



# Flanders AI Research Program

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imec  
embracing a better life

FLANDERS  
**MAKE**

sirris  
Using industry by technology

**VIB**

vito

**KU LEUVEN**

GHENT  
UNIVERSITY

VUB  
Vrije Universiteit  
BRUSSEL

University  
of Antwerp

**UHASSELT**  
UNIVERSITY OF APPLIED  
SCIENCES

**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

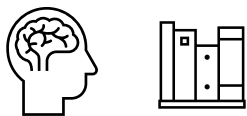
12 Mio €

15 Mio €

5 Mio €

1

## RESEARCH



Flanders AI  
Research Program

[www.flandersairesearch.be](http://www.flandersairesearch.be)

Director: Sabine Demey, imec

2

## IMPLEMENTATION



[www.digitaletekomst.be](http://www.digitaletekomst.be)

(Site in Dutch, for companies)

3

## SUPPORTING Activities



Education &  
Training



Citizen  
Projects



Ethical & Legal



Vlaamse AI Academie

[www.vaia.be](http://www.vaia.be)



Knowledge Centre  
Data & Society

[data-en-maatschappij.ai/en](http://data-en-maatschappij.ai/en)



# 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, ...

AGORIA



CATALISTI



ILVO



...

## GOVERNMENT



Policy Maker, Facilitator, User



DEPARTMENT OF  
ECONOMY  
SCIENCE &  
INNOVATION



AGENTSCHAP  
INNOVEREN &  
ONDERNEMEN



Agencies

...

AI FLANDERS

BUILDING OUR DIGITAL FUTURE



AI VLAANDEREN

BOUWEN AAN JE DIGITALE TOEKOMST



Knowledge Centre  
Data & Society



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) reserachers

90 professoren

10 consortiumpartners

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

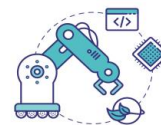


Translated into (technological) **Grand Challenges**  
of the **Flanders AI Research Program**

