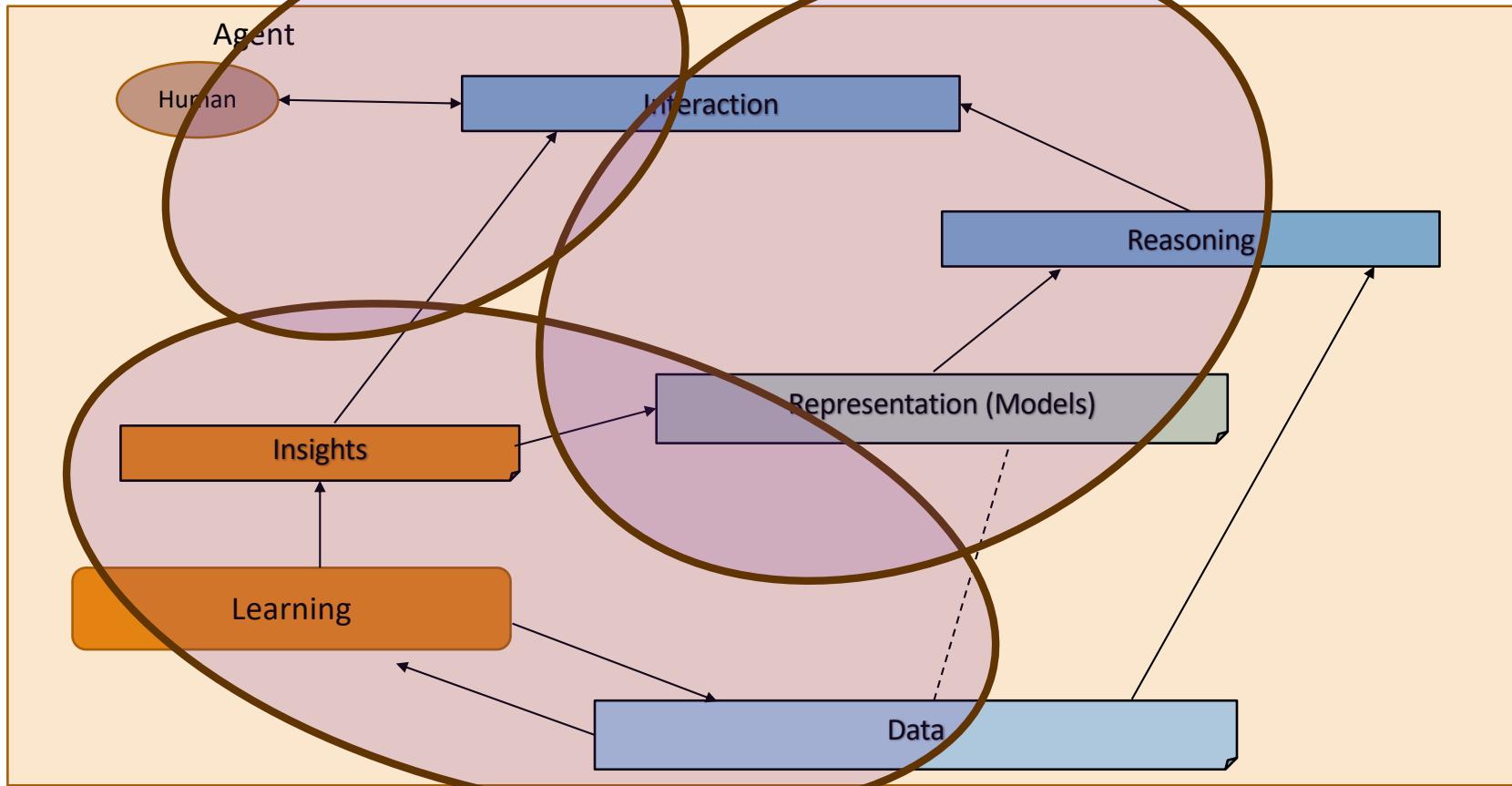
Carolinian Creed: "I will practice personal and academic integrity."

Credits: Copyrights of all material reused acknowledged

Organization of Week 14 - Lectures 26, 27

- Introduction Section
 - Recap from Weeks 12-13 (Lectures 22-25)
 - AI news
- Main Section
 - Lecture 26: Graduate paper presentations
 - Lecture 27: AI for the Real World – Bringing All Together; Advanced Topics
 - Smart Cities, Traffic, Health, Elections, Business Use cases – Business Intelligence, Team Collaboration
- Concluding Section
 - About next week/ classes – W16: Lectures 28, 29
 - Ask me anything

Relationship Between Main AI Topics (Covered in Course)



Recap of Weeks 12-13

We discussed

- Lecture 22: Planning
- Lecture 23: LLM and Planning
- Lecture 24: Quiz 3
- Lecture 25: RL

- Week 1: Introduction, Aim: Chatbot / Intelligence Agent
- Weeks 2-3: Data: Formats, Representation and the Trust Problem
- Week 3: Machine Learning – Supervised (Classification)
- Week 4: Machine Learning - Unsupervised (Clustering) –
- Topic 5: Learning neural network, deep learning, Adversarial attacks
- Week 6: Large Language Models – Representation and Usage issues
- Weeks 7-8: Search, Heuristics - Decision Making
- Week 9: Constraints, Optimization – Decision Making
- Topic 10: Markov Decision Processes, Hidden Markov models - Decision making
- Topic 11-12: Planning, Reinforcement Learning – Sequential decision making
- Week 13: Trustworthy Decision Making: Explanation, AI testing
- Week 14: AI for Real World: Tools, Emerging Standards and Laws; Safe AI/ Chatbots

Introduction Section

Upcoming Evaluation Milestones

- **Projects B: Sep 30 – Nov 20**
- Quiz 2: Oct 7
- **Quiz 3: Nov 11**
- Paper presentation (grad students only) : Nov 18
 - Put paper names in spreadsheet
- Finals: Dec 11

AI News

#1 NEWS – AIx Safe AI for Seniors: Takeaways

- Link: <https://sites.google.com/cse.sc.edu/safe-ai-for-seniors/>

- For seniors:

- AI is already being used by some of them for writing thank you letters, speeches, graphics, and translating; can potentially offer real benefits like easier access to information and new ways to stay connected and creative.
- However, AI, especially in conjunction with other changes, can create uncertainty, risk, and harm due to concerns of data privacy, over-dependence on AI, fake media and false information, inaccurate medical information, legality of using AI content, and job insecurity.

- For researchers: seniors urge that

- (AI) technology should serve people, respect privacy, and reflect human judgment and compassion.
- Identify gaps in the legal system regulating AI and propose possible solutions; analyze the different potential causes of action from different types of AI issues i.e. bias, misinformation, data breaches, deep fakes; and develop best practices for AI development to comply with legal and ethical concerns.

Main Section

Lecture 26: Graduate Paper Presentations

Presenters – Graduate Students

- Have presentation ready by Tuesday, Nov 11, 2025 for presentation on Nov 18, 2025 (Tuesday) in Google folder
- Present paper 1-by-1
- Stay within 5 minutes. Things to cover
 - Paper summary
 - Key contributions
 - Your critique about the paper.
 - A running example, if applicable
- After presentation, write your comments about the paper by Nov 21, 2025 (Friday)
 - What to have in the report – minimum 1 page per paper (<500 words).

Audience - Undergraduates

- See paper presentation before class
- Hear all paper presentations
- Ask questions
 - How much you liked the presentation
 - What you liked about the paper
 - What you liked about the presentation

Lecture 27:

Putting AI Together for Real World

Real World Problems

- Domains
 - **Health**
 - **Water**
 - **Traffic**
 - Food
 - Energy
 - **Governance**
- What can AI do here?



Major Community Challenges

Challenges

Growing population

- Access to safe water
- Need jobs

Photo by: Jennifer Wolf/ WolfHartt Image/ Marine Photobank - child's toy left on the beach.

Credit: <https://scdhec.gov/environment/your-water-coast/ocean-coastal-resource-management-ocrm/marine-debris-abandoned-vessels>



Reducing resources

- Land
- Potable water

Credit:

<https://www.greenvilleonline.com/story/news/2022/12/29/fatalities-on-sc-roads-decline-in-2022-greenville-roads-dangerous-spartanburg-anderson-traffic/69763182007/>



2015 IJCAI Tutorial - AI for Smart City Innovations with Open Data

<https://www.linkedin.com/pulse/tutorial-ai-smart-city-innovations-open-data-biplav-srivastava/>

South Carolina's traffic deaths rose by 26 percent from 1994 to 2020, marking the biggest increase by any state over those 26 years. In 2022, 1,035 people died on SC roads, per preliminary data reported by the SC Department of Public Safety

AI in the Real World

- AI is eventually like any technology for problem solving
- Key question: Why will someone use AI? What value does it provide?

AI builds on trends

Lots of data

Cheap compute

Access to online information

Basics: Smart City

Goals: Smart City? Millennium Development Goals?

Smart city can mean one or more of the following:

As a **resource optimization objective**, it is to know and manage a city's resources using data.

As a **caring objective**, it is about improving standard of life of citizens with health, safety, etc indices and programs.

As a **vitality objective**, it is about generating employment and doing sustainable growth.

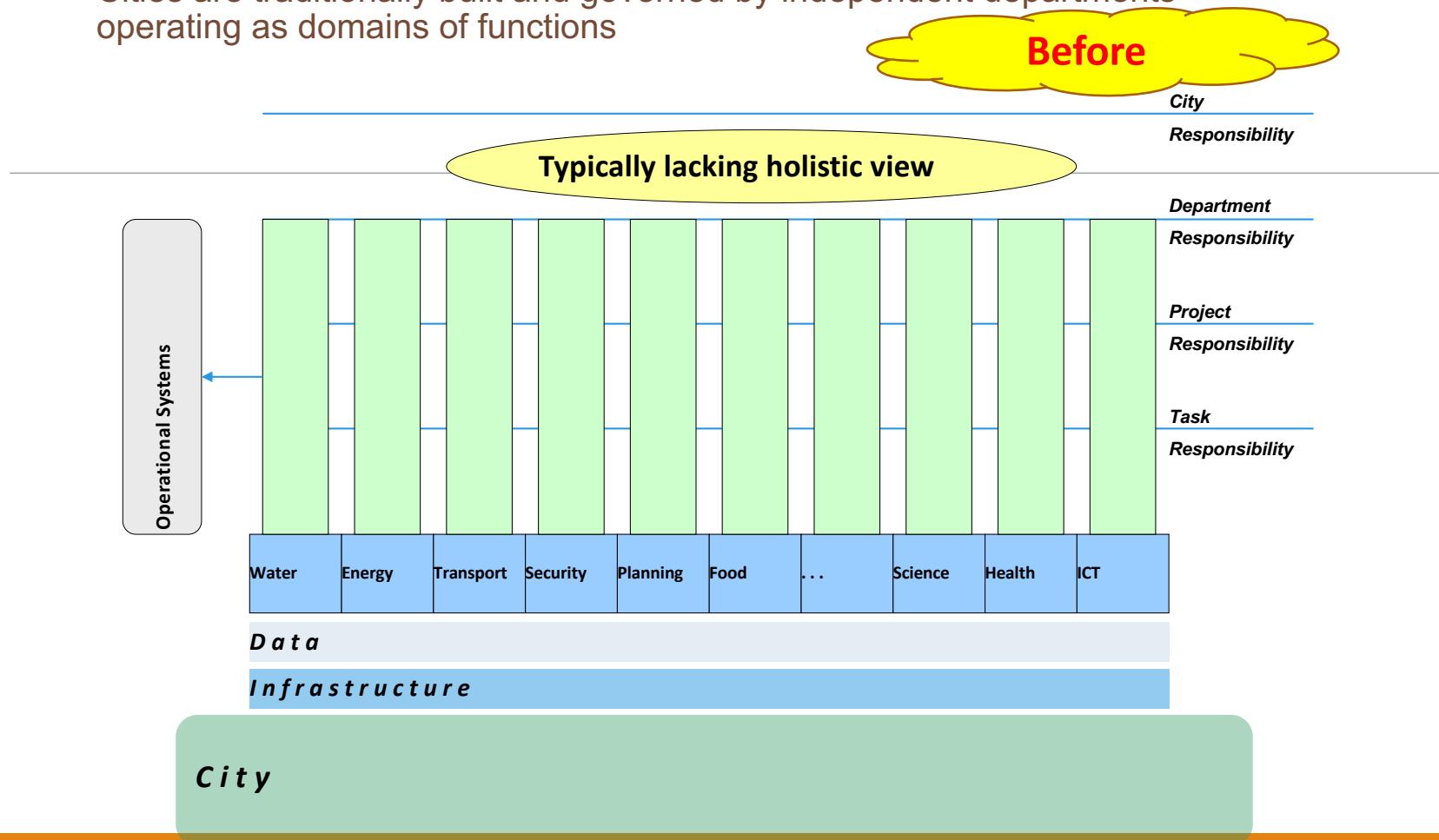
A city leadership can choose among these or define their own objective(s) and manage with measurements to pro-actively achieve it



