SoftNet 2021 Experts Panel II

Mobile Health and Patient-empowering: Smart Solutions for Smart Cities and Living Environments

(urban transportation, health resource discovery, smart living, wearable and ambient sensorsepidemic forecasting, securing patients data, patient interfaces, health mobile services, patient-oriented devices and services, etc.)

Panel Chair Position

Observations and Reflections

Lasse Berntzen, University of South-Eastern Norway, lasse.berntzen@usn.no

- *Six panelists with different perspectives*

1. *Empowering the patients*
2. *Shared decision making between doctors and patients*
3. *Combating misinformation*
4. *Using simulations*
5. *Improving mobility*
6. *Analyzing mobility and movement patterns*

Panellist Position

A self-care approach for health & wellbeing – Why it matters?

Marko Jäntti, Centre for Measurement and Information Systems,
Kajaani University of Applied Sciences
marko.jantti@cemis.fi

- Benefits of self-care approach
- Personal wellbeing & Wellbeing at work
- Digital health platform Kanta in Finland
- How the CEMIS centre is approaching the wellbeing challenge?

→ Enable self-service but don't forget the customer

→ Personal wellbeing and wellbeing at work go hand in hand

→ Do not focus on symptoms, find the root cause

→ Take an active part in your (health)care & wellbeing; it's **your** task, not your mother's, dog's or mother-in-law's

Panellist Position

Shared Decision Making (SDM): Bring physicians and patients on the same page

Andrea Corradini, Copenhagen School of Design and Technology, andc@kea.dk

- Shared decision making
- Decision-aid tools
- Patient engagement
- Patient empowerment

→ Some doctors believe patients are not interested in participating in health care decision making

→ Many patients believe that it is important to do whatever doctors think and say it is best for them

→ many patients wish more information were given to them and would like to be involved in health care decisions

→ Bring physicians and patients on the same page

Access to reliable information is critical to empowering the patient.

Combating Health Misinformation to Empower Patients

Nitin Agarwal, Chair & Distinguished Prof., UA-Little Rock,

Director, COSMOS Center, Arkansas, USA nxagarwal@ualr.edu

- Health misinformation and conspiracy theories impact individuals, patients, and society alike by eroding trust in government and scientific institutions.
- Detect and avoid commonly used tactics and techniques to spread health misinformation online, particularly through social media.
- Several ongoing research efforts to study and combat health misinformation to empower the patient.
- Preparing for the future by combating (health) misinformation – information reliability assessment, awareness & outreach, informed policymaking (government and media companies).

Panellist Position

Open-source potentiated medical simulation improving patient outcomes from newborns to geriatric patients.

Michel Audette Ph.D., Associate Professor – Computational Modeling and Simulation Engineering, Graduate Program Director – Biomedical Engineering, Old Dominion University
maudette@odu.edu

- Musculoskeletal simulation
- Deep neural networks
- Sim-optimized personalized devices
- Obstetrics, orthopedics, geriatrics

→ Broader definition of Internet of Things

→ Leveraging deep neural networks (DNNs) in medical simulation

→ Combining DNNs and digital atlases for high-fidelity anatomical modeling

→ Using open-source software tools to potentiate research & instruction

Panellist Position

"Navi Campus": an enhanced GPS navigation app for university Campuses

Jesus ZEGARRA FLORES, Project leader, Research and Innovation Department at Capgemini Engineering, Strasbourg/France

- Assistive Technology
- Mobility
- Artificial Intelligence
- Internet of Things

→ A navigation mobile app accessible for everybody

SoftNet Experts Panel II
Mobile Health and Patient-empowering: Smart Solutions for Smart Cities and Living Environments
(urban transportation, health resource discovery, smart living, wearable and ambient sensorsepidemic forecasting, securing patients data, patient interfaces, health mobile services, patient-oriented devices and services, etc.)
SoftNet 2021

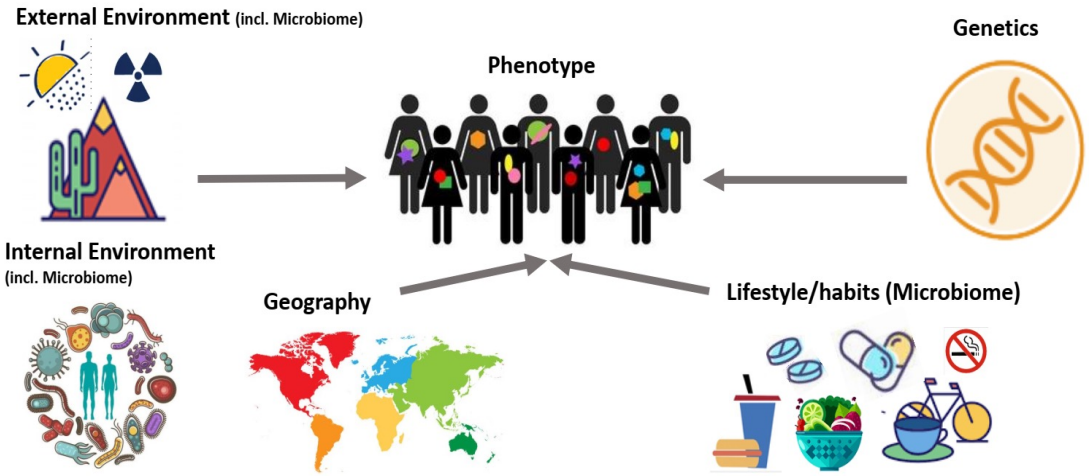
Panellist Position

Analysis of Movement and Mobility Patterns for Health Assessment

Hesham H. Ali, PhD, University of Nebraska Omaha, hali@unomaha.edu

Summary of position:

- There are many factors that impacts our health
- The connection between movement and mobility to health has been well-established
- Habits, practices and lifestyle contribute in a big way to health and overall quality of life
- While active lifestyle positively affects heath, mobility data can also help in assessing health levels
- We need to analyze all available health related data with the goal of advancing next generation of biomedical research and contributing to the preventive and personalized healthcare initiatives.



SoftNet Experts Panel II
Mobile Health and Patient-empowering: Smart Solutions for Smart Cities and Living Environments
(urban transportation, health resource discovery, smart living, wearable and ambient sensors, epidemic forecasting, securing patients data, patient interfaces, health mobile services, patient-oriented devices and services, etc.)
SoftNet 2021

Panellist Position

A self-care approach for health & wellbeing – Why it matters?

Marko Jäntti, Centre for Measurement and Information Systems,
Kajaani University of Applied Sciences
marko.jantti@cemis.fi

- Benefits of self-care approach
- Personal wellbeing & Wellbeing at work
- Digital health platform Kanta in Finland
- How the CEMIS centre is approaching the wellbeing challenge?

→ Enable self-service but don't forget the customer
→ Personal wellbeing and wellbeing at work go hand in hand
→ Do not focus on symptoms, find the root cause
→ Take an active part in your (health)care & wellbeing; it's **your** task, not your mother's, dog's or mother-in-law's

What is a self-care approach?

- Definition of the self-care: "**Ability** of individuals, families, and communities to **promote health**, **prevent disease, maintain health**, and to **cope with illness** and disability with or **without** the support of a **healthcare provider**" (World Health Organization[1])



[1]https://www.who.int/reproductivehealth/self-care-interventions/definitions/en/

Kainuu Region, Finland

Benefits of self-care approach

- Benefits
  - Finding purpose of life / work
  - Longer life
  - Better performance in work -> increased productivity
  - Reduced stress etc.
- Regional Council of Kainuu uses ”Vapauden valtatie, Highway of Freedom” slogan in promoting the region (elements of self care)
- Key marketing message: Everybody can create a meaningful life in Kainuu.

The first snow route shall open soon (Oct 10th) in Vuokatti, Sotkamo

There is a strong need for self-care in Kainuu, Finland

- Kainuu Social Welfare and Health Care Joint Authority (Kainuun sote) provides all the social welfare and health care services for the municipalities of Hyrynsalmi, Kajaani, Kuhmo, Paltamo, Ristijärvi, Sotkamo and Suomussalmi.
- People living in Kainuu region, Finland can enjoy very good healthcare services and sport & leisure possibilities
- Why do we have so many mental health problem related **visits** by adults? Finnish healthcare is too reactive, less proactive

Focus on root cause,
Not on symptoms

Visits related to Mental health and intoxicant services

Kainuu region vs. Whole country

Mielenterveys- ja päihdepalvelut	Kainuu	Koko maa	2014	2019
Aikuisten mielenterveyden avohoitokäynnit / 1 000 18 vuotta täyttänyttä (2019)	985,6	554,1		
Erikoissairaanhoidon avohoitokäynnit, lastenpsykiatria / 1 000 0 - 12-vuotiasta (2019)	200,5	338		
Erikoissairaanhoidon avohoitokäynnit, nuorisopsykiatria / 1 000 13 - 17-vuotiasta (2019)	1675,5	1149,2		
Psykiatrian laitoshoidon hoitopäivät / 1 000 asukasta (2018)	329,4	195,8		

Hyvinvointikertomus 2020 ja hyvinvointisuunnitelma 2021 - 2024 valmis.pdf (kainuu.fi) /Wellbeing report and wellbeing plan in Kainuu

Personal Wellbeing vs Wellbeing at work

- Personal wellbeing includes mental, psychological, **social**, emotional, and spiritual aspects.
- Wellbeing at work means that **work is safe, healthy, and pleasant**.
- Requires involvement of both employers and employees
- Employers are responsible for to ensure the safety of the work environment, good management and the fair treatment of employ

Digital Health Platform Kanta

- In My Kanta Pages you can see
- electronic prescriptions
- records related to your treatment
- the EU digital COVID-19 vaccination certificate
- laboratory tests and X-ray examinations
- which healthcare units and pharmacies have accessed your prescription and medical records through the Kanta Services. (Kanta.fi[1], 2021)

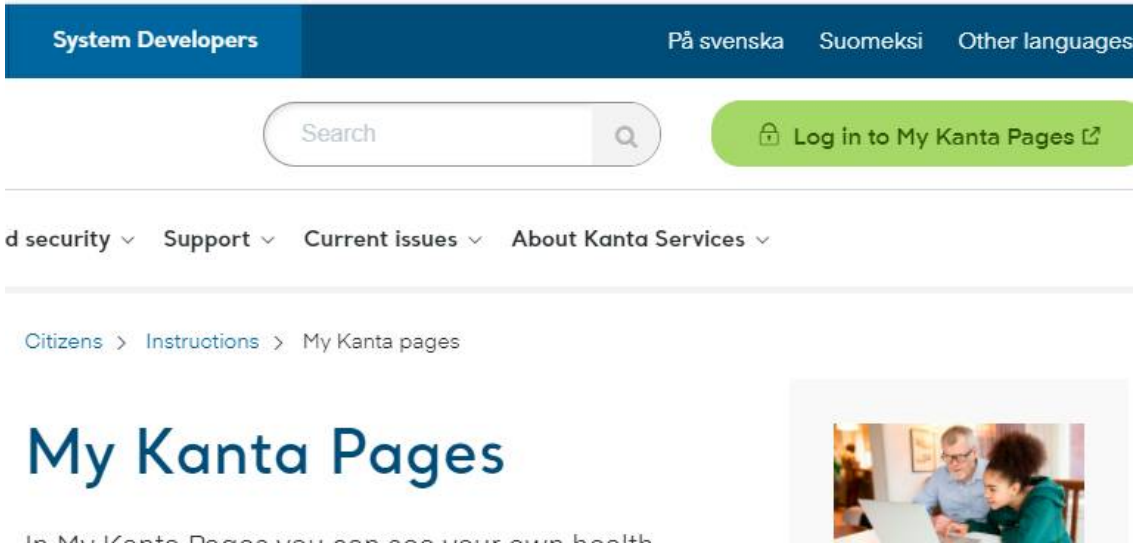


Figure: The frontpage of digital health platform Kanta

[1]https://www.kanta.fi/en/my-kanta-pages

Digital Health Platform Kanta

- Kanta enables citizens to view & renew prescriptions

Reseptit

Voit valita, mitä reseptejä haluat katsella. Reseptit ovat voimassa 2 vuotta, ellei voimassaoloaikaa ole eriksee
Tarkemmat tiedot reseptistä näet valitsemalla määräyspäivän.

Reseptit ajalta 14.5.2019 - 14.9.2021

Reseptit, joista on tehty uusimispyyntö (uusimisen tilanne)

Reseptit, joissa on lääkettä saamatta

Reseptit, jotka ovat voimassa enää alle 2 kuukautta

Hae

Reseptien uusiminen

Reseptien tulostaminen >

Määräyspäivä	Lääke	Määrätty määrä	Lääkettä saamatta	Resepti voimassa saakka
9.4.2020	[redacted]	[redacted] päivän annos	[redacted] kpl	9.4.2022

How the CEMIS centre is approaching the wellbeing challenge?

- CEMIS Centre for Measurement and Information Systems focuses on
  - Cleantech /Bioeconomy
  - Sports technology
- VR-based Nordic ski training simulator helps athletes to prepare for Beijing olympics

How the CEMIS centre is approaching the wellbeing challenge?)

- ÄLYLATU (SmartTrack) project aims at developing new service innovations for Nordic skiing
- The project includes 4 main topics:
  - Artificial ski track innovation
  - Virtual environments for professional Nordic skiing events
  - Using AI/pose estimation in Sport Motion Analysis
  - Validating sensors integrated into ski equipment

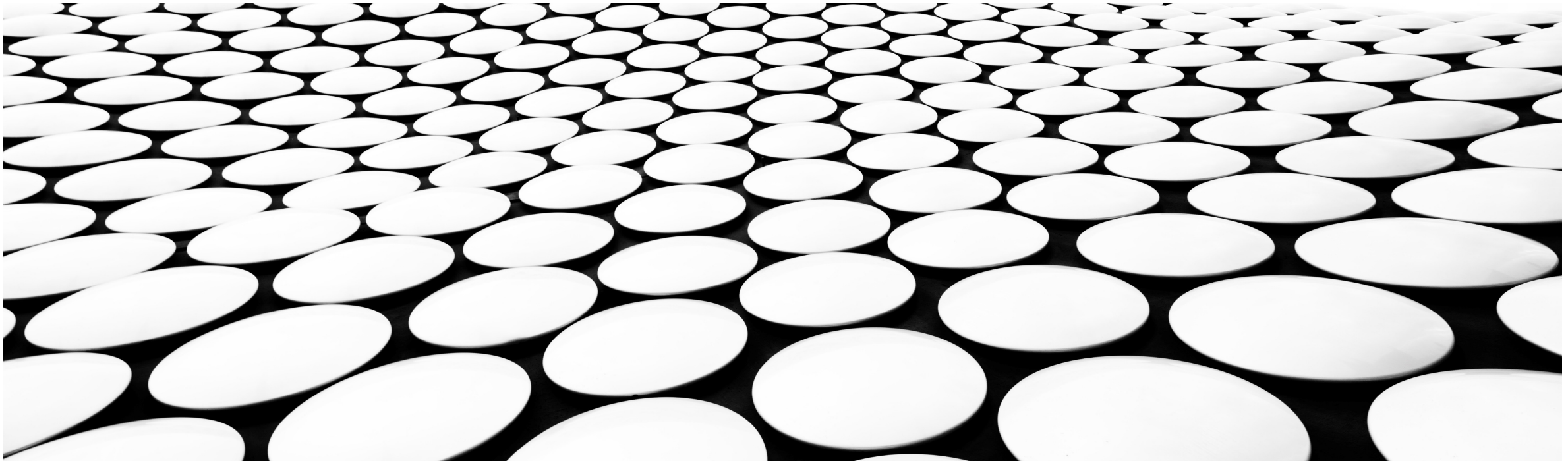
Conclusion

- Take an active part in your (health)care & wellbeing; it's **your** task, not your mother's, dog's or mother-in-law's
- **Questions / Comments:**
- **CEMIS:** Director Marko Jäntti marko.jantti@cemis.fi
- **Älylatu project:** Responsible leader, prof. Vesa Linnamo, project manager Anni Hakkarainen anni.s.j.hakkarainen@jyu.fi

SHARED DECISION MAKING: BRINGING PHYSICIANS AND PATIENTS ON THE SAME PAGE

ANDREA CORRADINI, COPENHAGEN SCHOOL OF DESIGN AND TECHNOLOGY

E-MAIL: ANDC@KEA.DK



DEFINING SHARED DECISION MAKING (SDM)

- Shared decision making is a conversation, based on partnership, that brings practitioners and patients together to ensure that decisions reflect:
  - evidence-based information about available treatment options
  - the clinicians' expertise in regard to the appropriate treatment and care options, risks and benefits
  - the patient's preferences, goals, values, beliefs, wants and needs based on personal circumstances

KEY DIFFERENCES

- Patients and doctors do not always focus on the same issues
  - some doctors believe patients are not interested in participating in health care decision making
  - many patients wish more information were given to them
  - many patients believe that it is important to do whatever doctors think and say it is best for them
- Delegation of decision making to completely to doctors may be problematic
  - doctors may not have all information about the patient's want and needs
  - patients do not receive the treatments that best match their individual goals, wants and needs

SDM GOALS

- Patients participate in their own care
  - they must have the education and support to make an informed decision
- Move from informed consent to informed choice
- Better utilization of medical resources

WHEN SDM

- Care for conditions where more treatment options exist
- Treatment options involve significant tradeoffs in the patient's quality and/or length of life
- Examples of conditions:
  - Prostate cancer (active surveillance vs surgery vs radiation)
  - Breast cancer (lumpectomy/radiation vs mastectomy/reconstruction)
  - Osteoarthritis (meds vs surgery)
  - Herniated disc (meds vs surgery vs physical therapy)
  - …

EXAMPLE: BREAST CANCER

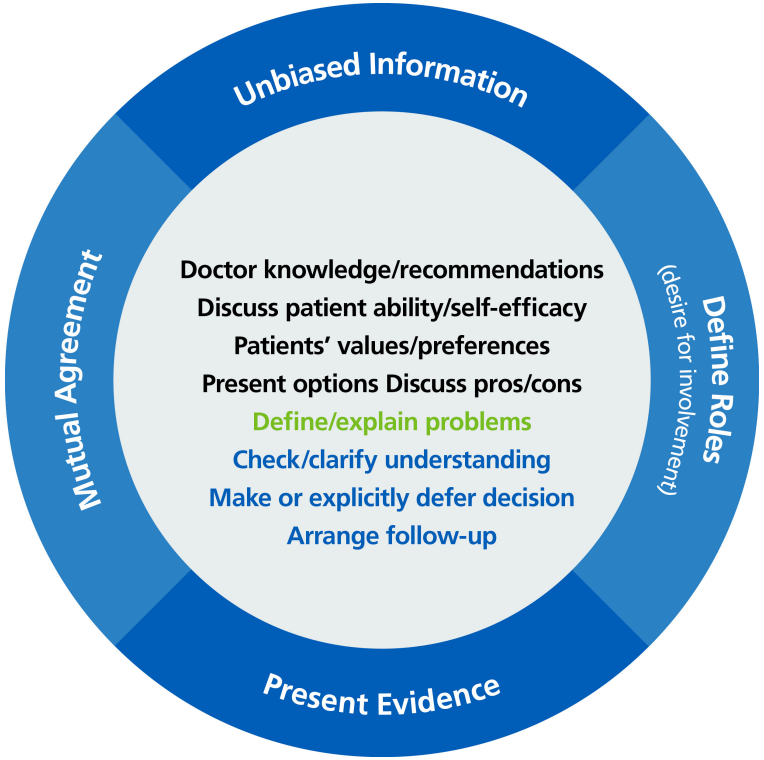
	Lumpectomy	Mastectomy
Survival	Same	Same
Esthetics	Keep breast	Breast removed
Recurrence	5-15% of cases	1-5% of cases
Surgery	20-50% of cases	rare
Radiotherapy	5-7 weeks	rare

IMPLEMENTING SDM

- Patients are engaged in a discussion
  - decision aids / tools are available to patients to help them navigate through their options and understand them
  - decision aids rely on materials that have reliable, unbiased summaries of evidence-based research
- Patients are supported to explore their treatment options
  - patients understand their options
  - patients think about and analyze the available options within the context of their own personal preferences, wishes and values
- Clinical discussion to reach a decision and evaluate it

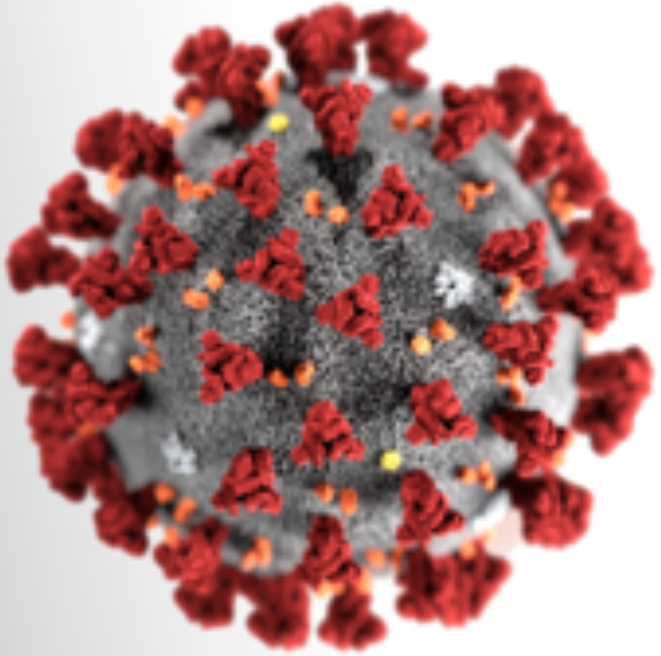
MAKOUL AND CLAYMAN'S ESSENTIAL ELEMENTS OF SDM

- Define and explain the problem to patients
- Present options to patients
- Discuss benefits, risks, costs, etc. with patients
- Clarify patient's values/preferences
- Discuss patient ability, understanding, and skills
- Discuss doctor's knowledge and recommendations
- Check patient's understanding
- Patients make or defer a decision
- A follow-up is arranged



Makoul G, Clayman ML; An integrative model of shared decision making in medical encounters. Patient Educ Couns. 2006;60(3):301-12.

COVID-19 Misinformation

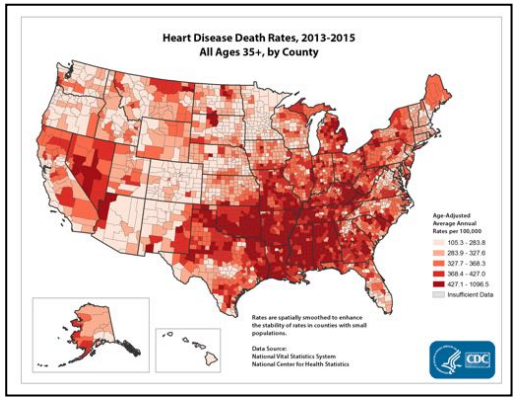


FIND OUT ABOUT COVID-19 MISINFORMATION, READ TIPS ON HOW TO IDENTIFY IT AND REPORT IT.

Nitin Agarwal, Ph.D. (nxagarwal@ualr.edu)
Jerry L. Maulden-Entergy Chair and Distinguished Professor
Director, COSMOS Research Center
University of Arkansas – Little Rock

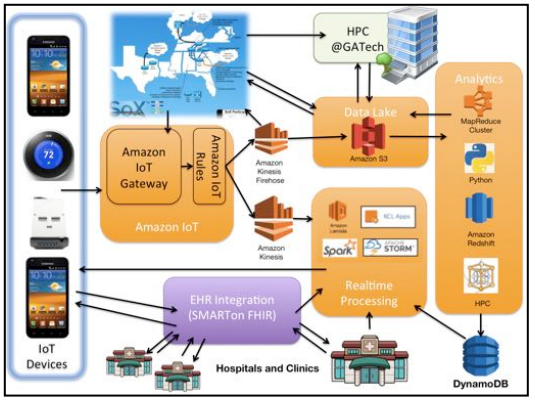
ArkansasResearchAlliance
Coming together to move Arkansas forward.

