Open Research Day

9 April 2025

09:55-10:25

Parallel Sessions- *lightning talks followed by breakout session*

A108: Social AI

Chair: Associate Professor Iolanda Leite, KTH

A123: Transforming Education

Chair: Associate Professor Olga Viberg, KTH

A108: Social AI

- Lightning talk: Session chair: Associate Professor Iolanda Leite, KTH

1. Humanizing the Sustainable Smart City Extended – HiSSx (CI)
2. Advanced Intelligent Homes – AIH (CI)
3. XR Horizons: Unravelling Multi-User Interaction, Multisensory Experiences, and Ethical Considerations in the Realm of Spatial Computing (RP)
4. Data-driven Improvement of Work-Flows at the Karolinska University Hospital (SI)*

   Mediverse: Multimodal clinical exploration and predictive search on a single graph (Demo)*

**In the Breakout session both projects will be presented one after the other at Screen #4*

HiSSx

Humanizing the Sustainable Smart city eXtended

Project team

Marco Molinari
Researcher,
KTH ITM

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KTH EECS

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KTH EECS

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KTH EECS

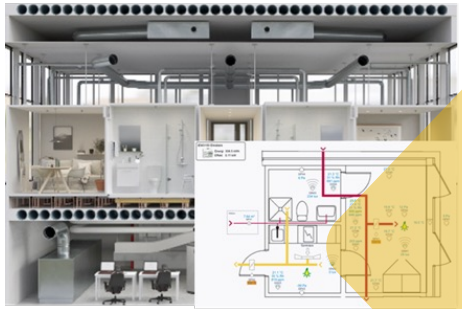
Cecilia Katzeff
Associate professor,
KTH ABE

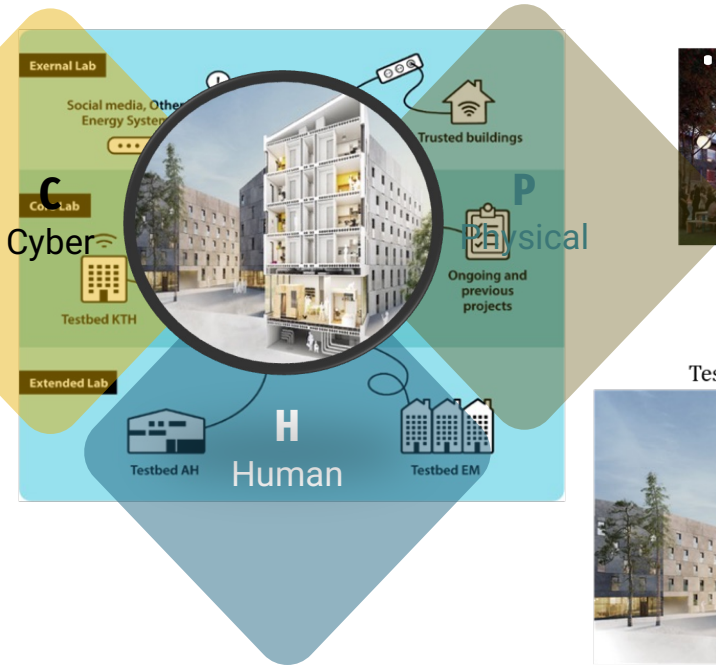
Mikael Skoglund
Professor,
KTH EECS

The path towards sustainability in smart cities

Living labs as complex CPH systems towards smart cities

Testbed KTH





Trusted buildings:
AH Draconis

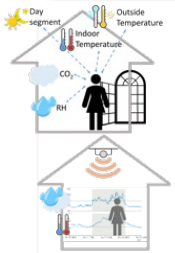
Testbed Akademiska Hus

Testbed Einar Matsson

CPH in practice: lessons learned from Live-In Lab experiments

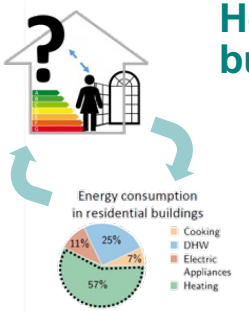
AIDA-B: AI-driven predictive maintenance for buildings (Einar Mattsson + KTH Seed Project)

Goal: Identify key drivers of building maintenance costs and develop accurate cost predictions



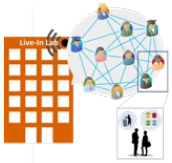
Interaction between building systems and building occupants' behaviors

Goal: Analyze and experiment with the real-world data collected from the KTH Live-In-Lab, exploring the complex interactions between the building systems and occupants' behaviors



How much are tenants influencing building energy consumption?

Goal: Study tenant behaviors w.r.t. windows operation. How does indoor air quality influence window opening-closing? How to integrate into future HVAC control systems?



How can sustainable behaviors diffuse within social groups in residential homes?

Goal: Longitudinal study to explore the dynamics of 17 sustainable behaviors. Can sustainable behaviors be diffused among tenants in the KTH Live-In Lab?

Smart homes in the sustainable energy system transition

- Identifying conflicts between ecological and social sustainability goals
- Digital energy solutions - challenges for trust and power relations in the home
- Field studies and design research to explore and visualize norms and power relations in the smart grid
- Empirical studies of homes with high level of smart home technology
- Critical design to form counter examples and elicit discussion
- Method development for participatory design of energy communities on equal grounds

Ehrnberger, K., Broms, L., & Katzeff, C.: Unleashing the Smart Killjoy. Interactions, In press, 2025

Thank you

Advanced Intelligent Homes – AIH (CI)

Name
Title, Affiliation

Adaptive Intelligent Homes (AIH)