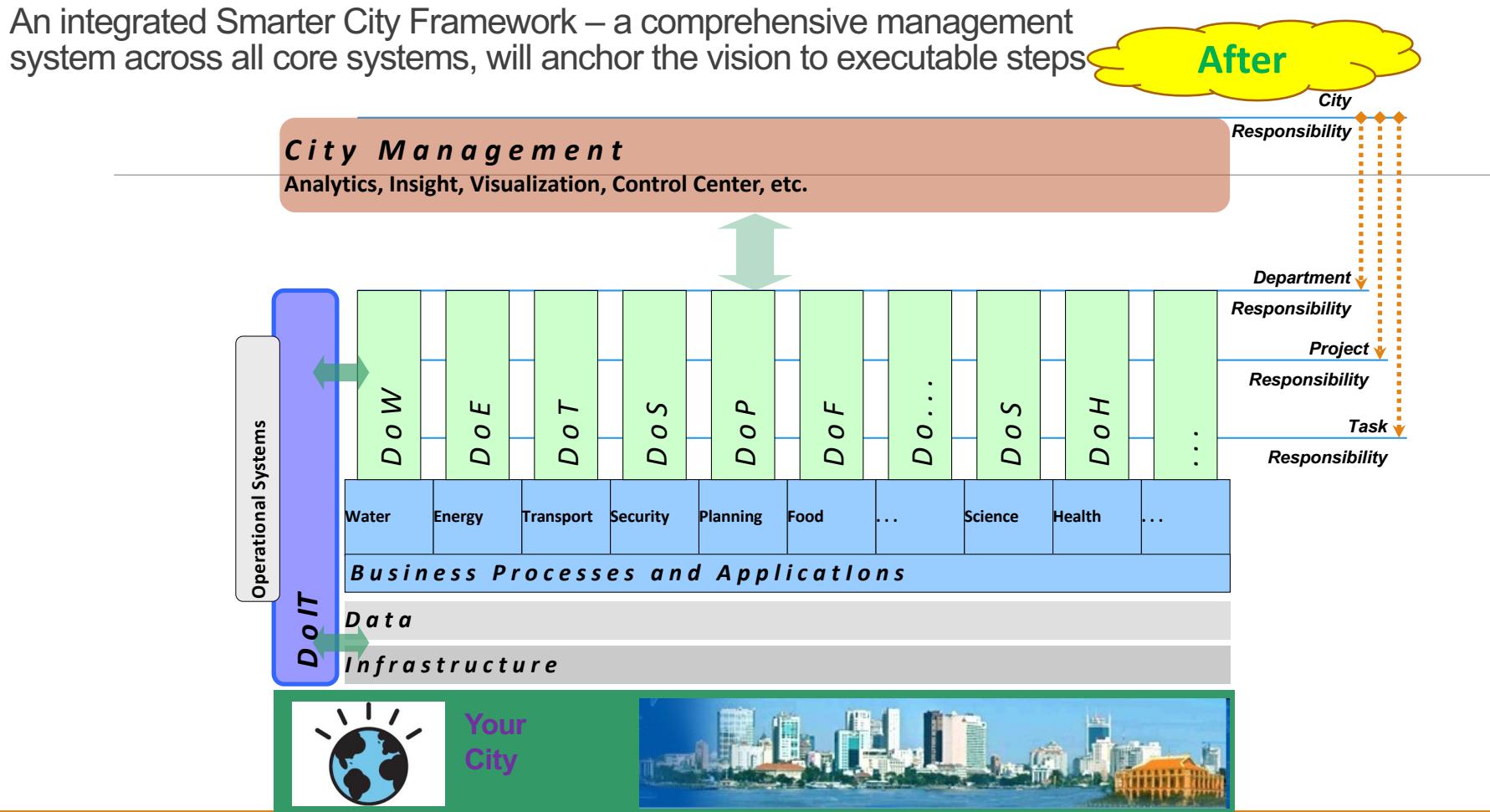
See other FAQs at: <https://sites.google.com/site/biplavsrivastava/research-1/intelligent-systems/scfaqs>

Credits: See:
<https://www.un.org/millenniumgoals/bkgd.shtml>

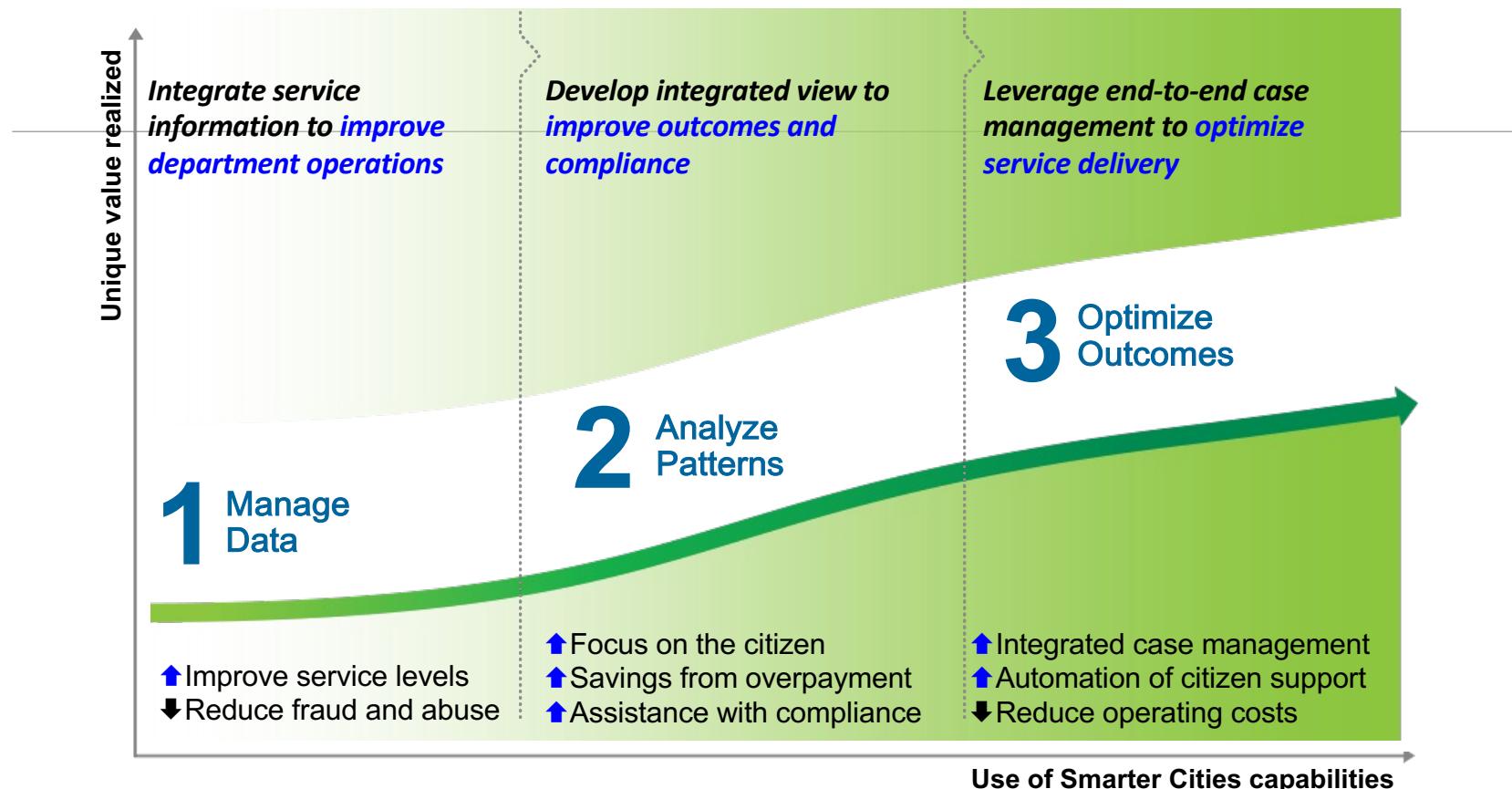
Cities are traditionally built and governed by independent departments operating as domains of functions



An integrated Smarter City Framework – a comprehensive management system across all core systems, will anchor the vision to executable steps



Smarter Cities solution paths leverage a similar approach



Major Community Challenges and Opportunities Today

Challenges

Growing population

- Access to safe water
- Need jobs

Reducing resources

- Land
- Potable water

Environmental degradation

- Air pollution
- Animal management

AI Opportunities - many avenues for impact

- Water management – e.g., clean plastics [1]
- Disease – detecting from photos [2]
- Video-based animal management
- Intelligent traffic control
- Promoting sustainable tourism
- Journalism - Media coverage of homicides and role of race [2]
- **Vision:** create participative and trustable technology solving real-world problems

References:

1. <https://theconversation.com/new-pfas-guidelines-a-water-quality-scientist-explains-technology-and-investment-needed-to-get-forever-chemicals-out-of-us-drinking-water-201855>
2. <https://www.prnewswire.com/news-releases/students-win-more-than-1-8-million-at-2023-regeneron-science-talent-search-for-remarkable-scientific-research-on-rna-molecule-structure-media-bias-and-diagnostics-for-pediatric-heart-disease-301772440.html>

2015 IJCAI Tutorial - AI for Smart City Innovations with Open Data

<https://www.linkedin.com/pulse/tutorial-ai-smart-city-innovations-open-data-biplav-srivastava/>

Open Data

- 2015 International Open Data Charter – established six norms for the publication of public data stating that data should be:
 - open by default
 - timely and comprehensive
 - accessible and usable
 - comparable and interoperable
 - for improved governance and citizen engagement
 - for inclusive development and innovation.
- Culmination of open data movements around the world, as discussed in first few lectures

Reference: https://opendatacharter.net/wp-content/uploads/2015/10/opendatacharter-charter_F.pdf

A Framework

A Systematic Approach

- **Identify:** Value of decision: before and after
- **Assess:** Data-needed
- **Explore:** Methods
- **Conduct:** Evaluation
- **Integrate:** solution with overall process



IJCAI 2015 Tutorial: <https://sites.google.com/site/aismartcitytutorial/>

Real-World Applications of Technology Follow a Pattern

- **Value (from Action, Decisions)** – Providing benefits that matter to people most in need of, and in a timely and cost-efficient manner. Going beyond technology to process and people aspects.
- **Data + Insights** – Available, Consumable with Semantics, Analysis, often including Visualization too
- **Access** - Apps (Applications), Usability - Human Computer Interface, Application Programming Interfaces (APIs)

Example – River Water Pollution

- Value – To individuals, businesses, government institutions
 - Example – Can I take a bath? Will it cause me dysentery?
 - Example – How should govt spend money on sewage treatment for maximum disease reduction?
- Data – Quantitative as well as qualitative
 - Dissolved oxygen,
 - pH,
 - ... 30+ measurable quantities of interest
- Access –
 - Today, little, and that too in water technical jargon
 - In pdf documents, website
- **Key Idea:** Can we make insights available when needed and help people make better decisions?

Example –Traffic Management

- Value – To individuals, businesses, government institutions
 - Example – Can I reach office on time? Where to park if I take my car?
 - Example – How much overt-time does the city need to give today? Where should I deploy my traffic cops today?
 - Example – When to service city's buses?
 - Data – Quantitative as well as qualitative
 - Volume – traffic count
 - Speed on road
 - City events
 - Access –
 - Today, little and on city websites
 - Facebook sites
- **Key Idea:** Can we make insights available when needed and help people make better decisions?

Journey Planning with Frugal Data

Traffic Management – Boston

Smart Cities Challenge – Boston –

https://www.cityofboston.gov/images_documents/IBM_SCC_Boston_Report_Final_LR_tcm3-36399.pdf

Promoting Public Transportation: Before and After We Seek

Many cities around the world, and especially in India and emerging ones, are getting their transportation infrastructure in shape.

- They have multiple, fragmented, transportation agencies in a region (e.g., city)
- They do not have instrumentation on their vehicles, like GPS, to know about their operations in real-time
- Schedule of public transportation is widely available in semi-structured form. They are also beginning to invest in new, novel, sensing technologies
- Cities give SMS-based alerts about events on the road.

Our approach seeks to accelerate time-to-value for such cities.