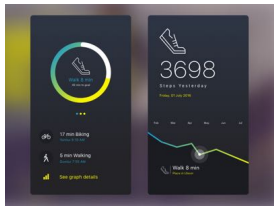
Smart Health and AI



Data fusion

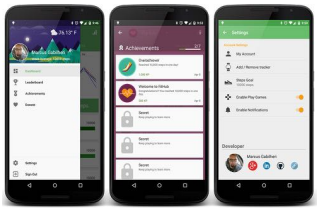
EHR, wearable fitness devices, 'data from the wild'





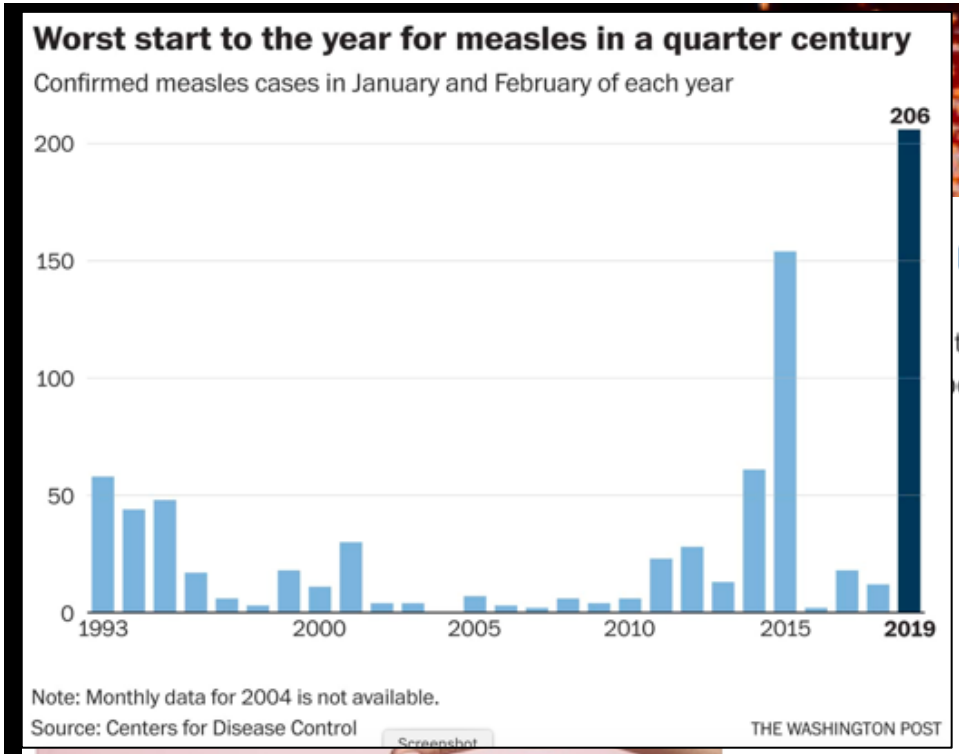
Collective Action

Design

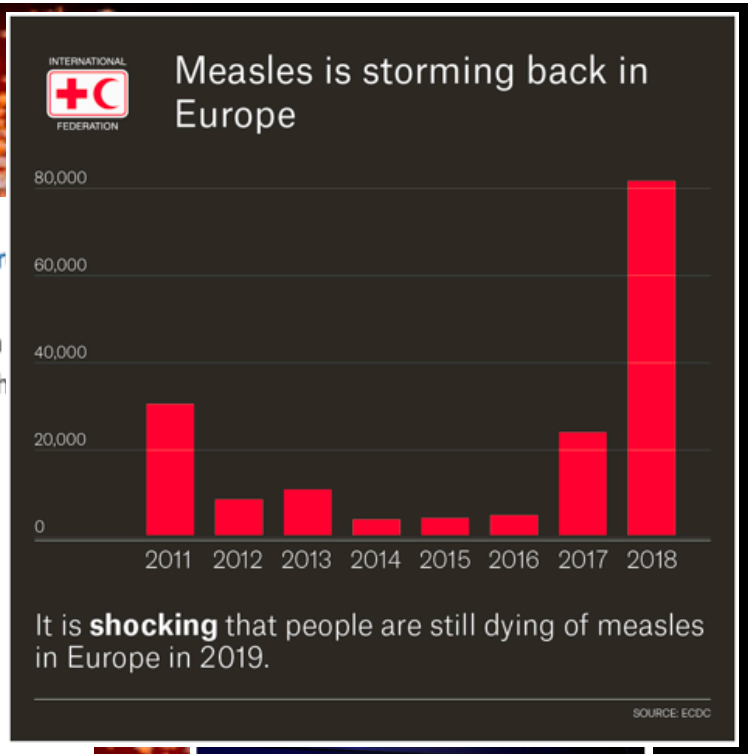


NSF-funded studies (over $5,000,000) on adopting Big Data approach to address health disparities (CVD) across Southern US

Medical Misinformation



The 206 cases in January and February already surpass annual totals for



IFRC Europe Regional Director, Simon Missiri, sa

vaccine refusal is an increasingly worrying trend

worldwide.

Health & Wellness Misinformation

The New York Times

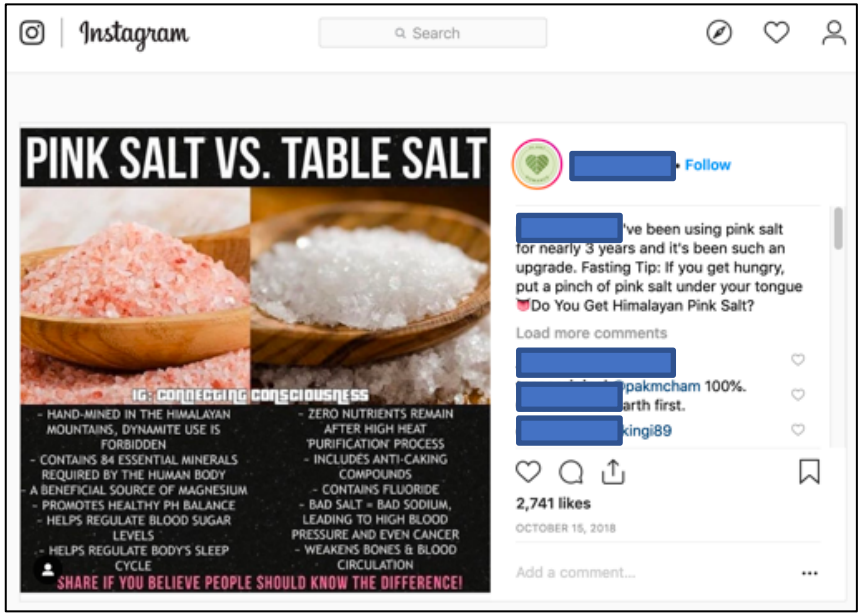
Dr. Google Is a Liar

Fake news threatens our democracy. Fake medical news threatens our lives.

By Haider Warraich
Dr. Warraich is a cardiologist.

Dec. 16, 2018

"Statins cause Cancer!"



Pink salt will "regulate your blood sugar and sleep cycle."

COVID-19 Misinfodemic

- Dr. Vivek Murthy, U.S. surgeon general, has released a public advisory calling misinformation a “serious threat to public health.”

CNN, July 16, 2021

Raising Awareness for COVID-19 Misinformation

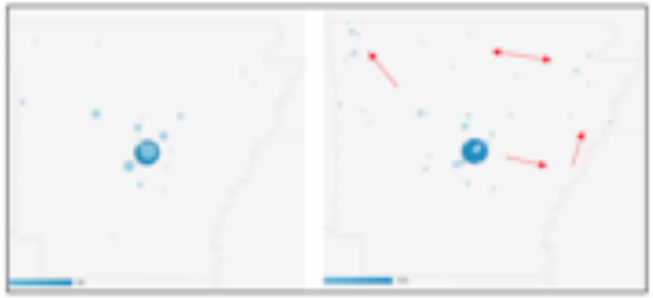
COVID-19 misinfodemic presents an example of emerging cyber-social threats. While there are similarities with other disinformation campaigns (e.g., anti-NATO, anti-US, anti-EU, anti-West in Indo-Pacific region), COVID-19 disinformation campaigns have their nuances such as global and regional narratives; high topical diversity (health, policy, religion, geopolitical affairs, etc.); high volume, velocity, veracity, and variety of false narratives. COVID-19 misinformation tracker tool developed in collaboration with the Arkansas Office of the Attorney General to support detection, investigation, and mitigation of cross-platform COVID-19 disinformation campaigns and scams to assist policy makers. Our efforts demonstrate that when researchers coordinate with policy makers it can make a difference, especially when that coordination remains an ongoing process.

Cross-platform false narratives detected using developed socio-computational methodologies

Education component of the effort

People notify us of scams and other misinformation cases not in our database which are then investigated


Daily reports to the AG's Office with our investigation results and recommendations for enhancing outreach/awareness


May 5, 2020 Jan 21, 2021

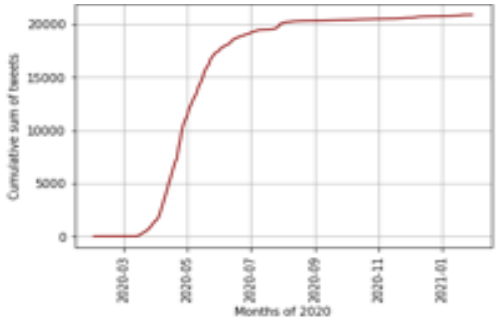
Increased penetration into rural areas of Arkansas as annotated by the arrows in the figure on right demonstrates the effectiveness of the tool and communications strategies.

Arkansas Office of the Attorney General Press Release on our COVID-19 Misinfo Tracker

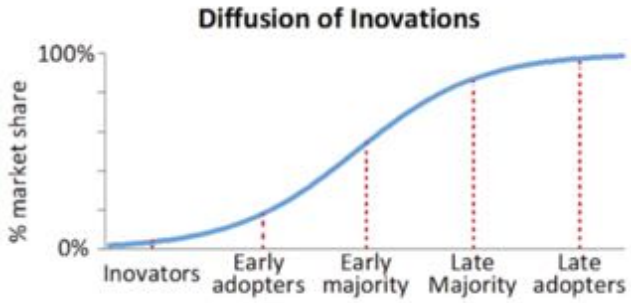
https://cosmos.ualr.edu/covid-19

Characterization of Misinformation Spread

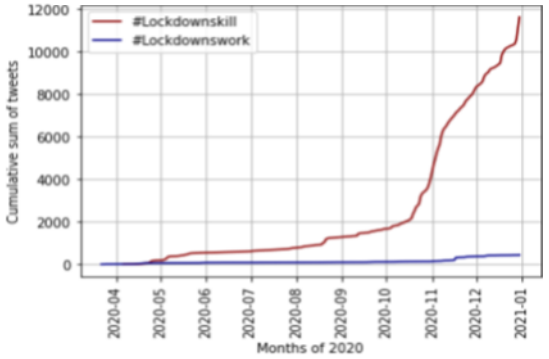
#BillGatesVirus



Characterization of Individuals based on Misinformation Adoption

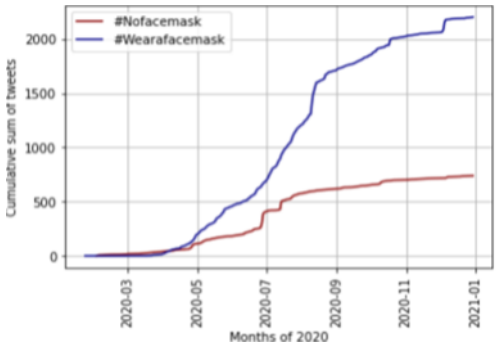


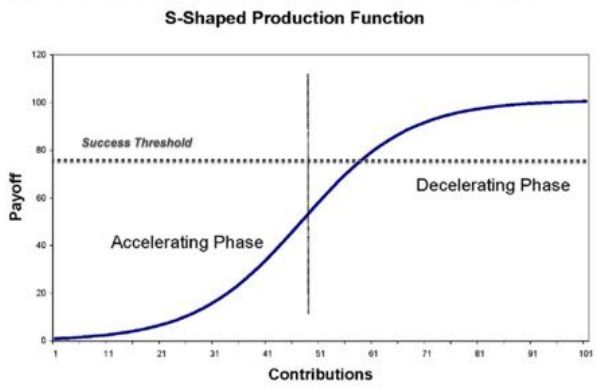
#Lockdownskill vs. #Lockdownswork



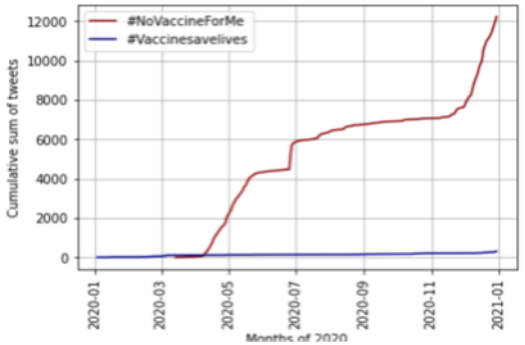
Characterization of the Overall Campaign Cycle

#Nofacemask vs. #Wearafacemask





#NoVaccineForMe vs. #Vaccinesaveslives



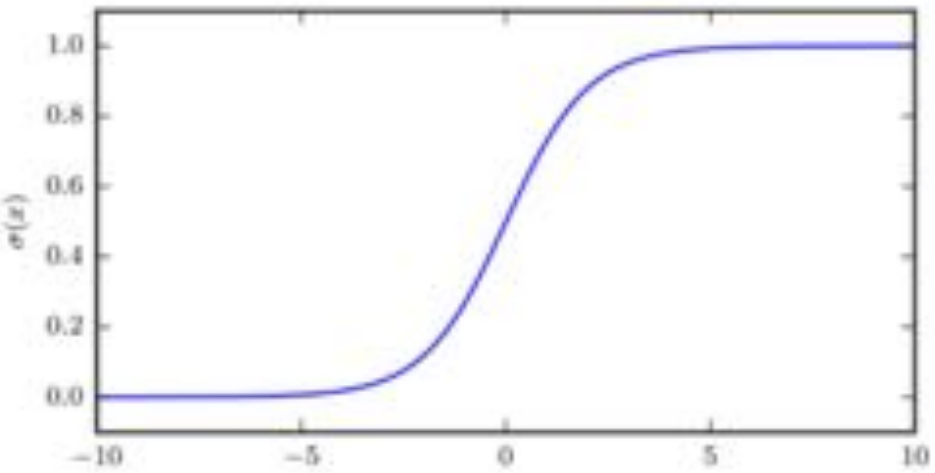
Spann, B., Agarwal, N., Mead, E., and Williams, T. (2021) Using Diffusion of Innovations Theory to Study Connective Action Campaigns. Proceedings of the *International Conference on Social Computing, Behavioral-Cultural Modeling & Prediction, and Behavior Representation in Modeling and Simulation* (SBP-BRiMS 2021), July 6-9, 2021, Washington D.C.

Predicting Adoption

- Develop a model that gives us a probability to adopt or not adopt connective action.

Logistic Sigmoid function

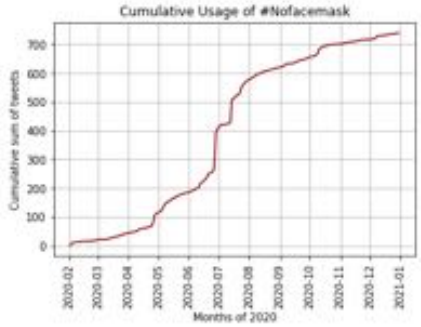
- The Logistic Sigmoid (σ) is the most common **activation function** used in major machine learning algorithms such as Logistic Regression and Neural Networks.
- It follows the S curve which saturates to 1 or 0 when input is very large or very small respectively.
- It converts a value ***x*** into a probability of something happening, such as, the probability ***p*** of rainfall given the weather conditions.
- If ***p*** >= 0.5, the output is marked as TRUE. If ***p*** < 0.5, output is FALSE.

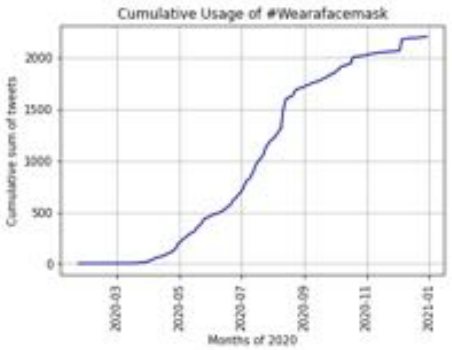


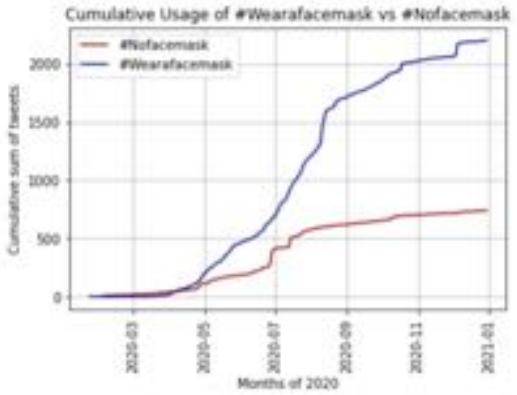
$$\sigma(x) = \frac{1}{1 + \exp(-x)}.$$

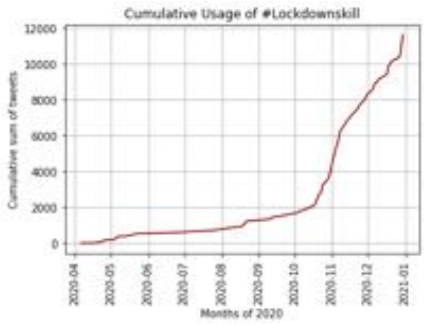
Probability of event

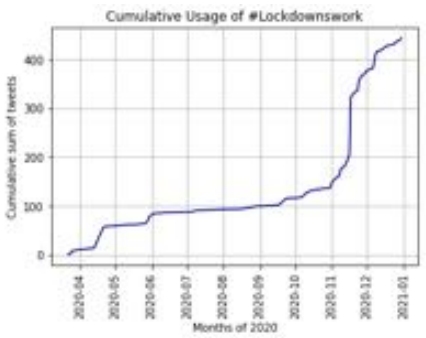
Counter Campaigns

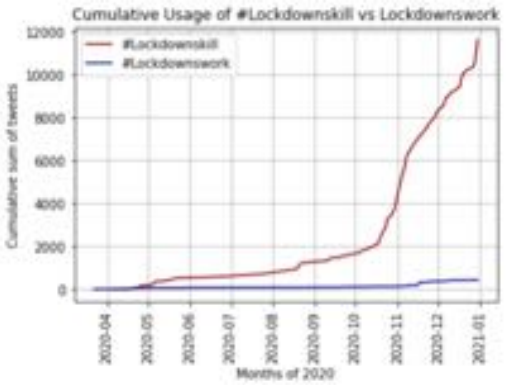






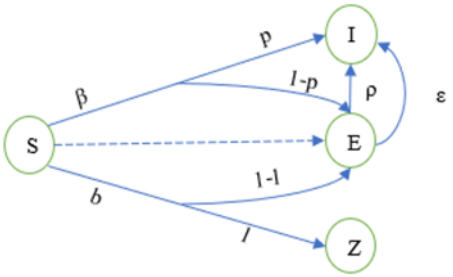






Inoculation Against Misinfodemic

How misinformation spreads? Leveraging epidemiological model.
(Maleki, Agarwal, et al. 2021) European Conference of Operations Research (EURO) 2021



SEIZ model

- S: Susceptible
- E: Exposed
- I: Infected
- Z: Skeptic

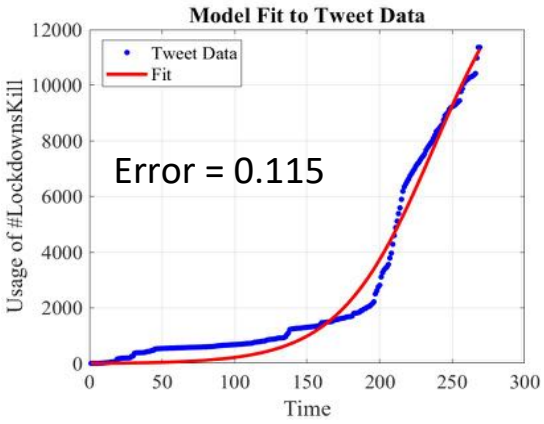
$$\frac{dS}{dt} = -\beta S\frac{I}{N} - bS\frac{Z}{N}$$

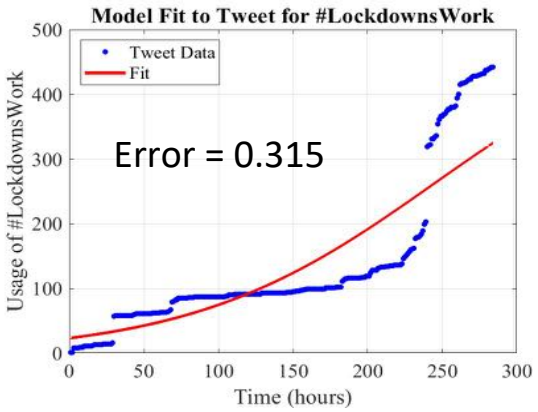
$$\frac{dE}{dt} = (1-p)\,\beta S\frac{I}{N} + (1-l)bS\frac{Z}{N} - \rho E\frac{I}{N} - \varepsilon E$$

$$\frac{dI}{dt} = p\beta S\frac{I}{N} + \rho E\frac{I}{N} + \varepsilon E$$

$$\frac{dZ}{dt} = lbS\frac{Z}{N}$$

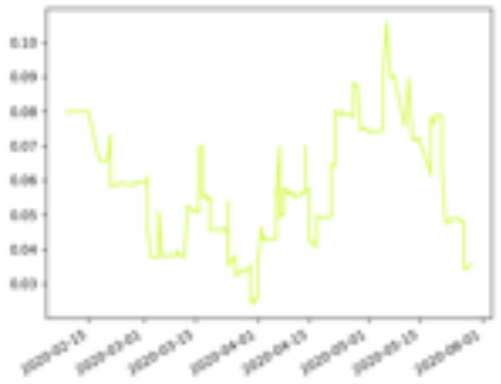
Parameter	Definition
β	Contact rate between S and I.
b	Contact rate between S and Z.
ρ	Contact rate between E and I.
p	Probability of S to I given contact with I.
1-p	Probability of S to E given contact with I.
ε	Transition rate of E to I (Incubation rate).
l	Probability of S to Z given contact with Z.
1-l	Probability of S to E given contact with Z.



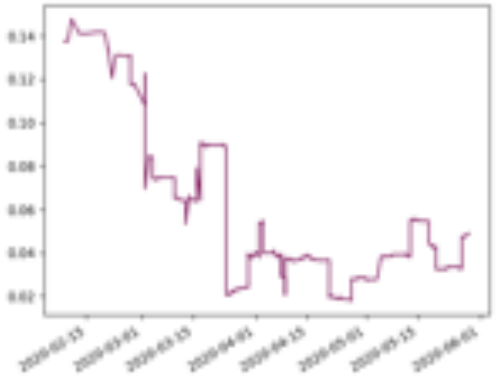


Maleki, M., Arani, M., Buchholz, E., Mead, E., and Agarwal, N. (2021) Applying an Epidemiological Model to Evaluate the Propagation of Misinformation and Legitimate COVID-19-related Information on Twitter. Proceedings of the *International Conference on Social Computing, Behavioral-Cultural Modeling & Prediction, and Behavior Representation in Modeling and Simulation* (SBP-BRiMS 2021), July 6-9, 2021, Washington D.C.