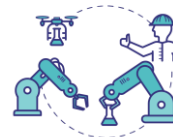
AI-driven data science



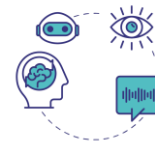
Edge AI



Collaborative AI



Human-like AI







HEALTH



GOVERNMENT  
& CITIZENS



INDUSTRY



ENERGY



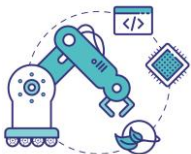


# Flanders AI Research Program

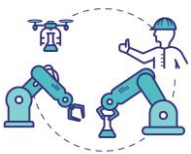
## 4 Research Challenges



*"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

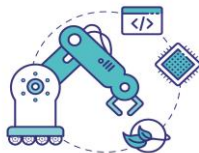
**1** AS ONE PROGRAM

### Generic research challenges

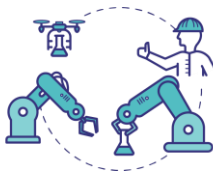
#### AI-driven data science



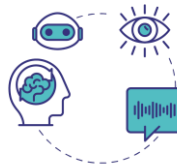
#### Edge AI



#### 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

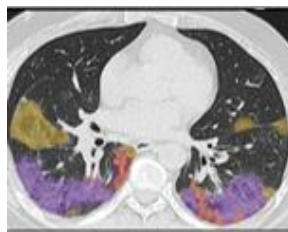
Multiple  
Sclerosis

Medical Imaging  
*Radiation  
Oncology and  
Radiology*

Epileptic  
Seizure  
Detection

Prediction of  
Length of Stay  
in Hospitals

Personal  
Health Data  
Management





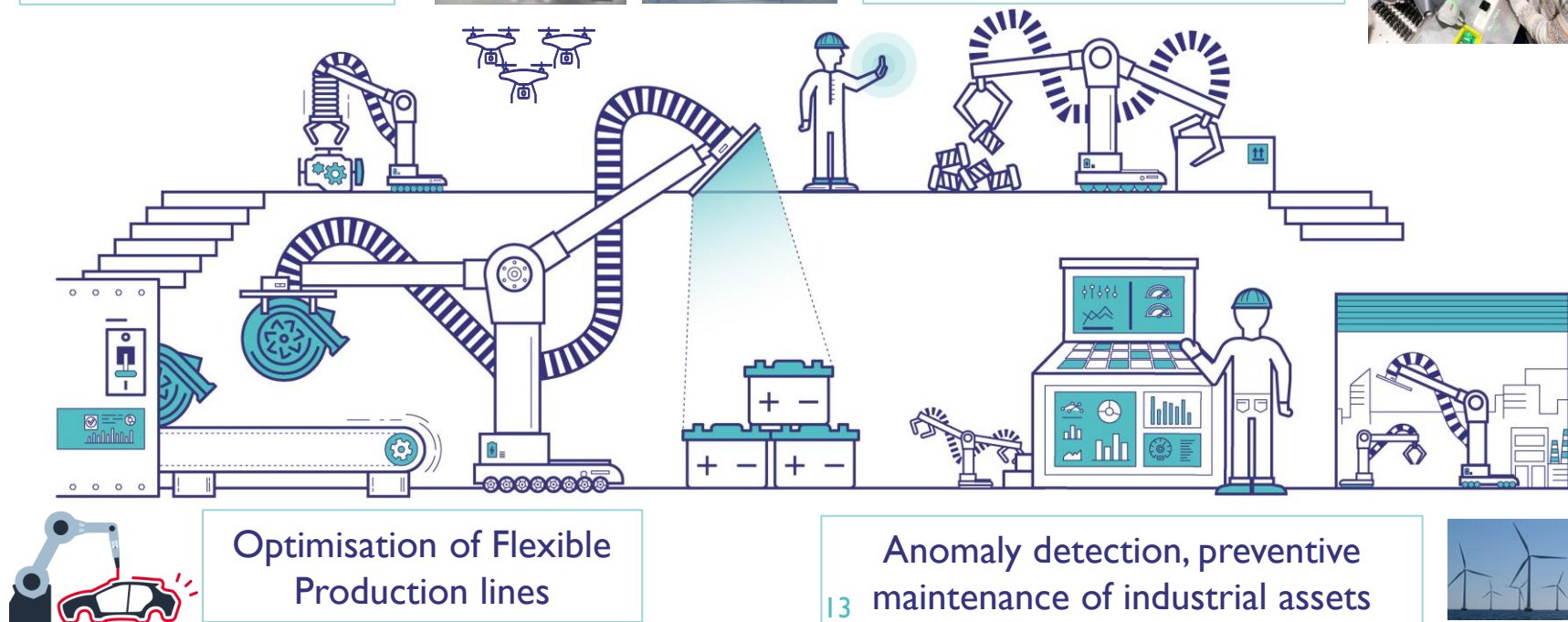
# INDUSTRY



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

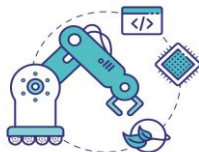
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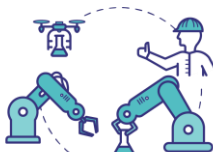
#### AI-driven data science



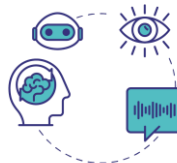
#### Edge AI



#### Collaborative AI



#### Human-like AI



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HEALTH



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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

