

Flanders AI Research Program

Prof. Dr. Bart De Moor

KU Leuven, Belgium

Bart.DeMoor@esat.kuleuven.be

imec
embracing a better life

**FLANDERS
MAKE**

siris
shaping reality by technology

VIB

vito

KU LEUVEN

**GHENT
UNIVERSITY**

VUB
Vrije Universiteit
BRUSSEL

**University
of Antwerp**

UHASSELT

.AGORIA

VOKE
Vlaams
netwerk van
ondernemingen

**AGENTSCHAP
INNOVEREN &
ONDERNEMEN**

**DEPARTEMENT
ECONOMIE
WETENSCHAP &
INNOVATIE**

**Flanders
State of
the Art**

AI FLANDERS
BUILDING OUR DIGITAL FUTURE



AI FLANDERS

BUILDING OUR DIGITAL FUTURE



1 FLANDERS AI RESEARCH PROGRAM

2 FLANDERS AI IMPLEMENTATION PROGRAM

3 FLANDERS AI SUPPORTING ACTIVITIES:
ETHICS, EDUCATION AND TRAINING

Annual budget

12 Mio €

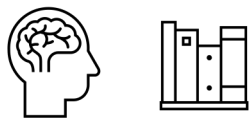
15 Mio €

5 Mio €



1

RESEARCH



Flanders AI
Research Program

www.flandersairesearch.be

Director: Sabine Demey, imec

2

IMPLEMENTATION



www.digitaletekomst.be

(Site in Dutch, for companies)

3

SUPPORTING Activities



Education &
Training



Vlaamse AI Academie
www.vaia.be



Citizen
Projects



Ethical & Legal



data-en-maatschappij.ai/en



DEPARTMENT OF
ECONOMY
SCIENCE &
INNOVATION



AGENTSCHAP
INNOVEREN &
ONDERNEMEN



DEPARTMENT OF
ECONOMY
SCIENCE &
INNOVATION



AGENTSCHAP
INNOVEREN &
ONDERNEMEN



Ecosystem in Flanders

KNOWLEDGE CENTERS

5 UNIVERSITIES
5 RESEARCH
CENTERS



CITIZENS



COMPANIES & (NON-PROFIT) ORGANISATIONS

Incl e.g. hospitals

Direct collactorations and via federations, networks, ...



GOVERNMENT



Policy Maker, Facilitator, User



Agencies

AI FLANDERS
BUILDING OUR DIGITAL FUTURE



AI VLAANDEREN
BOUWEN AAN JE DIGITALE TOEKOMST



Groundbreaking AI research
enabling a **meaningful impact** on
people, industry and society



Strategic Basic Research in AI



RESEARCH



Internationally recognized **demand-driven generic** AI research

DEMONSTRATE



Demonstrators **inspire** and **steer** research

CONNECT



We connect experts, teams, disciplines, partners, programs in Flanders and internationally

Flanders AI Research Program



Contributing to this program:

150 PhD students

100 (senior) researchers

90 professors

10 consortium partners

40 research groups

Funded by Flemish Government

Started: Mid 2019

Budget 2021: 12 MEuro



Part of:





HEALTH



INDUSTRY



ENERGY



GOVERNMENT &
CITIZENS




Human-centered AI



Sustainable AI



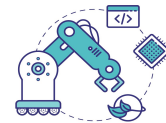
Data-efficient AI

Translated into (technological) **Grand Challenges** of the **Flanders AI Research Program**

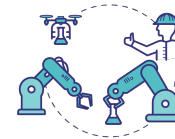
AI-driven data science



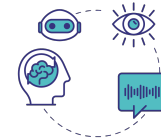
Edge AI



Collaborative AI



Human-like AI





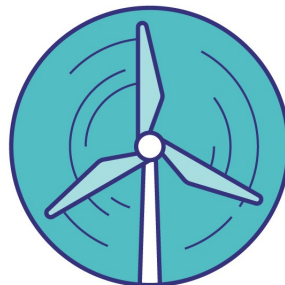
HEALTH



GOVERNMENT
& CITIZENS



INDUSTRY



ENERGY



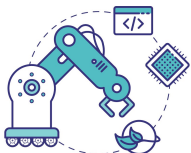


Flanders AI Research Program

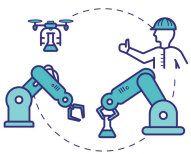
4 Research Challenges



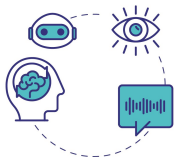
"AI-driven Data Science: Unlocking the value of data in a trusted and automated manner, supporting complex decision making and providing new insights that will empower individuals and society in generating major advances in healthcare, education, industry 4.0, energy systems and more."



"AI in the Edge: Improving edge device environments through the co-optimisation between power efficient AI processors and advanced machine learning tasks with as purpose to increase the real-time performance, reliable low-latency communication, power-efficient processing and data security."



"Multi-Agent Collaborative AI: Creating flexible coordination mechanisms for autonomous decision-making entities, allowing to adapt to changing environments, to interact flawlessly with humans, and to exchange privacy-sensitive data, in this way leveraging the power of AI in a highly connected and rapidly changing world."



"Human-like AI: Towards more natural, interactive, personalized, and human-inspired AI systems. Seamless interaction between humans and AI in Multi-modal perception, Multi-modal instruction, Personalized interaction and responses, Complex control: navigation, reasoning, etc."