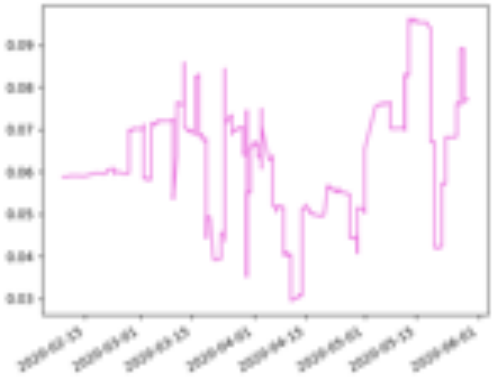
Misinformation Content Themes



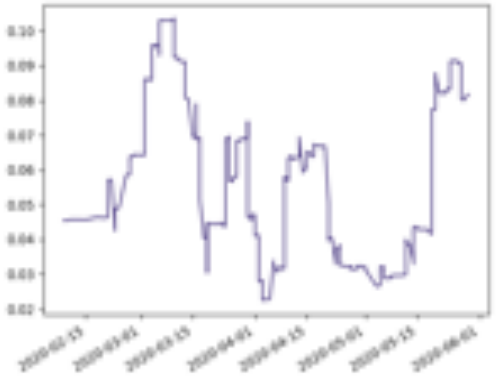
flu, china, die, weapon, outbreak, biological, deaths



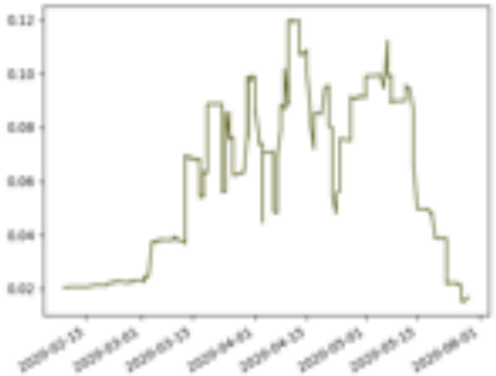
china, government, lab, russia, use, created



pandemic, vaccine, country, gates, testing, economic, american



virus, hydroxychloroquine, outbreak, countries, cases, water, russia



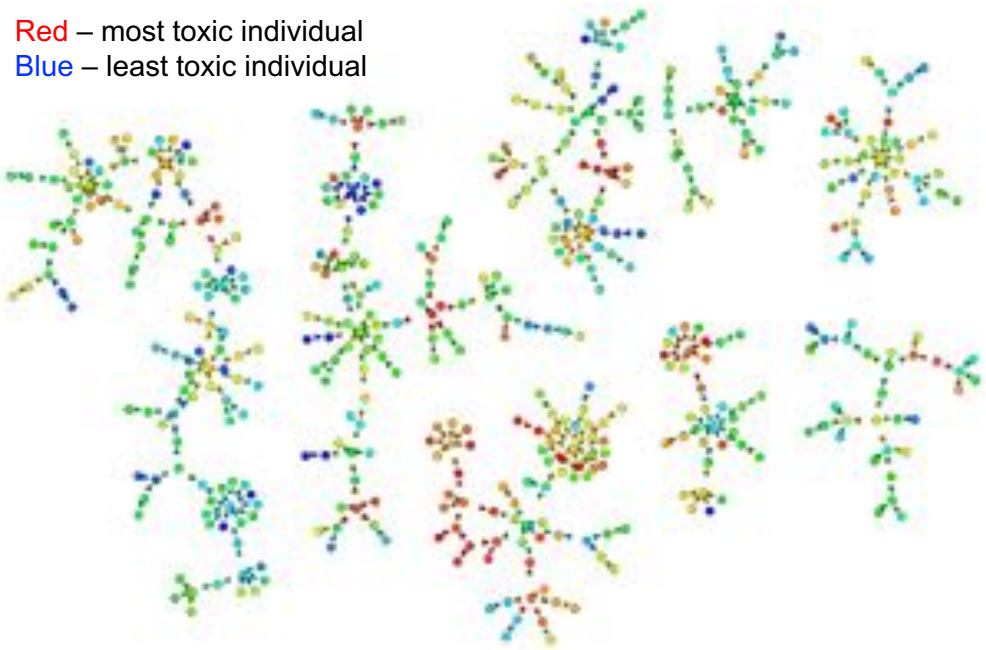
pandemic, new, scam, kill, infection, government, spread

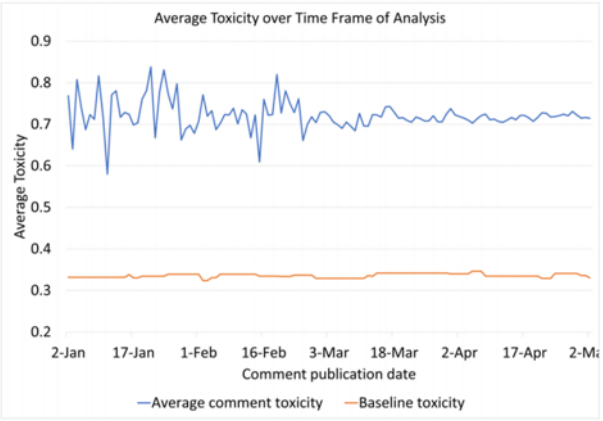
HUSO 2021

COVID-19 misinformation themes pushed on multiple platforms (blogs, twitter, YouTube, facebook, and other non-mainstream social media platforms). Recurring/periodic themes such as vaccine hesitancy, alternate medicines, conspiracy theories, etc. allow proactive communication strategies and policymaking to detect and mitigate emerging cyber-social threats.

Social Media Platforms and Toxicity

Red – most toxic individual
Blue – least toxic individual



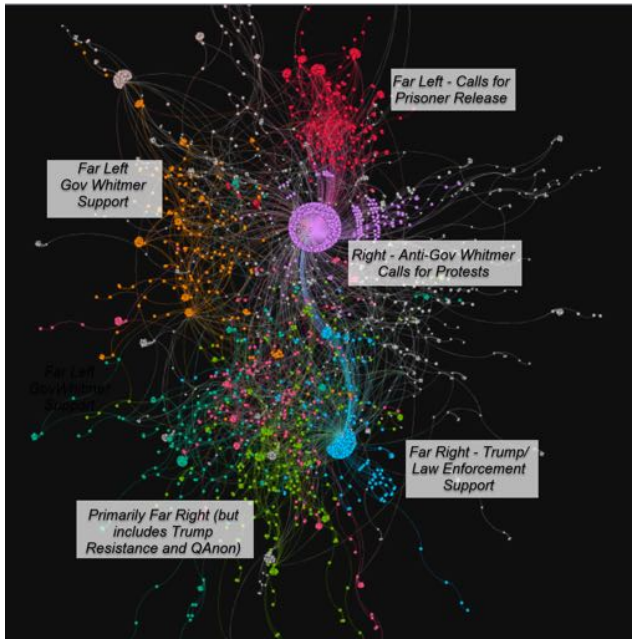


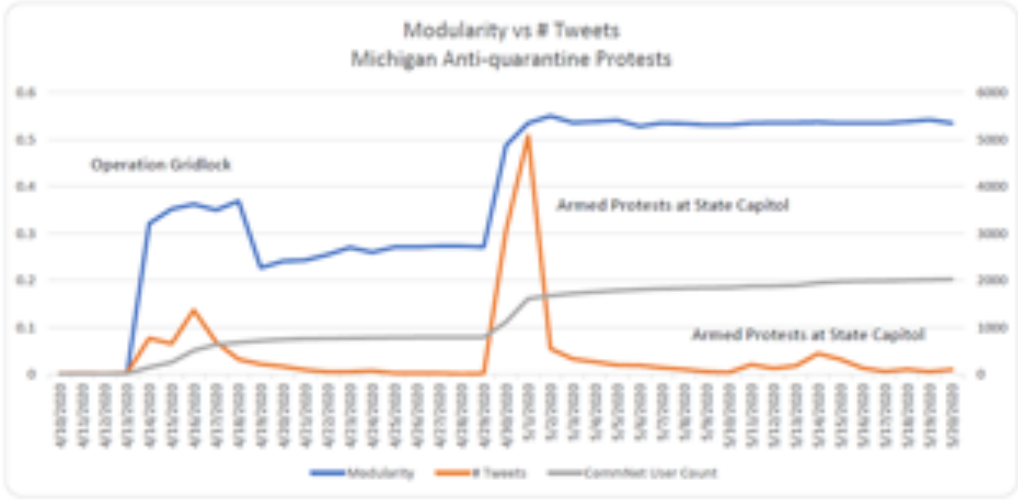
Experimental simulation	Toxicity score	Percentage reduction
Removal of top 10 users with high Betweenness centrality	0.720981759	0.21
Removal of top 10 users with high PageRank centrality	0.722317191	0.02
Removal of users with toxicity scores greater than 0.8	0.641927323	11.15

Toxicity analysis on YouTube commenters. Toxic discourse causes disruption and polarization/segregation among communities, as seen above. We demonstrate that by removing highly toxic users from a network, hate speech reduces, online discourse improves, and fractured communities heal. Our findings offer guidance to policymakers within each online social network to make informed decisions about the information environment and derive appropriate and timely countermeasures to continue providing a healthy platform for their users.

Obadimu, A., Khaund, T., Mead, E., Marcoux, T., and Agarwal, N. (2021) Developing a Socio-Computational Approach to Examine Toxicity Propagation and Regulation in COVID-19 Discourse on YouTube. *Information Processing and Management Special issue on Dis/Misinformation Mining from Social Media.* Vol. 58, Issue 5, 2021. Elsevier. DOI: 10.1016/j.ipm.2021.102660

Fringe Groups and COVID-19





Michigan anti-lockdown protest network
#LetMiPeopleGo, #MiLeg, #Endthelockdown, #MichiganProtest; April 1 to May 20; 16,383 tweets; 3,632 nodes; 382 groups (focused on 5 most powerful groups)
FSA/DCFM model showed powerful coordination among far-right twitter groups including QAnon calling for protest and actions against Gov. Whitmer as compared to far-left groups. FBI later unraveled a far-right wing plot to kidnap Gov. Whitmer.

Communities	Political Category	No. of Users in Each Community	No. of Nodes	No. of Edges	Modularity	Average Weighted Degree	Average Betweenness Centrality	DCFM Power
Largest Community	Right	459	510	526	0.294	1.457	0	90.88
Second Community	Right	152	284	419	0.578	2.771	0	77.12
Third Community	Right	212	269	322	0.468	1.792	0	280.98
Fourth Community	Left	78	204	491	0.422	9.779	24.26	10.36
Fifth Community	Left	115	243	339	0.608	7.683	0.16	28.94

Table Y1 - Top 5 Largest Modularity-Based Communities

Key Conspirator Networks

$$max \sum_{i=1}^{n} \delta_i \quad (1)$$

Subject to

$$\delta_i = \{d\vec{c}_1 \preccurlyeq d\vec{c}_2 \preccurlyeq d\vec{c}_3 \preccurlyeq \cdots \preccurlyeq d\vec{c}_i\} - \overline{dc_j^Q} \quad \forall i,j \quad (2)$$

$$d_i^c = \sum_j m_{ij} \quad \forall i \quad (3)$$

$$d_i^c \geq 2 \quad \forall i \quad (4)$$

$$D_G^L = \frac{1}{n}\sum_{i=1}^{n} d_i^c \quad (5)$$

$$D_G^L < d_i^c \leq D_G^U \quad \forall i \quad (6)$$

$$a_i^c = \frac{(\#\ of\ Triangles) \times 3}{\#\ of\ Connected\ Triples\ of\ Nodes} \quad \forall i \quad (7)$$

$$AC_G^L = \frac{1}{n}\sum_{i=1}^{n} a_i^c \quad (8)$$

$$AC_G^L < a_i^c \leq AC_G^U \quad \forall i \quad (9)$$

$$\overrightarrow{C_v} = \{\overrightarrow{c_1}, \overrightarrow{c_2}, \overrightarrow{c_3}, \dots, \overrightarrow{c_i}\} - \overline{c_j^Q} \quad \forall i,j \quad (10)$$

$$\overline{\vec{c}\delta}_{i\times k} = \overrightarrow{C_{\delta_i}} \quad \forall i \quad (11)$$

$$F = \left\{c_0, \overline{c_j^Q}, \overline{c_{j+1}^Q}, \dots, \overline{c_\kappa^Q}\right\} \quad \forall j,\kappa \quad (12)$$

$$max \sum_{j=1}^{n} \varrho_j^M \quad (13)$$

Subject to

$$\varrho_j^M = \{\varrho_1, \varrho_2, \varrho_3, \dots, \varrho_j\} \quad \forall j \quad (14)$$

$$\delta_j = \{\overrightarrow{c_1}, \overrightarrow{c_2}, \overrightarrow{c_3}, \dots, \overrightarrow{c_n}\} - \overline{\vec{c}\delta}_{i\times k} \quad \forall i,j \quad (15)$$

$$B = A_{ij} - \frac{dd^T}{2g} \quad \forall i,j \quad (16)$$

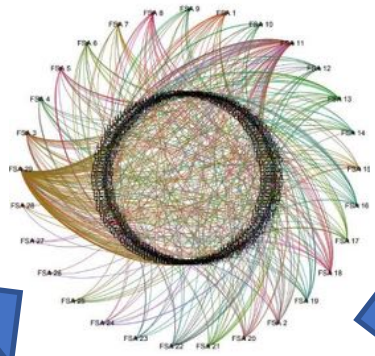
$$\xi_j = \{\overline{\vec{c}\delta}_i \cup \delta_j | \overline{\vec{c}\delta}_i \neq \delta_j\} \quad \forall i,j \quad (17)$$

$$\varrho_j = \frac{1}{2m} Tr\left(\xi_j B \xi_j^T\right) \quad \forall j \quad (18)$$

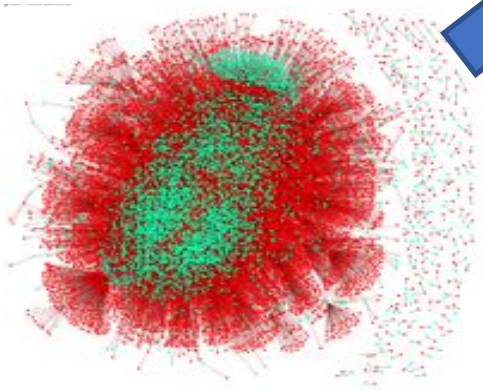
$$\varrho_\square^L \leq \varrho_j \leq \varrho_\square^U \quad \forall j \quad (19)$$

$$c_j^Q = \max\{\varrho_1, \varrho_2, \dots, \varrho_j\} \quad \forall j \quad (20)$$

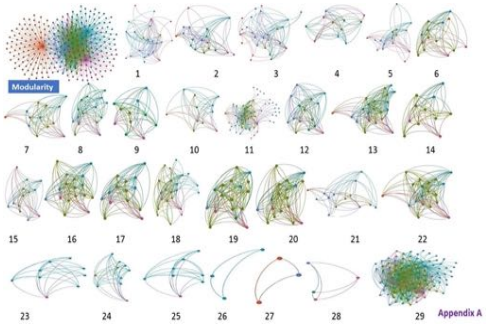
Multi criteria optimization formulation to identify disinformation spreaders. (Alassad, Agarwal, et al., 2021) Central European Journal of Operations Research, Springer



Identifying misinformation spreaders



YouTube COVID-19 misinformation video-user network



Sorted on effectiveness

Alassad, M., Hussain, M., and Agarwal, N. (2021) Decomposition Optimization Method for Locating Key Sets of Commenters Spreading Conspiracy Theory in Complex Social Networks. *Central European Journal of Operations Research*. Springer. DOI: 10.1007/s10100-021-00738-5.

COVID-19 Misinformation and Bots

JMIR Publications
Advancing Digital Health & Open Science

Articles | Search articles

Journal of Medical Internet Research

Published on 20.5.2021 in Vol 23, No 5 (2021): May

Preprints (earlier versions) of this paper are available at https://preprints.jmir.org/preprint/26933, first published January 04, 2021.

Bots and Misinformation Spread on Social Media: Implications for COVID-19

McKenzie Himelein-Wachowiak [1]; Salvatore Giorgi [1,2]; Amanda Devoto [1]; Muhammad Rahman [1]; Lyle Ungar [2]; H Andrew Schwartz [3]; David H Epstein [1]; Lorenzo Leggio [1]; Brenda Curtis [1]

Article | Authors | Cited by (1) | Tweetations (10) | Metrics

Abstract

As of March 2021, the SARS-CoV-2 virus has been responsible for over 115 million cases of COVID-19 worldwide, resulting in over 2.5 million deaths. As the virus spread exponentially, so did its media coverage, resulting in a proliferation of conflicting information on social media platforms—a so-called "infodemic." In this viewpoint, we survey past literature investigating the role of automated accounts, or "bots," in spreading such misinformation, drawing connections to the COVID-19 pandemic. We also review strategies used by bots to spread (mis)information and examine the potential origins of bots. We conclude by conducting and presenting a secondary analysis of data sets of known bots in which we find that up to 66% of bots are discussing COVID-19. The proliferation of COVID-19 (mis)information by bots, coupled with human susceptibility to believing and sharing misinformation, may well impact the course of the pandemic.

J Med Internet Res 2021;23(5):e26933

doi:10.2196/26933

IEEE SPECTRUM | Topics | Reports | Blogs | Multimedia

29 Jul 2020 | 19:00 GMT

Twitter Bots Are Spreading Massive Amounts of COVID-19 Misinformation

About 25 percent of links to "low credibility" sources of coronavirus information come from bots

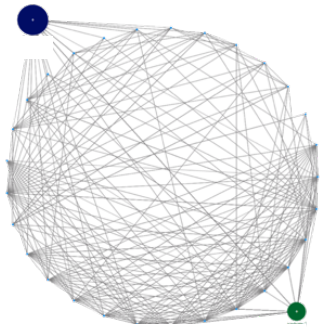
By Thor Benson

Sharing content and links to low credibility sources. Operating in a coordinated manner.

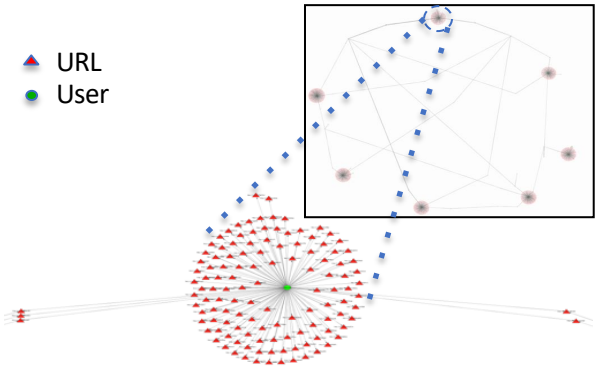
Evolution of Botnets

From bots → botnets → social bots

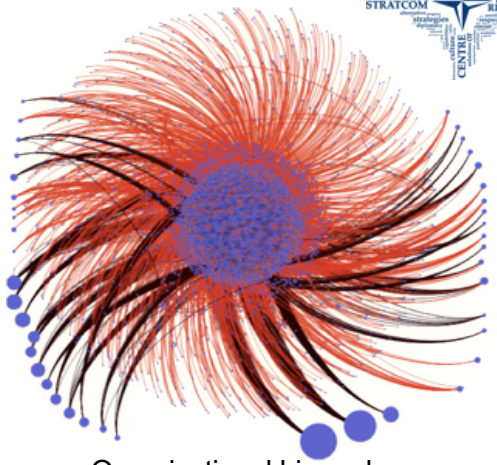
Published by NATO StratCom COE



Mutual reciprocity.
IFYFM & FMIFY



No mutual reciprocity.
Coordination in information network



Organizational hierarchy.
Core and peripheral bots

COORDINATION/BEHAVIOR COMPLEXITY

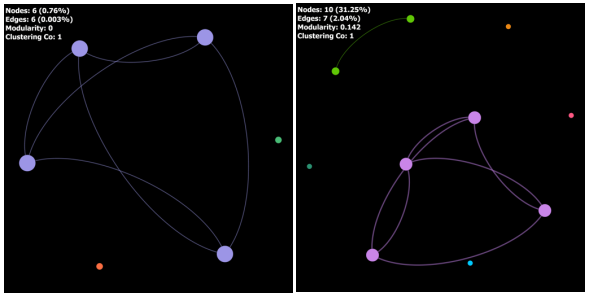
Crimean Invasion 2014

Dragoon Ride 2015

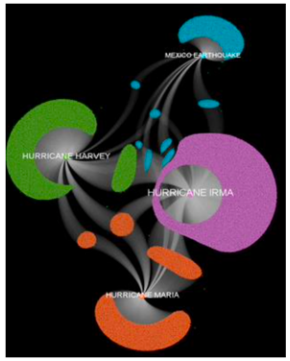
Trident Juncture 2015

ISIS Propaganda 2016

Assessing Botnet Coordination

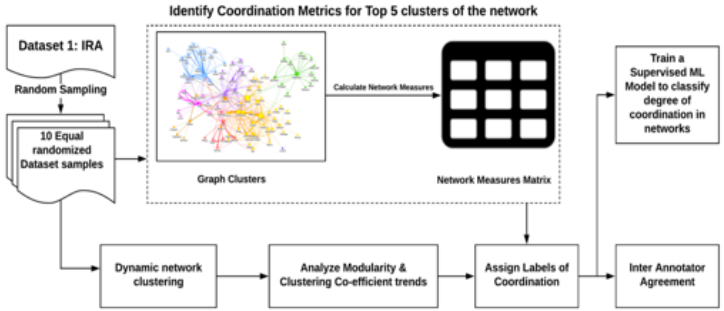


IRA Twitter bot data released by US Intelligence Agencies

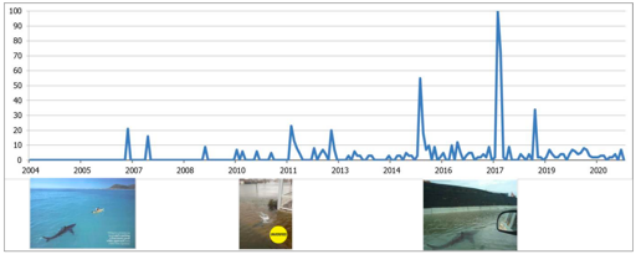


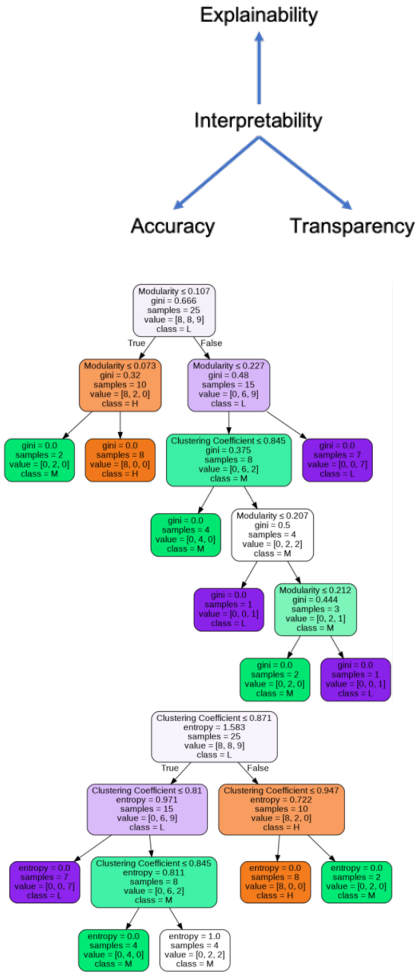
Language	Hashtag (Translation)
English	#DACA, #BlackLivesMatter
Spanish	#VenezuelaDemocraciaYDiálogo (Venezuela Democracy and Dialogue), #Cáncer (Cancer)
Arabic	(The demise Of Israel) #زوال_إسرائيل, (The Jews) #اليهود
French	#Nucléaire (Nuclear), #GendarmerieEnOpération (Gendarmerie Special Operations)
Mandarin	金正恩 (Kim Jong-un), 核试验 (Nuclear Test)

Detecting coordination among Twitter social bots (Khaund & Agarwal, 2020) SBP-BRiMS



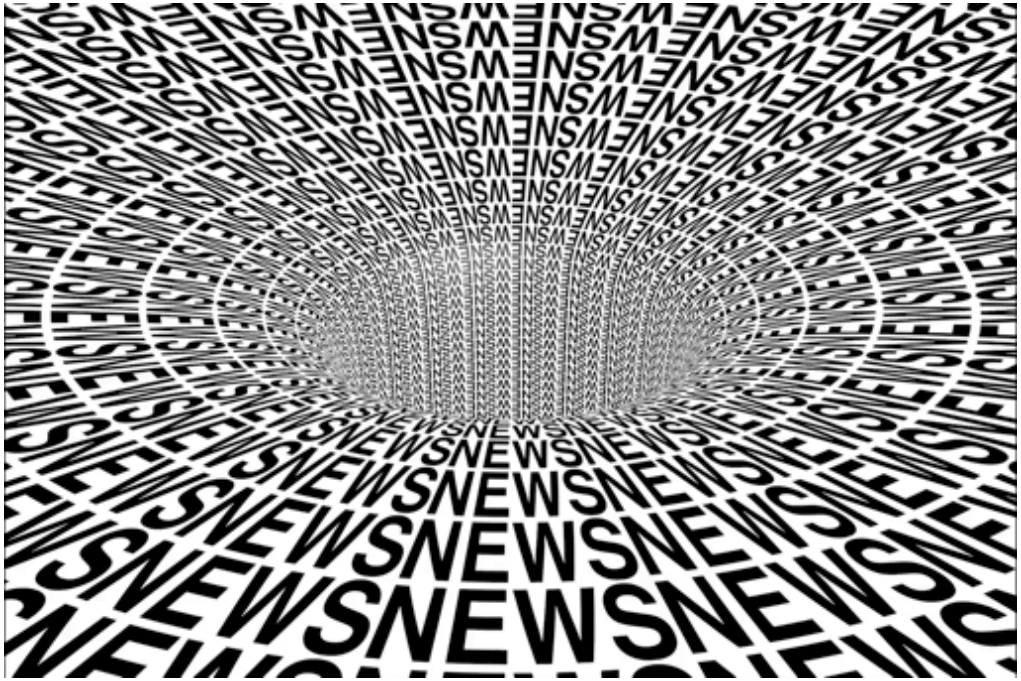
Bot coordinated misinformation during Hurricanes





Platform Vulnerability/Bias

- AI-based recommendation algorithms that predict our shopping behaviors, books and articles to read, videos to watch lack transparency.
- Recommendation algorithm learns from behavioral data and perpetuates the underlying bias in its recommendations.
  - YouTube's recommendation algorithm is known to push its viewers down the conspiratorial rabbit hole by suggesting related videos.
  - On Facebook, ads to recruit delivery drivers for Domino's Pizza Inc. were disproportionately shown to men, while women were more likely to receive notices in recruiting shoppers for grocery-delivery service Instacart Inc.
- Explainable model could help in identifying causes of biased recommendations thereby enhancing the model's transparency.