Kind of Information	Today Available to Bus User	With IRL-Transit+	Benefit
Bus Schedule (static)	Available online and pamphlets	Available from IT-enabled devices(low-cost phones, smart phones, web)	Increase accessibility
Bus Schedule Changes (dynamic)	No information	Infer from city updates	Increase information
Analytics (Bus Selection Decision Support)	No information	Will be available (Transit)	Increase information
Standardization of information	No support	Will be supported (SCRIBE, Transit)	Increase information's interoperability

Prior Work

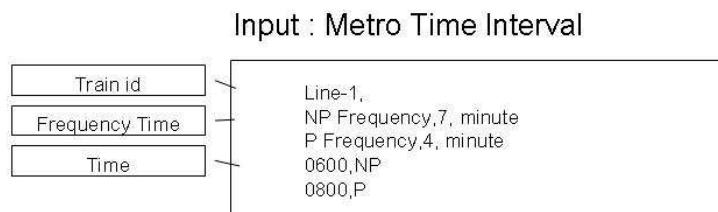
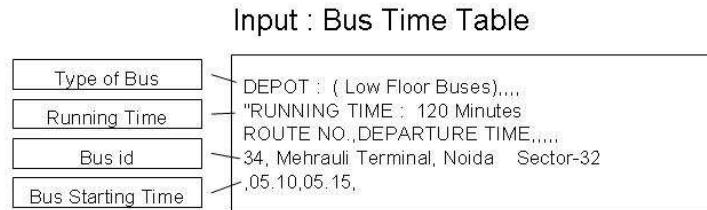
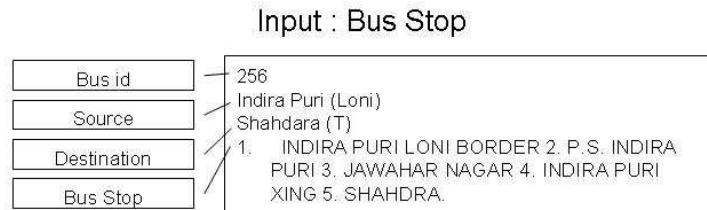
- **San Francisco Bay Area, USA has : <http://511.org>**
 - Multi-agency public authorities consortium, has advanced instrumentation
 - It is the model to replicate
- **Google has state-of-the-art from any non-public organization. It has separate services**
 - Maps for driving guidance
 - Transit for public transport, more than 1 mode
 - Gaps:
 - Considers only time, not other factors like frequency, fare and waiting time
 - Does not integrate across their services for different mode categories
 - Does not publish their data
 - Acknowledgement: We use their GTFS format to consolidate schedule data
- **Many experimental systems with capabilities less than Google,**
 - Delhi: Disha on DIMTS website - <http://61.16.238.196/disha/index.php>
 - Mumbai Navigator: <http://www.cse.iitb.ac.in/navigator1/index.html>
 - Mumbai: Go4Mumbai (portal)- A <http://www.go4mumbai.com/>
- **Shortest route finding algorithms from mapping companies**

Public Transport Journey Problem

- Invariant Inputs:
 - The person
 - has a vehicle (e.g., car), and
 - can also walk short distances
 - The city has taxis, buses, metros, autos, rickshaws
 - Buses and metros have published routes, frequency and stops
 - Autos and rickshaws can be available at stands, or opportunistically, on the road
 - Taxis can be ordered over the phone
- Input:
 - A person wants to travel from place A to B
- Output:
 - Suggest to the person which mode or combination of modes to select
- Observation: Using preferences over factors that matter to users to keep commuting convenient, while making best use of available public and para-transit commute methods

Background: Public Transportation Schedule Information

- Is widely available for public transportation agencies around the world
- Gives the basic, static, information about transportation service
- Usually in semi-structured format with varying semantics
- Can have errors, missing data



Solution Steps

- Use the widely available schedule information from individual operators (agencies)
- Clean and consolidate it across agencies and modes to get a multi-modal view for the region
 - Optionally: Convert it into a standard form
 - Optionally: Enhance (fuse) it with any real-time updates about services for the region
- Perform **what-if analysis** on consolidated data
 - Path finding using Djikstra's algorithm
 - Analyses can be pre-determined, analyses can also be user-created and defined
- Make analysis results available as a service
 - On any device
 - To any subscriber

Multi-Mode Commuting Recommender in Delhi And Bangalore

Timeframe:
2012-2014

Get public transit directions

City:

From:

To:

Start: End:

Mode:

No. of choices:

No. of hops:

Search

13 solutions found. Please click on the links to explore

⌚ Solution 1[# Hops = 0; Modes used = metro]

Source: aiims
Destination : rajiv chowk
Route Id : LINE-2
Starting Time : 17:00
Reaching Time : 17:22
Frequency : 005
Mode : metro

⌚ Solution 2[# Hops = 1; Modes used = bus , metro]

⌚ Solution 3[# Hops = 1; Modes used = bus , metro]



IRL - Transit - Search service details page
Plan trip understanding the best means of transportat

Get public transit directions

City:

From:

To:

Start: End:

Mode:

No. of choices:

No. of hops:

Search

2 solutions found. Please click on the links to explore

⌚ Solution 1[# Hops = 1; Modes used = bus , bus]

Source: bial Bgl
Destination : majestic (kbs) Bgl
Route Id : BIAS-1
Mode : bus

Source: majestic (kbs) Bgl
Destination : jn. of nice rd Bgl
Route Id : G-7
Mode : bus

⌚ Solution 2[# Hops = 1; Modes used = bus , bus]

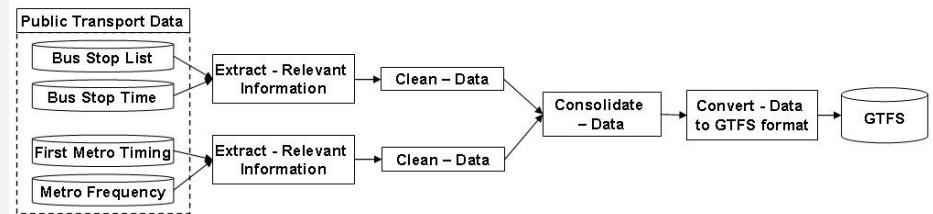
Technical Details – Scope, Accuracy, Future

• Factors which affect/ can improve accuracy

- Quality of schedule published by public transportation operators (bus and metro for us)
 - Names, spelling and conventions in stops by different agencies
 - **We correct and can do more** - If we correct too much, we remove the traceability to original published schedules
- Lack of co-relationship across stop names and location
 - Affects what the user sees when they select
 - **We can include geo-spatial analysis when we offer choice of locations**
- Increase inter-operability across agencies
 - Make traffic data into linked open data format
- Integrate with geo-spatial analysis of tools like STAT (IBM Research) or ESRI

• Future extension possibilities

- Technical
 - Include more cities; we currently have Delhi and Bangalore
 - Include more mode agencies
 - Include more data inputs as they become available, especially dynamic updates
 - Include fare, geo-spatial analysis and improved plans
- Business
 - Support a free or paid service to citizens in select cities by a client/ partner



IRL-Transit is only one type of decision support
We built others for private para-transit
agencies (e.g., radio taxis)

Extended Work* - Dynamic Updates

- Invariant Inputs:

- The person
 - has a vehicle (e.g., car), and
 - can also walk short distances
- The city has taxis, buses, metros, autos, rickshaws
 - Buses and metros have published routes, frequency and stops
 - Autos and rickshaws can be available at stands, or opportunistically, on the road
 - Taxis can be ordered over the phone

- Input:

- A person wants to travel from place A to B
- [Optional] City provides updates on ongoing events, some may affect traffic

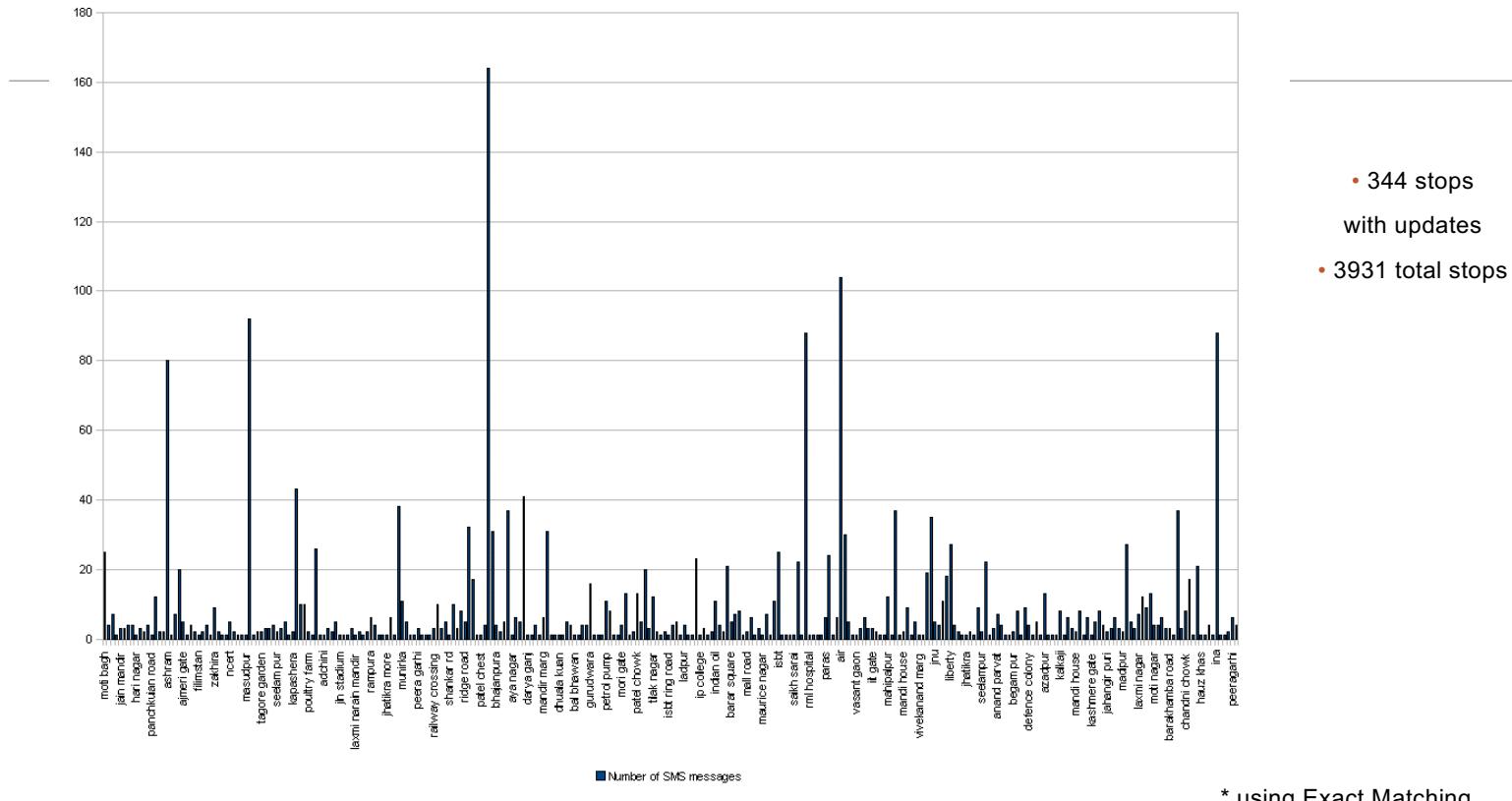
- Output

- Suggest to the person which mode or combination of modes to select

- Observation: Using preferences over factors that matter to users to keep commuting convenient, while making best use of available public and para-transit commute methods

- * [City Notifications as a Data Source for Traffic Management, Pramod Anantharam, Biplav Srivastava, in 20th ITS World Congress 2013, Tokyo](#)

Number of SMS messages for bus stops in Delhi for 2 years (Aug 2010 – Aug 2012)*



IRL-Transit

A Preference-aware Plan Selection for Mixed-Mode Commuting Powered With Just Schedule Data

IRL – Transit in Aug 2012

Get public transit directions

Examples

Delhi/AIIMS/Rajiv Chowk → Bangalore/Majestic/Marathalli

City:

Search From:

Search To:

Start:

Mode:

City Update:

No. of choices:

No. of hops:

Search

Clear

Key Points

- SMS message from city
- Event and location identified
- Impact assessed
- Impact used in search

100 solutions found for source **AIIMS** and destination **Ina**
Please click on the links to explore

Group Hop 0

↳ Solution 1[# Hops = 0; Modes used = Bus]

↳ Solution 2[# Hops = 0; Modes used = Bus]

↳ Solution 3[# Hops = 0; Modes used = Bus]

Source: AIIMS
Destination : Ina
Route Id : 465EXT
Mode : Bus

↳ Solution 4[# Hops = 0; Modes used = Bus ; Update used]

Source: AIIMS
Destination : Ina
Route Id : 543
SMS : Traffic is affected in th
SMS Time: 2012-07-05 10:08:29

Details :

ID	Message	Time	Name	Start Location	End Location	On Location
175	Traffic is moving in one lane only on Burari road due to MCD work in front of Delhi Jal Board office.msg@10.46am,230612.	23 Jun 2012 04:38:38 GMT	RepairWork	null	null	null
176	Traffic is affected at IGI stadium gate no.-16, from Raj ghat towards ITO.Due to break down of an container. Message at 07:45 am Date-23/06/2012.	23 Jun 2012 02:16:30 GMT	BreakDown	Raj ghat	ITO	null
177	From AIIMS crossing, the traffic will not go on Aurobindo Marg due to Jagannath Yatra.msg@3.52pm,210612.	20 Jun 2012 22:22:45 GMT	Procession	null	null	null
178	Traffic will remain closed from IIT to AIIMS between 2pm to 3 pm and 4pm to 4.30pm And from AIIMS to IIT between 3pm to 4pm due to Jagannath Yatra.msg@12.30pm,210612.	21 Jun 2012 07:06:55 GMT	Procession	IIT	IIT between 3pm to 4pm	null