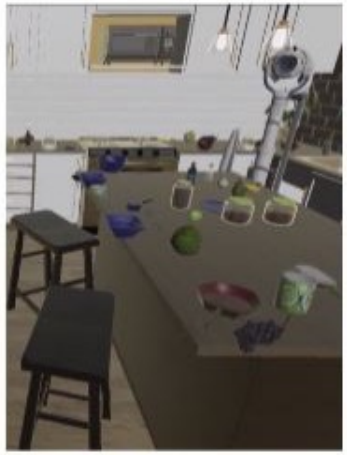
Presenter: Parag Khanna (Postdoc EECS/KTH)

PIs:
Iolanda Leite (EECS/KTH), Jonas Beskow (EECS/KTH),
Joakim Gustafson (EECS/KTH), Christian Smith (EECS/KTH),
Sanna Kuoppamäki (CBH/KTH) and Donald McMillan (DSV/SU)

About AIH

Conversational Interaction
Computer Supported Cooperative Work
Human-Robot Interaction

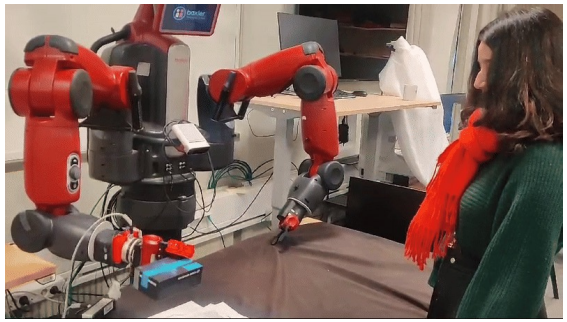
- Cross-disciplinary collaboration
- Integration of Dialog systems and Human-robot interaction for assisted cooking.
- Conversational agents, Gaze and Speech, Human-robot handovers




Adaptive Human-Robot Handovers

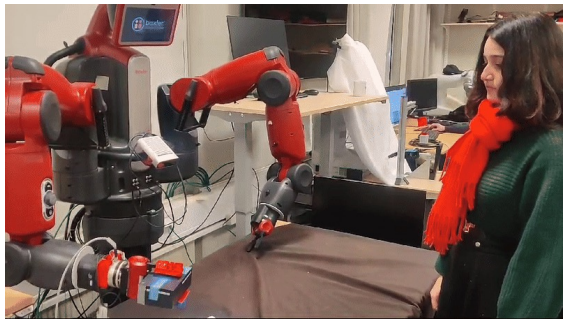
Learn from human-human handovers

- Impact of object weight on human motion. Reduced Acc. and Vel. With increased weight



- Predict weight change from human motion.

- Robot motion to convey weight change. Reduce velocity with increase in weight. Testing in experiments.



Adaptive Human-Robot Handovers

- Detecting Human intention for handovers:

  Does human want to give object to robot or place it next to the robot?

Adaptive Human-Robot Handovers

- Detecting Human intention for handovers:

  Does human want to give object to robot or place it next to the robot?

Adaptive Human-Robot Handovers

- Detecting Human intention for handovers:

  Does human want to give object to robot or place it next to the robot?

  Compared EEG brain signals, Gaze and Hand motion.

- Gaze is the best to tell which action is it!

  EEG can detect if the action will occur, 1.5sec before start of motor action.

Thank you

XR Horizons

Unravelling Multi-User Interaction, Multisensory Experiences, and Ethical Considerations in the Realm of Spatial Computing

Project team

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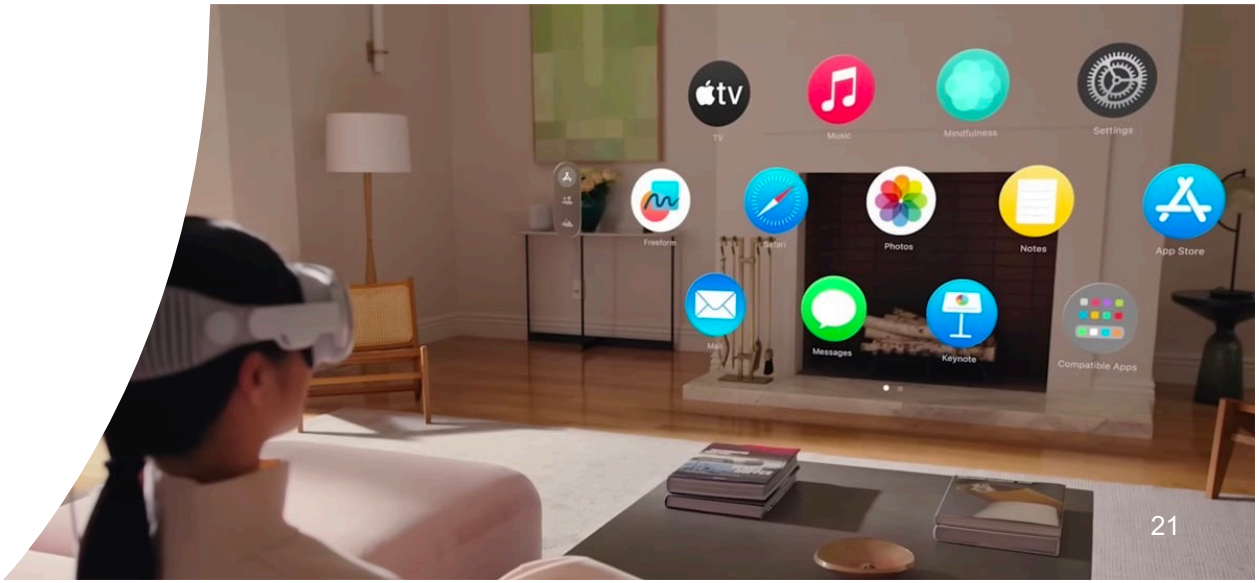
Research Motivation

Majority of existing XR experiences and solutions are limited to

- Individual
- Indoor
- Visual and auditory perceptions



Research Focus and Positioning

We focus on:

- Collaborative experiences
- Outdoors
- Adding haptics and sensations

Asreen Rostami, Kasper Karlgren, and Donald McMillan. 2022. Kintsugi VR: Designing with Fractured Objects. In Proc. IMX '22.