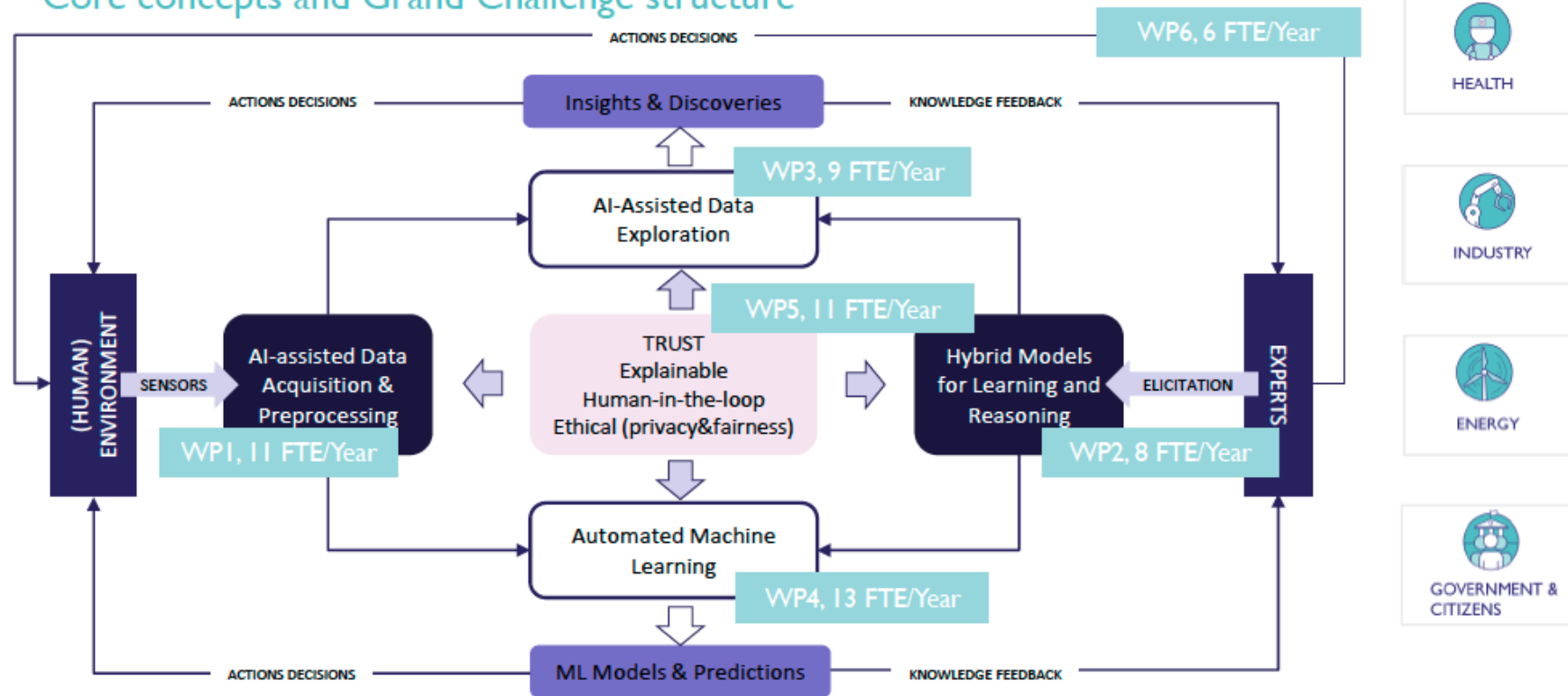


Mauricio Agudelo

- 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



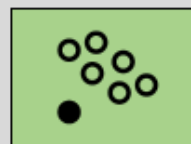
Relational  
Databases



Text



Active  
Learning



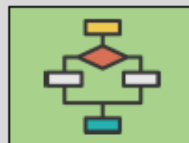
Anomaly  
Detection



Supervised  
Learning



Probabilistic  
programming



Symbolic AI

$$\min_x f(x)$$

Optimization



Single Cell and DNA  
sequence Analysis



Unsupervised  
Learning

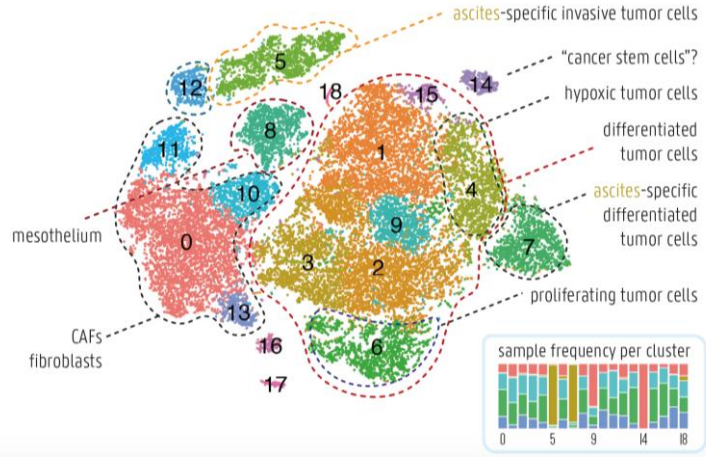


Natural Language  
Processing



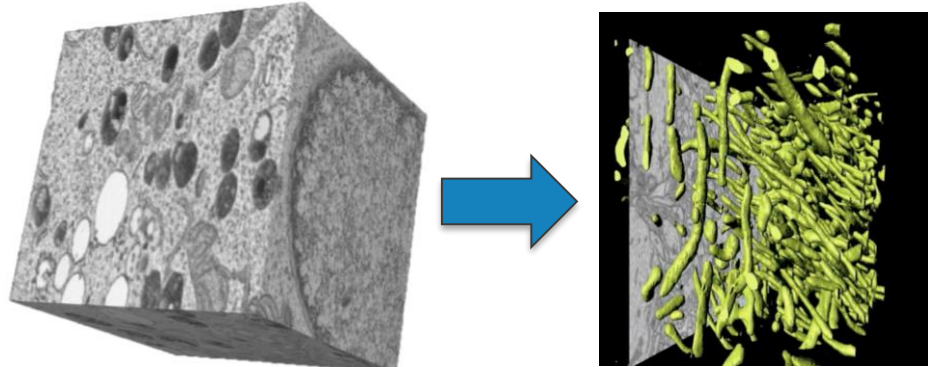
# Single-cell technologies: the next generation microscopes