Challenge-based Research with Demand-driven Impact

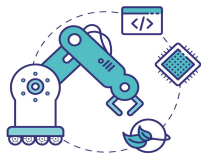
1 AS ONE PROGRAM

Generic research challenges

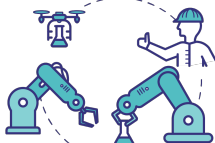
AI-driven data science



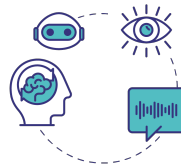
Edge AI



Collaborative AI



Human-like AI



Ambition

Increase adoption of AI

Uptake of research results in companies and organisations in ALL DOMAINS

Focus domains and use cases:



HEALTH



INDUSTRY



ENERGY



GOVERNMENT & CITIZENS

DEMONSTRATORS
Inspire &
Steer research challenges



HEALTH

PRECISION MEDICINE
IMPROVING PERSONAL
PATIENT TREATMENT
+ BIOMARKERS

CLINICAL DECISION SUPPORT
DIAGNOSIS & PATIENT MONITORING
WITH WEARABLES

**HOSPITAL
TREATMENT
DECISIONS**

**HEALTH
DATA
MGMT**

Single Cell
Technologies

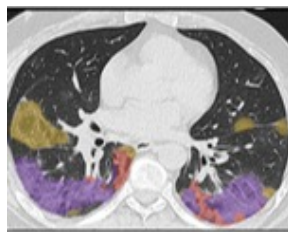
Multiple
Sclerosis

Medical Imaging
*Radiation
Oncology and
Radiology*

Epileptic
Seizure
Detection

Prediction of
Length of Stay
in Hospitals

Personal
Health Data
Management

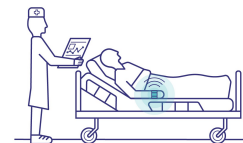


Accelerometer

EMG



Mobile EEG



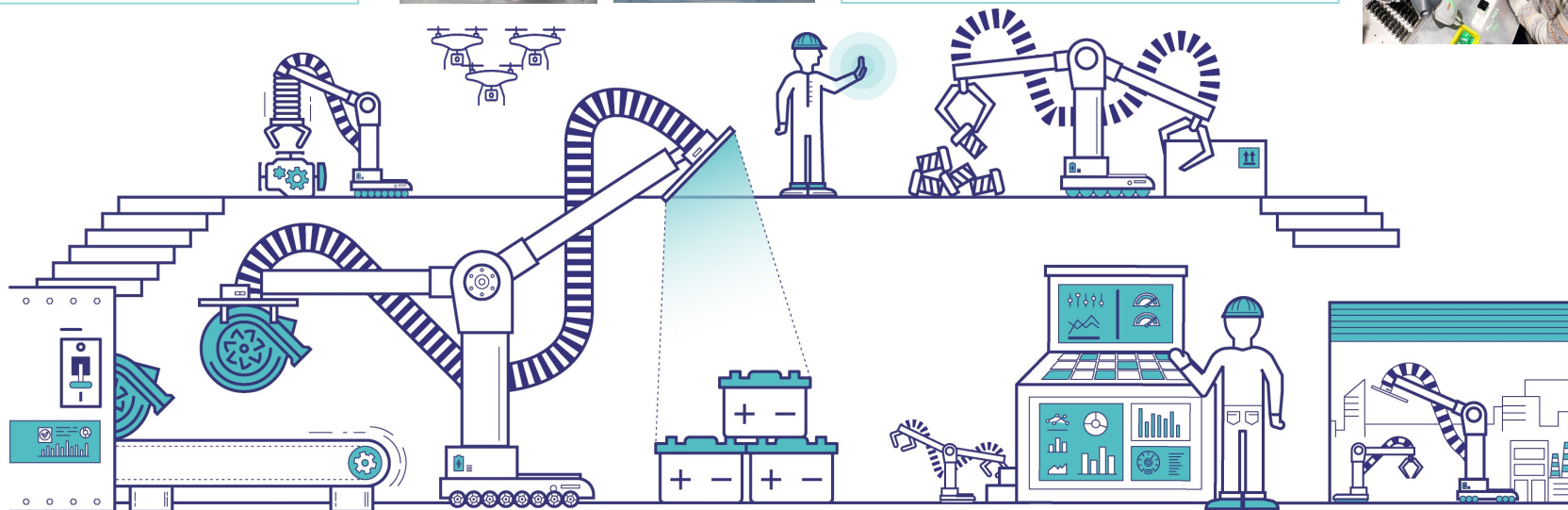


INDUSTRY

Collaborative AI-systems



People collaborating with AI-systems



Optimisation of Flexible Production lines



Anomaly detection, preventive maintenance of industrial assets





Sustainable energy

- Energy production
- Energy distribution
- Energy consumption

ENERGY





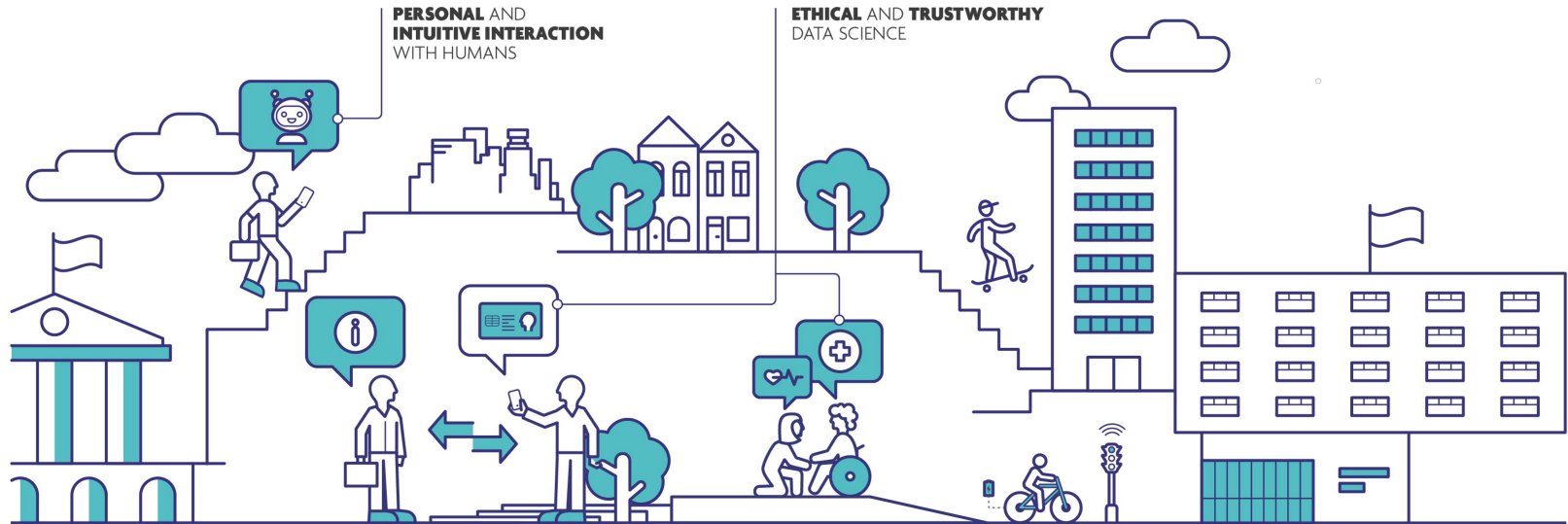
GOVERNMENT & CITIZENS

CONVERSATIONAL
AGENTS

RECOMMENDER
SYSTEMS

PERSONAL (HALTH)
DATA MANAGEMENT

PUBLIC EMPLOYMENT
SERVICES



Challenge-based Research with Demand-driven Impact

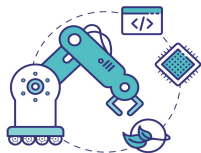
1 AS ONE PROGRAM

Generic research challenges

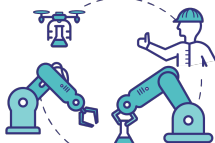
AI-driven data science



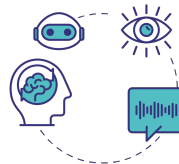
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GOVERNMENT & CITIZENS