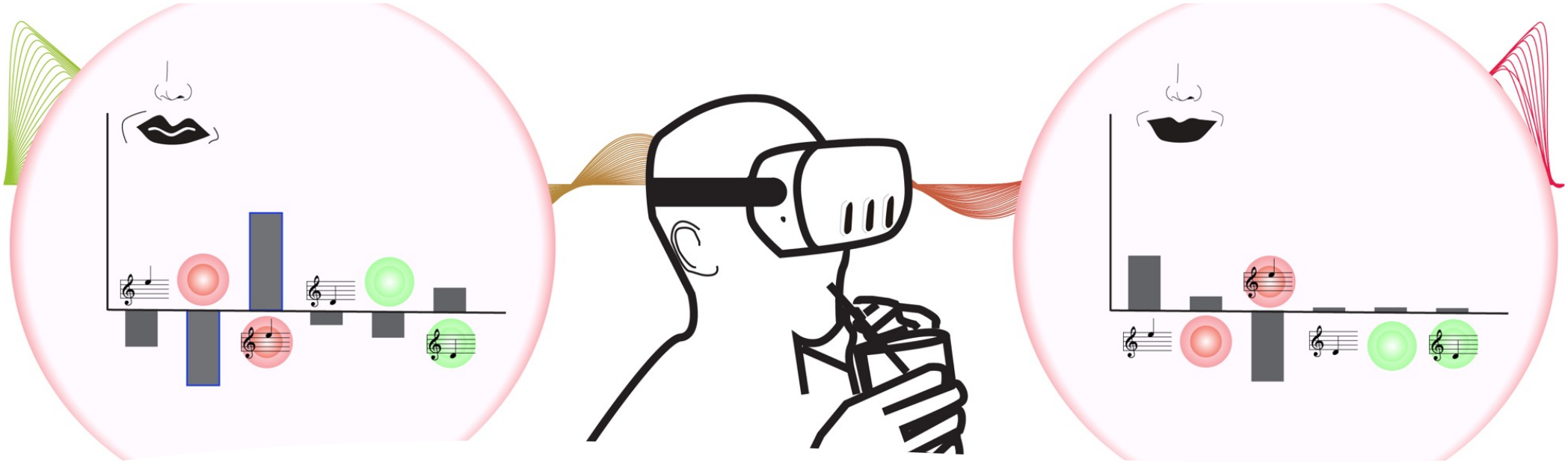
Andrii Matviienko, Hajris Hoxha, and Max Mühlhäuser. What does it mean to cycle in Virtual Reality? Exploring Cycling Fidelity and Control of VR Bicycle Simulators. In Proc.CHI '23

XR interaction for more than one user [Leader: RISE]

Multisensory individual XR experiences indoors and outdoors [Leader: KTH]

Ethical guidelines for interaction in Mixed Reality Environments

[Leaders: KTH and RISE]

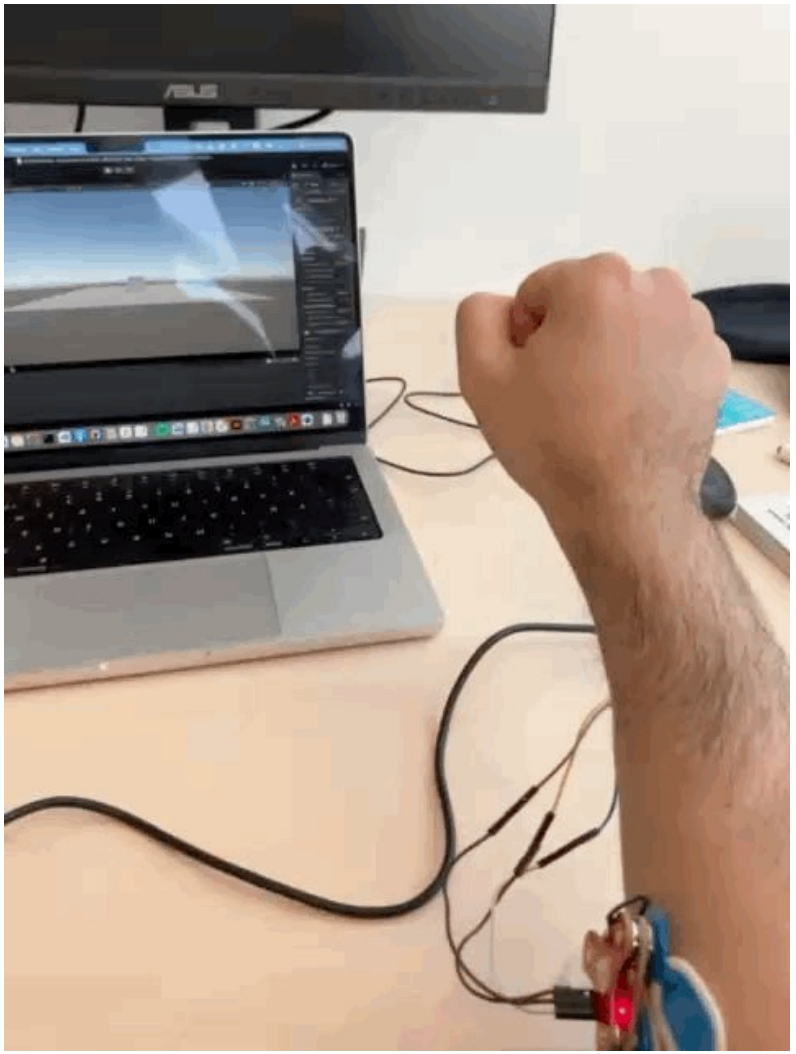


Taste Perception in XR

- The effects of audio and visual stimuli, and their interaction, on bitterness perception (left) and sweetness perception (right).
- Significant effects found for bitter taste are highlighted in blue.