## 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)

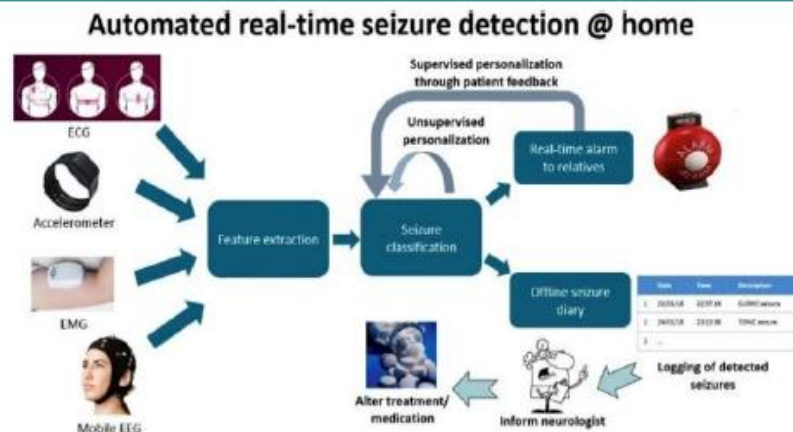
- **Automated segmentation** of cell organelles
- Very **few labeled** data (costly labels)
- Active learning, weakly supervised learning, transfer learning
- **Interpretability**

## 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

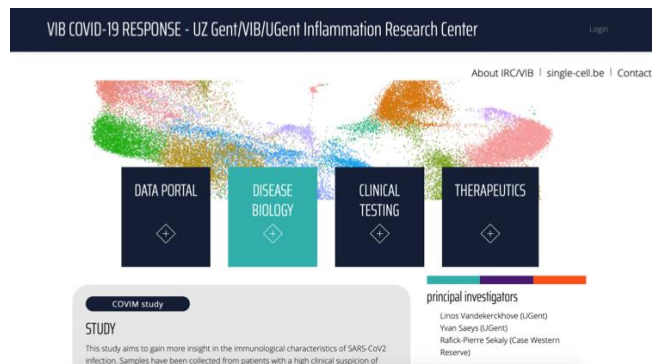
- Improve quantification of biomedical signals for seizure detection
- Improve multimodal classification
- Improve and facilitate personalization of seizure detection algorithms
- Interact with end user



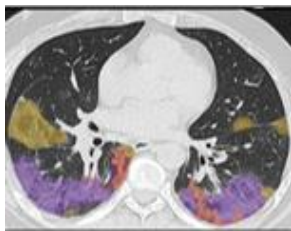
**Actors:** KUL (ESAT, Computer Science), UGHEM (IDlab, Bioscience), UHASSELT, IMEC, UZLEUVEN