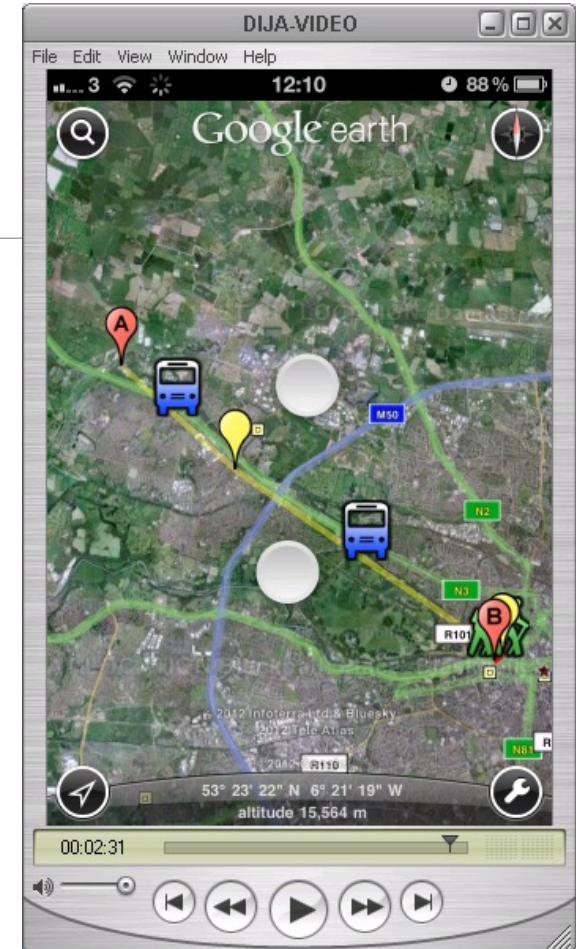
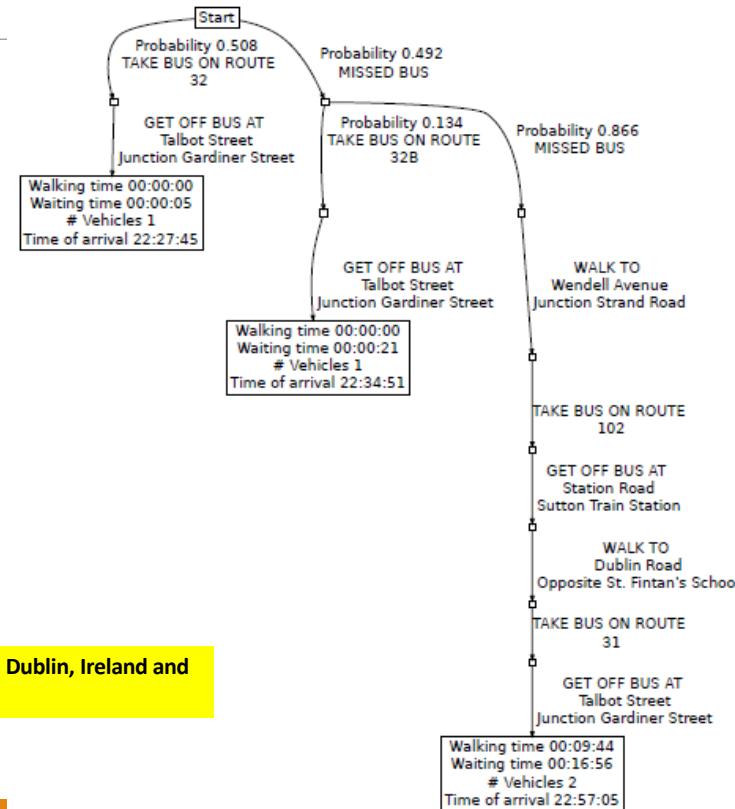
Increase Accessibility and Availability of Bus Information to Passengers (2013-end)

Kind of Information	Today Available to Bus Users	With Project in Bangalore	Mysore ITS (for reference)*	Benefit
Bus Schedule (static)	Available online and pamphlets	Available from low-cost phones (Spoken Web – Static)	Available online and pamphlets	Increase accessibility
Bus Schedule Changes (dynamic)	No information today	Will be available (Spoken Web - Human)	No information but in plan	Increase information
Bus Location	No information today	Will be available (GPS)	Will be available (GPS)	Increase information
Bus Condition	No information today	Will be available (Spoken Web - Human)	No information today	Increase information
Analytics (Bus Selection Decision Support)	No information today	Will be available (Transit)	No information but in plan	Increase information
Last –mile Connectivity to/ from nearest stop	No information today	Will be available (Spoken Web - Human)	No information today	Increase information
Standardization of information	No support	Will be supported (SCRIBE, Transit)	Some support due to GPS	Increase information's interoperability

* Opinion based on only public information

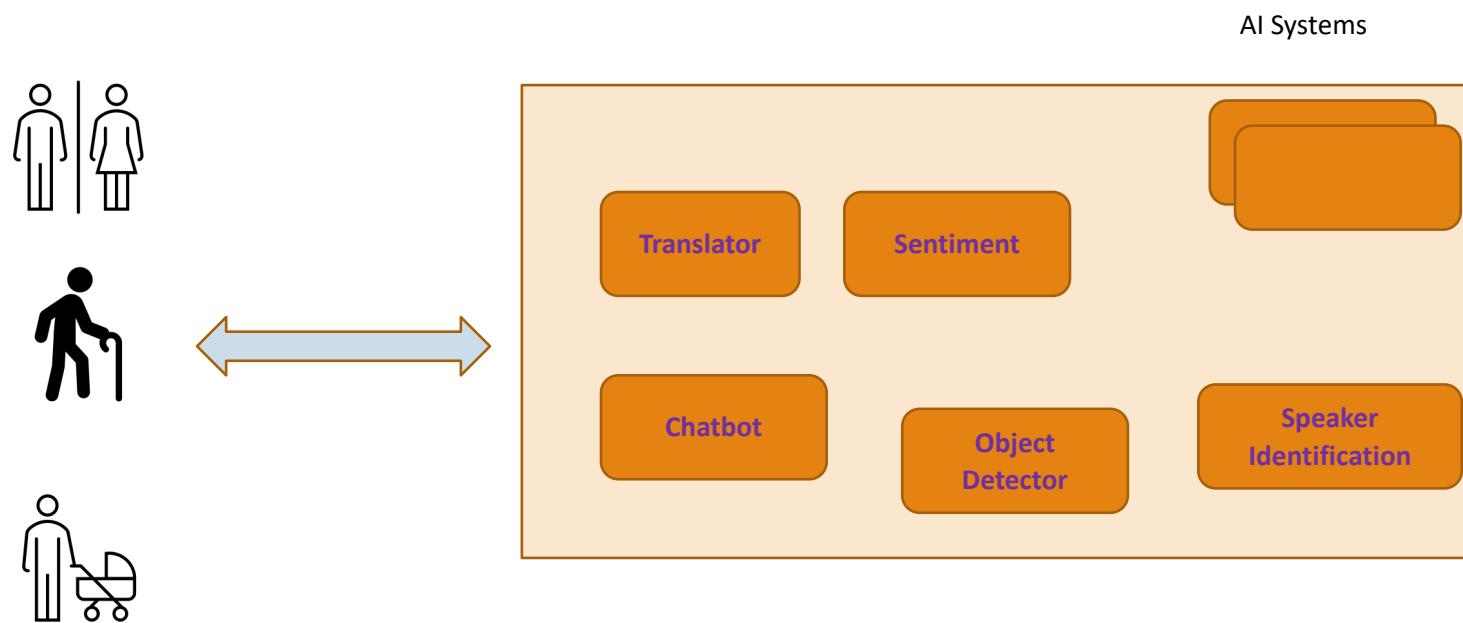
End Vision: Information to Commuters to Reach Destination in All Eventuality

A Flexible Journey Plan



Docit: An Integrated System for Risk-Averse Multi-Modal Journey Advising. Adi Botea, Michele Berlingero, Stefano Braghin Eric Bouillet, Francesco Calabrese, Bei Chen Yiannis Gkoufas, Rahul Nair, Tim Nonner, Marco Laumanns, IBM Technical Report, 2014

Technology and People



Trust: *Can people trust AI systems to perform capably, consistently, and with human values?*

Better Health

Two Tales from (Public) Health

Cutting-edge Technical Progress

- Enormous improvement in our understanding of diseases. E.g., Computational epidemiology
- Enormous advances in treating diseases are being made
 - We are living longer - A baby girl born in 2012 can expect to live an average of 72.7 years, and a baby boy to 68.1 years. This is 6 years longer than the average global life expectancy for a child born in 1990. (**Source:** WHO 2014 Health Statistics)
- Data on disease outbreaks is more available than ever before thanks to open data movement (E.g., data.gov, data.gov.in)

Stone-age Ground Reality

- Half of the top 20 causes of deaths in the world are infectious diseases, and maternal, neonatal and nutritional causes, while the other half are due to noncommunicable diseases (NCDs) or injuries. (**Source:** WHO 2014 Health Statistics)
- Worse – Indifference, mismanagement in response to communicable diseases - **late response to known diseases, in known period of the year**
 - E.g.: Japanese Encephalitis (JE) has been prevalent for ~3 decades in some parts of India killing 600+ every year
 - District level health experience is not reused over time and in similar regions

International Bodies

Ebola Data

eboladata.org

World Health Organisation
Ebola data and news maintained by the World Health Organisation.

4x [html](#)

Ebola Treatment Centres, Isolation Wards, Hospitals and Transit Centres
INACTIVE: Latest version of data is in <http://eboladata.org/dataset/ebola-treatment-centers-or-units>

3x [html](#)

Ebola Treatment Centers or Units
This dataset represents the best-known collection of status and location of the facilities known as Ebola Treatment Centers or Ebola Treatment Units in Guinea, Liberia and Sierra Leone.

1x [html](#)

Sierra Leone Ministry of Health and Sanitation
Updates and situation reports on disease incidence, treatment statistics, contact tracing

2x [html](#)

Standby Task Force
Comprehensive crowd-sourced maps of health facilities and related data: hospitals, laboratories, Ebola treatment centers, health centers, pharmacies

1x [html](#)

EbolaBigData.org Case Counts
Simple time series data of overall cases, deaths, and number of days.

1x [html](#)

Wikipedia Case Counts
Wikipedia record of major Ebola virus outbreaks by country and by date – 3 September to most recent WHO / Gov update.

1x [html](#)

National Government

Crowd sourced

Online

eboladata.org

Datasets Visualizations search

EBOLA DATA JAM

Welcome to DKAN site for the Ebola Open Data Jam.

This project will take place in person on Saturday, October 18, 2014 at Open Space 156 5th Avenue, 2nd Floor, New York, NY (map)

search

Datasets
Below are a list of datasets that are available to make tools with. [CSV](#) files can be downloaded or accessed through the DKAN Data 35 datasets

World Health Organisation
Ebola data and news maintained by the World Health Organisation.

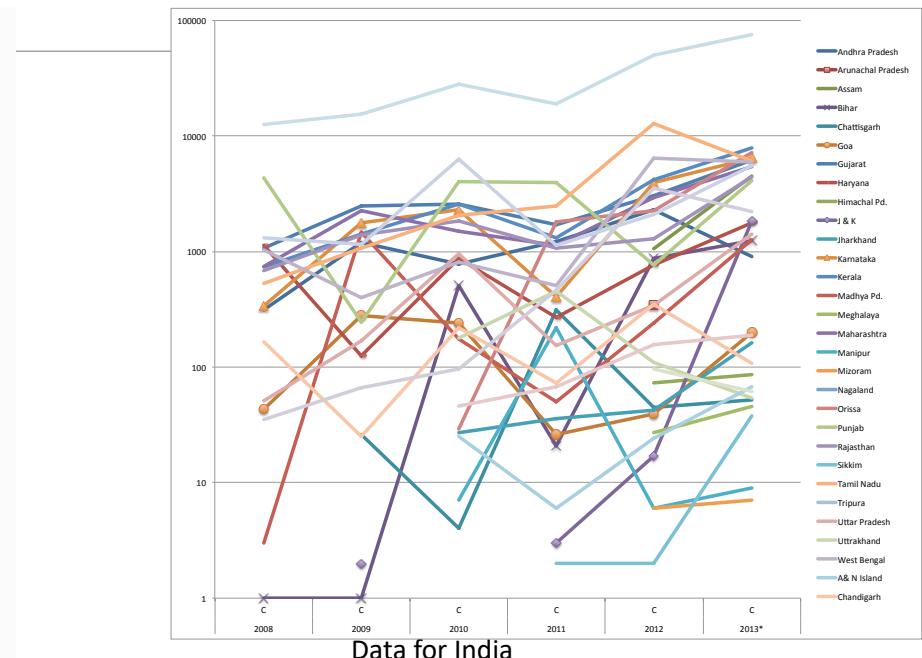
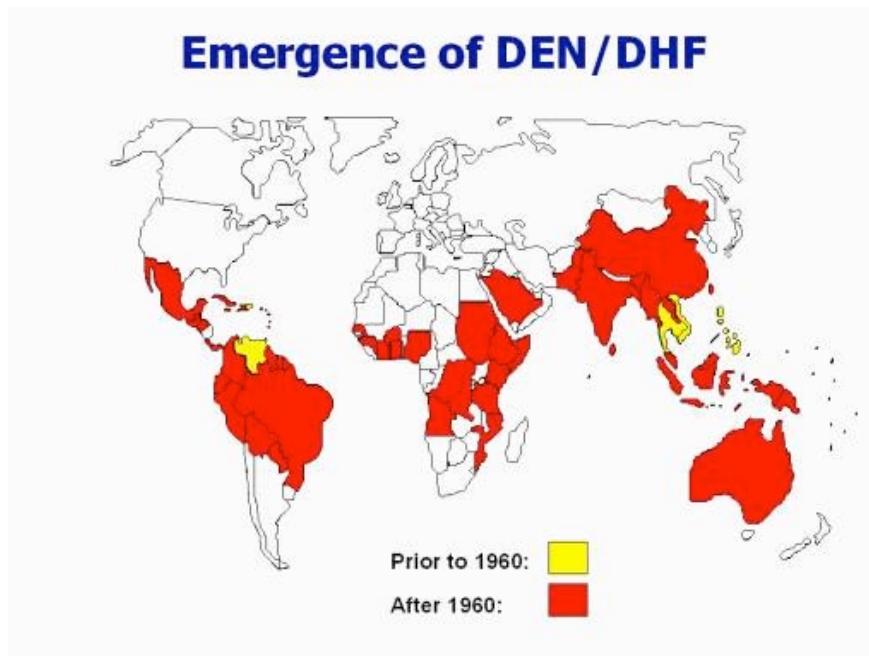
4x [html](#)

Ebola Treatment Centres, Isolation Wards, Hospitals and Transit Centres
INACTIVE: Latest version of data is in <http://eboladata.org/dataset/ebola-treatment-centers-or-units>

3x [html](#)

Dengue

So, Do We Control Dengue Effectively? **NO**



Source: <http://nvbdcp.gov.in/den-cd.html>

Decisions in Public Health - Dengue

- **Identify:** Value of decision
 - What specific steps can we take to reduce Dengue and when?
 - How to choose among a set of possible options?
- **Assess:** Data-needed
 - Directly available
 - Available by proxy
- **Explore:** Methods
 - Decision theory (benefit v/s cost), minimize risks (deaths)
- **Conduct:** Evaluation
 - What metrics are relevant?
- **Integrate:** solution with overall process
 - How can the solution be integrated in overall process at a City?