DEMONSTRATORS
Inspire &
Steer research challenges

AI-Driven Data Science

Luc De Raedt



Maarten De Vos



Hendrik Blockeel



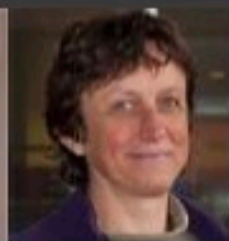
Tijl De Bie



Piet Demeester



Ann Ackaert



Matthew Blaschko



Yves Moreau



Tom Dhaene



Bart De Moor



Yvan Saeys

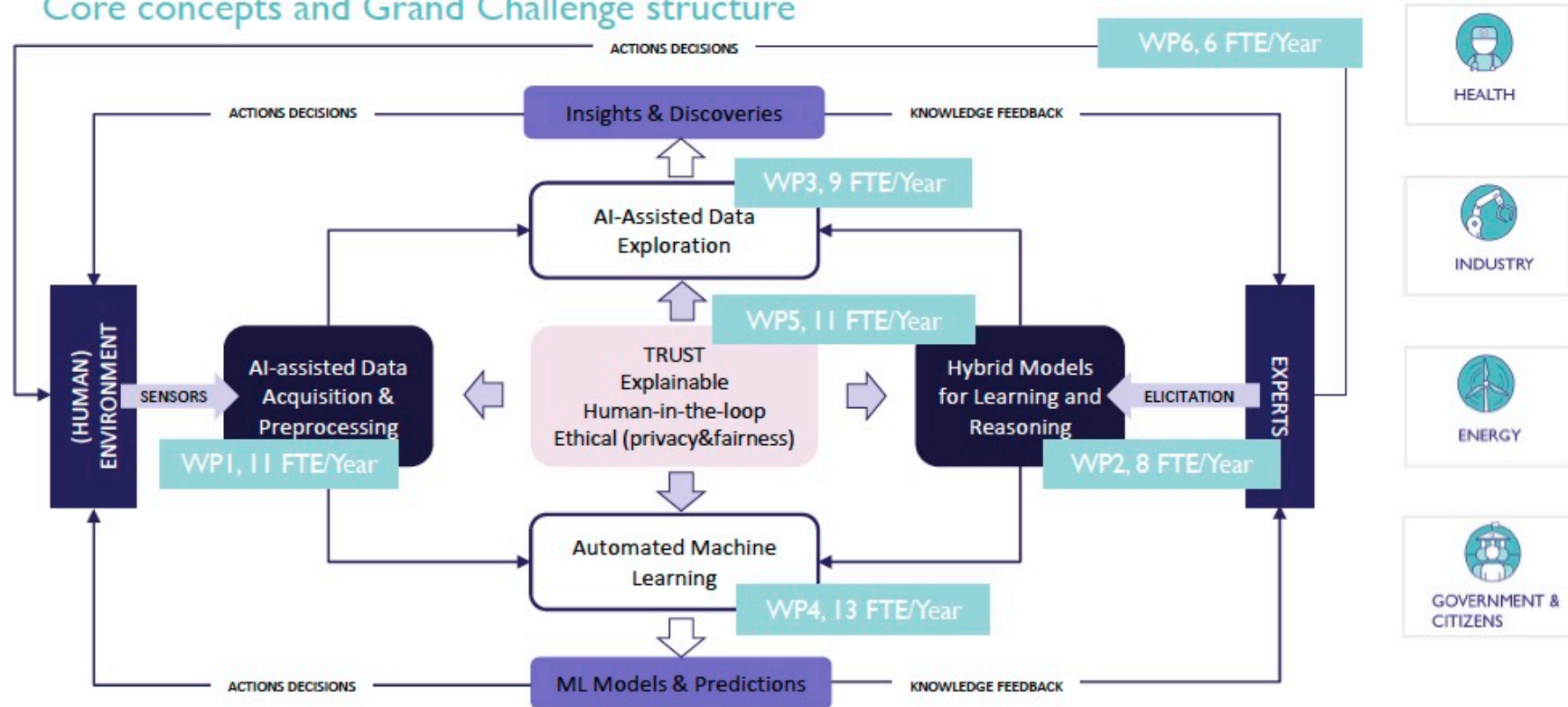


Mauricio Agudelo

- Methodological Work Packages
 - WP1: AI-assisted Data Acquisition and Pre-Processing (Luc De Raedt)
 - WP2: Integrating Learning and Reasoning (Hendrik Blockeel)
 - WP3: AI-Assisted Data Exploration (Tijl De Bie)
 - WP4: Automation in Machine Learning (Tom Dhaene)
 - WP5: Trustworthy AI (Yves Moreau)
 - WP6: Decision Support Systems (Matthew Blasckho)
- Use cases
 - Single Cell Technologies (Yvan Saeys)
 - Epilepsy Monitoring (Maarten De Vos)
 - Public Employment Services (Tijl De Bie)
 - Low Voltage Grid (Koen Vanthournout)

AI-Driven Data Science

Core concepts and Grand Challenge structure



AI Toolbox

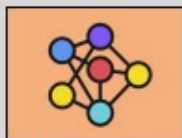
The tools developed fall into different categories



Time series



Images



Networks
& Graphs



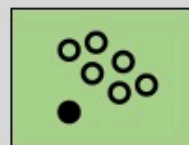
Relational
Databases



Text



Active