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

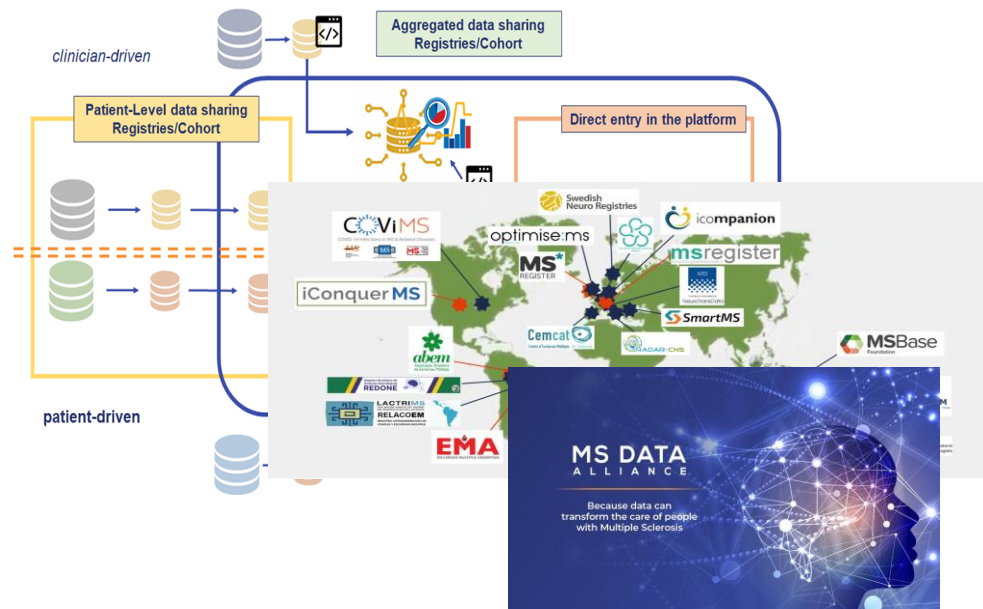
# Rapid response to COVID-19 challenge



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



Lung Segmentation

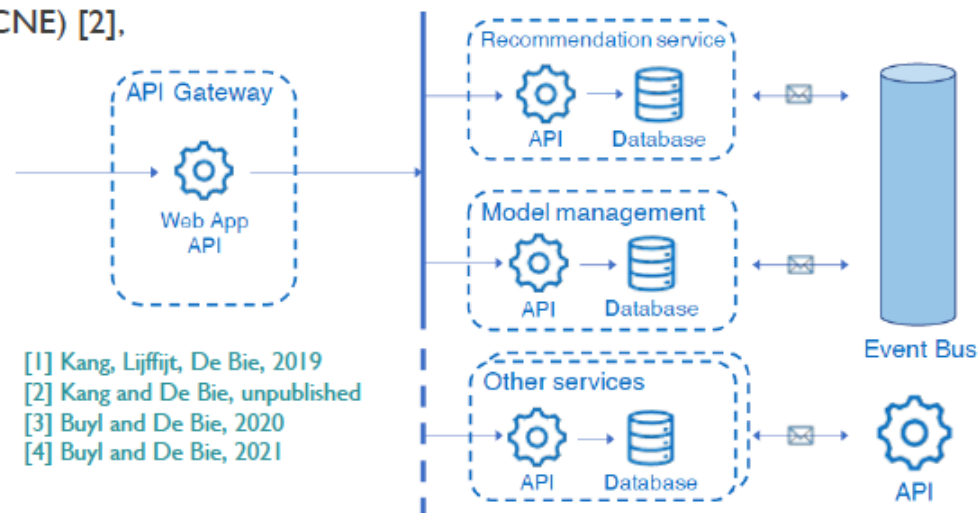


Federated infrastructure with automated data wrangling pipeline

# UC – Public Employment Services

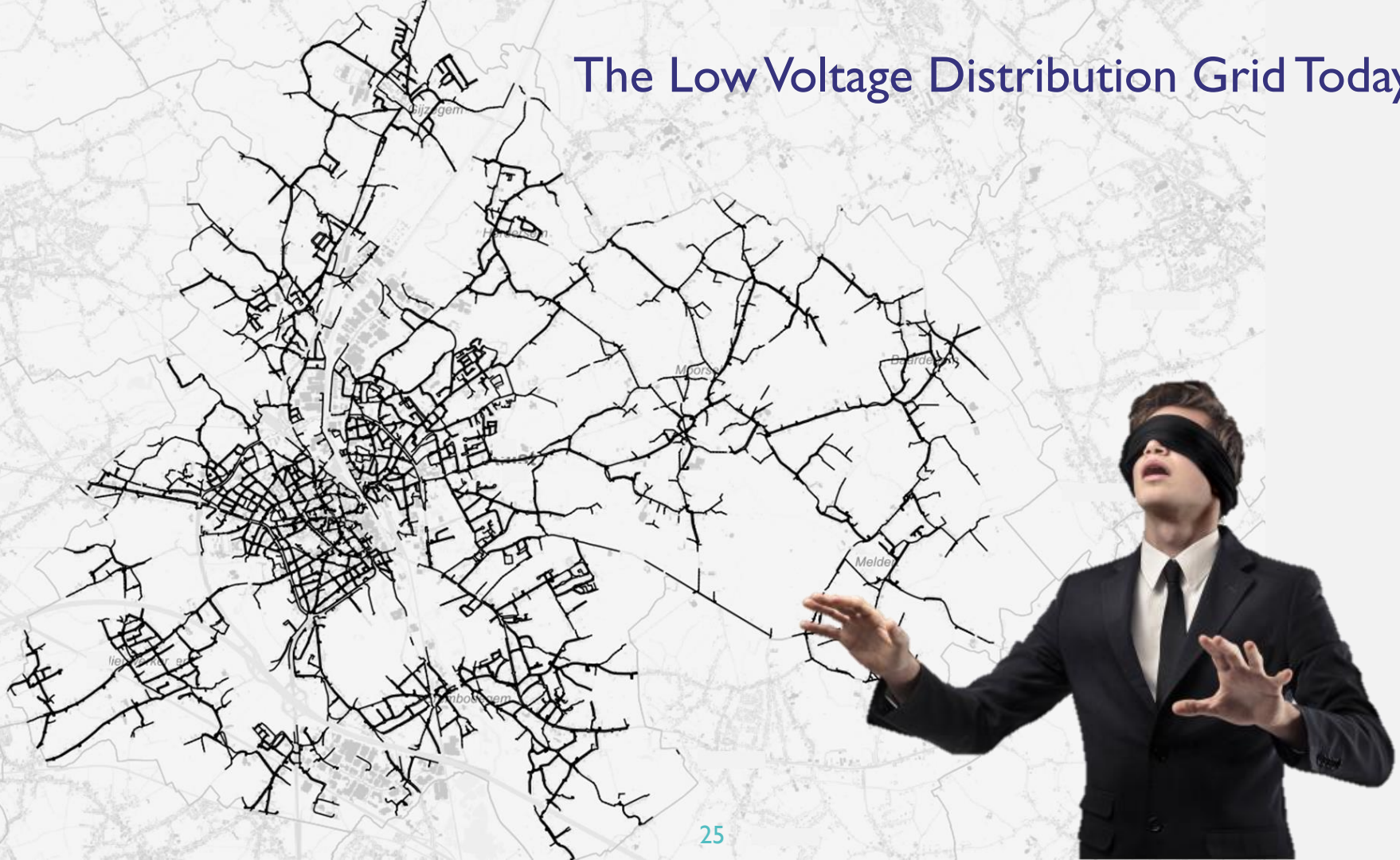
## The FEAST platform: an accurate and fair job recommender – PoC A: Job Seeker

- **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