Exploring EMG for UI Control

- Explore the potential for controlling UI elements
- Address challenges in sensor calibration, signal processing, and ergonomics.



Thank you

Data-driven Improvement of Work-Flows at Karolinska University Hospital

Jayanth Raghothama

KTH CBH

Problem

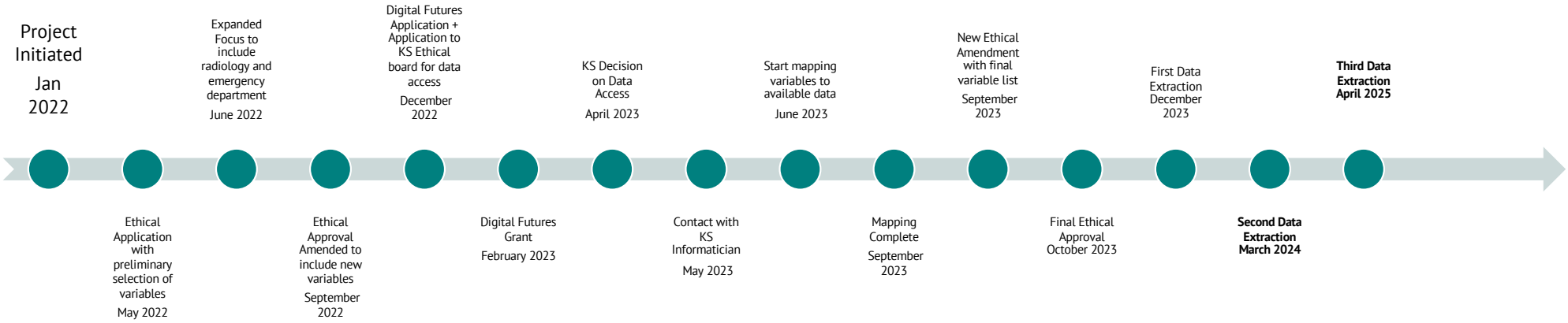
- Create a systemic basis for understanding and forecasting healthcare needs

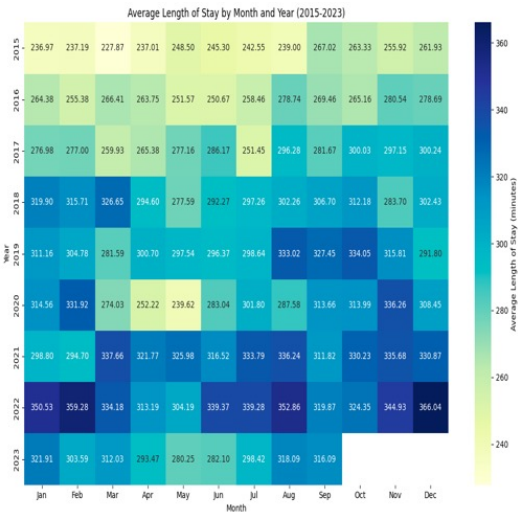
Methods

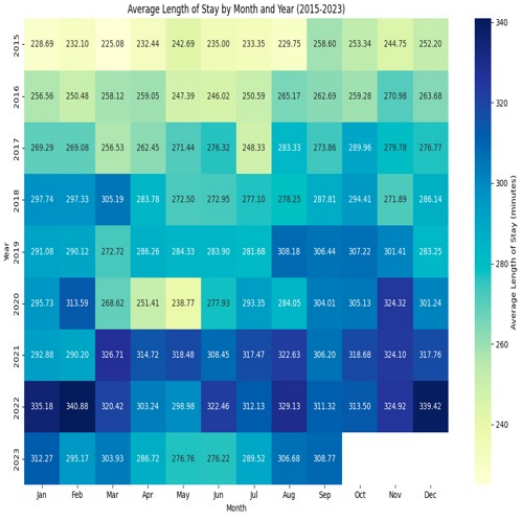
- Novel process mining and simulation approach combining machine learning, network analysis and simulation modelling

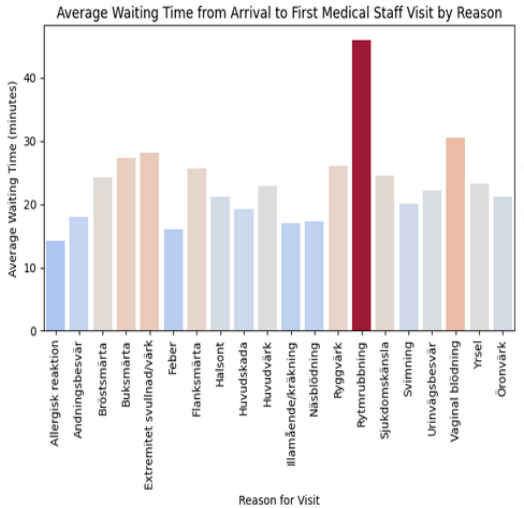
Impact

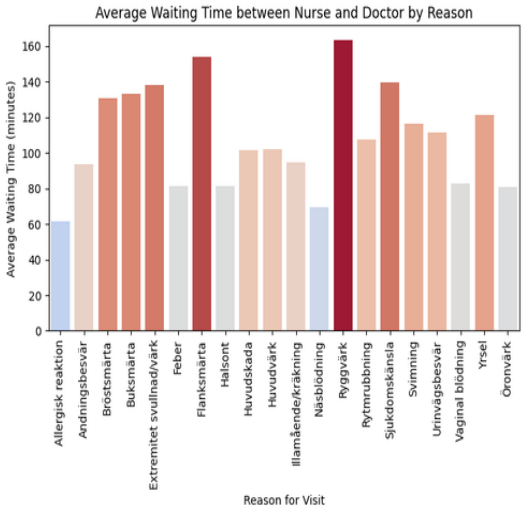
- Effective and efficient patient throughput and workflows.
- Reduced waiting and in-hospital times for patients.
- Reduced external staffing cost