Learning



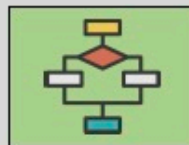
Anomaly
Detection



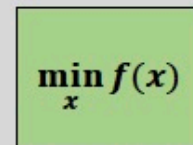
Supervised
Learning



Probabilistic
programming



Symbolic AI



Optimization



Single Cell and DNA
sequence Analysis

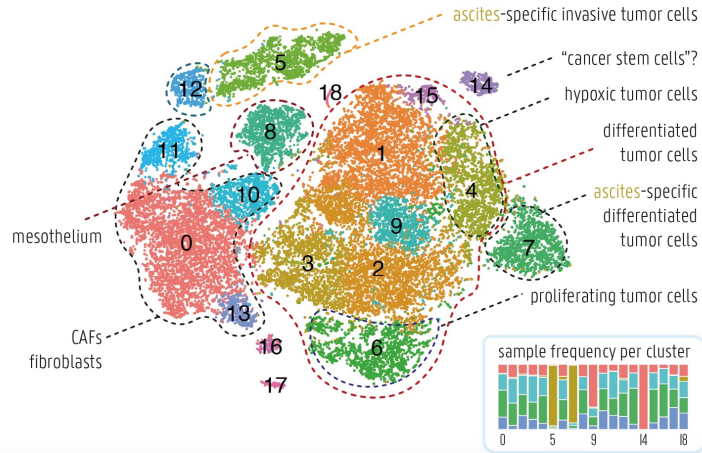


Unsupervised
Learning



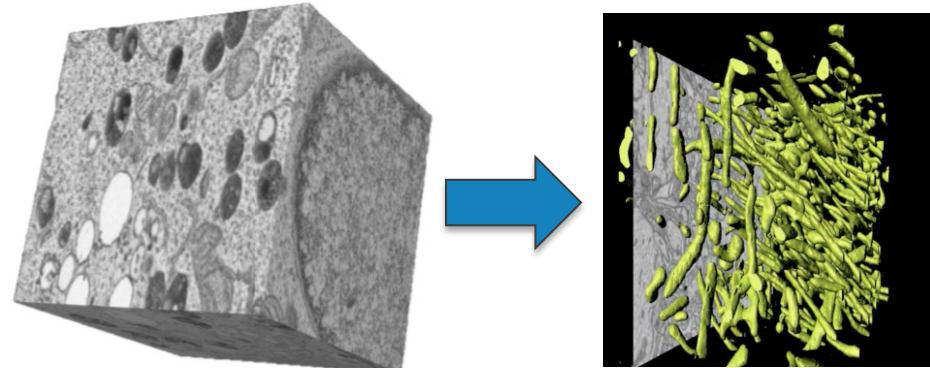
Natural Language
Processing

Single-cell “omics”



- **Interactive** visual analytics
- **Structure learning** (clusters, cell type hierarchies, cell developmental trajectories)
- Incorporation of **prior biological background knowledge**

3D electron microscopy



1 Dataset: 100 to 2000 slides (5 to 380 GB)

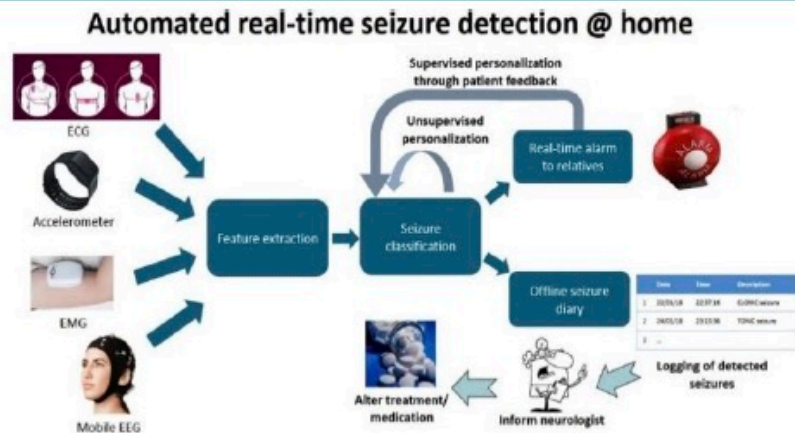
- **Automated segmentation** of cell organelles
- Very **few labeled** data (costly labels)
- Active learning, weakly supervised learning, transfer learning
- **Interpretability**

UC – Epilepsy monitoring: Goal and Challenges

- Epilepsy is a neurological disease that affects around 65 million people worldwide. Despite treatment, still 35% of the patients continue to have seizures for the rest of their lives.
- Our **TARGET**: Automated real-time seizure detection for long-term home monitoring