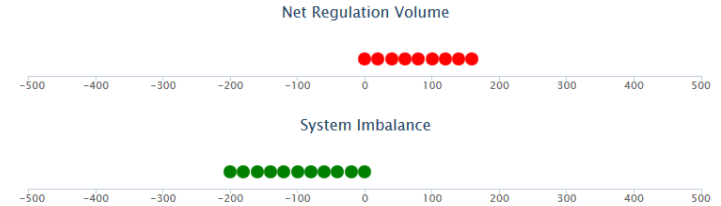


# Times are changing...

Electrification of transport and heating,  
renewable production and batteries



## Demand response



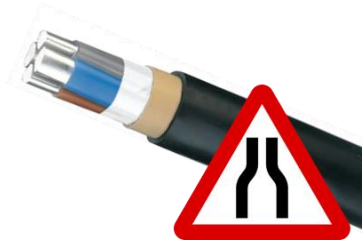
Larger currents, more concurrency, more synchronization

Fit&forget becomes more and more expensive

→ Potential energy transition bottleneck

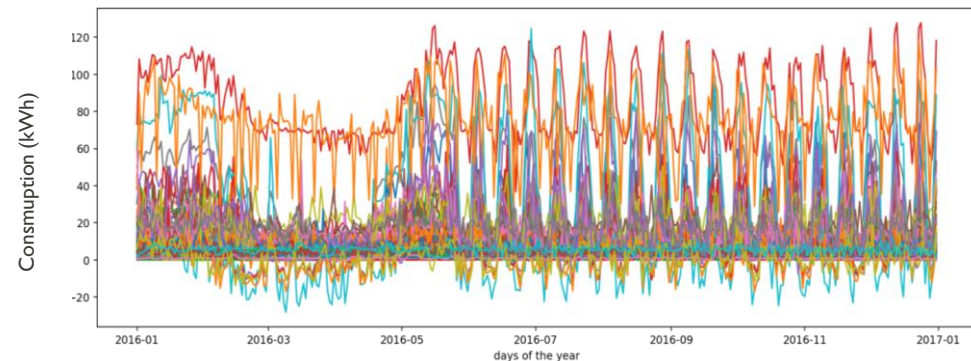
Can we use the existing capacity more optimally?

Can we safely operate closer to the limits?

