Széchenyi Terv Plusz Építsük együtt Magyarországot!
Magyarország Kormánya
Az Európai Unió finanszírozásával NextGeneration EU

HUN REN Magyar Kutatási Hálózat

ARTIFICIAL INTELLIGENCE National Laboratory

Mesterséges Intelligencia a HUN-REN kutatóhálózatban: stratégiák és alkalmazások

Benczúr András, Friedman Noémi

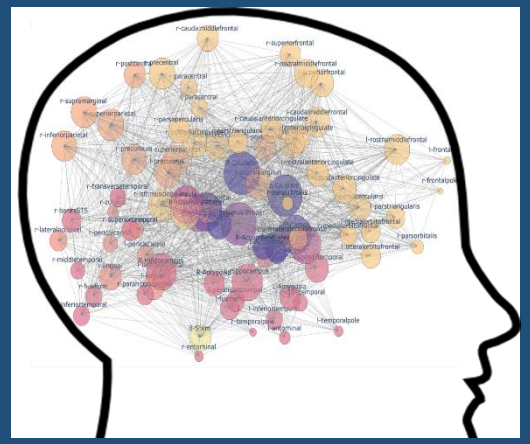
DIGITAL TWINS infrastructures & cities

Supported by the European Union project RRF-2.3.1-21-2022-00004 within the framework of the Artificial Intelligence National Laboratory Program, and the Development and Innovation Office, Hungary (OTKA146113)

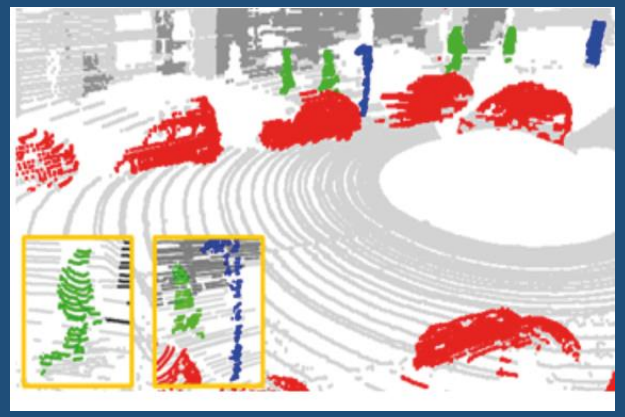
MESTERSÉGES INTELLIGENCIA
Nemzeti Laboratórium

Hat munkacsoport

NEMZETI LABORATÓRIUM



Matematikai alapok
(Szegedy Balázs, Rényi)



Gépi érzékelés
(Csabai István, ELTE)

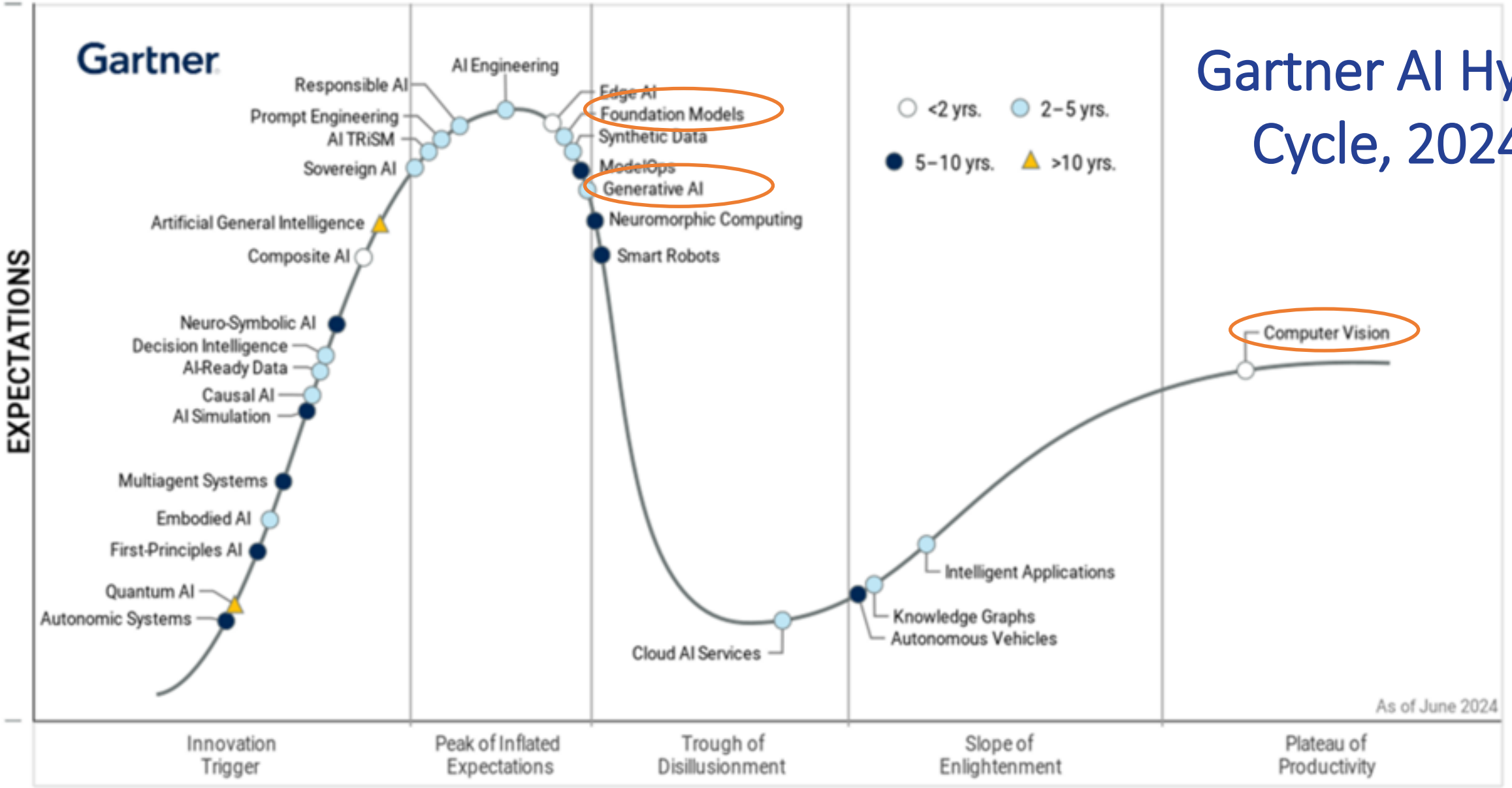
Nyelvi technológia
(Farkas Richárd, SZTE)