Platform Vulnerability/Bias

Computational propaganda tactics on YouTube detected using a groundbreaking multimedia processing approach based on color theory. Research received Best Paper award at the International Conference on Human and Social Analytics (HUSO), Oct.18-22,2020

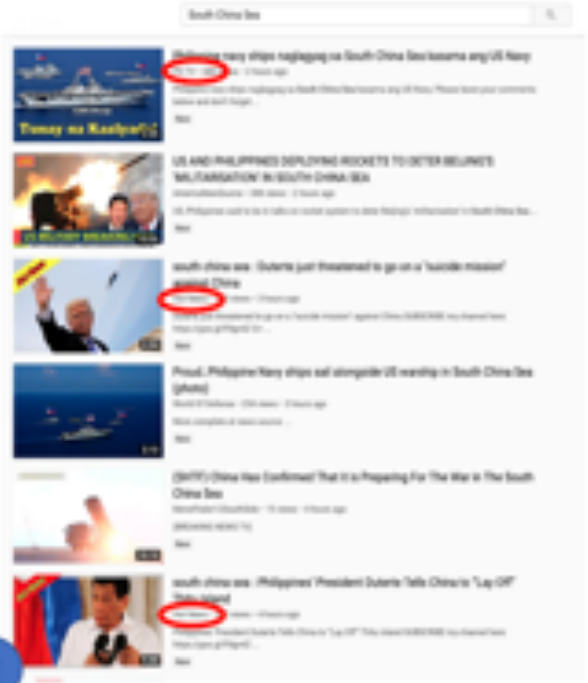
Video ID: OM5vaF2kzPA
Title: China vs US The War in the South China Sea already Start
Channel: Breaking News TV

Video ID: GsCmudyXY2o
Title: China vs US The War in the South China Sea already Start
Channel: DOT COM US

Similar videos detected on different YouTube channels using barcode approach. Below, network of channels identified deploying crowd amplification tactic.

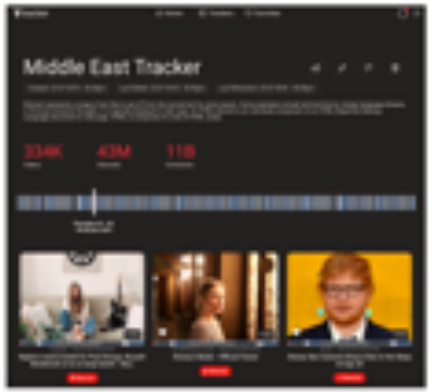
1

Crowd amplification tactic successfully manipulated YouTube's search results. "Hot News" - a prominent channel disseminating anti-US videos related "South China Sea" conflict – shows up at top of the search results.

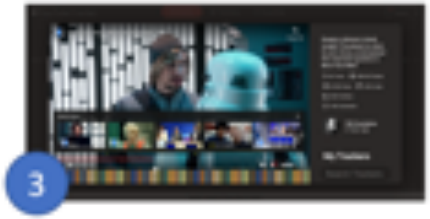


2

Video barcode technique has been transitioned to YouTubeTracker



Video barcode technique allows us to navigate interesting narrative elements for a collection of videos pertaining to an event (above) or a single video (below)



3

Virality over veracity!

Platform Vulnerability/Bias Characterization

How to observe, identify, and measure algorithmic bias?

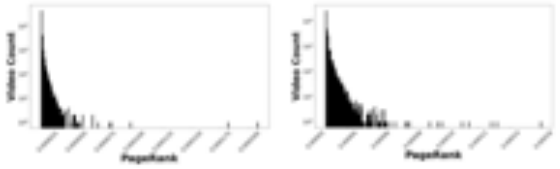


Fig. 1. Distribution of PageRank values in the recommendation graphs 1 (left) and 2 (right). We observe similar results in all recommendation graphs. The count of videos is represented in log scale on the y-axis.

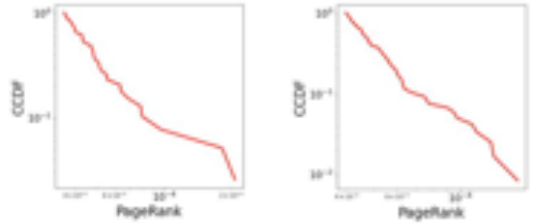
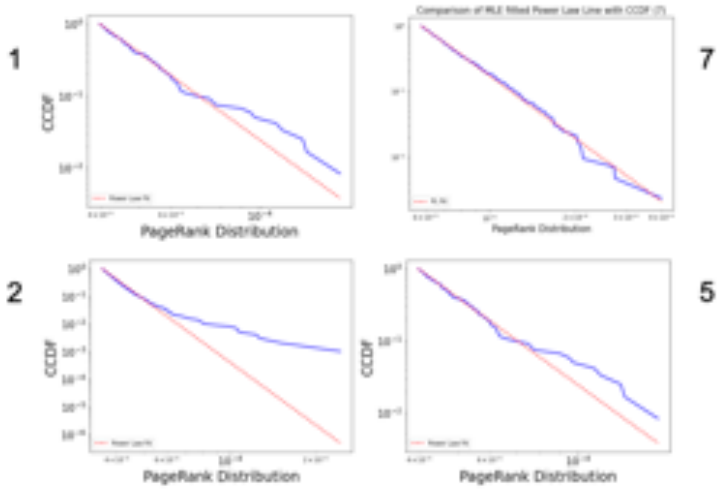


Fig. 2. Complementary Cumulative Distribution Function (CCDF) Plots of PageRank Scores in each Recommendation Graphs 1(left) and 2 (right).

Topic drift and decrease in relevance was observed.



Top PageRank videos were removed weeks or months after their appearance in the recommendation network. Reason for content removal is violation of platform terms and services.

Kirdemir, B., Kready, J., Mead, E., Hussain, M., Agarwal, N., and Adjeroh, D. (2021) Assessing Bias in YouTube's Video Recommendation Algorithm in a Cross-lingual and Cross-topical Context. Proceedings of the International Conference on *Social Computing, Behavioral-Cultural Modeling & Prediction, and Behavior Representation in Modeling and Simulation* (SBP-BRiMS 2021), July 6-9, 2021, Washington D.C.

Looking Ahead

- Develop publicly available technologies and solutions
- Social media companies need to be more proactive, Algotransparency.org
- Emerging technologies like blockchain for content validation, decentralized social media platforms
- Build collaborative networks of practitioners, researchers, policy makers to address this problem together
- Strengthen media literacy programs
- Need to advance the dialog on cyber diplomacy

Thank you!

Nitin Agarwal, nxagarwal@ualr.edu

COSMOS Tools Developed:

- **COVID-19 -** https://cosmos.ualr.edu/covid-19
- **Blogtrackers** - https://btracker.host.ualr.edu/
- **YouTubeTracker** - https://vtracker.host.ualr.edu/
- **Focal Structure Analysis** - http://fsa.host.ualr.edu/

Blogtrackers YouTubeTracker

FOCAL STRUCTURE ANALYSIS

https://cosmos.ualr.edu/

Follow **cosmographers** on

ACKNOWLEDGEMENTS

This research is funded in part by the U.S. National Science Foundation (OIA-1946391, OIA-1920920, IIS-1636933, ACI-1429160, and IIS-1110868), U.S. Office of Naval Research (N00014-10-1-0091, N00014-14-1-0489, N00014-15-P-1187, N00014-16-1-2016, N00014-16-1-2412, N00014-17-1-2675, N00014-17-1-2605, N68335-19-C-0359, N00014-19-1-2336, N68335-20-C-0540, N00014-21-1-2121), U.S. Air Force Research Lab, U.S. Army Research Office (W911NF-20-1-0262, W911NF-16-1-0189), U.S. Defense Advanced Research Projects Agency (W31P4Q-17-C-0059), Arkansas Research Alliance, the Jerry L. Maulden/Entergy Endowment at the University of Arkansas at Little Rock, and the Australian Department of Defense Strategic Policy Grants Program (SPGP) (award number: 2020-106-094). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funding organizations. The researchers gratefully acknowledge the support.

COSMOS Collaboratorium for Social Media and Online Behavioral Studies

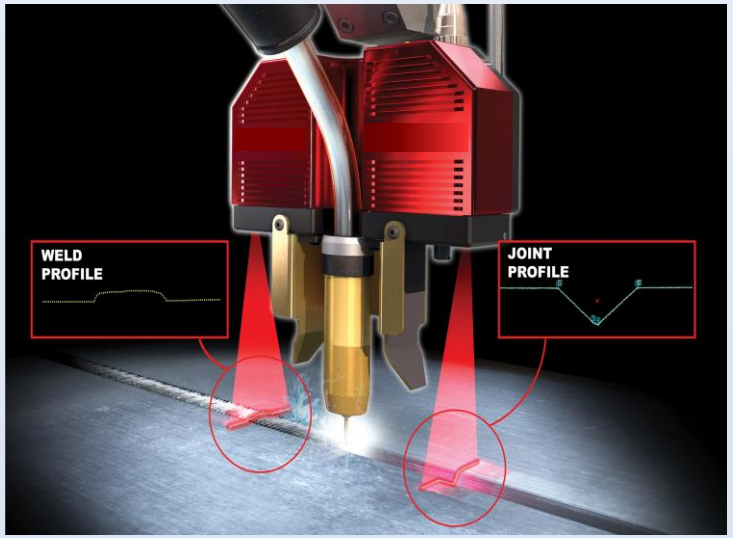
National Science Foundation · Office of Naval Research · Air Force Research Laboratory · Defense Advanced Research Projects Agency · Army Research Office · Department of Homeland Security · Arkansas Research Alliance

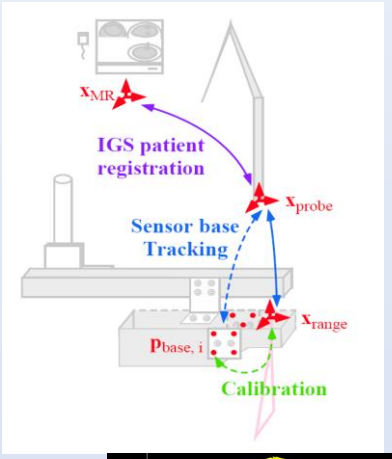
Open-source potentiated medical simulation for improving patient outcomes from newborns to geriatric patients

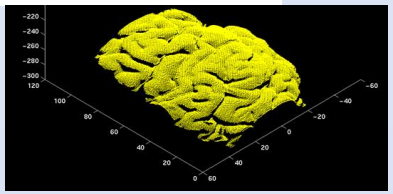
Michel Audette Ph.D., Associate Professor,
Computational Modeling & Simulation Engineering
Graduate Program Director, Biomedical Engineering
Old Dominion University, Norfolk, VA

How I got here…

- B. Eng. EE (McGill) 1986; 1986-88 ***Flight Sim at CAE Electronics.***
  - Expertise: fooling avionics computers into thinking sim is real aircraft.
- M.Eng. EE (Ecole Polytechnique- comp. vision) 1992; ‘92-94: ***welding automation***.
- ***Ph.D. BME*** (McGill University); thesis brain shift estimation, 2001.
- Post-docs: Tsukuba, Japan 2001-05; Leipzig, Germany 2006-08; ***Kitware*** 2008-11.
- ***Assistant Prof. ODU*** ‘11-17, ***Associate Prof***. ‘17-now; ***GPD BME*** ’20

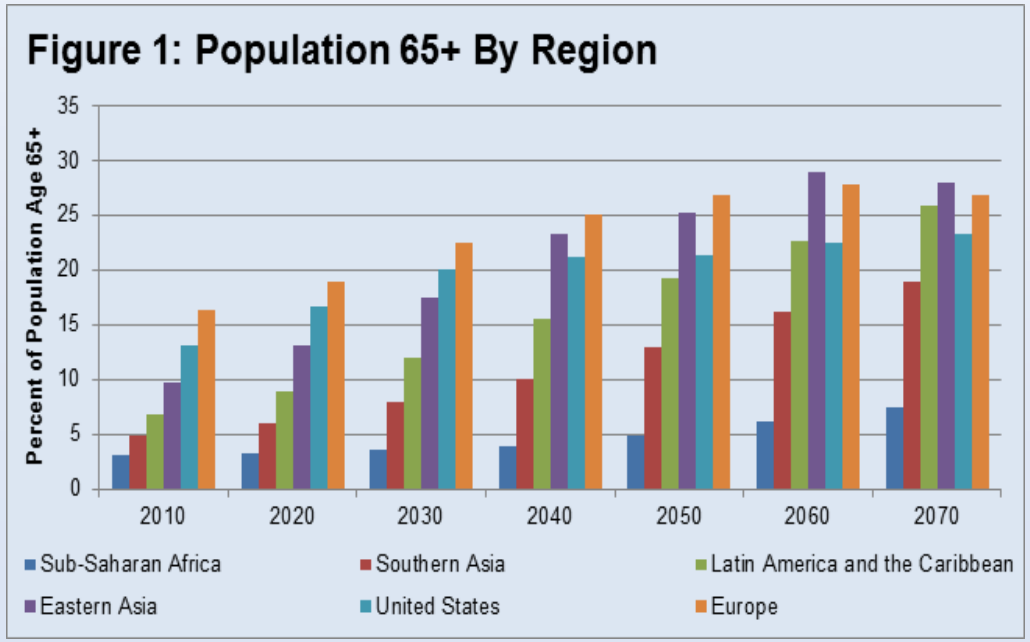


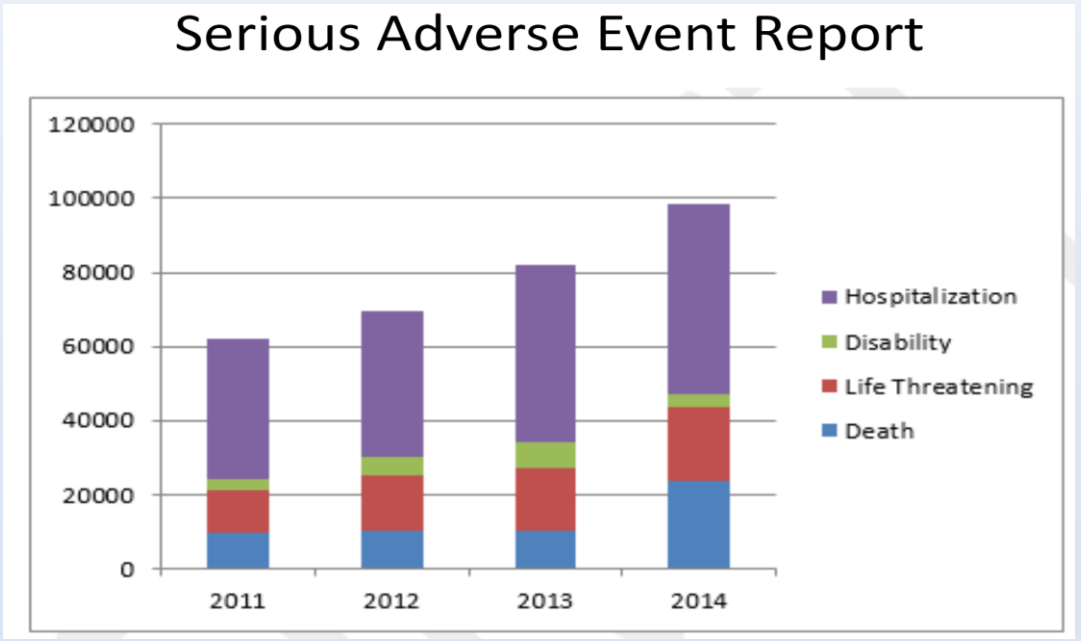




What is the problem?

- ***Aging population***… everywhere in the world.
- ***Explosion in demand*** for ***medical devices***: huge growth in MedTech industry.
- The FDA tracks ***Serious Adverse Events*** in medical devices: death, hospitalization, life-threatening, disability, congenital anomaly and/or other serious outcome.
- As ***medical device revenues increase***, so do ***adverse event reports.***

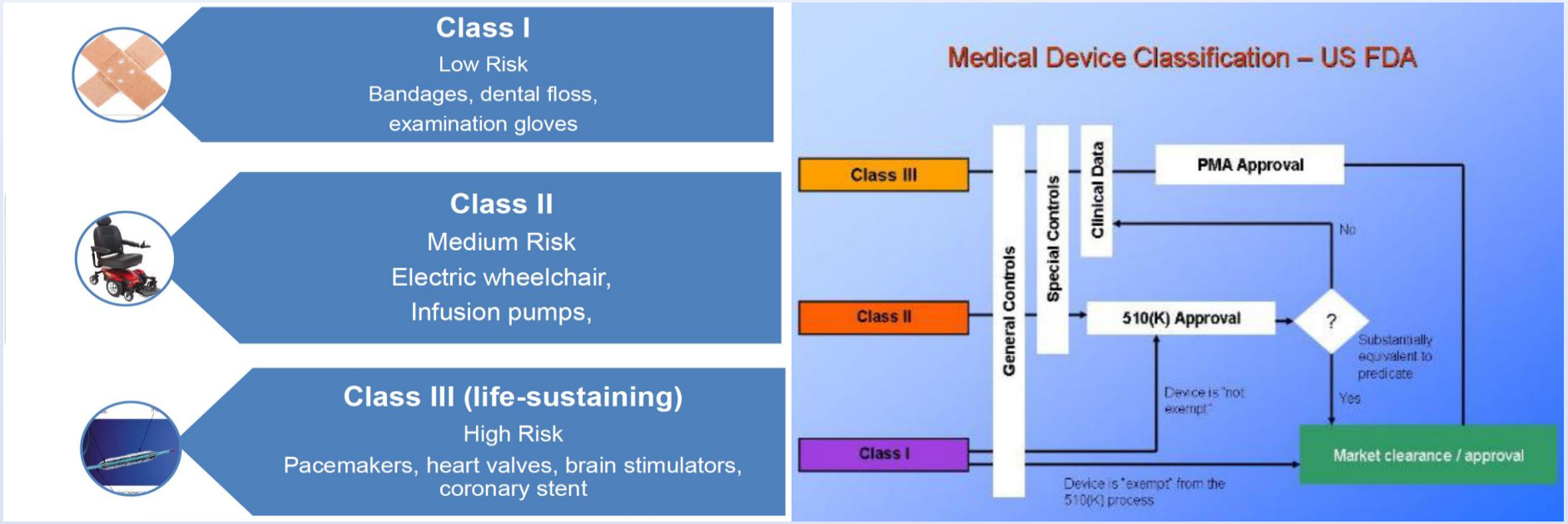




www.fda.gov/drugs/questions-and-answers-fdas-adverse-event-reporting-system-faers/faers-reporting-patient-outcomes-year
www.slideshare.net/rocheam/medical-device-reporting-27-sep2016 www.hobbsmedical.com/blog/still-too-many-adverse-events

What is a Medical Device?

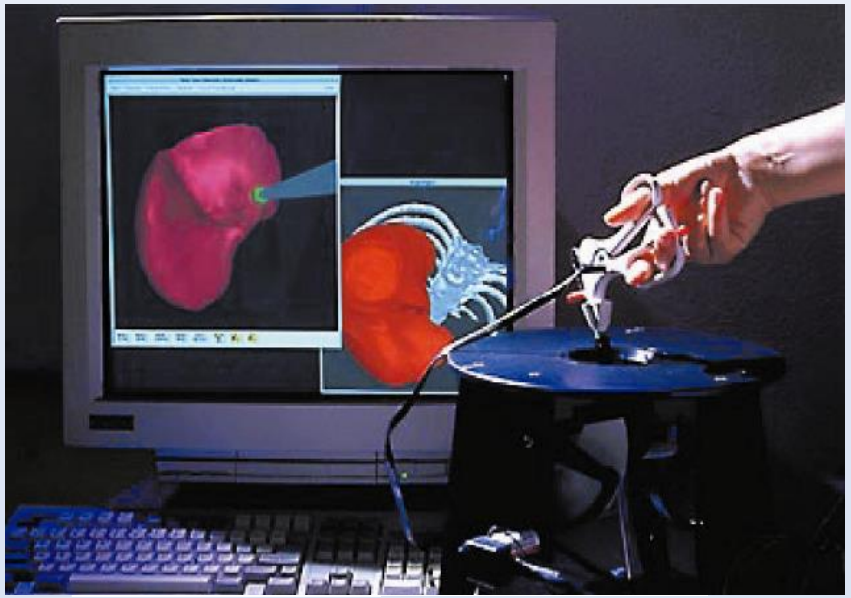
- "an ***instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent***, or other similar or related article… which:
  - Is intended for use in the ***diagnosis, treatment/cure, mitigation or prevention of disease*** in humans or animals;
  - Does not act through chemical actions or which ***does not need to be metabolized*** before acting >> that means ***which is no drug***.



J. De Largen, Medical Device Reporting. https://www.slideshare.net/rocheam/medical-device-reporting-27-sep2016

Limitations in Therapy Simulation & Image Guided Therapy

- **Therapy simulation:** synthesize tissue response to therapeutic action.
  - ***Predictive vs Interactive;*** patient, therapy (& collision) models.
- **Image-guided therapy–** orient clinician w.r.t. ***patient anatomy in OR.***
  - Undermined by ***soft tissue shift*** & ***anatomical modeling limitations***.
- So far, ***limited clinical impact,*** esp. simulation: incl. to ***medical devices***.