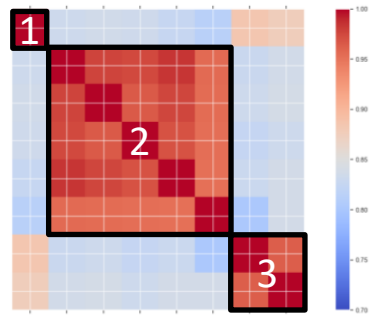




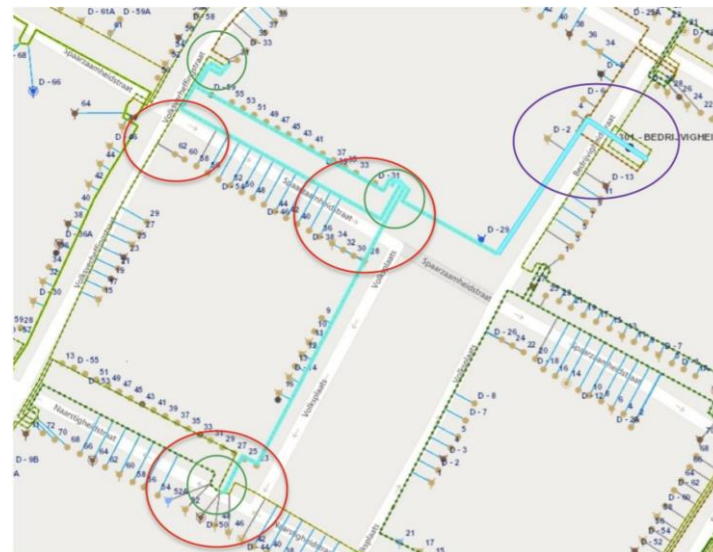
## Example sub challenges



- 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

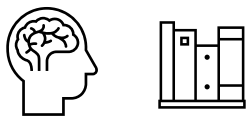


## Improve and correct GIS grid data

- Correct historic manual drawing anomalies
- Improve house2cable assignment

1

## RESEARCH



Flanders AI  
Research Program

[www.flandersairesearch.be](http://www.flandersairesearch.be)

Director: Sabine Demey, imec

2

## IMPLEMENTATION



[www.digitaletekomst.be](http://www.digitaletekomst.be)

(Site in Dutch, for companies)

3

## SUPPORTING Activities



Education &  
Training



Citizen  
Projects



Ethical & Legal



Vlaamse AI Academie

[www.vaia.be](http://www.vaia.be)



Knowledge Centre  
Data & Society

[data-en-maatschappij.ai/en](http://data-en-maatschappij.ai/en)

# Work Plan VAIA 2021-2022

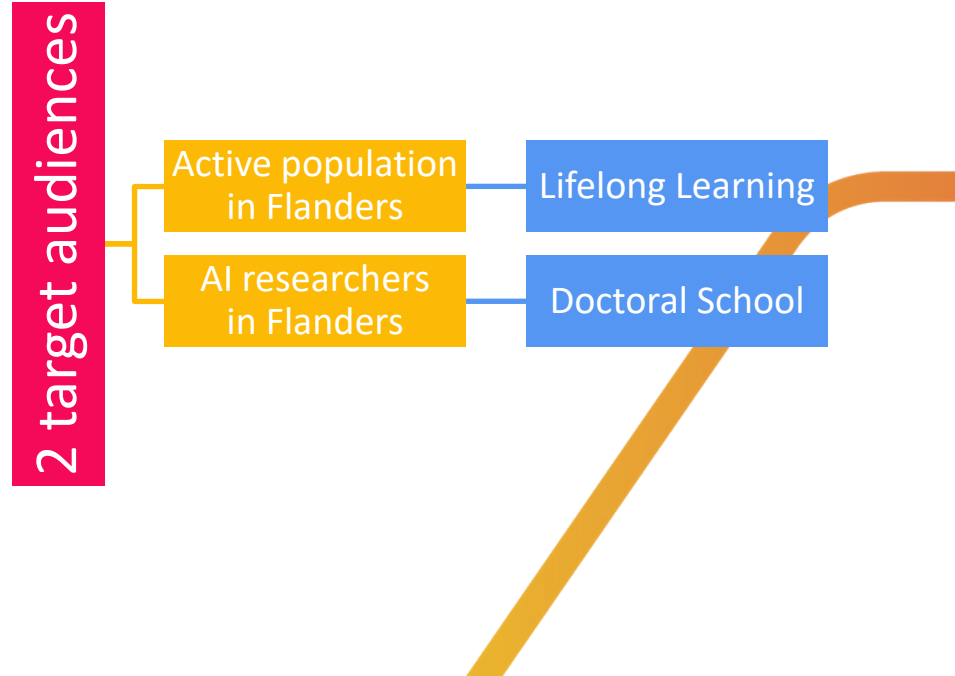
Prof. Dr. Bart De Moor, chairman VAIA



# Principles and origin of Flanders AI Academy (VAIA)

- ⑩ **Doctoral School:**  
for young researchers in Flanders
- ⑩ **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