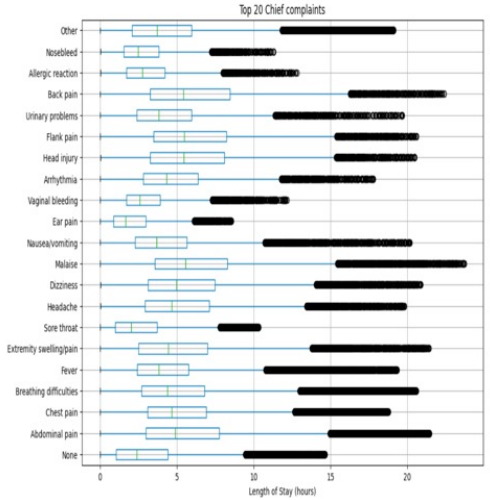


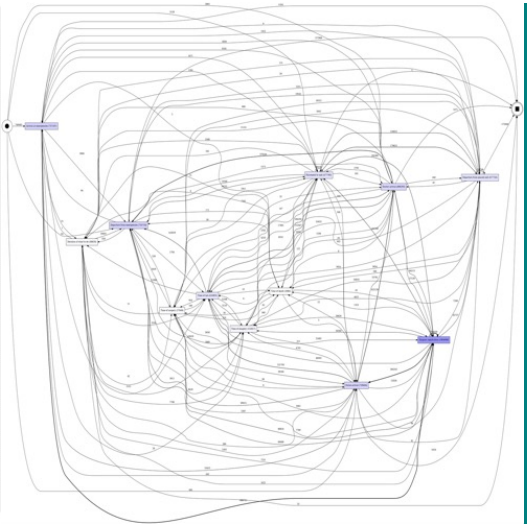












Preliminary Results

Next Steps

- Use Cases:
  - Investigate and reduce the number of scans needed for a set of diagnosis codes
  - Map ED processes
  - Map imaging modalities across complaints and diagnosis codes
- InfraVis
  - Use sequence and process mining and visualization for engagement with stakeholders
- Expansion into Akademiska Uppsala (fall prevention) and BUP

Thank you

Mediverse: Multimodal clinical exploration and predictive search on a single graph (Demo)

Name
Title, Affiliation

Mediverse

Multimodal clinical exploration and search on a single graph

Jayanth Raghothama

KTH CBH

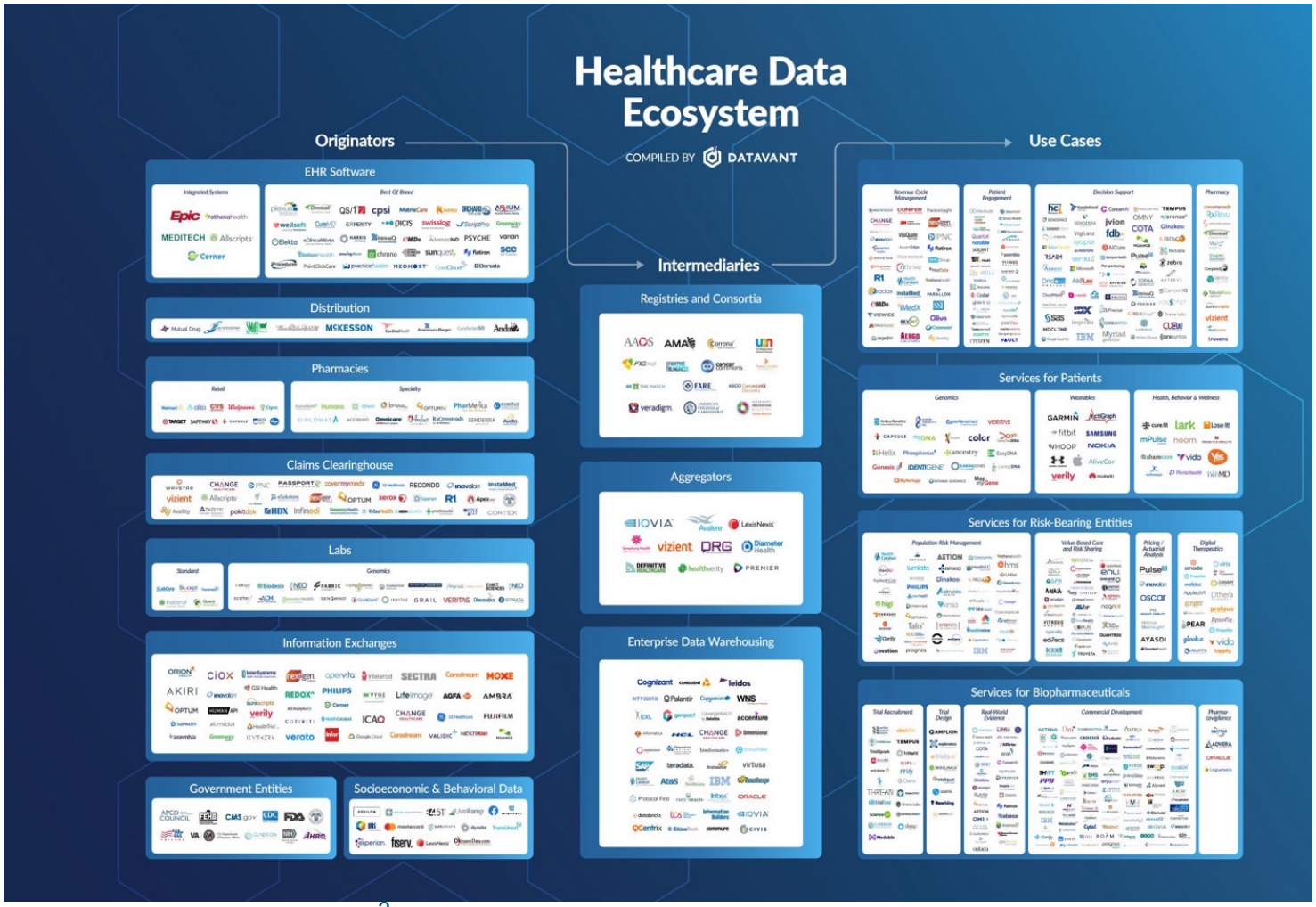
Healthcare Data is Siloed

This hinders progress in medical and health research

- Healthcare practice is heterogeneous and contextual.
- Standardisation helps, but no standard covers everything.