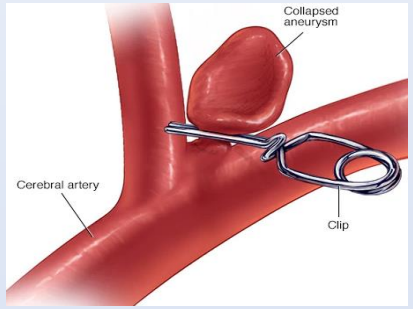
Images reproduced from M. Chabanas, Université de Grenoble, S. Cotin, INRIA, brainlab.com irsthealth.org

Requirements through Medical Ontologies

- On-going work : ***medical ontologies*** = description of each procedure in discrete stages (neuro & orthopedic surgery).
- ***Ontological representation:***
  - Broad description of surgery;
  - Organized acc. to 2 parameters:

  i) ***approach:*** pterional, transnasal, etc.

  ii) ***pathology***: tumor type, aneurysm, DBS target, etc.



Medical device

Positioning

Skin Incision

Interfascial Dissection

Craniotomy

Drilling of Sphenoid Wing

Dural Opening

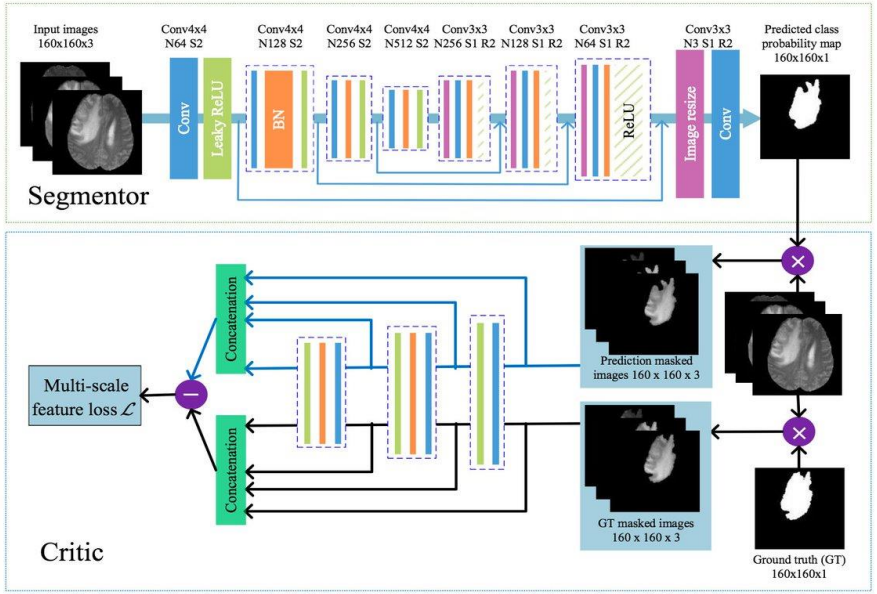
Opening of Sylvian Fissure And/or Basal Cisterns

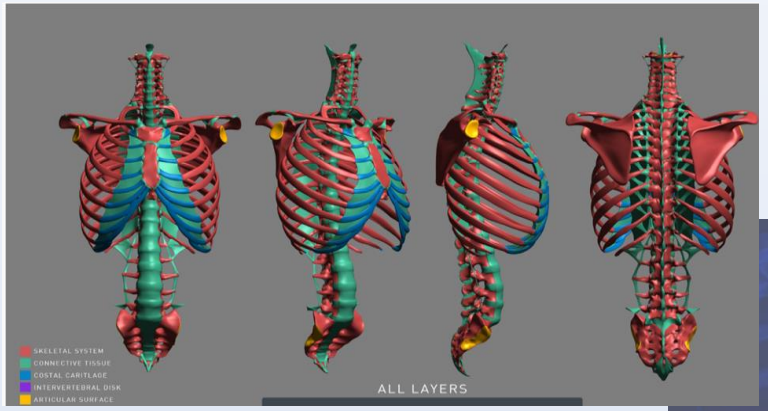
Therapy/resection

Closing

Anatomical Modeling Trends: Segmentation

- ***Patient-specific anatomical modeling.*** Revolution underway: mapping MRI CT US to tissues by ***Deep Neural Network-based segmentation & digital atlases.***
- DNNs ***identify*** visible tissues; digital atlases impose prior ***anatomical knowledge***.



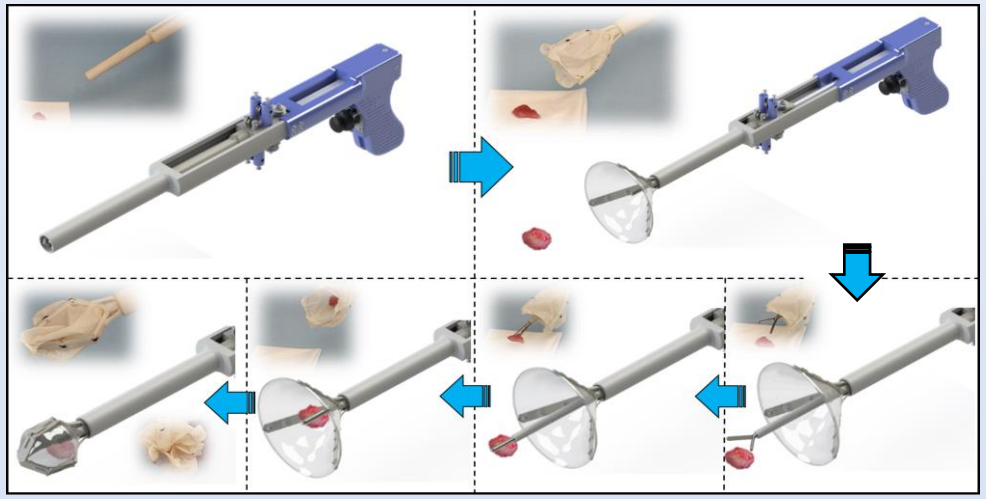


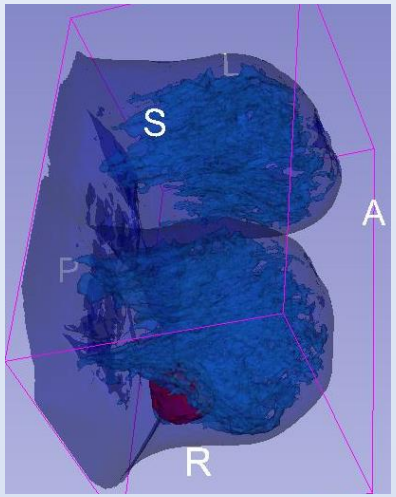
Y. Xue, SegAN: Adversarial Network with Multi-scale L1 Loss for Medical Image Segmentation, www.arxiv-vanity.com/papers/1706.01805

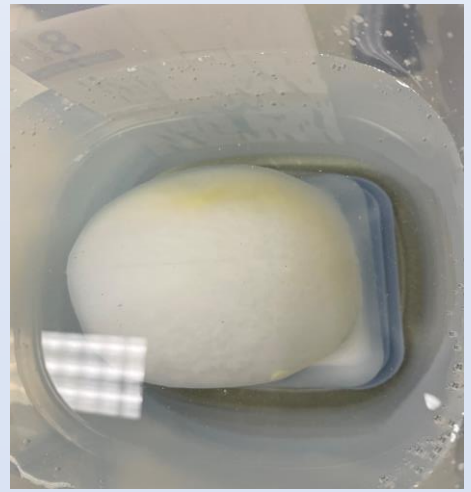
A. Tapp, M. Audette et al, Generation of Patient-Specific, Ligamentoskeletal, Finite Element Meshes for Scoliosis Correction Planning, MICCAI CLIP Workshop, 2021.

Anatomical Modeling: 3D-Printing-based Phantoms

- ***Segmented volumes*** can map to ***surfaces***, which can be 3D-printed directly for ***clinical visualization***, or alternately: used to produce a ***3D-printed mold for soft tissue phantoms.***
- Phantoms can be constructed of ***Polyvinyl Alcohol Cryogel (PVA-C),*** a liquid that once frozen and thawed (Freeze-thaw cycle) becomes an elastic solid.
- PVA-C patient-specific ***breast phantoms*** for robotic breast surgery navigation development.

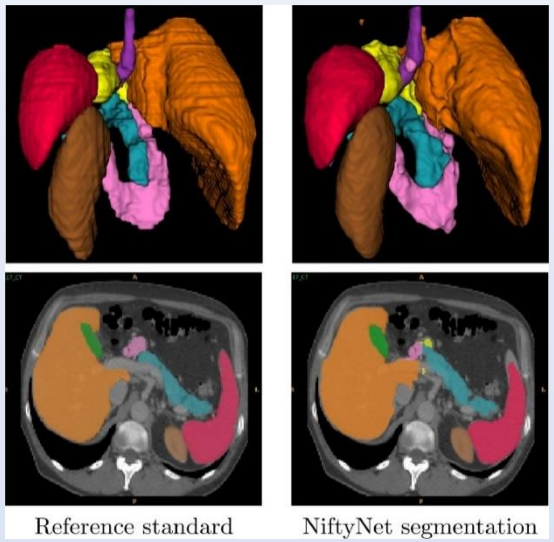


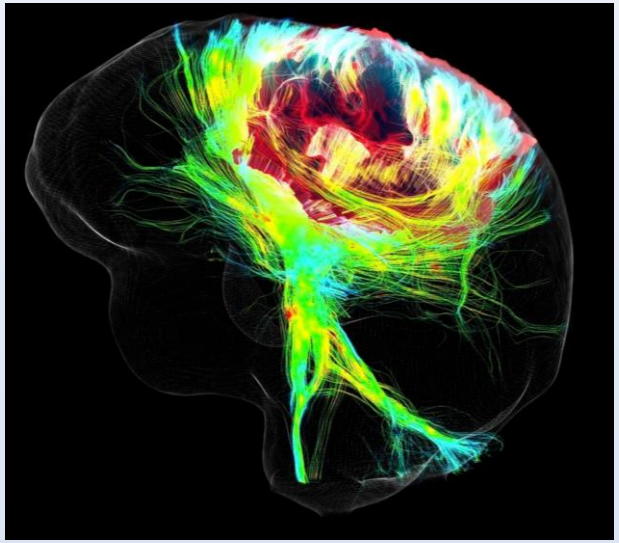


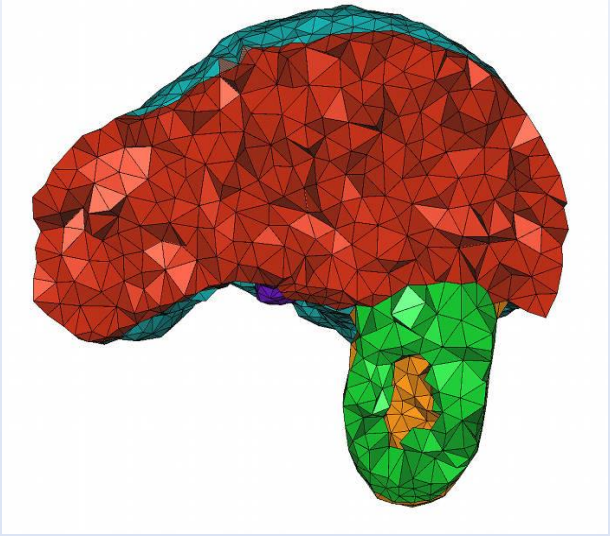


Anatomical Modeling Open-Source Tools

- Many professional-grade ***open-source software tools.***
- ***Deep Learning***: Tensorflow, DLTK, Caffe, NiftyNet, many more on GitHub.
- ***Medical image processing***: ITK, MITK, Slicer3D, FreeSurfer, DiPy, Elastix.
- ***Tet Meshing***: Computational Geometry Algorithms Library, Tetgen, BioMesh3D.



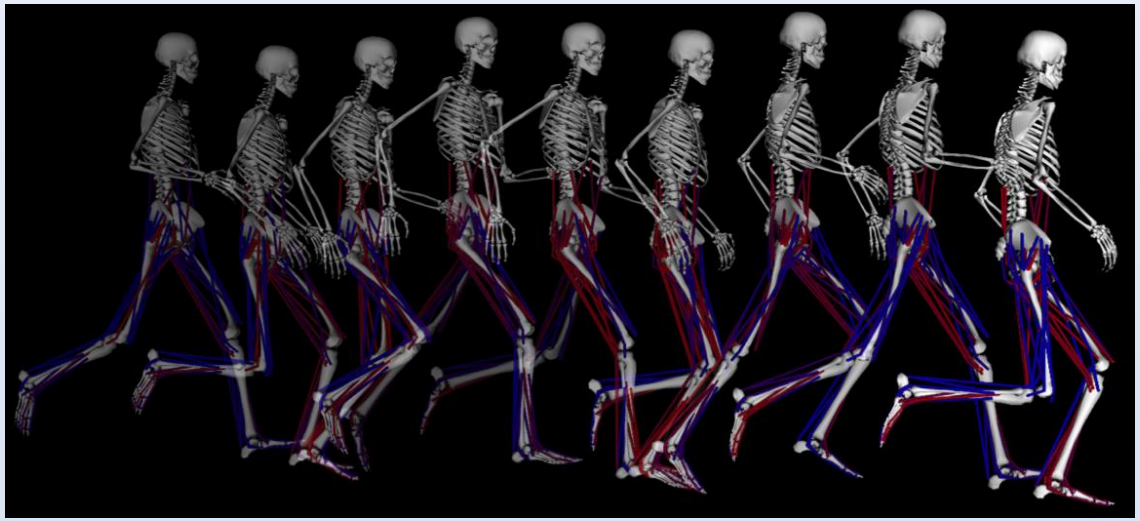


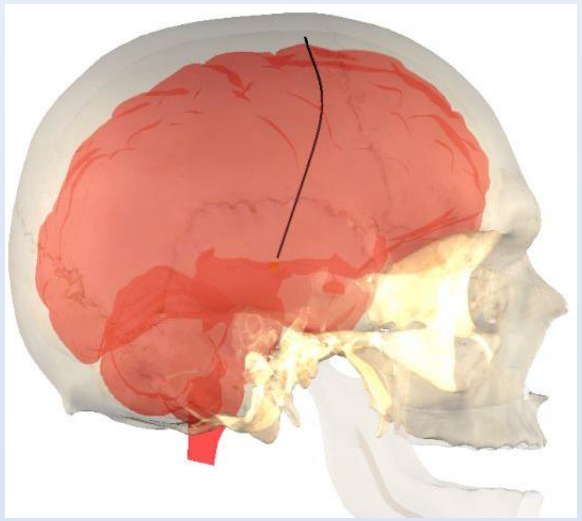


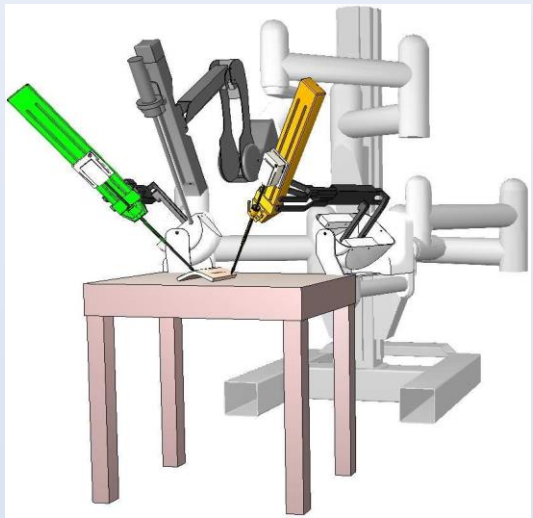
E.Gibson et al, NiftyNet: a deep-learning platform for medical imaging, Comp. Meth. & Prog in Biomed., 158: 113-122, 2018. www.tensorflow.org dltk.github.io caffe.berkeleyvision.org github.com/NifTK/NiftyNet github.io itk.org mitk.org slicer.org surfer.nmr.mgh.harvard.edu dipy.org scil.dinf.usherbrooke.ca elastix.org cgal.org wias-berlin.de/software/tetgen www.sci.utah.edu/software/scirun/biomesh3d.html

Therapy & Function Simulation: Open-Source Tools

- Many ***open-software software tools*** for simulating ***tissue response.***
- ***Interactive sim: tissue & musculoskeletal mechanics***: SOFA, IMSTK, OpenSim.
- ***High-fidelity tissue response***: FEBio, OpenFoam (CFD/FSI), Virtual Brain.
- ***Image-guided therapy & robotics***: Slicer3D/SlicerIGT, PLUS, MITK.
- ***Robotics, device sim & development***: OpenRave, dVRK, Raven II (open robot).







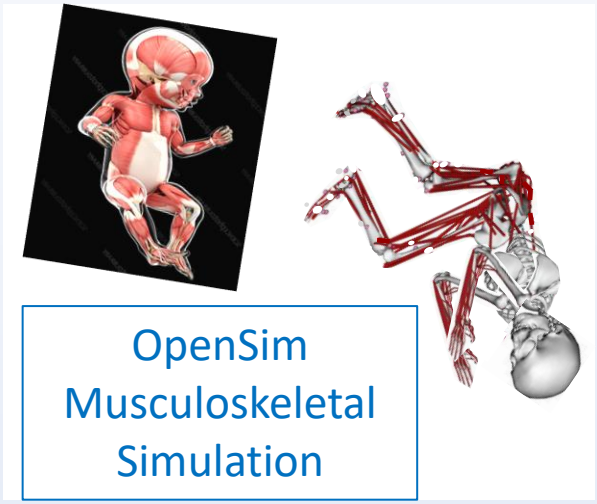
www.sofa-framework.org imstk.org simtk.org/projects/opensim febio.org openfoam.org www.thevirtualbrain.org slicer.org
github.com/SlicerIGT plustoolkit.github.io mitk.org openrave.org github.com/jhu-dvrk rll.berkeley.edu/raven/

Functional Sim - Applications from Newborns to Geriatric Subjects

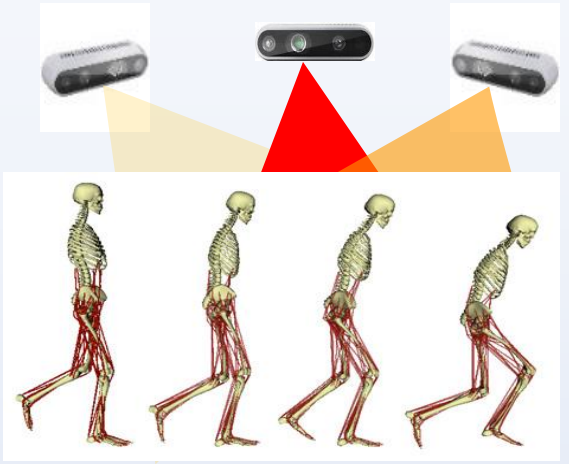
Department of Computational Modeling & Simulation Engineering

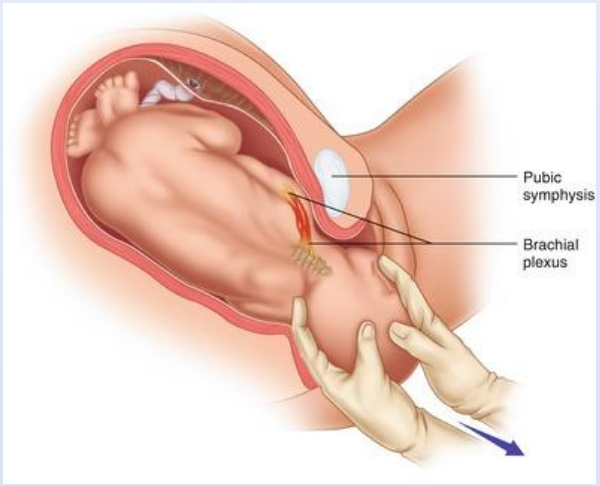
Biomedical Engineering Institute

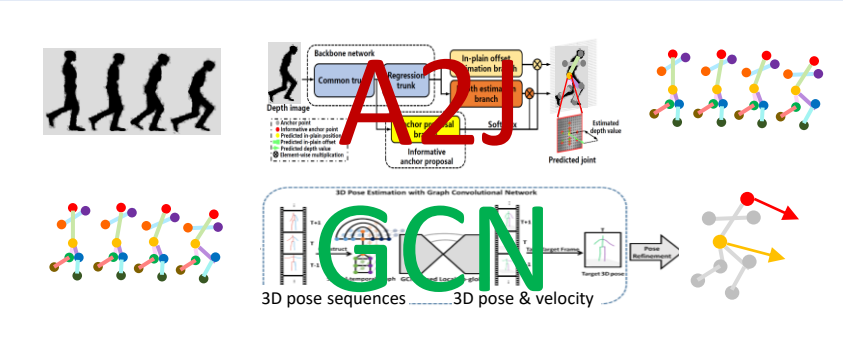
- ***Medical device*** definition varies depending on ***area of medicine.***
- ***Obstetricians & geriatricians:*** different needs than surgeons & radiologists.
- OpenSim-based ***musculoskeletal (MS) simulation*** is broadly applicable.
- Obstetricians need sim training on fetal problem cases, e.g. ***shoulder dystocia***.
- Geriatricians must mitigate injuries to seniors due to falls: ***DNN-based human pose estimation*** & airbag deployment.



OpenSim Musculoskeletal Simulation







Towards Improved Medical Device Outcomes

- Is it feasible for FDA to require ***device simulation*** for certification?
- There are many factors that can ***argue for feasibility.***
  - ***Better use of ontologies***; else, risk “dumbing down” problem.
  - ***Progress in anatomical modeling:*** imaging, DL, atlases, meshing.
  - ***Therapy modeling***, IGT, robotics: tissue/MS sim → device sim/IGT.
- ***How to get there***? Tougher FDA & EMA? More funding at NIH & Euro equivalent?

“Navi Campus”: an enhanced GPS navigation app for university Campuses

Jesus Zegarra Flores

Laurence Rasseneur

Presenter : Jesus Zegarra Flores, Research and Innovation project leader, e-health, Capgemini Engineering

jesus.zegarraflores@capgemini.com

Presenter: Ph.D. Jesus Zegarra Flores

Professional Experience:

- Research and Innovation Leader at the Capgemini Engineering.
- Research and Development Engineer at the Strasbourg University.
- Research engineer at CNRS in France.

Publications & Activities:

- In charge of research projects in the fields of Assistive Technology, Mobility, Artificial Intelligence and Internet of Things.
- Lecturer at ECAM (Engineering School) in the field of IoT.
- Catheter Tracking and data fusion for reducing the X-ray exposition in an interventional Radiology procedure (2020).
- Conception of a touchless human machine interaction system for operating rooms using deep learning (2017).
- Navi Campus : an enhanced GPS navigation app for University Campuses,» 12th ITS European Congress (2017).

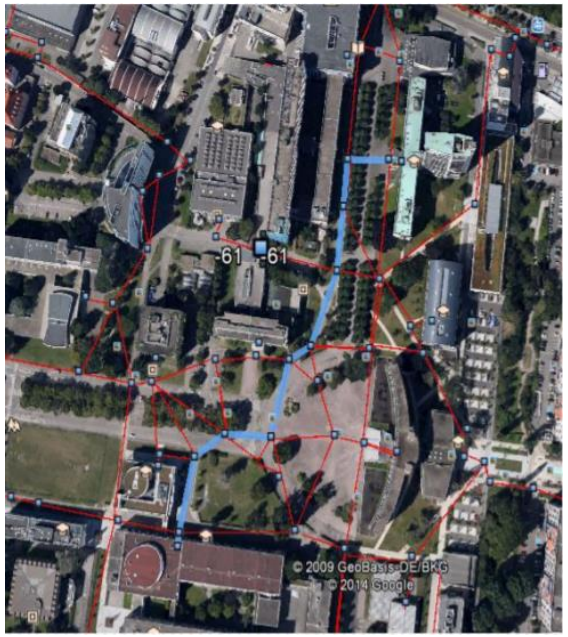
Objectives

- To allow people to navigate in unfamiliar places (use case: Esplanade campus in the Strasbourg University).