Case Study: Dengue (Mosquito-borne)

Overall cost of a Dengue case is US\$ 828 (Sabchareon et al 2012).

From 9 countries in 1960s, it has spread to more than 110 countries now

Prevention methods

COMMUNITY

1. **Mosquito Coils & Candles:** The use of mosquito coils, candles & vapor mats indoors and outdoors of homes to combat mosquitoes.
2. **Window screens & Bed Nets:** The use of window screens in homes and bed nets in bedrooms to keep mosquitos out.
3. **Insecticide Application:** Application of insecticide to kill mosquitos that invade homes and surrounding areas.
4. **Larviciding at Home:** Application of larvicide in homes to kill larvae that live in stagnant water breeding sites like small ponds, gutters, cisterns, barrels, jars, and urns.
5. **Household/Community Cleanup:** Organize cleanups within communities in the surrounding housing areas and individual homes to recycle potential breeding sites like discarded plastic bottles, cans, old tyres, and any trash that can hold water for mosquitoes to breed in.

GOVERNMENT

6. **Surveillance For Mosquitoes:** Conduct periodical surveillance in hotspot areas and other communities to look for signs of mosquitoes.
7. **Medical Reporting:** To collate and compile reports of dengue cases and statistics to prioritize and focus dengue and vector mosquito control efforts and actions for best results.
8. **Effective Publicity & Campaigns:** To foster and champion effective campaigns amongst communities and create adequate public awareness of combating dengue.
9. **Enforcement:** Support and enforce the public and communities to practice effective dengue vector elimination under existing laws and implement new laws as appropriate for public health.
10. **Insecticide Fogging:** Conduct fogging in areas that have mosquitoes and dengue outbreak hotspots to kill adult mosquitoes.
11. **Public Education:** Foster, promote, and participate in public education in schools and all possible public meeting places to inform communities how to eliminate dengue vector mosquitoes, recognize early symptoms of the disease, and proper medical care and reporting.

CORPORATE

12. **Education:** To undertake community service initiatives and campaigns through marketing expertise and the media of TV, radio, and newspapers.
13. **PR/CSR:** To use public relations and customer service relations to reach communities on the fight against dengue.
14. **Adult Mosquito Traps:** To provide adult mosquito traps and other measures within the work areas to protect employees and workers from mosquitoes bites that transmit dengue.
15. **Mosquito Repellants:** Provide mosquito repellants to employees and workers within the work areas for further protection.
16. **Mosquito Control Materials, Methods, and Agents:** To provide the tools to the public and government that are necessary for dengue mosquito vector control like pesticides, biocontrol agents, mosquito traps, repellants, and other means to prevent dengue by eliminating the mosquito vectors.

WHO, 2013, Dengue Control. At
<http://www.who.int/Denguecontrol/research/en/>, Accessed 21 June 2013.

Entogenex, 2013, Integrated Mosquito Management. At
<http://www.entogenex.com/what-is-integrated-mosquito-management.html>, Accessed 21 June 2013.

(ROI) Metrics - Illustration

Expense for disease control

- \$/person spent: How much money (in \$) is spent for a given method divided by the population of the region. Lower is better.

Impact of a disease control method

- Reduction: What is the magnitude of reduction in disease cases due to a method, expressed as a percentage, in a time period (e.g., year, disease season)? Higher is better.
- Cases/ person: How many reported cases of a disease occurred in a time period divided by the population of the region when a method was adopted? Lower is better.

Cost-effectiveness:

- Cases / \$: how many cases were reported for a disease per dollar spent on controlling it in a given time period? Lower is better.

Major Methods to Tackle Dengue

M1: Public awareness campaigns: to prevent conditions conducive to disease propagation, to improve reporting

M2: Chemical Control: Aerosol space spray

M3: Biological Control: Use of biocides

M4: Distributing equipments: bednets, insecticide- treated curtains

M5: Vaccination against the disease

Dengue Control Case Studies from Literature

Ap proach	Method s used (Mi)	Nature (Region, Population, area, year)	Expens e per person	Reduction in number of cases
A1	M1, M2, M3	Sau Paulo, Brazil; 10,927,985; 2005	US \$1.14	34%
A2	M3	Puerto Rico; -; 2003	< US\$ 2.50	50% (in Dengue transmission)
A3	M2	Songkhla, Thailand; 162,645; 2009	US\$ 1.24	
A4	M5	Bang Phae, Thailand; 207,000; - AND Thailand; 4002; 2009 - 2014		0-70%, 30.2%

- An approach may use 1 or more method(s)
- They incur different costs per person
- Their efficacy is subject to various factors

Still, can we reuse these results in new areas?

Details:

Vandana Srivastava and Biplav Srivastava, Towards Timely Public Health Decisions to Tackle Seasonal Diseases With Open Government Data , International Workshop on the World Wide Web and Public Health Intelligence (W3PHI-2014), AAAI 2014

Challenge: Prescribe Methods to Use for a Hypothetical, Illustrative Area - Sundarpur

- City is Sundarpur
 - Made up of 10 districts
 - 10,000 people in each district.
- Disease control
 - Each district allocates \$10,000 per annum to prevent disease.
 - The city has a district-level health administrator per district and then an overall citywide public health administrator.
- What approach/ method should the district health officer use? What should the city health officer recommend?
 - a mix of control methods to produce the maximum reduction feasible.
 - **Default option is to do nothing. This is unfortunately followed a lot!**

Cost-benefits for Different Approaches

Approach Option	Population P	Amount available for expenditure (in USD) (a)	Expense per person for each method (in USD) (b)	Number of people exposed to the given method in the given amount $c = (a)/(b)$	Reduction in number of cases for each method (d)	Reduction in number of cases among exposed persons $(e) = (c)*(d)$	Effectiveness of the method $E = (e) / P$
O_def	10,000	10,000	0	0	0%	0	0%
O1_A1	10,000	10,000	1.14	8772	34%	2982	30%
O2_A2	10,000	10,000	2.5	4000	50%	2000	20%
O3_A3	10,000	10,000	1.24	8065	10% *	806	8%
O4_A4	10,000	10,000	8*	1250	70%	875	9%

* represents assumption made to compensate for missing data.

Prescription for Sundarpur

Best tactical option for administrators at Sundarpur (at district and the whole city level)

- is O1_A1 since it brings the maximum reduction.
- If the administrators are interested to cover the maximum number of people in the given budget, the best method is still O1_A1.
- If the administrators are interested to show maximum reduction in cases for a pocket of the city (sub-district level which may be more prone to the disease), they may choose O4_A4 but it costs maximum and thus can be perceived as taking resources away from the not-directed areas.

Strategic option

- Select top-2 (O1_A1 and O2_A2), and try them in 5 districts each in one year. It hedges risk of variability between Sundarpur and old location of previous studies.
- Based on efficacy, decide the single best option for Sundarpur in subsequent year.
- She may also use the vaccine option only when the disease outbreak is above certain threshold.

Details:

Vandana Srivastava and Biplav Srivastava, Towards Timely Public Health Decisions to Tackle Seasonal Diseases With Open Government Data , International Workshop on the World Wide Web and Public Health Intelligence (W3PHI-2014), AAAI 2014

New Data Practices

- Find correlation among methods (positive or negative)
 - We assumed independence
 - Needs: Historic Data, Experiment Design
- Learn rate of return for approaches and methods (new combinations not tried in health literature)
 - Need: Collect data on efficacy of method individually
- Find similarity among regions
 - Data Need: Spatio-temporal modeling/ STEM
- Multi-objective optimization
 - Examples: Effectiveness of approach, Reduction of case, people coverage
 - Needs: Data about approaches tried historically

Request to Medical Community on Data

- Report both **cost** and **effectiveness** of approaches and methods
 - Overlooking one hampers reuse of results
- Interact with AI community to learn and try mixed approaches that reduce cost and improve overall effectiveness
 - All combinations cannot be tried on the ground due to practical constraints
 - Get more effective approaches rolled out faster targeted to new regions

Better Governance

Context: Elections



[https://founders.archives.gov/documents/
Adams/99-02-02-6371](https://founders.archives.gov/documents/Adams/99-02-02-6371)

"I do not say that democracy has been more pernicious on the whole, and in the long run, than monarchy or aristocracy. **Democracy has never been and never can be so durable as aristocracy or monarchy; but while it lasts, it is more bloody than either. ... Remember, democracy never lasts long. It soon wastes, exhausts, and murders itself. There never was a democracy yet that did not commit suicide.** It is in vain to say that democracy is less vain, less proud, less selfish, less ambitious, or less avaricious than aristocracy or monarchy. It is not true, in fact, and nowhere appears in history. Those passions are the same in all men, under all forms of simple government, and when unchecked, produce the same effects of fraud, violence, and cruelty. When clear prospects are opened before vanity, pride, avarice, or ambition, for their easy gratification, it is hard for the most considerate philosophers and the most conscientious moralists to resist the temptation. Individuals have conquered themselves. Nations and large bodies of men, never."

John Adams, one of the Founding Fathers of the United States

The Semantics We Will Use

- What is Democracy ?
 - People electing people govern people, independently

- What is voting v/s electing?
 - Voting is exercising right to make a choice (including not voting for available candidates)
 - Electing is selecting a candidate from the panel available (≥ 2 people)
- Party v/s people
 - Democracy cannot be complete when restriction is put on people - e.g., voters or candidates
 - Democracy can be present without any party
 - But if there are parties, they should be two or more; if there is one party, independent candidates have to be allowed - otherwise, there is restriction on candidates
 - Democracy cannot be present without empowered voters
 - Voters should be able to make independent decisions
- Why is the topic (“Credible Elections”) important?
 - Governance model that respects individual liberty
 - Best model known to ensure peaceful transition of governance over time

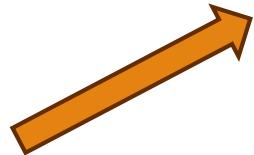
The Election's Challenge

- The voting turnout rate (62.8%, 2020) in the U.S. is very low in comparison with other countries [1].
- Promoting voter participation using traditional approaches is often costly, time-consuming, and yielding little to no results.

[1] D. Desilver, [Turnout in U.S. has soared in recent elections but by some measures still trails that of many other countries](https://www.pewresearch.org/short-reads/2022/11/01/turnout-in-u-s-has-soared-in-recent-elections-but-by-some-measures-still-trails-that-of-many-other-countries/),
<https://www.pewresearch.org/short-reads/2022/11/01/turnout-in-u-s-has-soared-in-recent-elections-but-by-some-measures-still-trails-that-of-many-other-countries/>, PEW Research, 2022

Election Ecosystem and PROMISE Team

- Technology (AI)
 - Data (creation, access, provenance)
 - Improve competence (performance, robustness)
 - Transparency and explainability
- People
 - Needs and wants, behavior (individual)
 - Belief, Influence, ... (group dynamics)
 - Diversity – culture, ethics (across the world)
- Human-AI collaboration
 - Human centered design
 - Improve access (for diverse backgrounds)
- Frameworks, Standards, Funding
 - Benchmarks and reference standards for tackling technical challenges without politicizing
 - NIST AI Safety Consortium



Stakeholders considered

- **Voters (V):** *make choices*
- **Candidates (C):** *available to make choices*
- **Election Commission (EC):** *conduct election*

Others, not considered

- Media
- Equipment vendors
(Technology, material,...)

A New Approach

The Case for Official Information to Tackle Information Disorders

Biplav Srivastava, A Vision for Reinventing Credible Elections with Artificial Intelligence,
Thirty-Ninth AAAI Conference on Artificial Intelligence (AAAI-25), Philadelphia, USA, Feb
2025, [AI, Elections]

Terminology

- **Information disorder:** misinformation, disinformation, malinformation
- **Official information:** providers required by law to give right and timely information – e.g., authoritative agencies (elected officials, election officials); and if they do not, they can be held accountable via legal means

The Election's Challenge and Solution Value

Challenges

- The voting turnout rate (62.8%, 2020) in the U.S. is very low in comparison with other countries [1].
- Promoting voter participation using traditional approaches is often costly, time-consuming, and yielding little to no results.