Four main challenges defined

- Improve quantification of biomedical signals for seizure detection
- Improve multimodal classification
- Improve and facilitate personalization of seizure detection algorithms
- Interact with end user



Actors: KUL (ESAT, Computer Science), UGHENT (IDlab, Bioscience), UHASSELT, IMEC, UZLEUVEN

Stakeholders: Pharma companies, Medical devices industry, Health care professionals, Patients and their relatives

Rapid response to COVID-19 challenge

VIB COVID-19 RESPONSE - UZ Gent/VIB/UGent Inflammation Research Center

About IRC/VIB | single-cell.be | Contact

DATA PORTAL | DISEASE BIOLOGY | CLINICAL TESTING | THERAPEUTICS

COVID study

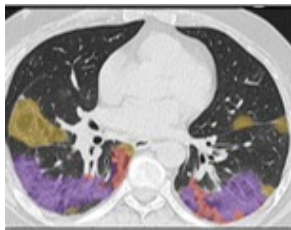
STUDY

This study aims to gain more insight in the immunological characteristics of SARS-CoV2 infection. Samples have been collected from patients with a high clinical suspicion of

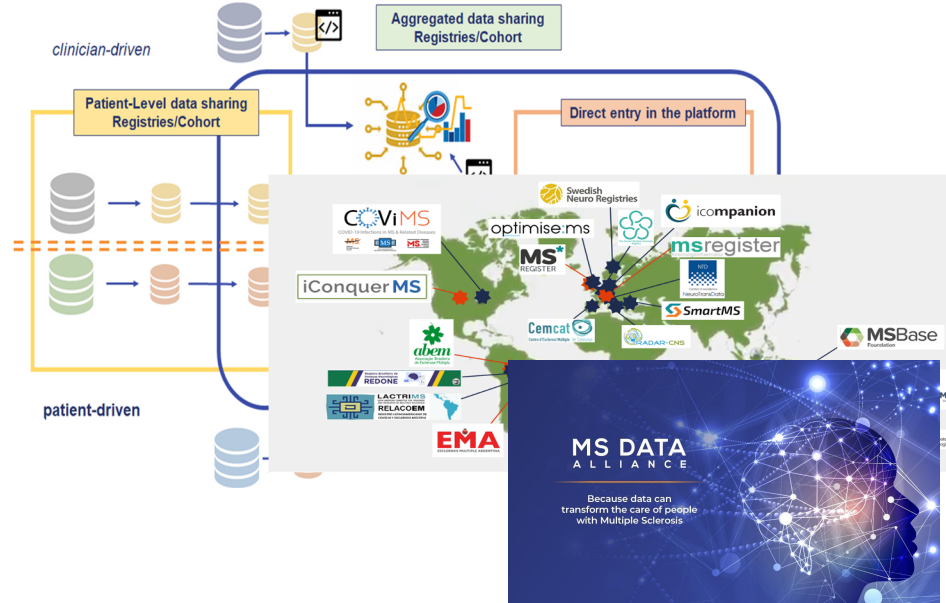
principal investigators

- Linos Vandekerckhove (UGent)
- Yvan Saeyls (UGent)
- Rafika-Pierre Sekaly (Case Western Reserve)

COVID-19 cell Atlas project, clinical trial
<https://www.single-cell.be/covid19/>