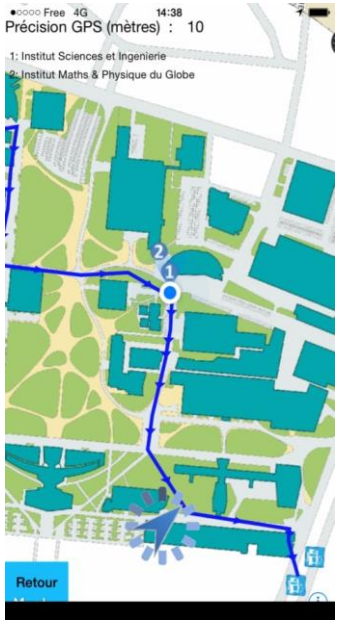
- To give adapted instructions and guidance for reduced mobility people.

The user select the destination in the app

Dijkstra algorithm draw the best path

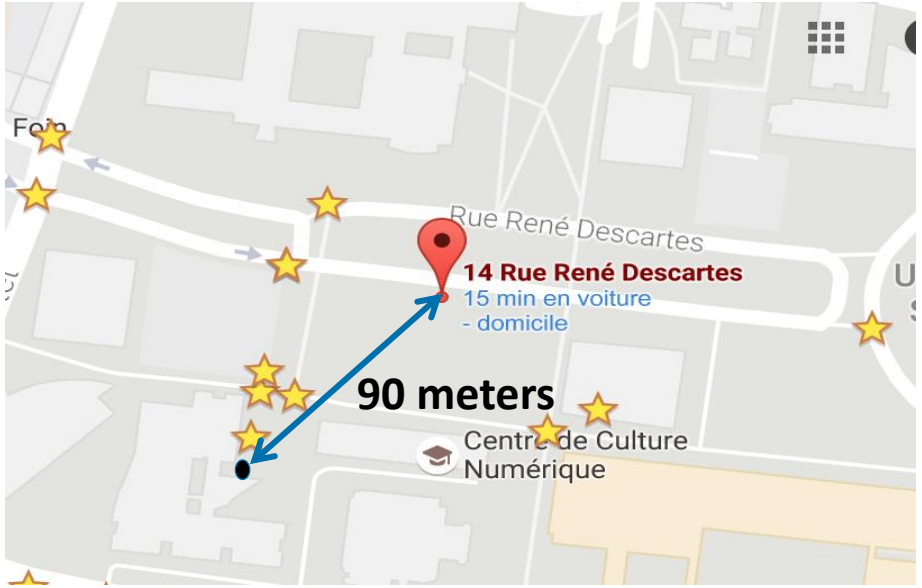


The user is guided with a map where the person can see his/her current location and orientation



Difficulties of classic GPS devices

- Cartography of the maps is not well elaborated in campuses.
- Specific information about faculties or the buildings are not given in standards GPS.
- Walking paths obtained do not take into account the accessible paths for reduced mobility people.
- In some classic GPS devices, the GPS coordinates found from a faculty building address do not correspond to the real entrance.

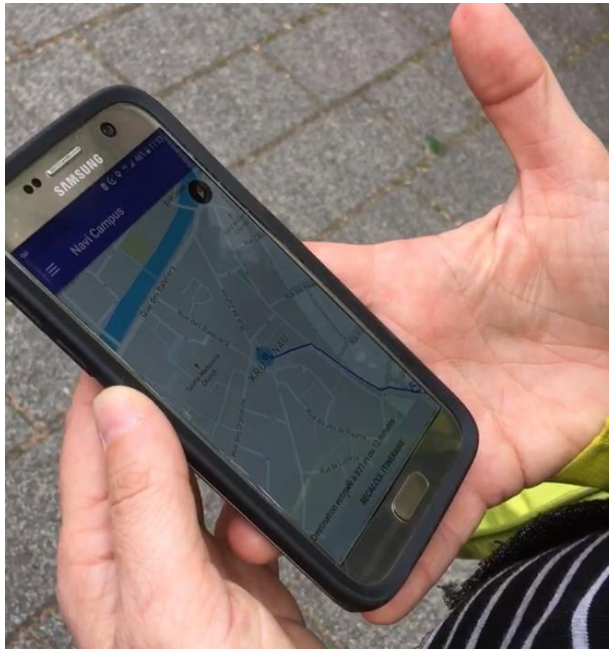


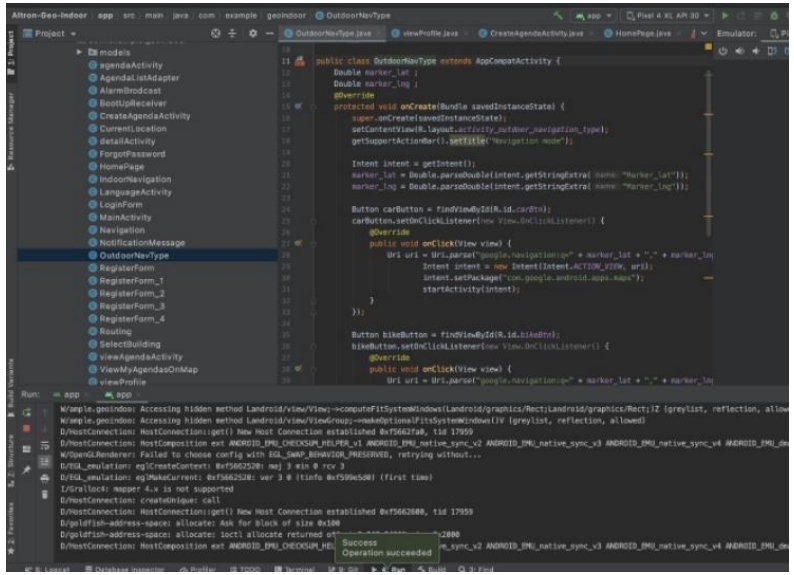
Materials

- Prototype developed in an Android device.

- Devices which come with sensors: GPS, compass, accelerometer, gyrometers and barometers. It can also be used with devices which only have GPS antennas.

- Programming in java Android (Android Studio).





Human Machine Interaction

Two ways of using the app:

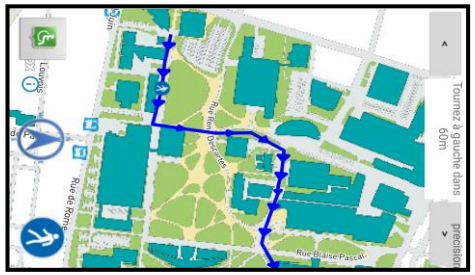
In navigation mode.

- ✓ Possibility to give vocal instructions and guidance.
- ✓ Building detection when the user location is less than 50 meters.
- ✓ Itinerary calculator (between buildings and public transport or vice versa) taking into consideration eventual accessible paths.

Out of navigation mode.

- ✓ Possibility to do a virtual navigation (including accessible paths) in order to discover the campus and buildings.
- ✓ Building detection for giving information when clicking on the screen.

Parts of the app



Display of functional accessible paths and guidance instructions

-Map integration

-Calibration of the map

-Building detection (highlighting contour)

-Detection of the two closest buildings from my current position.

-Functional path detection.

GPS localization

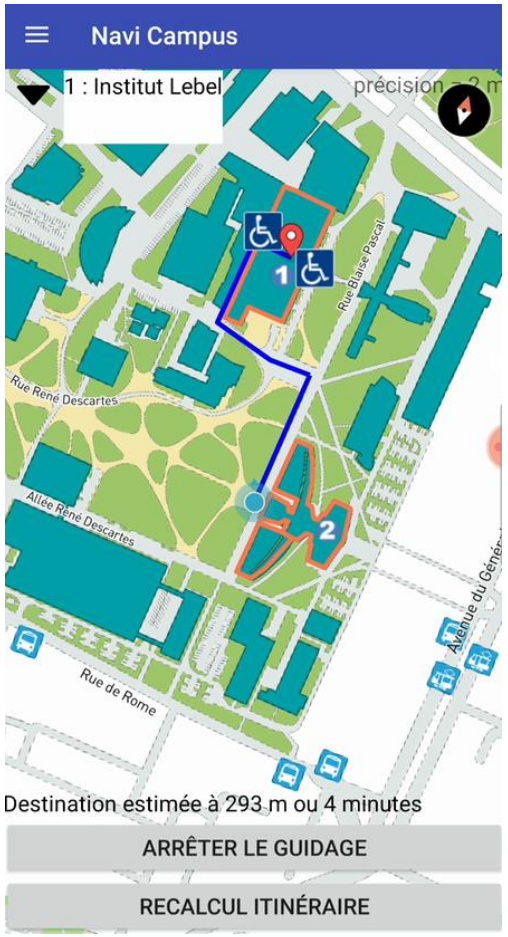
Detection of the accessible paths

- Creation of specific data source avoiding passing through stairs.
- This collection of data is done manually . (New ways of recuperating this information are in progress).
- The pathfinding algorithm used is Dijkstra.

Functions of the app

Click on building

Building detection (less than 50m)

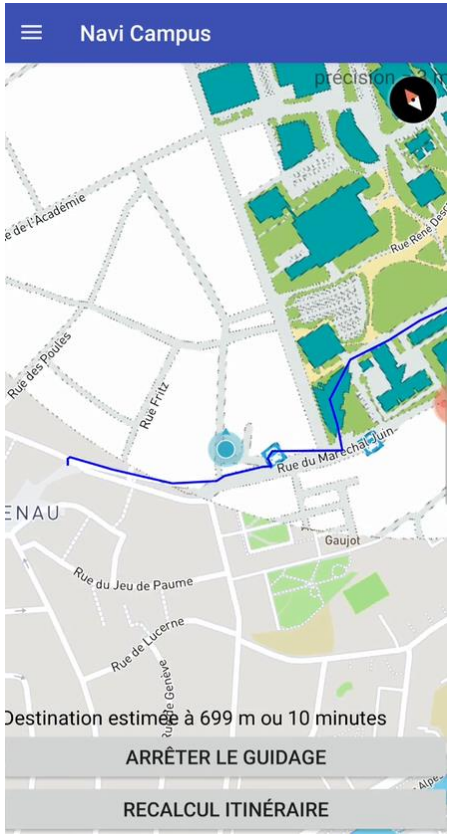


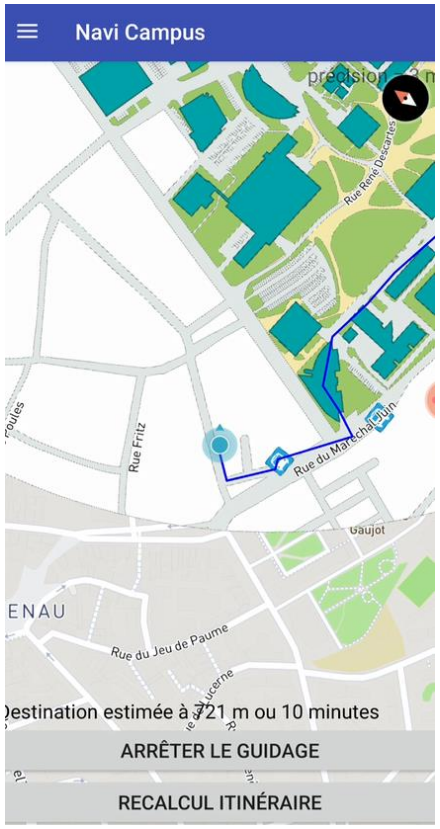
Destination

Pathfinding (accessible entrance door)

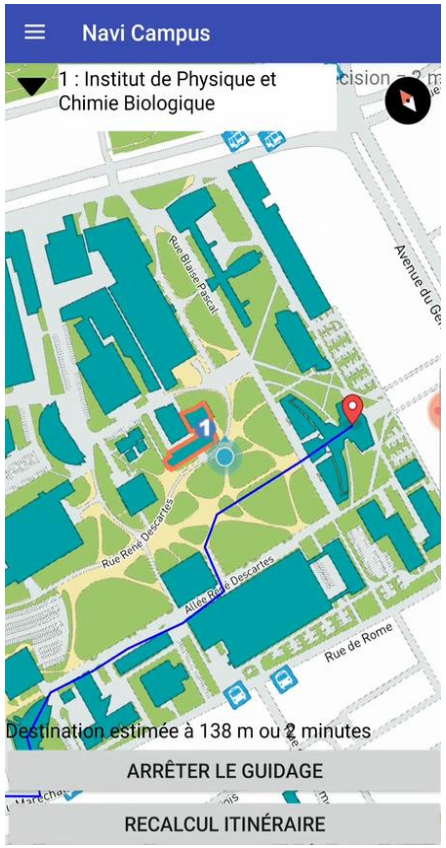
Functions of the app

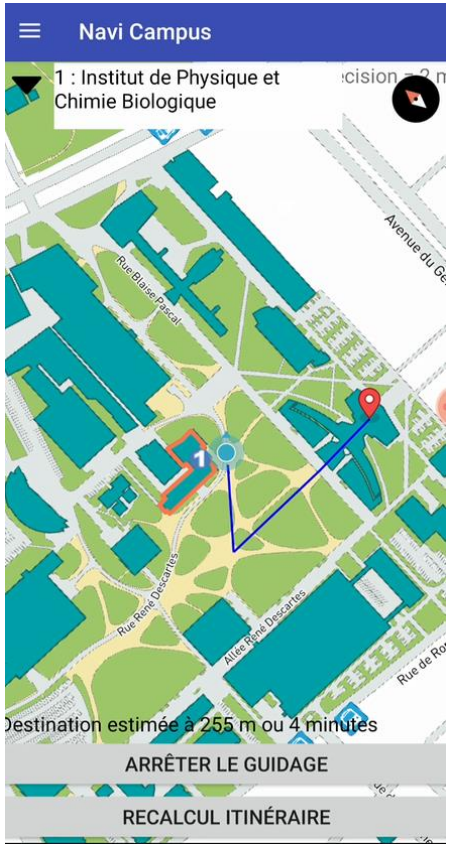
When people go out from the path.

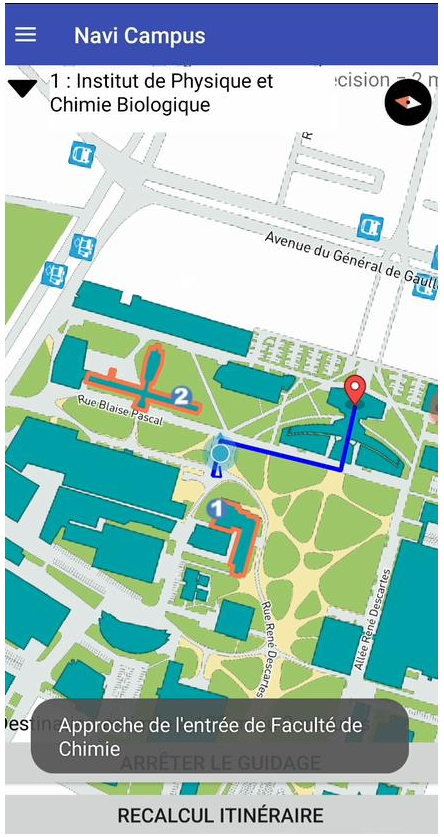




Outside the campus



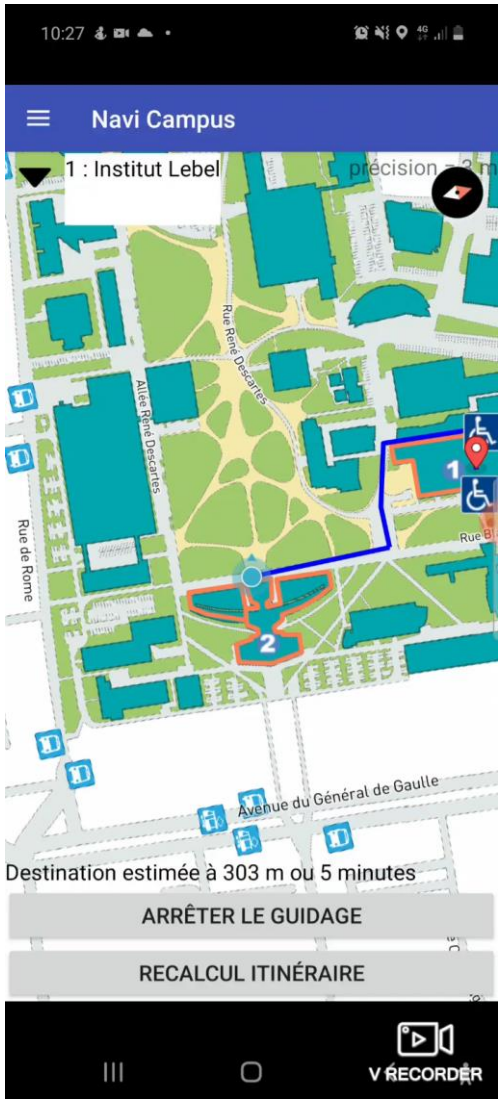


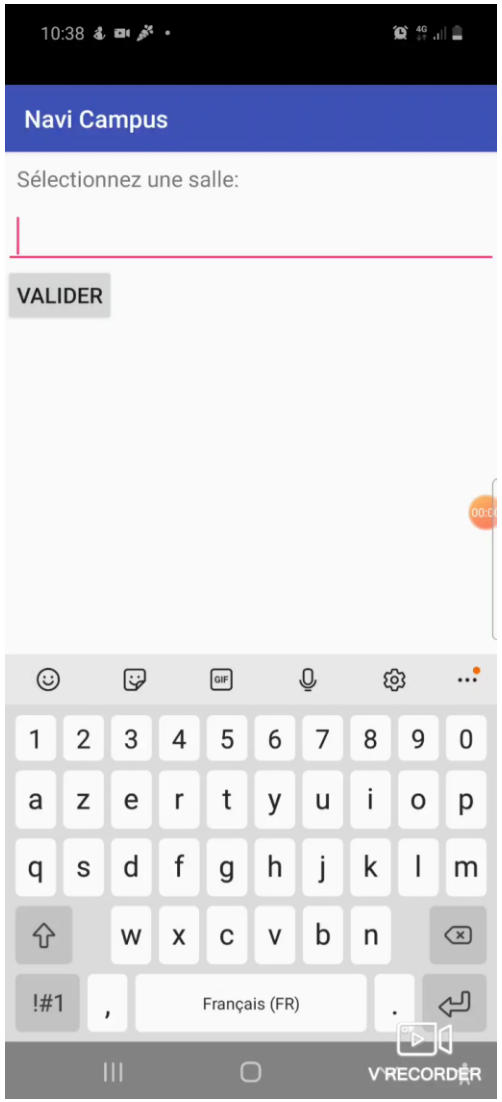


Inside the campus

Navigation tests

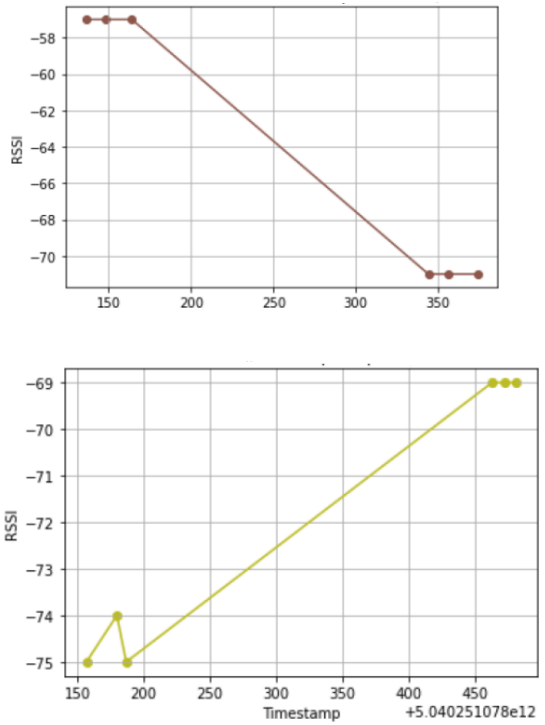
Videos demonstration



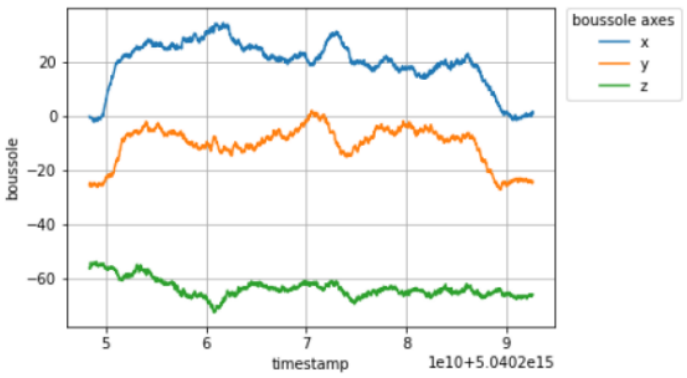


Future work

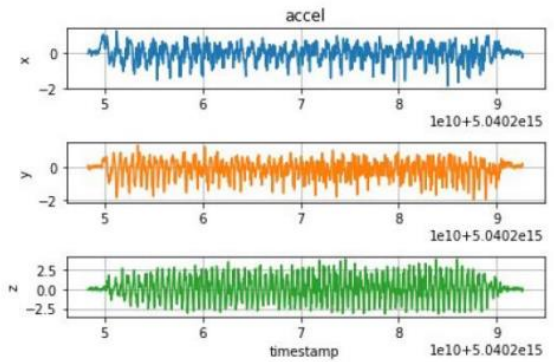
- Testing with more newcomer students to analyze the efficiency of the app.
- GPS signal can be coupled to other sensors like accelerometers and gyroscopes in order to reduce GPS limitations (signal perturbation and loss of signal).
- Work with hybrid technology (compass, IMU sensors and Wi-Fi) for allowing indoor navigation.
- Machine learning could be used for counting steps and detecting the way people walk in different situations.



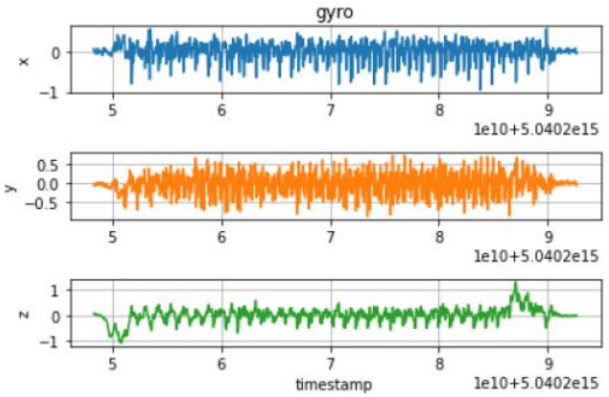
RSSI Wi-Fi



Compass



Accelerometers



Gyroscopes

University of Nebraska at Omaha

Analysis of Movement and Mobility Patterns for Health Assessment

October 5, 2021

Hesham H. Ali
UNO Bioinformatics Core Facility
College of Information Science and Technology

Hesham H. Ali, PhD

Background and Professional Experience:

- Professor of Computer Science, College of Information Science and Technology, University of Nebraska Omaha (UNO)
- Director of UNO Bioinformatics Core Facility
- Served as the Lee and Wilma Seemann Distinguished Dean of UNO College of Information Science and Technology between 2006 and 2021
- Published over 200 articles, books and book chapters in various IT areas including scheduling, distributed systems, data analytics, wireless networks, and Bioinformatics
- Has been leading a Research Group that focuses on developing innovative computational tools to analyze all health-related data with the goal of advancing next generation of biomedical research and contributing to the preventive and personalized healthcare initiatives

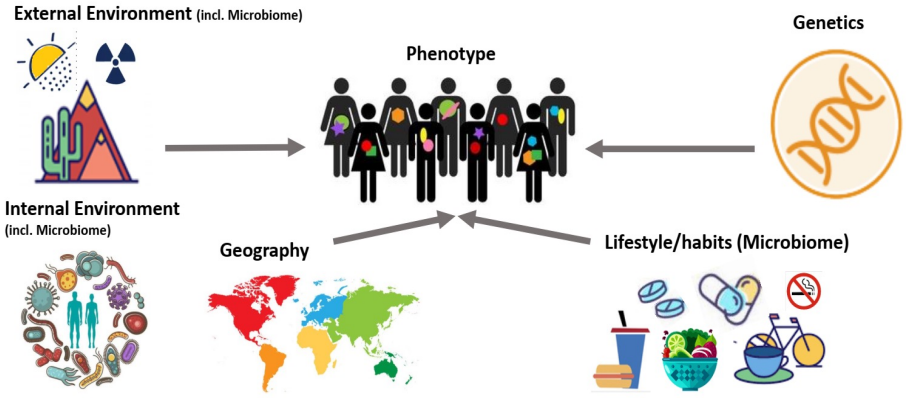
Panellist Position

Analysis of Movement and Mobility Patterns for Health Assessment

Hesham H. Ali, PhD, University of Nebraska Omaha,
hali@unomaha.edu

Summary of position:

- There are many factors that impacts our health
- The connection between movement and mobility to health has been well-established
- Habits, practices and lifestyle contribute in a big way to health and overall quality of life
- While active lifestyle positively affects heath, mobility data can also help in assessing health levels
- We need to analyze all available health related data with the goal of advancing next generation of biomedical research and contributing to the preventive and personalized healthcare initiatives.