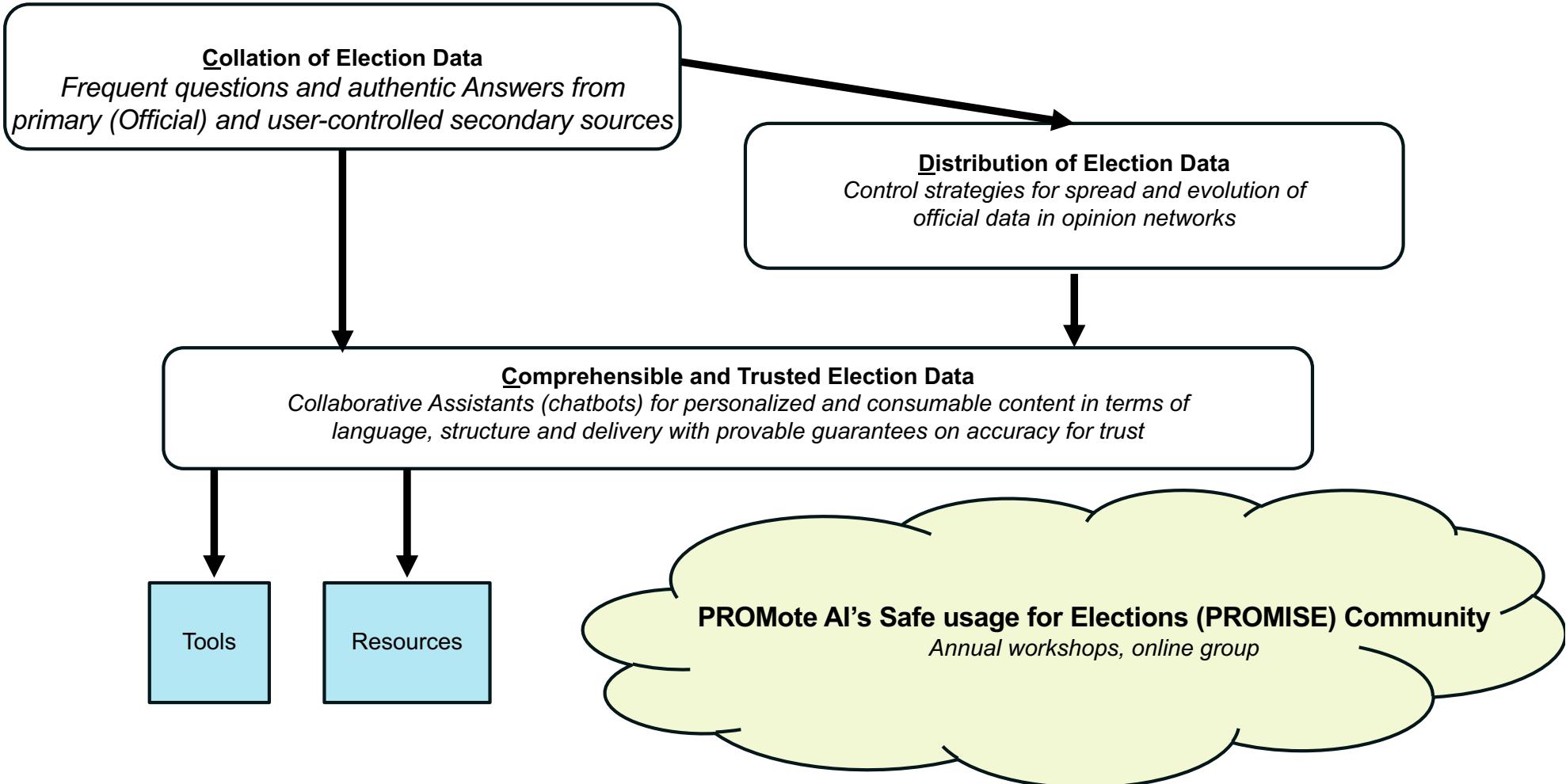
Hypothesis: Using technology for voter engagement, especially among seniors and youths, will increase participation [2].

CDC approach

- **Collate:** Collate good/ official information
- **Distribute:** Safely distribute in opinion and social networks
- **Comprehension:** Make content easy to understand

[1] D. Desilver, [Turnout in U.S. has soared in recent elections but by some measures still trails that of many other countries](https://www.pewresearch.org/short-reads/2022/11/01/turnout-in-u-s-has-soared-in-recent-elections-but-by-some-measures-still-trails-that-of-many-other-countries/),
<https://www.pewresearch.org/short-reads/2022/11/01/turnout-in-u-s-has-soared-in-recent-elections-but-by-some-measures-still-trails-that-of-many-other-countries/>, PEW Research, 2022

[2] Bergan, D. E., Carnahan, D., Lajevardi, N., Medeiros, M., Reckhow, S., & Thorson, K. (2022). Promoting the youth vote: the role of informational cues and social pressure. *Political Behavior*, 44(4), 2027-2047.



The Case for Official Information

- Information disorder is prevalent
 - Why? – (**hypothesis**): Due to lack of understanding and effort to promote official information.
- Official information: Anyone, other than official sources, giving information are open to doubt.
 - Analogy: When the state executes a person, it is called justice; when a person executes another, it is called a murder.
- Continuous efforts are needed to improve official information ecosystem: better collection, preservation and dissemination.
- Need to provide official data easily to AI tools that in turn can help stakeholders make better decisions.

Number of Queries and Sources

Country	No. of Queries	Sources
India (IND)	11	https://www.vice.com/en/article/gy4x3m/10-most-googled-questions-about-indian-election
United States of America (USA)	39	https://www.usa.gov/how-to-vote ; https://www.cnn.com/interactive/2020/politics/voting-questions-answers/
Indonesia (IDN)	6	https://www.vice.com/en/article/neawv8/most-googled-questions-about-indonesian-election-2019
Ireland (IRE)	11	https://www.citizensinformation.ie/en/government-in-ireland/elections-and-referenda/types-of-elections-and-referendums/
United Kingdom (UK)	7	https://fullfact.org/election-2019/election-questions-answered/
Estonia (EST)	50	https://www.valimised.ee/en/internet-voting/frequently-asked-questions/
South Africa (SA)	47	https://www.elections.org.za/content/for-voters/FAQ-For-Voters/
Canada (CA)	11	https://www.tvo.org/article/your-federal-election-questions-answered

Table 1: The number of queries collected from each country with the corresponding country name and source.

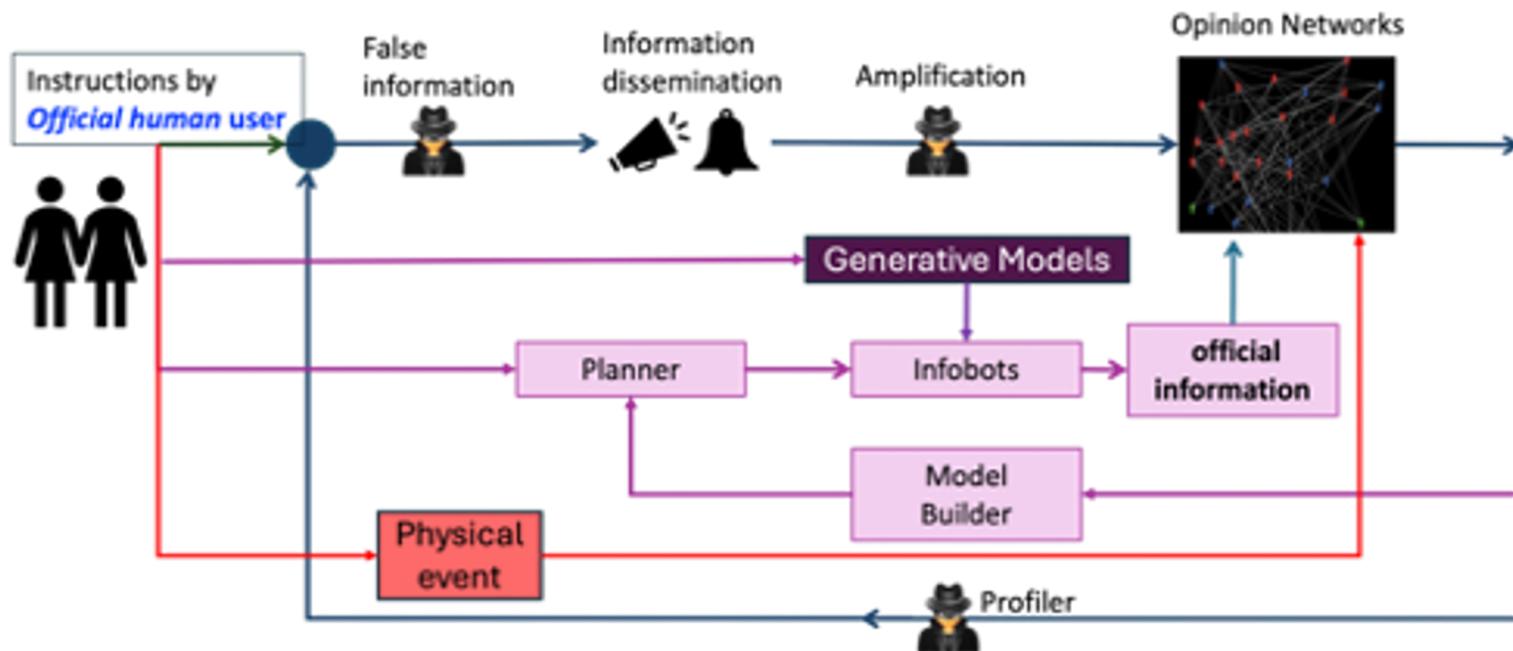
Data Sample

- **Query categories based on the stakeholders involved:** voters, candidates, and Election administration / Journalists.
 - **Sub-categories:** ‘What’, ‘How’, ‘When’, and ‘Who’ questions.

Stakeholders	Sub-category	Question - general	Parameter(s)	Region(s) Applicable	Reference to country-specific tab
Voter	What	What counts as a "fair" election?	None	Any	IDN-Q6
	How	How would the voters of advanced age vote as actively as the young?	None	Any	EST-Q36
	When	When can the <region> begin to count absentee & mail-in ballots?	<region>	Any	USA-Q35
	Who	Who can run for <Head-of-state> of <region>?	<Head-of-state>, <region>	<Head-of-state>, <region> = King Queen, Canada, President, USA, India, South Africa, Indonesia	IRE-Q2
Candidate	What	Do <poll officers> have any guidelines about conditions when a candidate can request a recount in a close result?	<poll officers>	Any	UK-Q3
	How	How is it ensured that each voter votes themselves (independently) (in <region>)?	<region>	Any	EST-Q20, EST-Q43
Election Administration / Journalist questions	What	What goes into the cost of an election in <region>?	<region>	Any	CA-Q7
	How	How does <region> handle voter abstention?	<region>	Any	IDN-Q3
	Who	Who are Millennial voters?	None	Any	IDN-Q1

Table 2: Sample generalized queries extracted from different sources with corresponding stakeholders, sub-categories, parameters, regions applicable, and reference to the country-specific tab. The country codes for each country are shown in Table 1.

A Simulator for modeling and controlling spread of information in the presence of other data sources and actors



Part 2: Distribution of Data

Simulation Tool

Expressive and Flexible Simulation of Information Spread Strategies in Social Networks Using Planning

Bharath Muppasani, Vignesh Narayanan, Biplav Srivastava,
Michael N. Huhns

Proceedings of the Thirty-Eighth Annual Conference of Association for Advancement of Artificial Intelligence - Demonstrations Track (AAAI-24 Demo), 2024

<https://www.youtube.com/watch?v=Sn0FFTsTqXM>



Interaction With Official Data

On safe and usable chatbots for promoting voter participation

Bharath Muppasani, Vishal Pallagani, Kausik Lakkaraju, Shuge Lei, Biplav Srivastava, Brett Robertson, Andrea Hickerson, Vignesh Narayanan

AI Magazine, 2023

<https://doi.org/10.1002/aaai.12109>

Solution Value: Role of Chatbots

- **Hypothesis:** Using technology for voter engagement, especially among seniors and youths, will increase participation [2].
- CDC approach
 - **Collate:** Collate good/ official information
 - **Distribute:** Safely distribute in opinion and social networks
 - **Comprehension:** Make content easy to understand
- Chatbots can proactively and interactively deliver useful information for voting compared with websites.
 - A safe chatbot architecture is needed that can be verified (like voting systems)
 - The effectiveness of using chatbot to improve voting turnout has not been evaluated.