- ⑩ **Flemish universities:** Manama, master, Flemish doctoral schools + VLIR (doctoral programmes), Lifelong Learning: UGain, Law, KULAK, 'Voorsprongfonds' Weyts / recovery plan
- ⑩ **VLHORA**
- ⑩ **Government:** e.g., VDAB
- ⑩ **Business federations:** VOKA, AGORIA, UNIZO, SIRRIIS, pharma.be, flux50, ...
- ⑩ **Professional federations:** Domus Medica, ...
- ⑩ **Businesses:** Datacamp, SAS, Coursera, EDX
- ⑩ **International networks:** AIDA, UNA, CLAIRE...
- ⑩ **AI Barometer:** annual survey by the Knowledge Center Data & Society and the Flemish Policy Support Center for Economics & Entrepreneurship, asking firms about:
  - ⑩ Missing AI skills & knowledge
  - ⑩ Perceived difficulties to attract staff with the right AI Skills
  - ⑩ Sought after AI skills

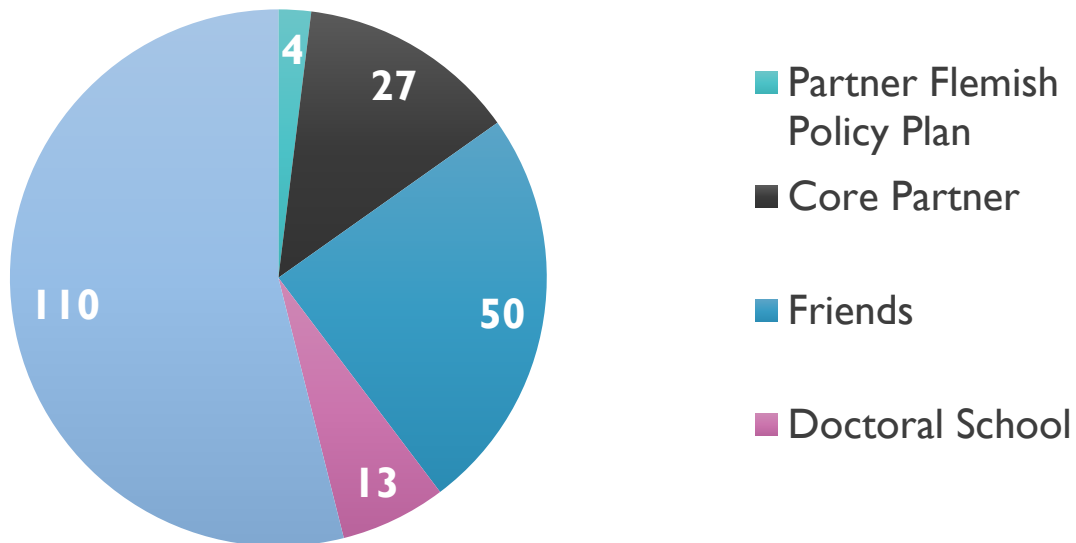


# Development of our Activities Orientation



Amplifier

## Partners on the VAIA Radar



Expanding network  
(continuous task)

## Methodology to develop new courses



Creation

# Co-creation of courses

## Course & training Development

### Lifelong Learning

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

### PhD & researchers

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

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

## Sense & Sensibility of AI seminars

- ⑩ Started 28 mei 2021
- ⑩ On a monthly basis, 1 speaker each month
- ⑩ Researchers and professionals with knowledge of the technical aspects of AI & ML
- ⑩ <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:**

- ⑩ Expand target audiences quickly & efficiently
- ⑩ Promotion of programmes, stepping stone
- ⑩ Amplifier: a stage for partners and stakeholders
- ⑩ Expertise: we offer insight in our elaborate network and the speakers in our network
- ⑩ Umbrella function: the place to learn about AI, on a regular basis. Once established, we can also provide partners with a bigger stage

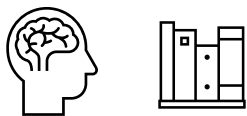
## Time series seminar

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



1

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Projects



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