Lung Segmentation

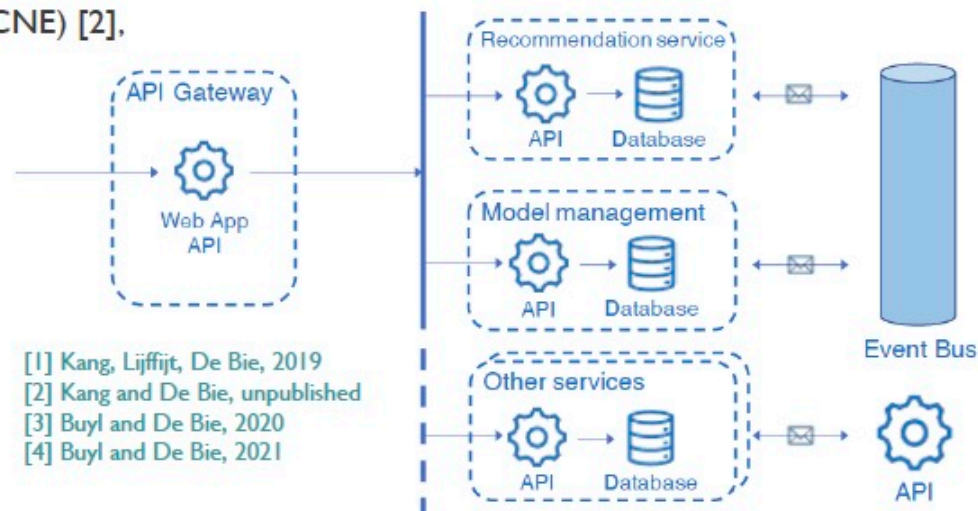


Federated infrastructure with automated data wrangling pipeline

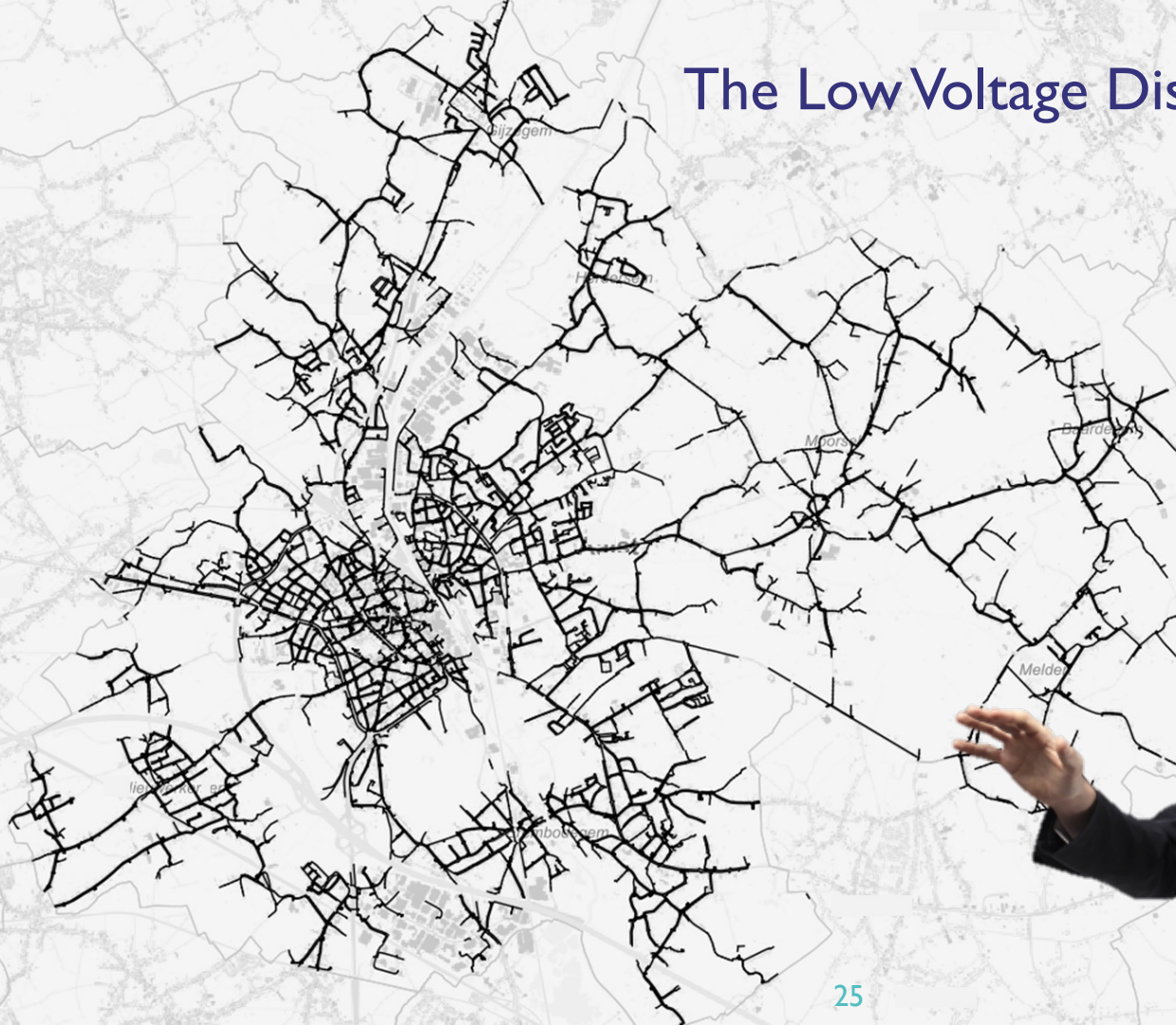
UC – Public Employment Services

The FEAST platform: an accurate and fair job recommender – PoC A: Job Seeker

- **Fair job recommender system** implementation
- Based on Conditional Network Embedding (CNE) [2], debiased variants [3,4].
- Implemented using micro-services, designed to be **scalable** and **extensible**
- **Benchmark:**
 - Accuracy / ranking metrics on VDAB data
 - AU-ROC
 - Accuracy-at-k
 - A panel of fairness metrics on VDAB data
 - Demographic parity
- **Baselines:**
 - State-of-the-art recommender systems
 - If possible: VDAB recommender in production



The Low Voltage Distribution Grid Today

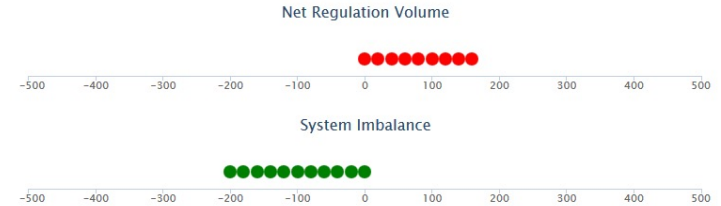


Times are changing...

Electrification of transport and heating,
renewable production and batteries



Demand response



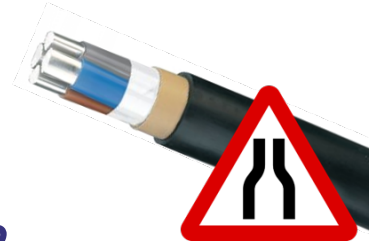
Larger currents, more concurrency, more synchronization

Fit&forget becomes more and more expensive

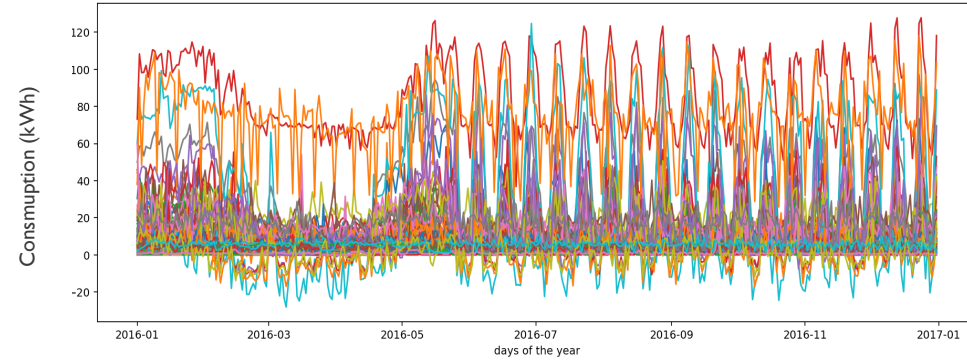
→ Potential energy transition bottleneck

Can we use the existing capacity more optimally?