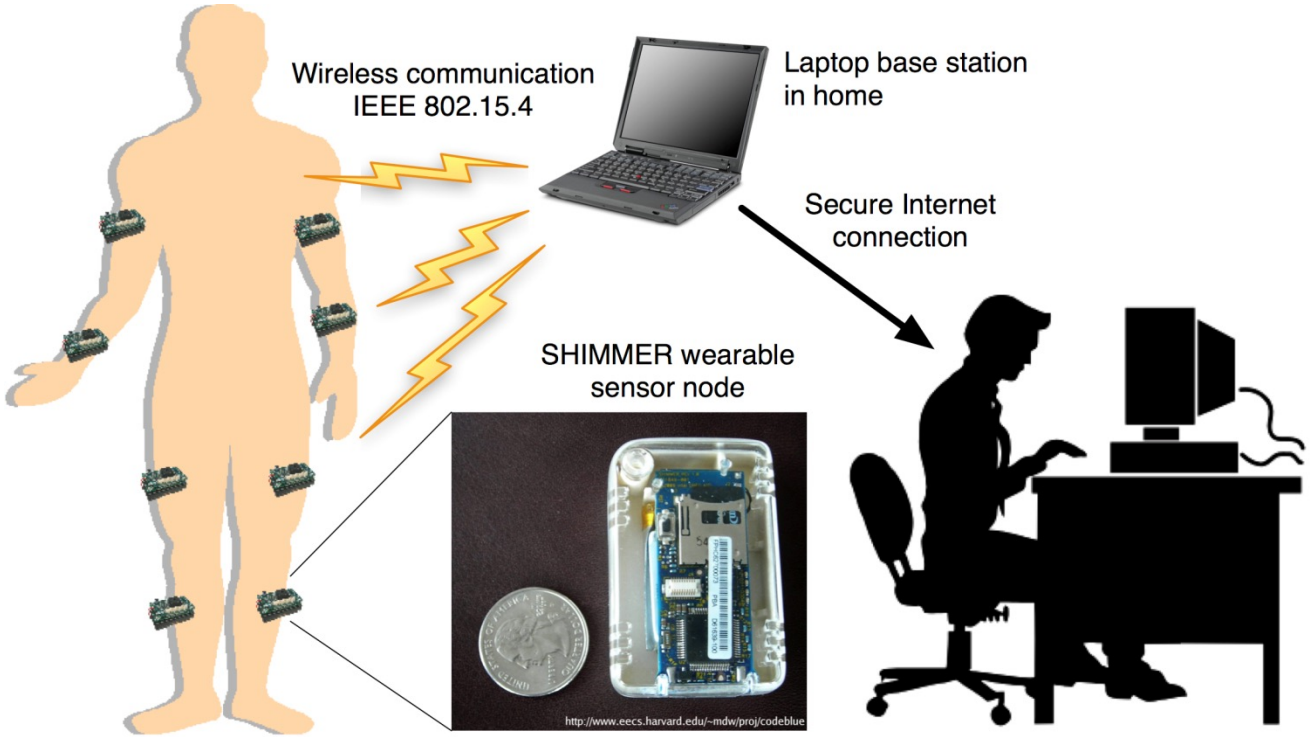


Mobility Applications in Health

- The explosive and widespread use of sensors and wearable devices
- Many studies connected the way people move to their health (physical and mental), safety concerns and overall states of people and environments
- We can collect and store mobility levels parameters
- Data Analytics, AI and machine learning are critical in extracting knowledge from mobility data

Wireless Sensors and Mobility Monitoring

- Inexpensive
- Comfortable
- High mobility
- Simple



http://fiji.eecs.harvard.edu/Mercury

Mobility Monitoring

- Availability of many large useful devices – focus on collecting relevant data
- Availability of numerous helpful software packages
- Lack of data integration and trendiness of the discipline
- Fragmented efforts by computational scientists and domain experts
- Lack of translational work – from the research domain to engineering and healthcare applications
- Increasing interest among researchers, industry and educators

How to Compare Mobility Patterns -Movement Words Coding Scheme

UNO BIOINFORMATICS

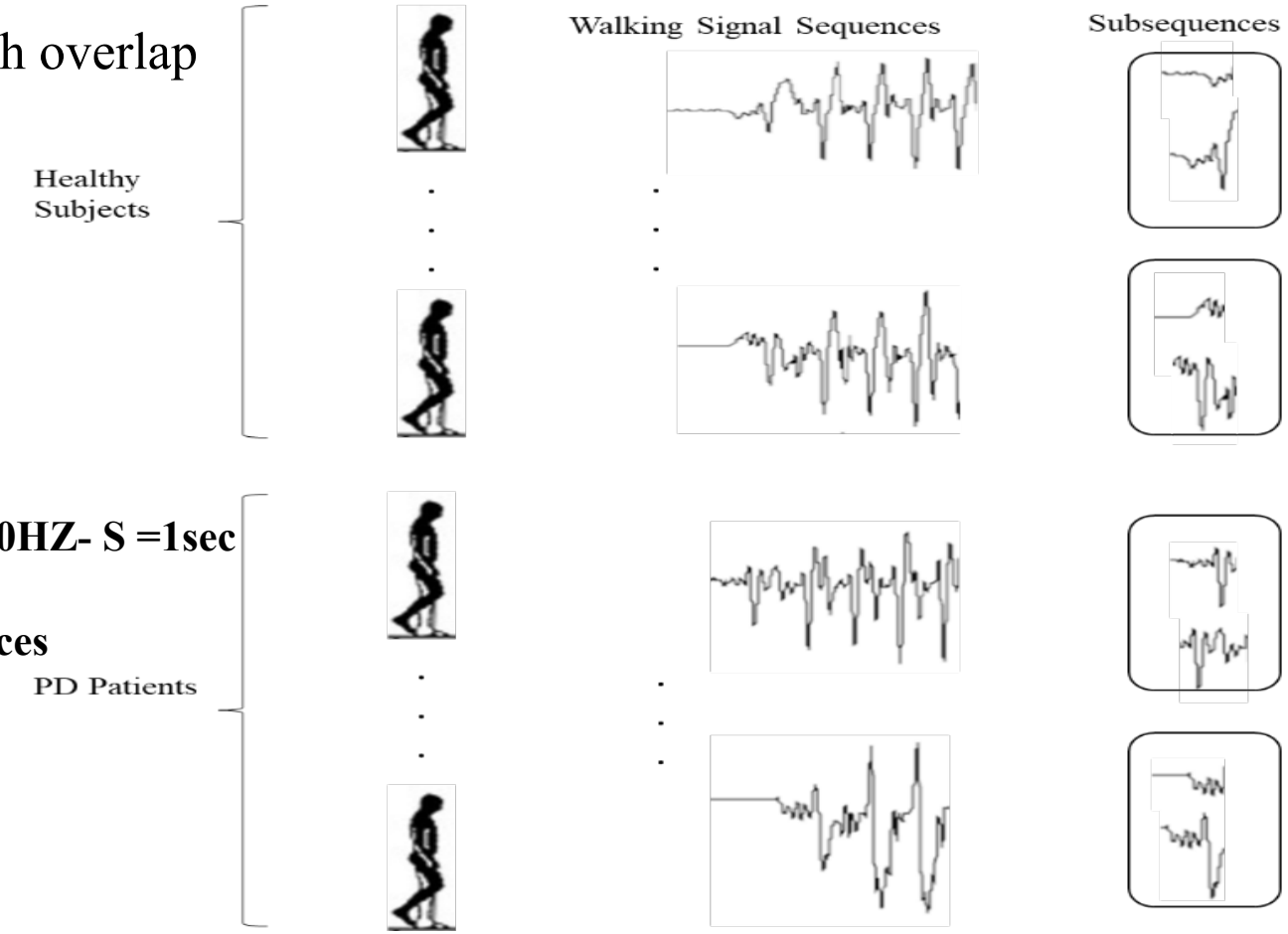
Generating Subsequences of Signal

Window Size = S sec with overlap

$$N = \sum_{i=1}^{n} 2 * \left(\frac{ti}{s}\right) - 1$$

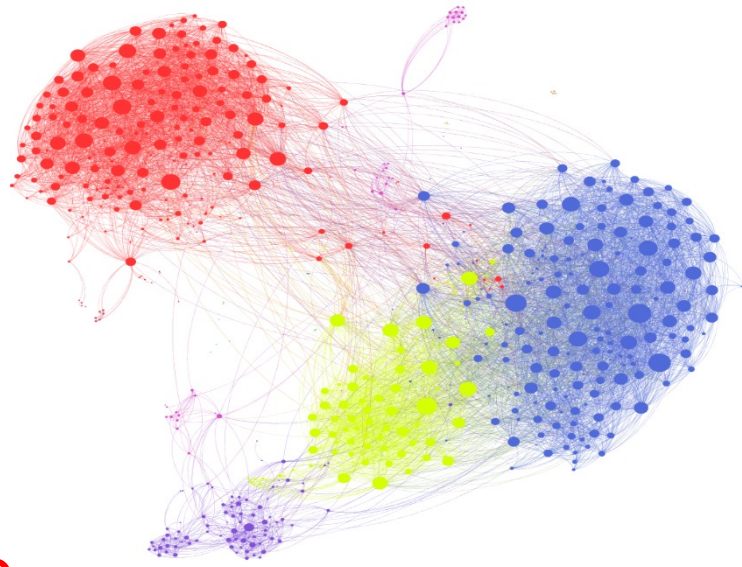
1 Person-1 Day- Frequency 100HZ- S =1sec

8,640,000 subsequences



Target Populations

- Parkinson's Disease
- Multiple Sclerosis
- Amyotrophic Lateral Sclerosis
- Huntington's disease
- Aging (Geriatrics)
- …
- Healthy Control (age-matched)



Dataset: Participants and Protocol (Ankle Data)

- Protocol:
  - 4 minute Walking (around the hospital)
  - Sampling frequency:100
  - **Moderate PD**

	Control	PD	Geriatrics
Number of subjects	5	5	5
Gender (M/F)	3:2	3:2	2:3
Age	64 ± 10	72 ± 6.3	81 ± 5.9
UPDRS III		20.8 ± 6.1	
H & Y		2.6 ± 0.5	

Dataset: Participants and Protocol (Wrist Data)

- Three phases of data collection (6-months period between each two phases)- One week of data per individual-per week
- Sampling frequency:100
- Mild, moderate, and sever PD (overall mild PD)

	Healthy young	Healthy elderlies	PD
Number of subjects	3	3	3
Gender (M/F)	2:1	1:2	1:2
Age	23 ± 3.6	65.3 ± 16.2	66 ± 5.0
UPDRS III		------	
H & Y		2.16 ± 0.88	

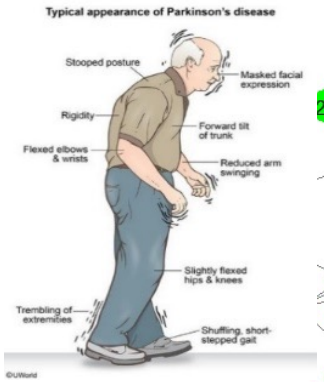
Selected Set of Features

Feature's Name	Description	Feature category
Variabiltiy_StrideTime	Variability of stride time	Signal level
Variability_SVM	Variability of vector magnitude	Signal level
Variability_RMSX	Variability of root mean square in the AP direction	Signal level
Variability_RMSZ	Variability of root mean square in the ML direction	Signal level
Velocity	velocity	Signal level
Smoothness_X	Smoothness in the AP direction	Signal level
Smoothness_Z	Smoothness in the ML direction	Signal level
RMSZR	Root mean square relative to the mean value in the ML direction	Stride level

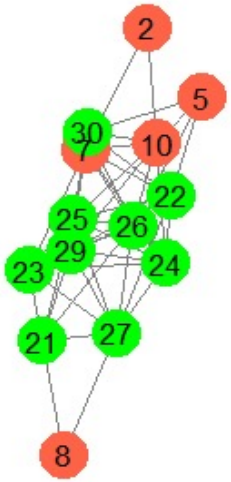
Modeling: Machine Learning

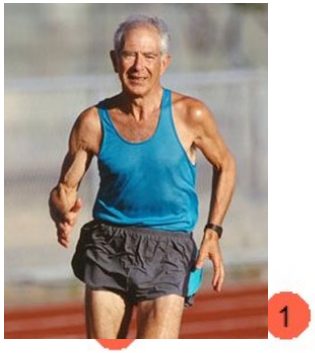
- **Standard Features:**
  - All features (32)
  - First reduced set of features (22)
    - Using Information Gain and Ranker methods
  - Second reduced set of features (8)
    - Using Pearson Correlation coefficient and ANOVA table
  - Third reduced set of features (7)
    - feature sets with one feature less than the optimal number of features
- **Document-of-Words Features:**
  - 10 Features for wrist data and 4 features for ankle data
- **Various Machine Learning Techniques:**
  - SVM, Random Forest, Naïve Bayes, AdaBoost, and bagging
- **Validation:**
  - K-Fold Cross validation
- **Accuracy measures:**
  - F-measure, Precision, Recall

Similarity Network Model – Wrist Data-Word Features

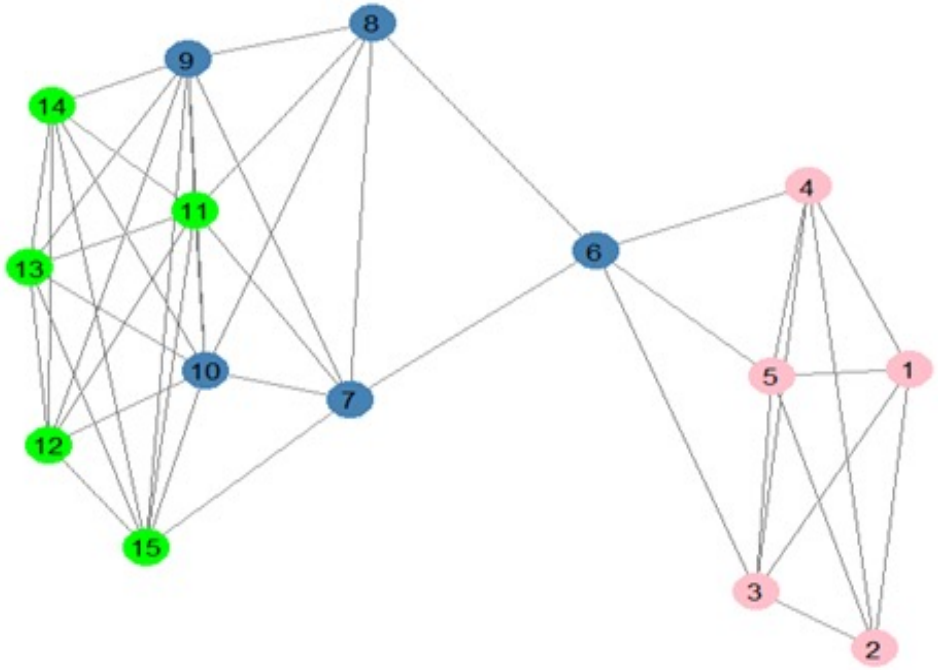


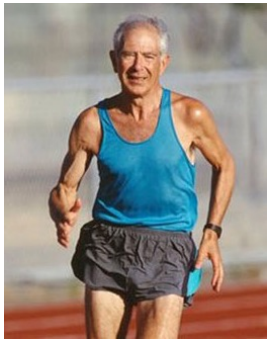
Similarity Network Model- Ankle Data (Mild PD) All Features



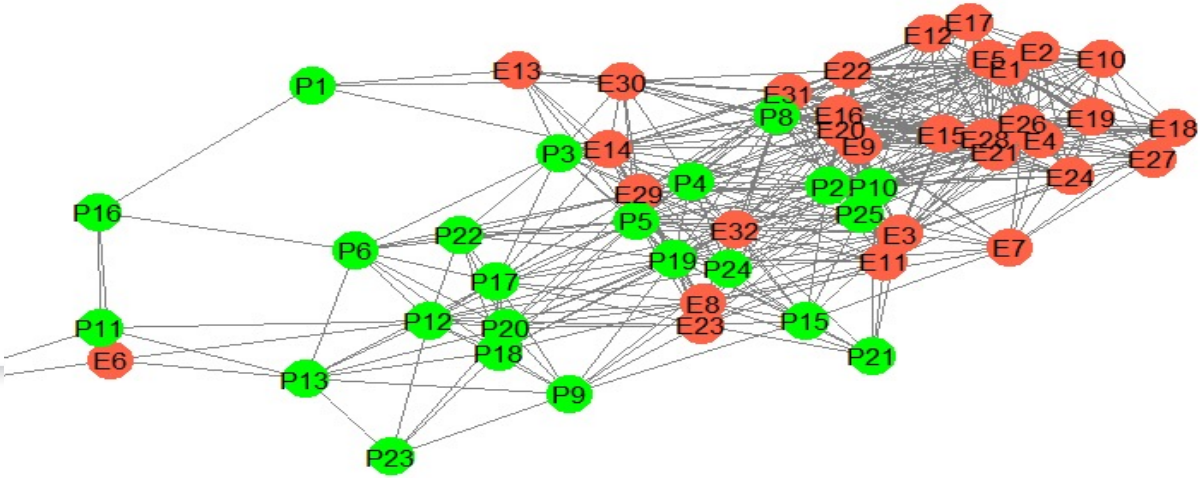


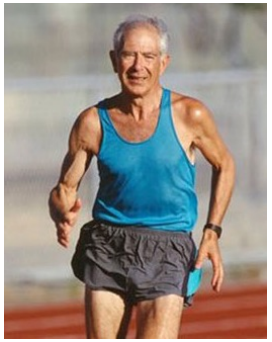
Similarity Network Model- Ankle Data (Moderate PD)-All Features





Similarity Network Model for the data from the first phase of wrist dataset- Threshold at **90%-** PD and HE





Subject	Gender	Age	MoCA	FoG	FAB	TUG	GDS	H&Y	MFES	Lawton
PD8	Male	69	28	2	39	6.7	0	1	10	8
PD10	Male	71	28	1	39	6.7	1	1	9.3	8
PD1	Male	83	26	8	39	11.2	0	1	8.6	8
PD21	Male	54	25	0	39	9.0	0	1	10	8

Post-operative Nursing Care

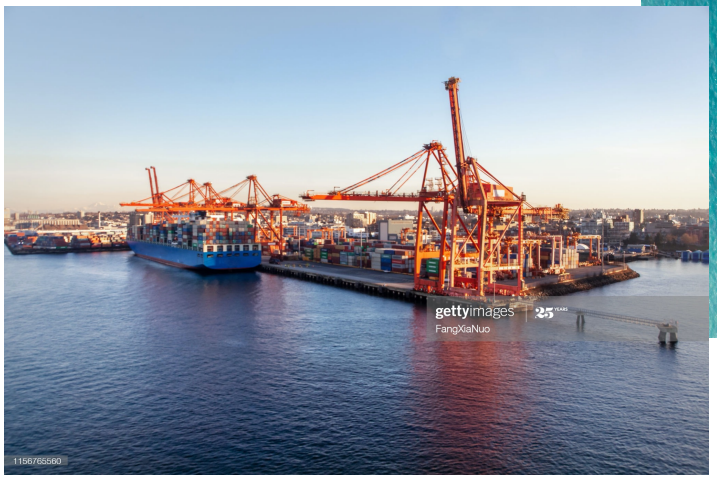
- A *post-operative* assessment is very important to a full and speedy *recovery from* any type of *surgery*.
  - a full assessment and an individualized treatment plan based upon the patient's needs and level of function, coupled with clinician expectations

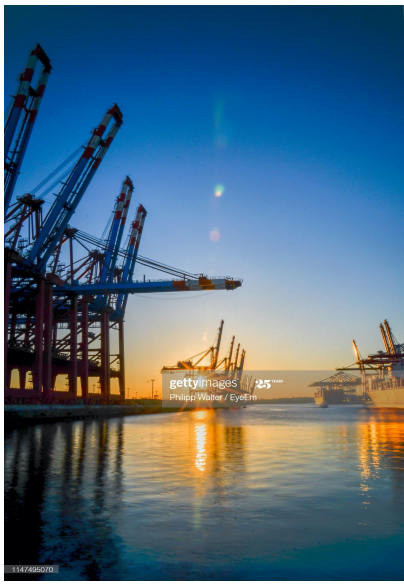
Applications for health subject: Physical therapy / Rehabilitation

- Help a patient perform rehabilitation exercises to improve their balance and mobility, and
- Find exercises that meet patient's specific needs and abilities.

Mobility in Ports and Marine Applications

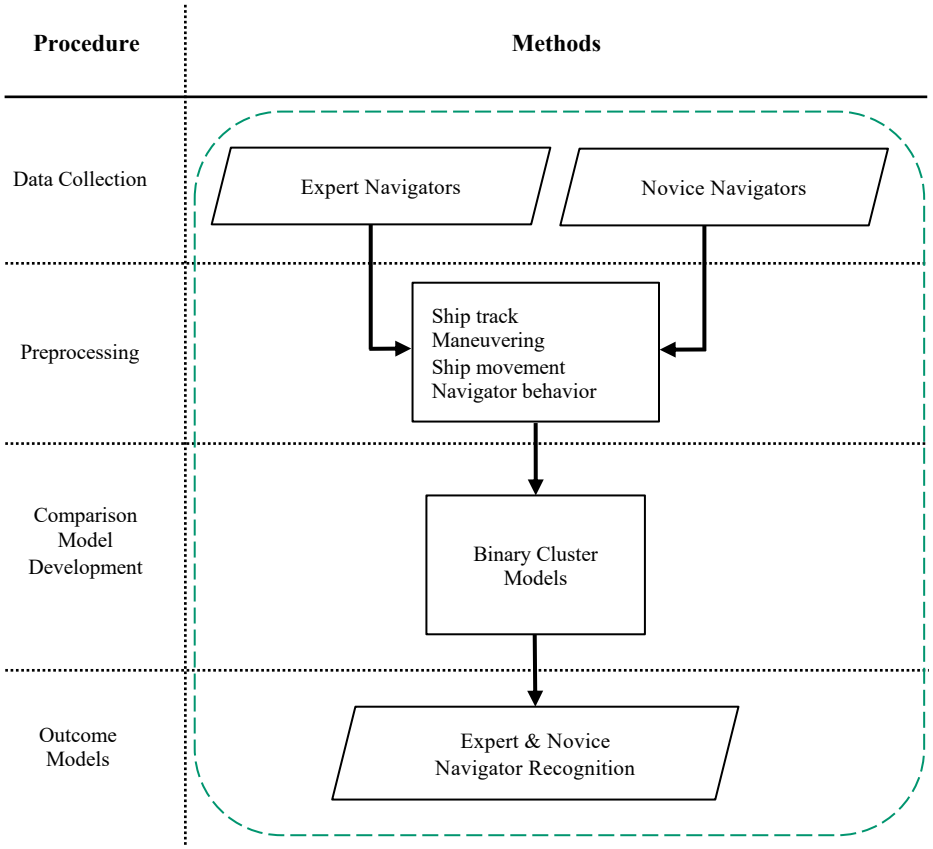
- Efficient movement in moving platforms represents additional challenges - proper assessment is completely missing in such applications
- Many critical functions in such environments depend on mobility parameters.
- Network models can be used to assess workers' ability to adjust to moving grounds.