Promise and Problem with Chatbots

Promise

- A. Allows people to interact with data naturally
- B. Can adapt content to user's cognitive and learning ability (language/ dialect, style, mode – text / graphics/ audio, font, accent)
- c. Make content easily available when needed

Demonstration of SafeChat-Elections-SC:
<http://casy.cse.sc.edu/Election-Chatbot-SC-main/>

Problems

- A. Difficult to link output to input data sources (**provenance**)
- B. Hard to control output (**fragile**)
 - a. May contain abusive language.
 - b. May exhibit bias.
- C. Requires deep AI skills to build (**costly**)
- D. Long development time to build (**costly**)
- E. Lack of testing guidance (**unreliable**)

1. Biplav Srivastava, Kausik Lakkaraju, Tarmo Koppel, Vignesh Narayanan, Ashish Kundu, Sachindra Joshi, Evaluating Chatbots to Promote Users' Trust -- Practices and Open Problems, On Arxiv at: <https://arxiv.org/abs/2309.05680>, 2023 [Chatbot evaluation, AI Trust]
2. Biplav Srivastava, Did Chatbots Miss Their 'Apollo Moment'? A Survey of the Potential, Gaps and Lessons from Using Collaboration Assistants During COVID-19, To Appear Cell PATTERNs, Aug 2021. (Preprint on Arxiv: <https://arxiv.org/abs/2103.05561>, March 2021) [Chatbots, COVID]

SafeChat / Novelty Statement

The unique aspects of SafeChat that can address the various problems with the chatbots are: **(how)**

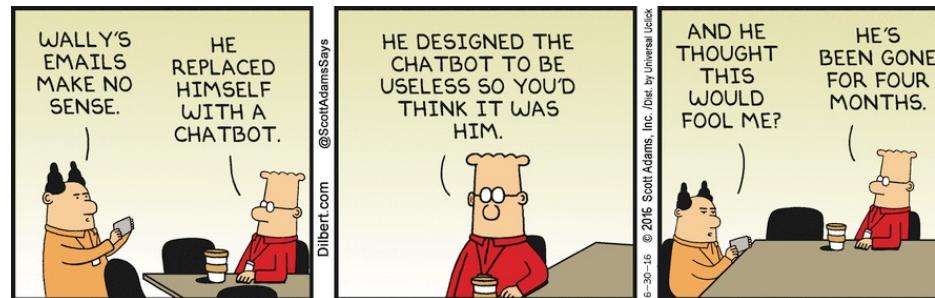
1. A safe design where only responses that are grounded and traceable to an allowed source (e.g., official question/answer) will be answered via system's self-awareness (metacognition) **[Problem A]**
2. A do-not-respond strategy that can deflect certain user questions which may be harmful if answered. **[Problem B]**
3. Trust ratings provided to communicate the chatbot's expected behavior **[Problem B]**
 1. abusive language and
 2. bias exhibited.
4. A CSV-driven chatbot building workflow that does not require deep AI expertise, making it accessible to developers with varying levels of AI knowledge and experience. **[Problems C, D]**
5. A low-programming design pattern based on the open-source Rasa platform to generate chatbots quickly for any setting (e.g., domain, language, localization) **[Problems C, D]**. The backend can be extended with CSV-driven web integration.
6. Support for control and treatment group formation and analysis of results, to support RCT testing **[Problem E]**

Problems (What)

- A. Difficult to link output to input data sources (**provenance**)
- B. Hard to control output (**fragile**)
 - a. May contain abusive language.
 - b. May exhibit bias.
- C. Requires deep AI skills to build (**costly**)
- D. Long development time to build (**costly**)
- E. Lack of testing guidance (**unreliable**)

Our approach works with any rule-based, also called slot-based or event-condition-action based chatbot building platform, like Rasa or DialogFlow. They in turn may use learning for their functionality like intent specification.

Solving Real Business Problems



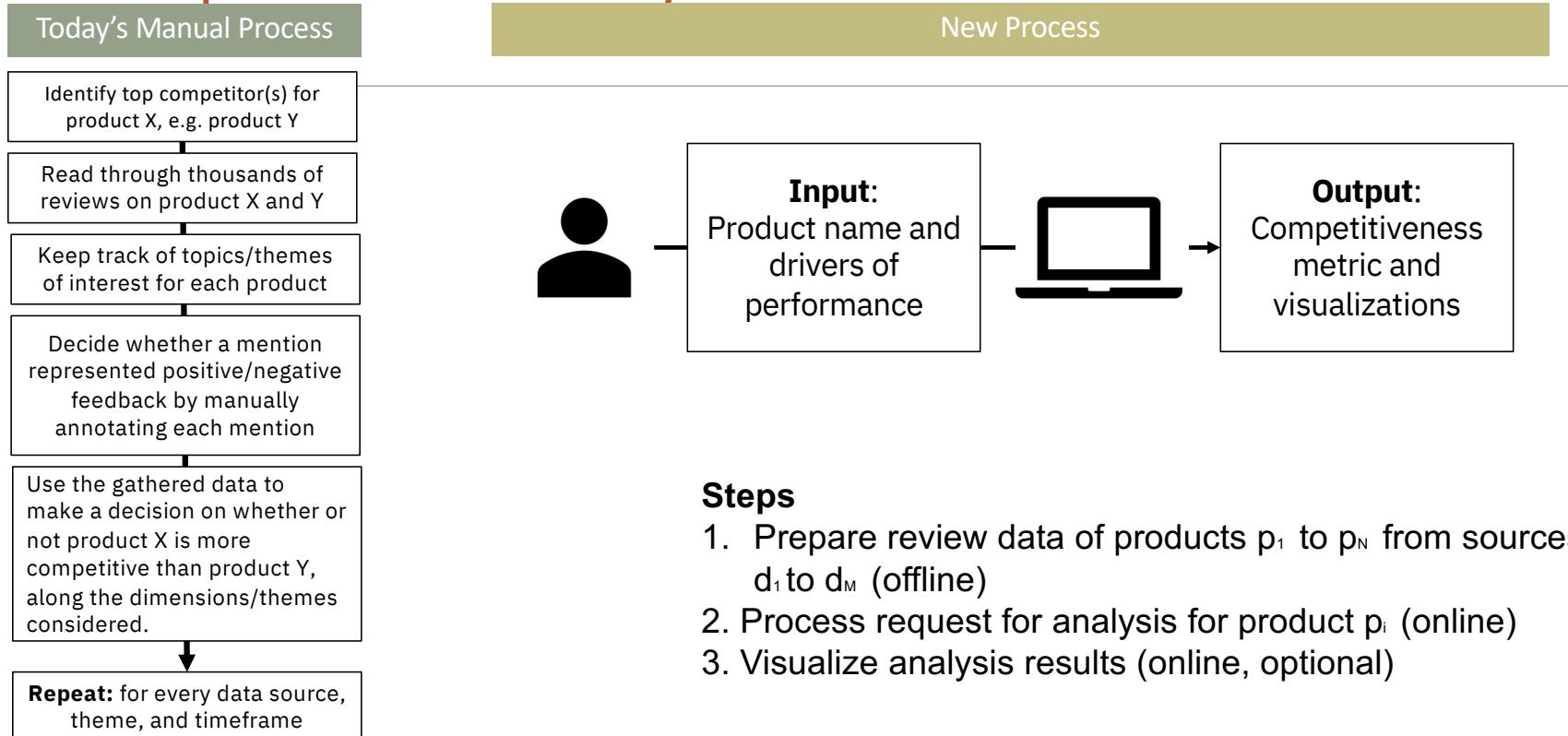
Credit: Dilbert – June 30, 2016

Case Study of Sentiment in Business

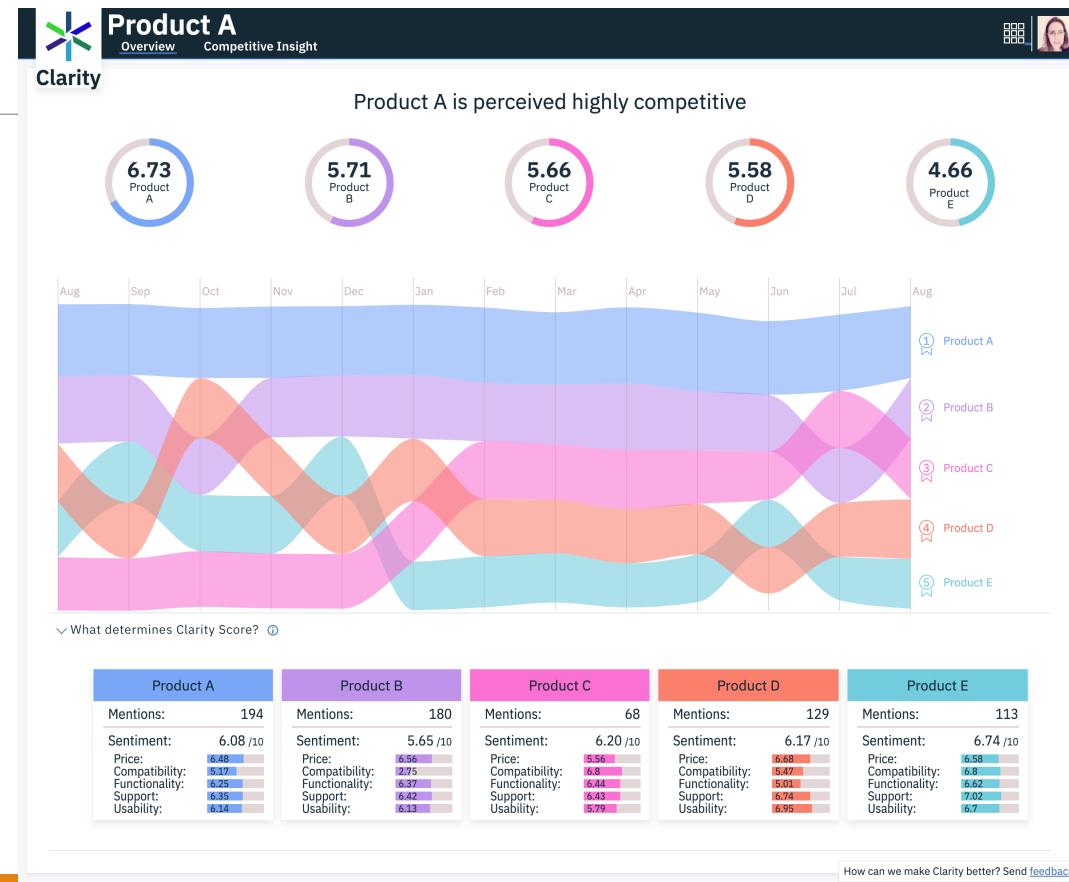
Clarity: Data-Driven Competitive Analysis

1. Sheema Usmani, Mariana Bernagozzi, Yufeng Huang, Michelle Morales, Amir Sabet Sarvestani, Biplav Srivastava, Clarity: Data-driven Automatic Assessment of Product Competitiveness, IAAI/AAAI 2020, **Deployed Application Award**
2. (Demo paper) Data-driven ranking and visualization of products by competitiveness, Sheema Usmani, Mariana Bernagozzi, Yufeng Huang, Michelle Morales, Amir Sabet Sarvestani, Biplav Srivastava, AAAI 2020
3. [Yufeng Huang](#), [Mariana Bernagozzi](#), [Michelle Morales](#), [Sheema Usmani](#), Biplav Srivastava, [Michelle Mullins](#), Clarity 2.0: Improved Assessment of Product Competitiveness from Online Content. [AI Mag. 42\(2\)](#): 59-70 (2021)

Competitive Analysis: Before & After



Illustrative Output



Clarity Score and Trends

Methodology

Data ingestion

Feature Extraction

Sentiment Analysis

Aspect mining

Aggregation

Sentiment Analysis

Keywords



Calculate keyword level sentiment

Separate out the negative and positive parts of review

Run summarization algorithm

Review Summary

"The DB2 LUW performance on multi-table workloads are demonstrated on the speed improvements using the same queries for both standard row store and column store environments. The column store environment in that one can have mixed mode databases comparing both column and row store tables. DB2 LUW also supports columnar which supports both row and column based tables. Very few problems when we migrate from DB2 LUW to Oracle. Excellent customer support. My local IBM account team has been great in helping us in getting the right resources to resolve our company's DB2 databases avoid any performance issues."

"Oracle has excellent scalability, robust documentation, robust support but since it's IBM it's costing document quickly. The product is fairly stable but requires a lot of resources to run. Oracle is a good choice when you want to have more features than MySQL. Soles are available but are not all that great. For pure up-and-running functionality, Oracle is the best choice."

"Some of the tools are bordering on ridiculous but tool creation was originally done by Oracle. Not Oracle as Oracle so hard to find DBAs. Also Oracle has a lot of paid tools. Oracle tools (performance measurement tools / etc) are harder to find. Oracle consumes more GBA time than does LUW."

Case Study of Collaboration in University

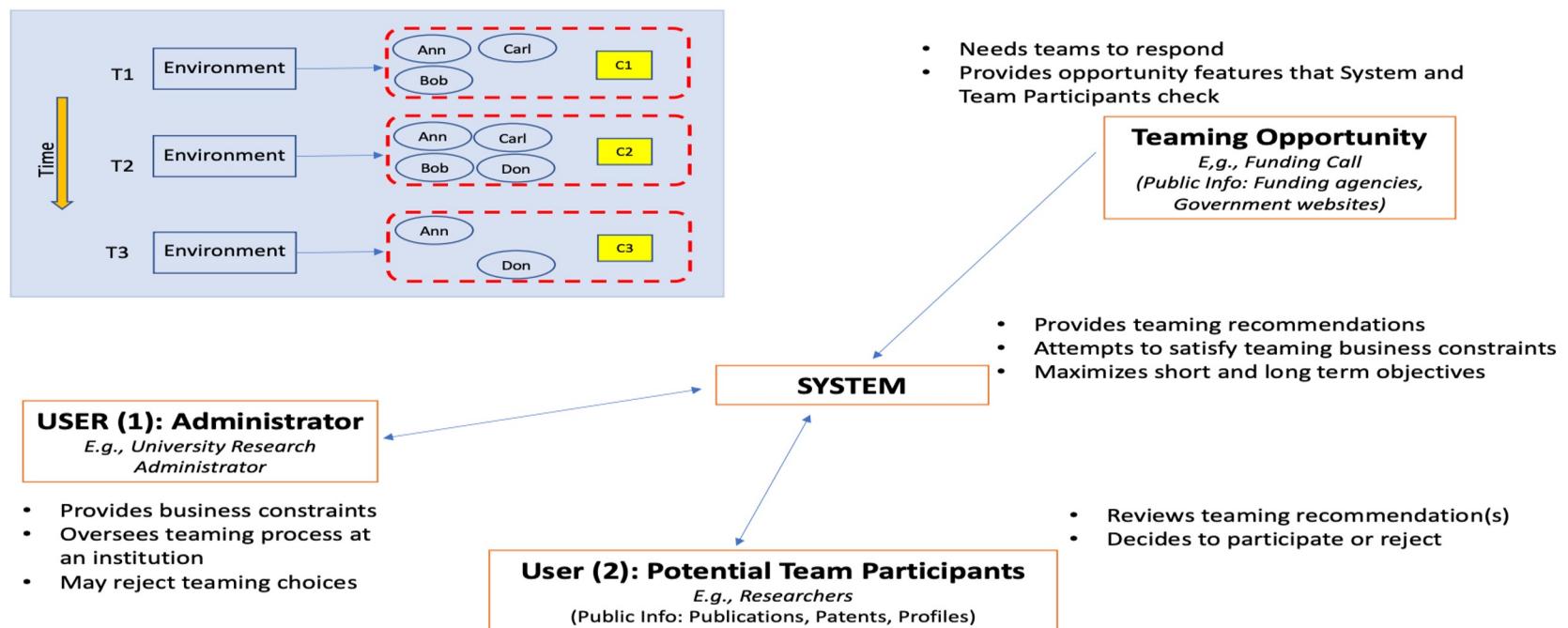
ULTRA



<https://www.youtube.com/watch?v=8MUTxsfVNIU&t=7s>

1. AI-Assisted Research Collaboration with Open Data for Fair and Effective Response to Call for Proposals, AAAI AI Magazine, 2024
2. **2024 AAAI-IAAI Deployed Application Award -**
Promoting Research Collaboration with Open Data Driven Team Recommendation in Response to Call for Proposals, AAAI-IAAI 2024, The Thirty-Sixth Annual Conference on Innovative Applications of Artificial Intelligence (IAAI-24)