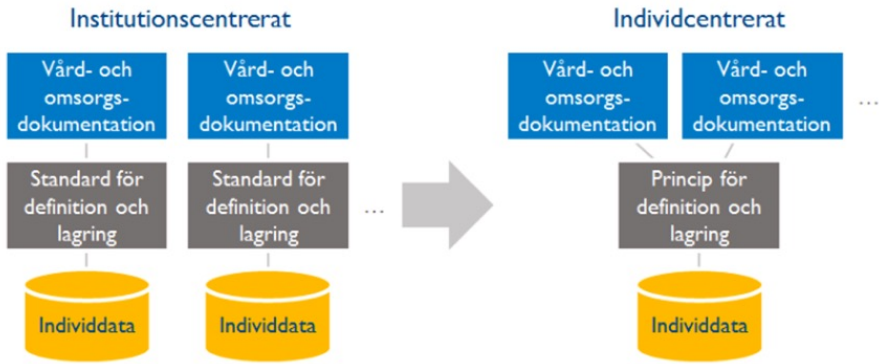
- **Within EU**: EHDS, AI Act and MDR regulations change legal landscape
  - *primary vs secondary use*

- **SotA**: major investments in data infrastructures. 1+MG, EU-CAIM, TEF Health, few OLOG and OMOP approaches, HDABs



Source: Medium.com, Travis May

Strategic Focus in Sweden



- National government has many on-going policy investigations in parallel

data integration, security, and responsible use of AI are high-priority issues for the Swedish government.

Sebastiaan Meijer

Digitalisering

Här är utredningarna att hålla koll på inom e-hälsa

E-hälsa och digitaliseringen av vård, omsorg och socialtjänst är ett område som får betydande utredningsresurser inom välfärdssektorn. Vi ger dig överblicken över pågående utredningar.

Statliga uppdrag

1 Nationell samordnare för digital infrastruktur i hälso- och sjukvården
Särskild utredare: Tomas Werngren, tidigare vd för Kommuninvest.
Redovisning av uppdraget: Delbetänkande senast den 1 maj 2024. Slutredovisas senast den 1 januari 2026.

Tomas Werngren bistår regeringen i det pågående arbetet med den nationella digitala infrastrukturen som ska tillgängliggöra hälsodata i hela vårdkedjan, oavsett huvudman. Utredaren har två huvuduppgifter: att informera om regeringens arbete och att förbereda för ett införande av infrastrukturen i nära dialog med aktörer som kommuner, regioner, patientföreträdare samt privata utförare av hälso- och sjukvård och tandvård.

2 Göra hälsodata nationellt tillgänglig i hela vårdkedjan
Utredare: Mats Nilsson, avdelningschef, Forte.
Redovisning av uppdraget: Delredovisningar senast den 31 mars 2024 och den 1 juni 2024. Slutredovisas senast den 22 januari 2026.

Uppdraget är inriktat på att analysera de rättsliga förutsättningarna för att tillgängliggöra patienters hälsodata, som journalanteckningar, genom hela vårdkedjan oberoende av vilken vårdgivare som registrerat uppgifterna. Utredningen ska lämna förslag som tar hänsyn till den planerade EU-lagstiftningen om ett europeiskt hälsodataområde (EHDS).

3 Hälsodata för bättre uppföljning av hälso- och sjukvården
Särskild utredare: Ingela Alverfors, jurist.
Redovisning av uppdraget: Senast den 30 juni 2024.

Utredningen ska föreslå ändamålsenliga regler, som ökar förutsättningarna för att förbättra hälso- och sjukvården med hjälp av uppföljning baserad på hälsodata.

4 Utvecklingspotentialen för nationella läkemedelslistan (NLL)
Utredare: Sofia Wallström, generaldirektör på Inspektionen för vård och omsorg.
Redovisning av uppdraget: Senast den 14 februari 2025.

Utredningen ser över möjligheterna att utveckla registret nationell läkemedelslista (NLL).

5 Infrastruktur för hälsodata som nationellt intresse
Särskild utredare: Annemieke Ålenius, avdelningschef på E-hälsomyndigheten.
Redovisning av uppdraget: Delbetänkande 7 december 2023 (SOU 2023:83). Slutbetänkande 30 april 2024.

Utredningens förslag ska skapa bättre och säkrare informationsförsörjning av hälsodata mellan system och aktörer. Målet är ökad patientsäkerhet, mer patientcentrerad vård och minskat administrativt dubbelarbete för vårdpersonal. Förslagen ska även ge förutsättningar för utveckling av medicinska behandlingar, arbetssätt och hälsofrämjande preventiva insatser.

Tomas Werngren, särskild utredare. Foto: Jeanette Dahlström / Bildbyrån

Mats Nilsson, utredare. Foto: Rickard L Eriksson

Sofia Wallström, utredare. Foto: Jessica Gow/TT

Annemieke Ålenius, utredare. Foto: E-hälsomyndigheten

6 Statlig e-legitimation på högsta tillitsnivå
Utredare: Henrik Ardhede, rådman.
Redovisning av uppdraget: Delredovisning i oktober 2023. Slutredovisning senast den 31 maj 2024.

Utredningen ska bland annat föreslå hur en digital identitetsplånbok kan utfärdas.

Myndighetsuppdrag i urval

7 Öka tillgång till hälsodata för forskning
Utredare: Socialstyrelsen.
Redovisning av uppdraget: Senast den 30 juni 2025.