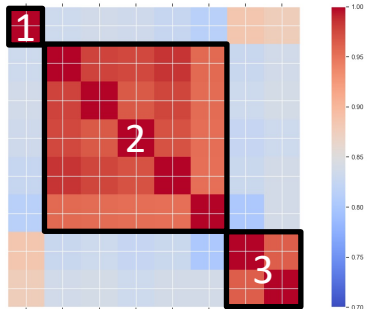
Can we safely operate closer to the limits?



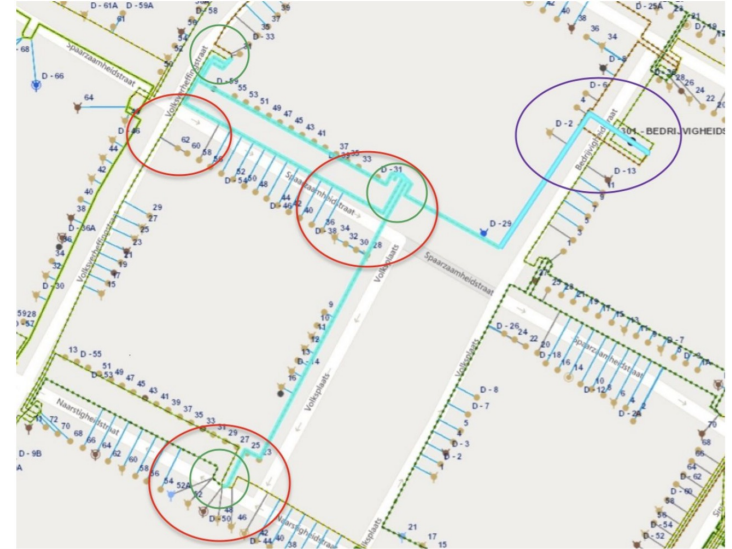
Example sub challenges



- Cluster electricity profiles with similar congestion impact
 - Semi-supervised, active clustering based on expert preferences
- Statistical day ahead forecast of individual profiles



Determine grid connection phase, using digital meter voltage measurements



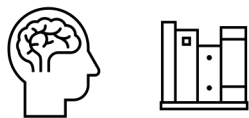
Improve and correct GIS grid data

- Correct historic manual drawing anomalies
- Improve house2cable assignment



1

RESEARCH



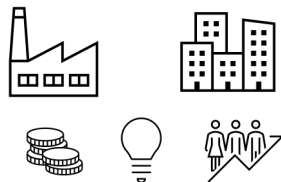
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www.flandersairesearch.be

Director: Sabine Demey, imec

2

IMPLEMENTATION



www.digitaletekomst.be

(Site in Dutch, for companies)

3

SUPPORTING Activities



Education &
Training



Vlaamse AI Academie
www.vaia.be



Citizen
Projects



Ethical & Legal



data-en-maatschappij.ai/en



DEPARTMENT OF
ECONOMY
SCIENCE &
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AGENTSCHAP
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DEPARTMENT OF
ECONOMY
SCIENCE &
INNOVATION



AGENTSCHAP
INNOVEREN &
ONDERNEMEN



Work Plan VAIA 2021-2022

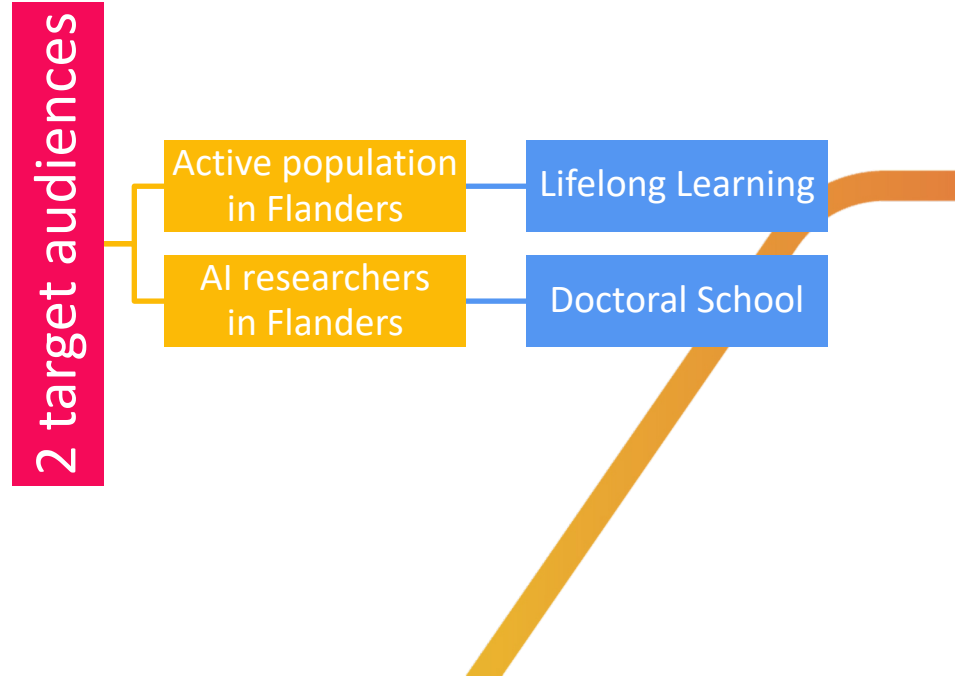
Prof. Dr. Bart De Moor, chairman VAIA

VAIA

Principles and origin of Flanders AI Academy (VAIA)

- **Doctoral School:**
for young researchers in Flanders
- **Lifelong Learning:**
continuous and refresher courses
organised at Flemish universities
(incl. universities of applied sciences),
organised outside of regular education
(short- and long-term)