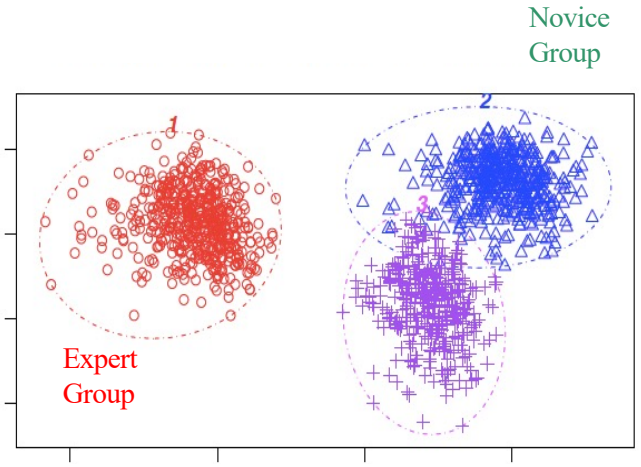


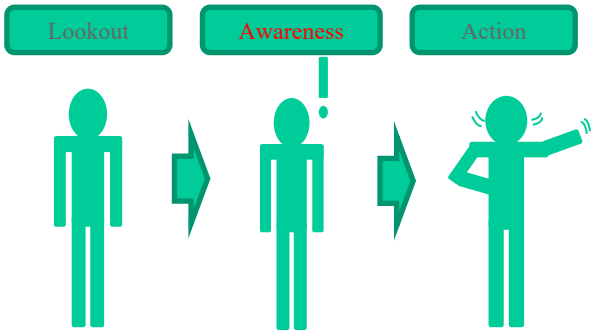


Expert & Novice Navigator Recognition

Explore the differences human behavior base on proficiencies







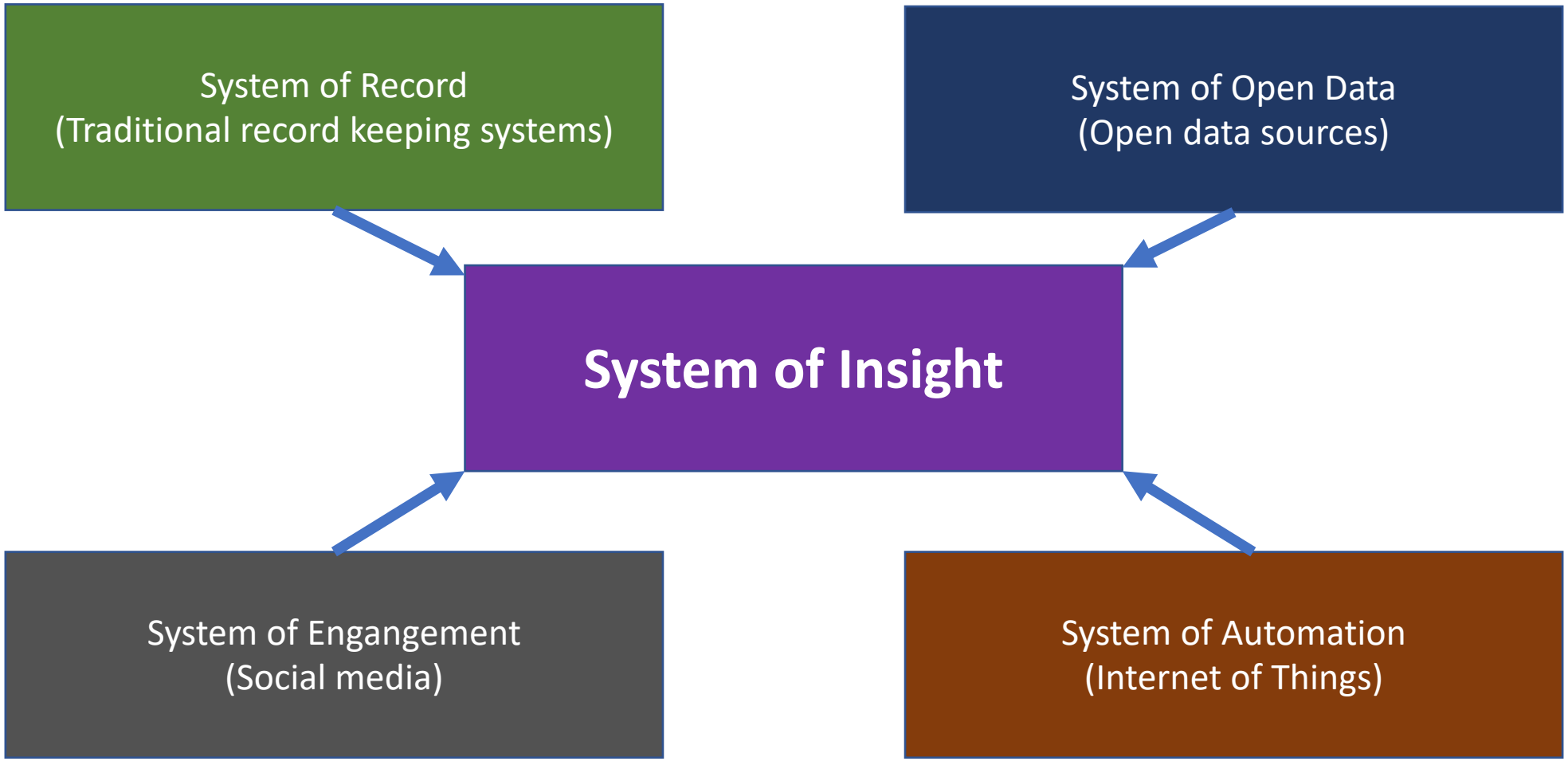
University of South-Eastern Norway

Mobile Health and Patient-empowering: Smart Solutions for Smart Cities and Living Environments Observations and Reflections

The Role of Data and Analytics

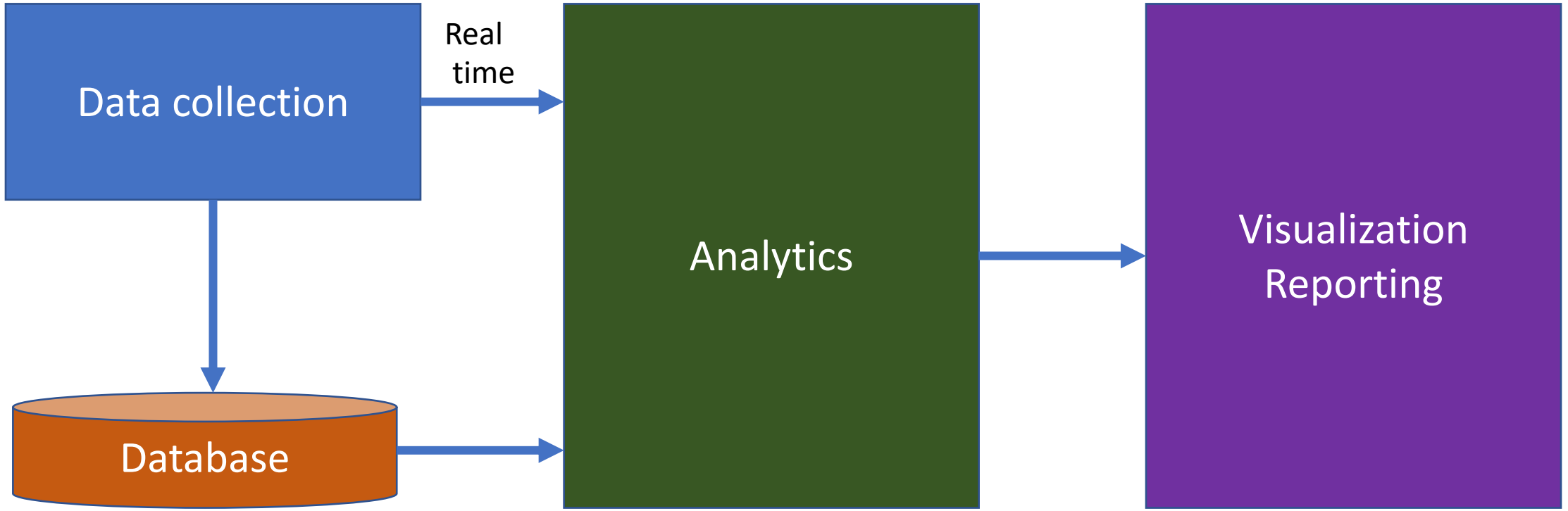
Lasse Berntzen
University of South-Eastern Norway
lasse.berntzen@usn.no

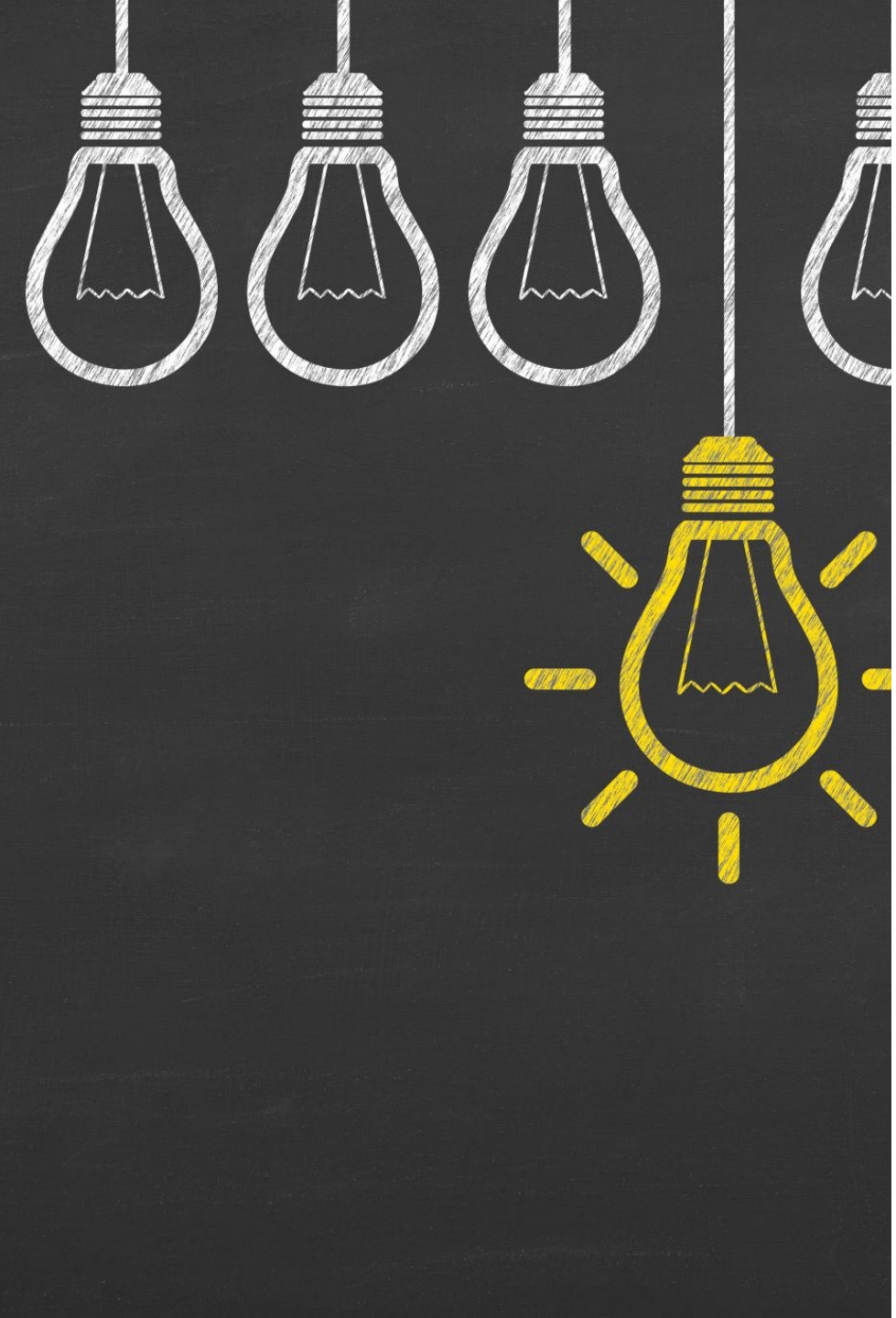
System of Insight



Inspired by the book Business Analytics – A Contemporary Approach by Thomas W. Jackson and Stevem Lockwood, macmillian international, 2018

It is the combination..

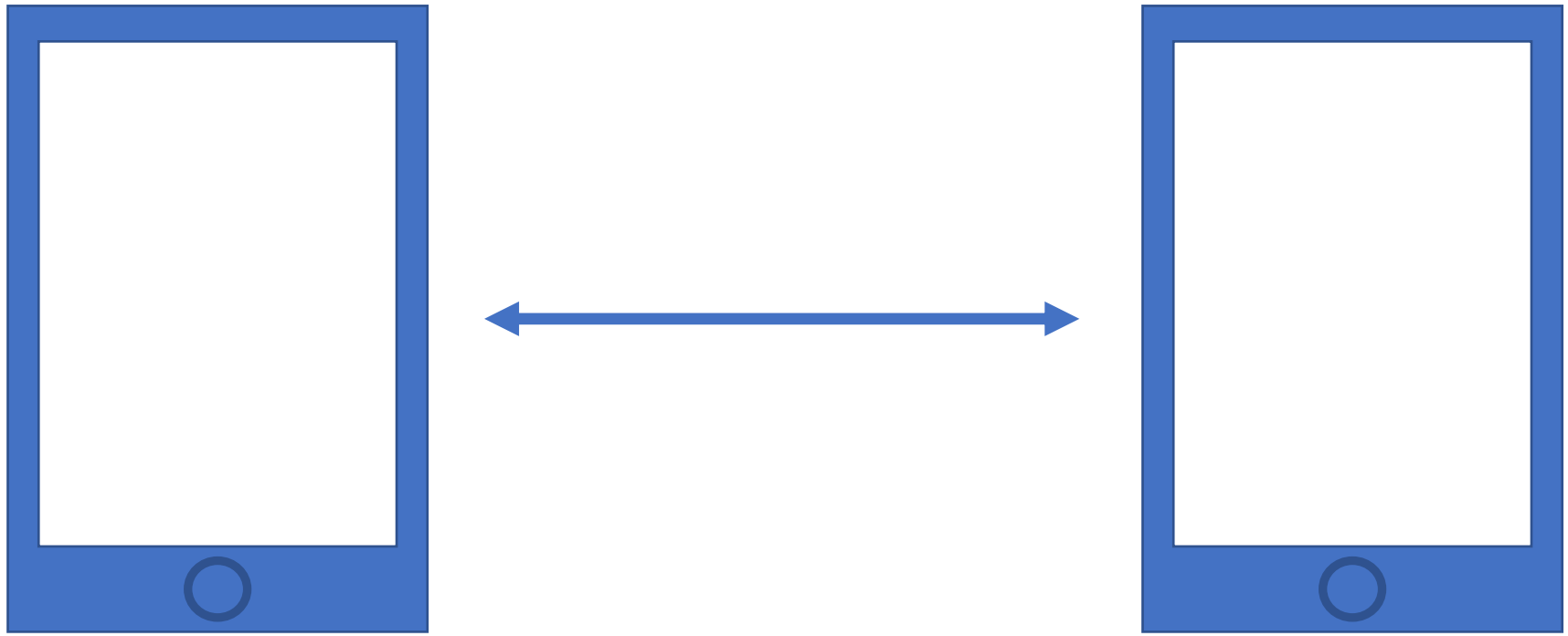


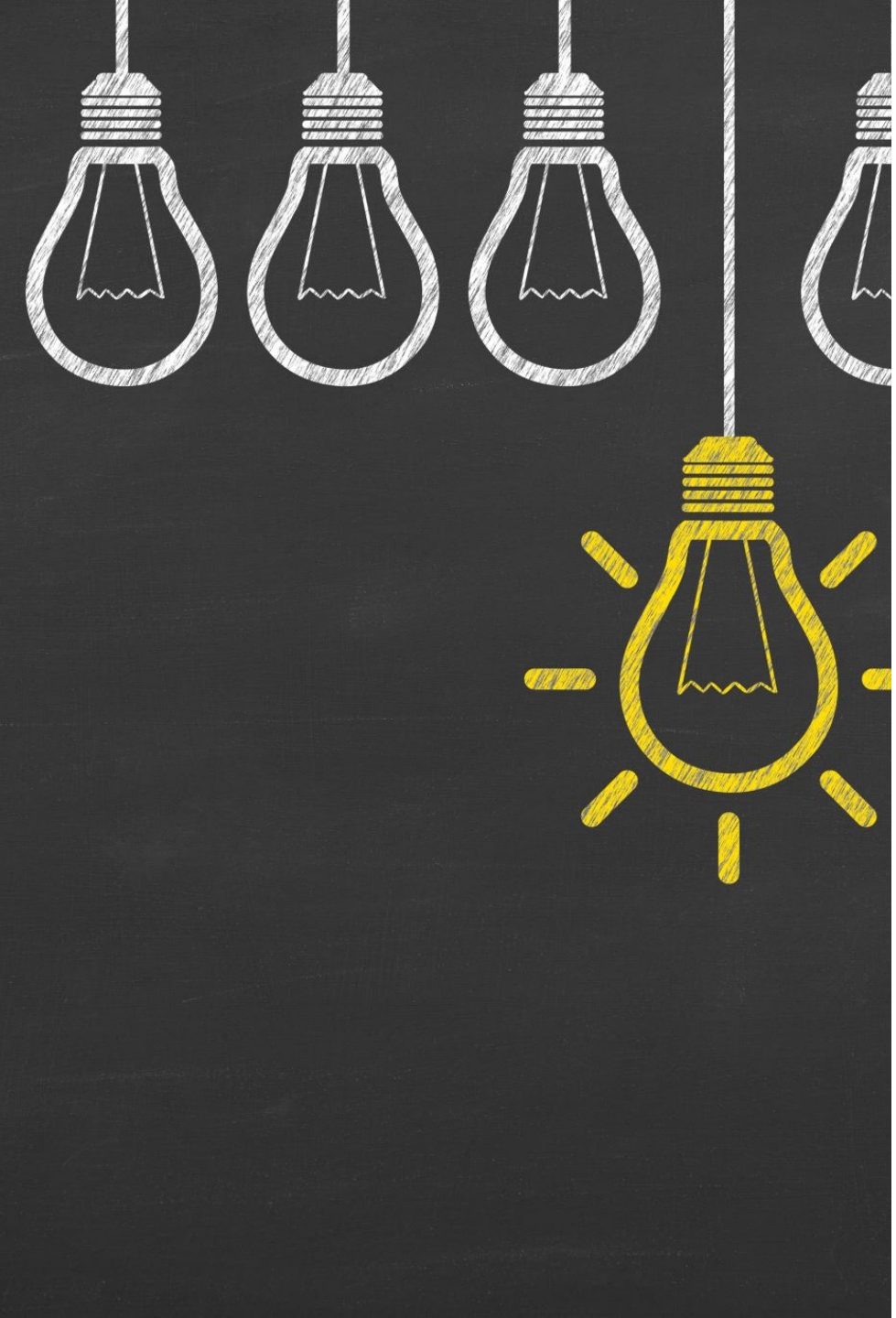


Observations and Reflections

- Marko: Self-care, social well-being, digital health platform, new service innovations.
  - Big data, AI, IoT,
- Andrea: Shared decision making
  - Explain and prersent options, AI
- Nitin: Covid-19 misinforation
  - How to ensure correct information, trust

Covid-19 relevance

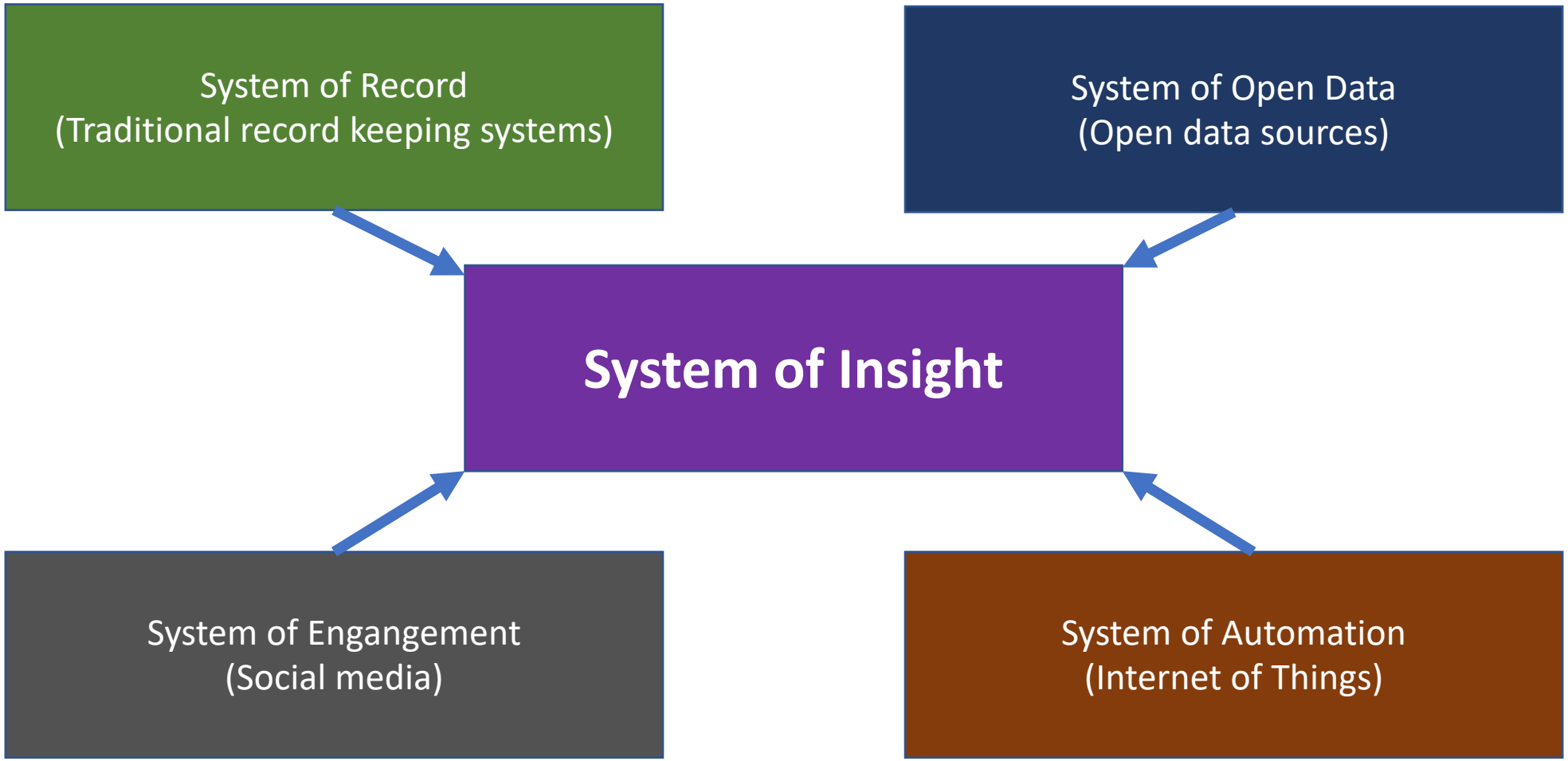




Observations and Reflections

- Michel: Reliability of medical devices
  - AI, Deep neural networks, visualization
- Jesus: Navi Campus
  - IoT, mobile, visualization
- Hesham: Movement and mobility patterns
  - Data analytics, AI, machine learning

System of Insight



Inspired by the book Business Analytics – A Contemporary Approach by Thomas W. Jackson and Stevem Lockwood, macmillian international, 2018