8 Färdplan för nationell digital infrastruktur för hälso- och sjukvården
Utredare: E-hälsomyndigheten.
Redovisning av uppdraget: Delredovisning 29 september 2023. Slutredovisning 31 mars 2024.

9 Infrastruktur för ett nationellt vårdsöksystem
Utredare: E-hälsomyndigheten.
Redovisning av uppdraget: Delredovisning den 31 oktober 2023 och slutrapport den 31 mars 2025.

10 Nationell katalog över vårdgivare och utförare av socialtjänst
Utredare: E-hälsomyndigheten.
Redovisning av uppdraget: Delredovisning december 2023 och den 30 juni 2024. En första release av tjänsten ska vara klar senast den 30 april 2025.

11 Automatisk informationsöverföring till nationella kvalitetsregister
Utredare: E-hälsomyndigheten.
Redovisning av uppdraget: Senast den 31 oktober 2024

▶ Utöver dessa hanteras inom Regeringskansliet för närvarande resultaten av utredaren Katarina Nyströms utredning om sekundäranvändning av hälsodata, Catrina Andersson Forsmans om e-recept och patientöversikter inom EES och Sverige samt Björn Eriksson utredning om effektiv och behovsbaserad digital vård.

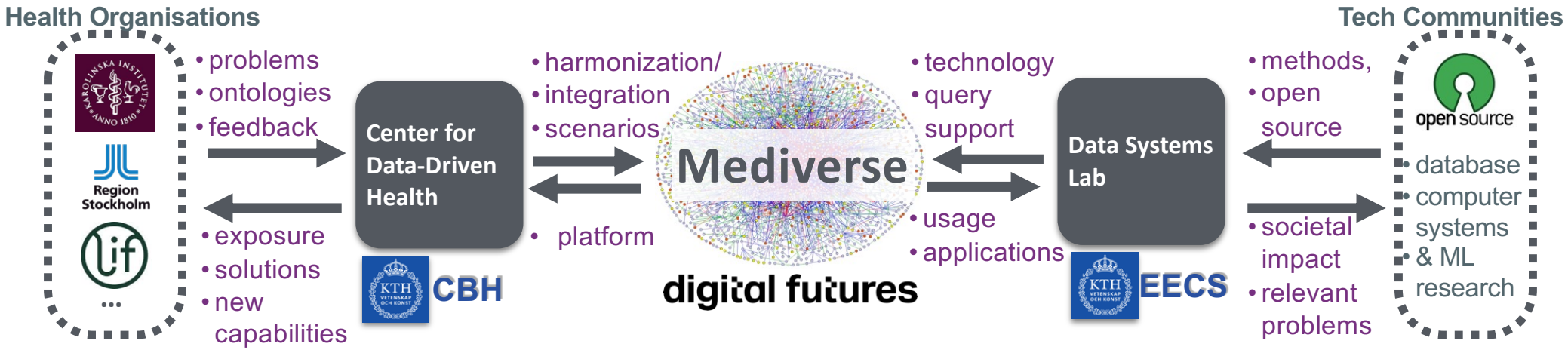
Jonny Sågänger
jonny.saganger@bbm.bonnier.se

Objectives

With **Mediverse** we aim to develop and demonstrate an **automated medical data platform** that will:

- **O1.** Enable native data harmonization across modalities and clinics
- **O2.** Facilitate multi-modal, cross-site predictive analyses and studies
- **O3.** Allow for tunable inference via uncertainty estimation and calibration techniques

Mediverse - An Overview



Ontological Graph Harmonization (O1)

1. **Semantic Link Creation**:

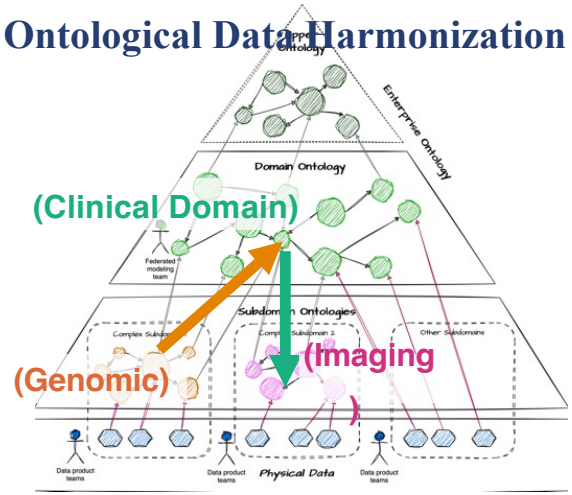
• Leverage existing ontologies (e.g., SNOMED CT, OMOP) and use tools like COMA and CUPID for dynamic mapping tailored to each use case.

2. **Meta-Ontology Framework**:

• Develop a meta-ontology to connect diverse standards, creating semantic links without requiring full data standardization.

3. **Adaptive Harmonization Strategy**:

• Use a flexible, case-by-case approach, aided by Graph Neural Networks (GNNs), to predict and bridge missing links in the data.




```
MATCH (patient:Patient)-[:HAS_MUTATION]
      ->(mutation:GenomicFeature { ID:'MGMT'})
MATCH (mutation)-[:ASSOCIATED_WITH]->(effect:DrugResistance)
MATCH (patient)-[:RECEIVED_TREATMENT]
      ->(therapy:Treatment { name: 'Targeted Therapy'})
MATCH (patient)-[:UNDERWENT_IMAGING]->(mri:MRI_Scan)
WHERE mri.result = 'Tumor Shrinkage'
```

Multi-Modal Predictive Studies with tunable uncertainty (O2,O3)

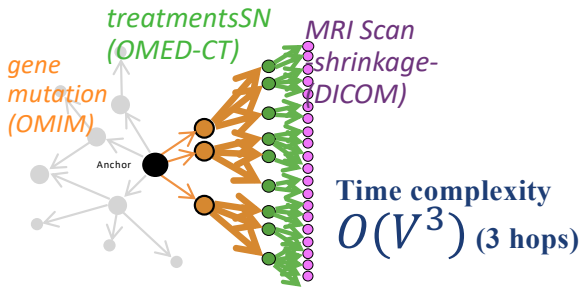
1. **Integrated Multi-Modal Analysis**: Combine genomic, clinical, and imaging data to perform cross-modality predictions, enabling comprehensive patient insights.