(The ESF-supported practical training programme for companies (and their employers) is also part of lifelong learning, but it is no part of VAIA)



The VAIA profile

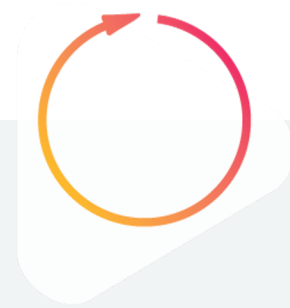
Our activities



Amplifier



Expertise



Creation

VAIA Watch

monitor demand & refine our offer

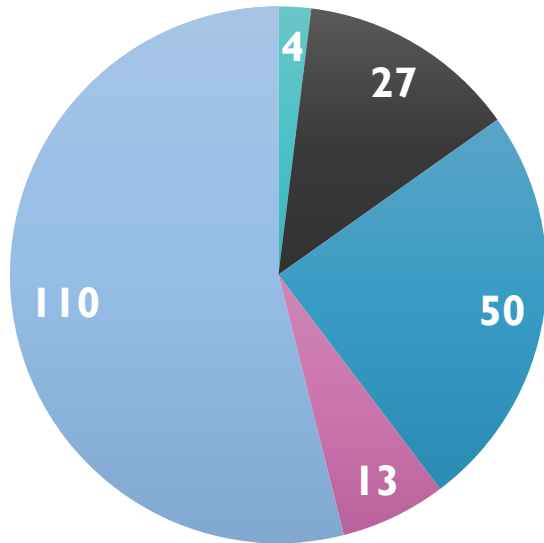
- **Flemish universities:** Manama, master, Flemish doctoral schools + VLIR (doctoral programmes), Lifelong Learning: UGain, Law, KULAK, 'Voorsprongfonds' Weyts / recovery plan
- **VLHORA**
- **Government:** e.g., VDAB
- **Business federations:** VOKA, AGORIA, UNIZO, SIRRIIS, pharma.be, flux50, ...
- **Professional federations:** Domus Medica, ...
- **Businesses:** Datacamp, SAS, Coursera, EDX
- **International networks:** AIDA, UNA, CLAIRE...
- **AI Barometer:** annual survey by the Knowledge Center Data & Society and the Flemish Policy Support Center for Economics & Entrepreneurship, asking firms about:
 - Missing AI skills & knowledge
 - Perceived difficulties to attract staff with the right AI Skills
 - Sought after AI skills

Development of our Activities Orientation



Amplifier

Partners on the VAIA Radar



■ Partner Flemish
Policy Plan

■ Core Partner

■ Friends

■ Doctoral School

Expanding network
(continuous task)

Methodology to develop new courses



Creation

Co-creation of courses

Course & training Development

Lifelong Learning

- AI & industry: Human-machine interaction
- AI for General Practitioners – wearables, apps & AI
- Flemish States General
- AI in hospitals
- AI voor General Practitioners - Buzzwords in AI and Healthcare – virtual encyclopedia
- Introductory Course Artificial Intelligence
- Introductory Course Data Science
- Introductory Course Machine Learning
- Fairness and Bias in NLP
- Adversarial Learning
- AI & Industry: Occupational Health & Safety
- AI for Digital Humanities: Cultural Heritage
- Explainable and Trustworthy AI
- RPA & AI for municipalities

PhD & researchers

- AI for digital humanities: Digital text analysis
- Introduction to AI and Machine Learning for Biomedical Research
- Sense & Sensibility of AI: Seminar

**Mixed mode
Doctoral School – Lifelong Learning
often possible**

Sense & Sensibility of AI seminars

- Started 28 mei 2021
- On a monthly basis, I speaker each month
- Researchers and professionals with knowledge of the technical aspects of AI & ML
- <https://www.vlaamse-ai-academie.be/calendar/sense-sensibility-of-ai/>

Siri, what's your advice? On AI and moral judgment

Katleen Gabriels, University of Maastricht

30 September 2021, online

Seminar series '[Sense & Sensibility of AI](#)'

VAIA Presents...

'Your weekly AI appetizer'

Inspiration

big name, fascinating story...

Scientific Seminar

researchers explain the latest developments in/with AI

Industry

big & small companies share their AI Story

Policy Track

on AI in administration, ethics & legislation

Every week, Tuesday, 12,30h
Online presentation of 0,5 hour

Objectives:

- Expand target audiences quickly & efficiently
- Promotion of programmes, stepping stone
- Amplifier: a stage for partners and stakeholders
- Expertise: we offer insight in our elaborate network and the speakers in our network
- Umbrella function: the place to learn about AI, on a regular basis. Once established, we can also provide partners with a bigger stage

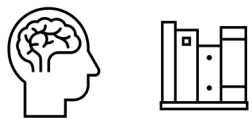
Time series seminar

- 28 October – John Lataire (VUB-ELEC)
- 18 November – Koen Vanthournout (EnergyVille)
Decision Support for the Low Voltage Distribution Grid; the role of electricity consumption time series
- 2 December 2021 – Jesse Davis (KU Leuven, Computer Science, DTAI)
- 16 December 2021 – Nick Harley (VUB Computational Creativity Lab)
Statistical learning of knowledge from sequence data
- 10 February 2022 - Willem Waegeman (UGent KERMIT)
- 24 February 2022 – Christos Chatzichristos (KU Leuven, ESAT-STADIUS)
Seizure detection with wearable devices and AI
- 10 March 2022 – Elena Tsiporkova (Sirris)
- 24 March 2022 – Peter Karsmakers (KU Leuven, Campus Geel)
Semi-Supervised Guided Deep Learning to Automatically Add Semantics to Time Series
- 21 April 2022 – Johan Suykens (KU Leuven, ESAT-STADIUS)
Kernel machines for dynamical systems modelling



1

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Director: Sabine Demey, imec

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SUPPORTING Activities



Education &
Training



Vlaamse AI Academie
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Citizen
Projects



Ethical & Legal



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