ULTRA: TEAMING SETUP



Sample Input Data from University of South Carolina

Faculty Researcher Data

Faculty Name	Research Interests
Agostinelli, Forest	['Artificial Intelligence, Deep Learning, Reinforcement Learning, Search, Bioinformatics']
Bakos, Jason D.	['computer architecture, reconfigurable computing, heterogeneous computing, high performance computing, embedded systems']
Banerjee, Sourav	['Wave Propagation, Ultrasonics, Acoustics, Metamaterials, Biomedical']
Bayat, Mahmoud	['Structural Health Monitoring, Probabilistic Analysis, Nonlinear Vibrations, Machine Learning, Earthquake Eng']

Requests/Calls for Proposals (RFPs) Data

RFP ID	RFP Title	Description
nsf20540	NSF-Simons Research Collaborations on the Mathematical and Scientific Foundations of Deep Learning	The National Science Foundation Directorates for Mathematical and Physical Sciences (MPS), Computer and Information Science and Engineering (CISE), Engineering (ENG), and the Simons Foundation Division of Mathematics and Physical Sciences will jointly sponsor up to two new research collaborations consisting of mathematicians, statisticians, electrical engineers, and theoretical computer scientists. Research activities will be focused on explicit topics involving some of the most challenging questions in the general area of Mathematical and Scientific Foundations of Deep Learning.

ULTRA: SAMPLE INPUT TO SYSTEM

SAMPLE RFP ABOUT QUANTUM COMPUTING FROM NSF:
[HTTPS://WWW.NSF.GOV/PUBS/2017/NSF17548/NSF17548.HTM](https://www.nsf.gov/pubs/2017/nsf17548/nsf17548.htm)

Ideas Lab: Practical Fully-Connected Quantum Computer Challenge (PFCQC)

PROGRAM SOLICITATION
NSF 17-548

REPLACES DOCUMENT(S):
NSF 16-520

National Science Foundation
Directorate for Mathematical & Physical Sciences
Division of Physics
Directorate for Computer & Information Science & Engineering
Division of Computing and Communication Foundations
Directorate for Engineering
Division of Electrical, Communications and Cyber Systems

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:
Ideas Lab: Practical Fully-Connected Quantum Computer Challenge (PFCQC)

Synopsis of Program:

Quantum computing is a revolutionary approach to information processing based on the quantum physics of coherent superposition and entanglement. Advantages of quantum computing include efficient algorithms for computationally difficult tasks, efficient use of resources such as energy and time for computation, and new platforms for the simulation of quantum-mechanical systems that are currently intractable using conventional computers. Applications for quantum computing, such as integer number factoring, search and optimization algorithms, and quantum simulations, will accelerate discoveries in a broad range of disciplines including physics, engineering, and computer science.

SAMPLE RESEARCHER PROFILE:
DR. MICHAEL HUHNS



Michael Huhs
Professor of Computer Science and Engineering, University of South Carolina
bioRxiv preprint doi: https://doi.org/10.1101/1741
multagent systems · service-oriented computing · ontologies · computer vision · distributed computing

CITED BY	YEAR
13616	2005
47	16
124	26

VIEW ALL

Public access
2 articles · 6 articles · not available

Based on funding mandates

SAMPLE RFP ABOUT ARTIFICIAL INTELLIGENCE FROM NSF:
[HTTPS://WWW.NSF.GOV/PUBS/2020/NSF20604/NSF20604.HTM](https://www.nsf.gov/pubs/2020/nsf20604/nsf20604.htm)

This document has been archived and replaced by NSF 20-500.

National Artificial Intelligence (AI) Research Institutes
Accelerating Research, Transforming Society, and Growing the American Workforce

PROGRAM SOLICITATION
NSF 20-604

REPLACES DOCUMENT(S):
NSF 20-503

National Science Foundation
Directorate for Biological Sciences and Engineering
Division for Biological Sciences
Directorate for Education and Human Resources
Division of Early Education and Development
Division for Geosciences
Directorate for Mathematical and Physical Sciences
Division of Materials Research and Economic Sciences
Office of Integrative Activities

National Institute of Food and Agriculture
USDA
Department of Homeland Security, Science & Technology Directorate

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:
National Artificial Intelligence (AI) Research Institutes

Synopsis of Program:

Artificial Intelligence (AI) has advanced tremendously and today promises personalized healthcare; enhanced national security; improved transportation; and more effective education, to name just a few benefits. Increased computing power, the availability of large datasets and streaming data, and algorithmic advances in machine learning (ML) have made it possible for AI research and development to create new sectors of the economy and related industries. Continued advancement, enabled by sustained investment and directed toward issues of national importance, holds the potential for further economic impact and quality-of-life improvements.

The 2019 update to the National Artificial Intelligence Research and Development Strategic Plan, informed by visioning activities in the scientific community as well as interaction with the public, identifies as its first strategic objective the need to make long-term investments in AI research in areas with the potential for long-term payoffs in AI. The President's Council of Advisors for Science and Technology has published [Recommendations for Strengthening American Leadership in Industries of the Future](#), including AI, and calls for new and sustained research in AI to drive science and technology progress. The National AI Research Institutes program enables longer-term research and U.S. leadership in AI through the creation of AI Research Institutes.

SAMPLE RESEARCHER PROFILE:
DR. QI ZHANG



Qi Zhang
University of South Carolina
Verified email at cse.sc.edu · [Homepage](#)
Artificial Intelligence · Reinforcement Learning · Multi-Agent Systems

FOLLOW

CITED BY	YEAR
2	2024
6	2023
0	2022
0	2021
0	2020
0	2019
0	2018
0	2017

TITLE

Leveraging Domain Adaptation for Accurate Machine Learning Predictions of New Halide Perovskites
DD Gupta, ZJL Bane, S Yew, S Adhikari, B DeCost, Q Zhang, C Musgrave, ...
arXiv preprint arXiv:2401.10998

Exploring MDP Symmetries for Offline Reinforcement Learning
J Luo, Q Zhang
CoRL 2023 Workshop on Learning Effective Abstractions for Planning (LEAP)

ULTRA Tools and Screenshots

Group Recommendation With Teaming as a Use Case: ULTRA UI Prototype for University of South Carolina

<http://casy.cse.sc.edu/ultra/DataExplorer/>

Ultra Family of Tools



- Explore Ultra Data - [See Data](#) [See API](#)

Click on See Data to see the latest extracted proposals, users and awards.
Click on See API to redirect to Swagger pages and retrieve the content.

- Explore Text Content - [Unsupervised Text Visualization with KITE](#)

An Unsupervised, Effective and Inclusive Approach for Textual Content Exploration

- Text to Classification Mapper - [Mapper](#)

Tool that display the code and description from the ACM and JEL tree based on the text we enter

- See Recommendation for Teaming - [Teaming Under Development](#)

Website Demo – 3 Use Cases (UCs) With 4 Teaming Methods (M#)

Ultra Demonstration and Survey
Each

Select a Use Case:

UC1 UC2 UC3

UC1: Names/Method → Proposal/Teams

Given a researcher's name and a matching method, show a list of highest proposals and candidate teams.

Select researcher's name: Agostinelli, Forest

Select method: M3: Boosted Bandit Matching

Number of Results: 5 Number of teams per proposal: 3

<http://casy.cse.sc.edu/ultra/teaming/>

Use Case 3 - Sample Results

Selected Proposal: quantum, Selected Method: M3: Boosted Bandit Matching						
Index	Skills	Proposal ID	Proposal Name	Recommended Teams	Overall Goodness Score	
1	quantum	nsf17548	Ideas Lab: Practical Fully-Connected Quantum Computer Challenge (PFCQC) (2017)	<ul style="list-style-type: none"> ['Chao, Yuh J.', 'Farouk, Tanvir I.', 'Huang, Xinyu', 'Rizos, Dimitris', 'Zhang, Bin'] ['Farouk, Tanvir I.', 'Gatzke, Edward P.', 'Huang, Xinyu', 'Rizos, Dimitris', 'Zhang, Bin'] ['Chao, Yuh J.', 'Farouk, Tanvir I.', 'Huang, Xinyu', 'Rizos, Dimitris', 'Zhang, Bin'] ['Farouk, Tanvir I.', 'Gatzke, Edward P.', 'Huang, Xinyu', 'Rizos, Dimitris', 'Zhang, Bin'] ['Banerjee, Sourav', 'Farouk, Tanvir I.', 'Huang, Xinyu', 'Rizos, Dimitris', 'Williams, Christopher'] ['Banerjee, Sourav', 'Chao, Yuh J.', 'Huang, Xinyu', 'Rizos, Dimitris', 'Williams, Christopher'] 	0.5938	

ULTRA-USC: QUANTITATIVE RESULTS

Teaming Method	Average Quality of Teams (measured via a goodness score from [0,1]) Represented using $mean \pm STD$	Average Volume of Teams (number of teams available per researcher) $Max number of teams = 10$
M0 - Random Matching (Baseline)	0.0879 ± 0.0290	10
M1 - String Matching	0.3673 ± 0.1569	10
M2 - Semantic Query Matching	0.4097 ± 0.1313	9
M3 - Bandit Learning Matching	0.5295 ± 0.0816	6

- As recommendation methods become data-informed (sophisticated), they improve teaming quality while reducing team size.
- (Teaming recommendations have been generated from an initial dataset size of 434 RFPs and 200 researchers. Through a user study, ULTRA has then been evaluated in USC's College of Engineering.)

Lecture 27: Summary

- **A template for building AI-based solutions for the real world**
- **Identify:** Value of decision: before and after
- **Assess:** Data-needed
- **Explore:** Methods
- **Conduct:** Evaluation
- **Integrate:** solution with overall process

Weeks 14: Concluding Comments

We talked about

- Lecture 26: Graduate paper presentations
- Lecture 27: AI for the Real World – Bringing All Together; Advanced Topics

- Week 1: Introduction, Aim: Chatbot / Intelligence Agent
- Weeks 2-3: Data: Formats, Representation and the Trust Problem
- Week 3: Machine Learning – Supervised (Classification)
- Week 4: Machine Learning - Unsupervised (Clustering) –
- Topic 5: Learning neural network, deep learning, Adversarial attacks
- Week 6: Large Language Models – Representation and Usage issues
- Weeks 7-8: Search, Heuristics - Decision Making
- Week 9: Constraints, Optimization – Decision Making
- Topic 10: Markov Decision Processes, Hidden Markov models - Decision making
- Topic 11-12: Planning, Reinforcement Learning – Sequential decision making
- Week 13: Trustworthy Decision Making: Explanation, AI testing
- Week 14: AI for Real World: Tools, Emerging Standards and Laws; Safe AI/ Chatbots

Projects B: Sep 30 – Nov 20 (7 weeks; 400 points)

- End date: **Thursday, Nov 20**
 - Remember to update spreadsheet on data/ time when finished (**Column I**)
- Choices
 - Given by instructor
 - Defined by student using project-b teamplate; reviewed and approved by instructor

Upcoming Evaluation Milestones

- Projects B: Sep 30 – Nov 20
- Quiz 2: Oct 7
- Quiz 3: Nov 11
- Paper presentation (grad students only) : Nov 18
- **Finals: Dec 11**

About Week 16 – Lectures 28, 29

Week 16 – Lectures 28, 29

Project-B Presentations – Students doing

- Custom project
 - 2-slides on custom project
- Given project
 - 1-slide: Status and challenges faced
 - 1-slide: What would be one custom project you would like to do – fill project template

- Week 1: Introduction, Aim: Chatbot / Intelligence Agent
- Weeks 2: Data: Formats, Representation, ML Basics
- Week 3: Machine Learning – Supervised (Classification)
- Week 4: Machine Learning - Unsupervised (Clustering) –
- Topic 5: Learning neural network, deep learning, Adversarial attacks
- Week 6: Large Language Models – Representation and Usage issues
- Weeks 7-8: Search, Heuristics - Decision Making
- Week 9: Constraints, Optimization – Decision Making
- Topic 10: Markov Decision Processes, Hidden Markov models - Decision making
- Topic 11-12: Planning, Reinforcement Learning – Sequential decision making
- Week 13: Trustworthy Decision Making: Explanation, AI testing
- Week 14: AI for Real World: Tools, Emerging Standards and Laws; Safe AI/ Chatbots

Note: exact schedule changes slightly to accommodate for exams and holidays.