2. **Graph Neural Networks (GNNs)**: model complex relationships and dependencies between different data modalities, improving predictive accuracy.

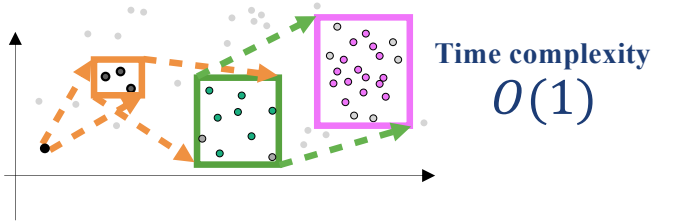
3. **Uncertainty Estimation Methods**: Implement **tunable uncertainty estimation** using methods like Conformal Prediction and Venn Predictors to provide confidence intervals for predictions

4. **Adaptive Prediction Mechanism:** Allow clinicians to adjust the uncertainty level to balance prediction confidence with risk tolerance in medical decisions. Enable real-time adjustment of predictive models based on new data, ensuring predictions remain relevant and accurate as patient information evolves.

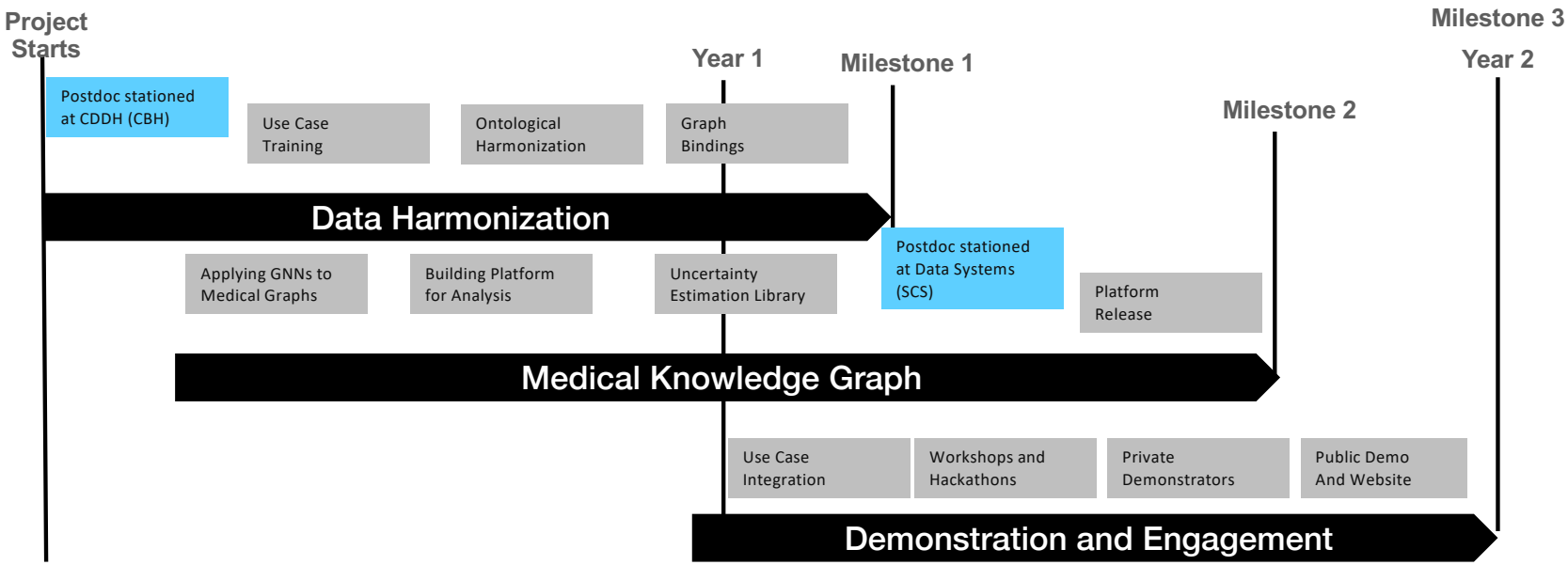
Multi-modal Graph Query Search



Predictive Search via Representation-Learning (Query2Box)



Roadmap: Cross-Clinic Data Integration



- **M1**: Harmonization Solution: Graph Representation and Terminology Bindings.
- **M2**: Platform for Multi-Modal Analysis and Uncertainty Estimation.
- **M3**: Demonstrations, Stakeholder Engagement, and Public Data Portal.

Clinical Impact – Current use cases

Predicting Mental Health Outcomes:

• **Scenario**: Combine data from psychiatric assessments, genetic markers, and neuroimaging studies to predict the likelihood of relapse in patients with severe mental health conditions.

• **Impact**: Assist mental health professionals about potential risk factors and help tailor long-term care plans to minimize relapses.

- **Data sources:** BUP Stockholm, Psykiatri Sydväst, KI (NVS)

Joint Treatments during Clinical Trials within CVD (KS):

• **Scenario**: Combine genetic and clinical data to cluster/group patients

• **Impact**: Implement optimised joint treatment and increase throughput

- **Data Sources**:Lp(a) cohort

Team Composition

Sebastiaan Meijer
Prof

Jayanth Raghothama
Assoc Prof

New Postdoc: Andra Ionescu

Paris Carbone
Assoc Prof

Sonia Horchidan
PhD Candidate

Frida Lindberg
Health Care collaboration manager

Amanuensis

Mediverse

Multimodal clinical exploration and search on a single graph

Thank you

digital futures

PARTNERS