Egészségügyi alkalmazások
(Becker Dávid, SE)

Szenzor, IoT, telekommunikáció
(Levendovszky János, BME)

Biztonság, adatvédelem, infrastuktúra
(Ferenc Rudolf, SZTE)

Gartner AI Hype Cycle, 2024



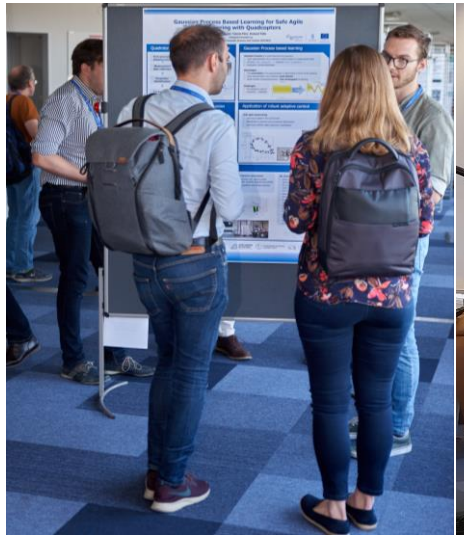
Az MI / ML működésének alapja: az adat

- Az AI “adatéhes” technológia
- A nagy nyelvi modellek már minden elérhető szöveges adatot felhasználtak
- Más alkalmazási területeken (egészségügy, gyártás, pénzügy, …) nem osztják meg az adatokat ⇨ nincs jelentős áttörés
  - Adatvédelem, szabályzások (pl. GDPR)
  - Üzleti és egyéb érdekek az adatmegosztás ellen
- Jellemzően néhány ezer kép szükséges az orvosi diagnosztikai modellek betanításához
  - Adatsovinizmus, adatszuverenitás, …

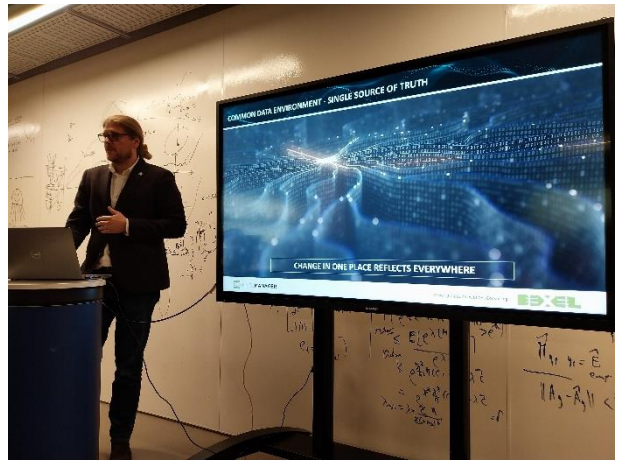
Christian Szegedy, 2023

Közösség építés

Hungarian Machine Learning Gathering



- Meetups
  - Generative AI
  - Medical AI
  - Industrial AI
  - AI and Law
  - AI in construction



A legkíválóbb magyar származású ML kutatók (Szepesvári, Neu, Huszár, …) minden augusztusban Budapesten:
Cambridge, Carnegie Mellon, Google, Yahoo, DeepMind, Huawei, Warwick, …

HUN-REN AI4Science kezdeményezés

SZAKMAI TERÜLET KUTATÓJA

AI kutatási ötlet validálási űrlap

AI kutatás, tervezés, támogatás űrlap

Jelentkezés kutatási ötlet validálására vagy tervezésre

HUN-REN AI4Science Program

AI / ML technikai támogatás a kutatáshoz

Kölcsönös érdekeltségen alapuló kutatási együttműködés

AI/ML szakértő

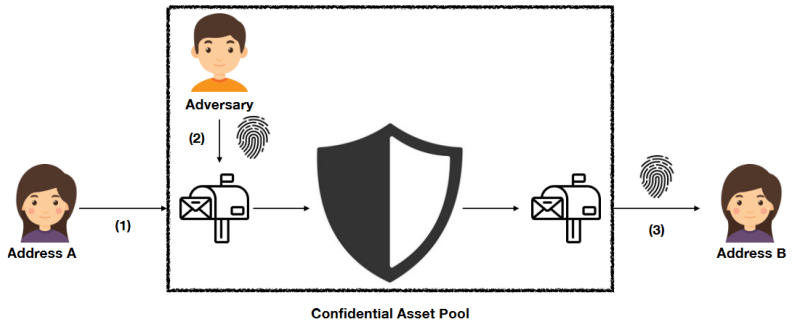
Kutatási partner-programban való részvétel

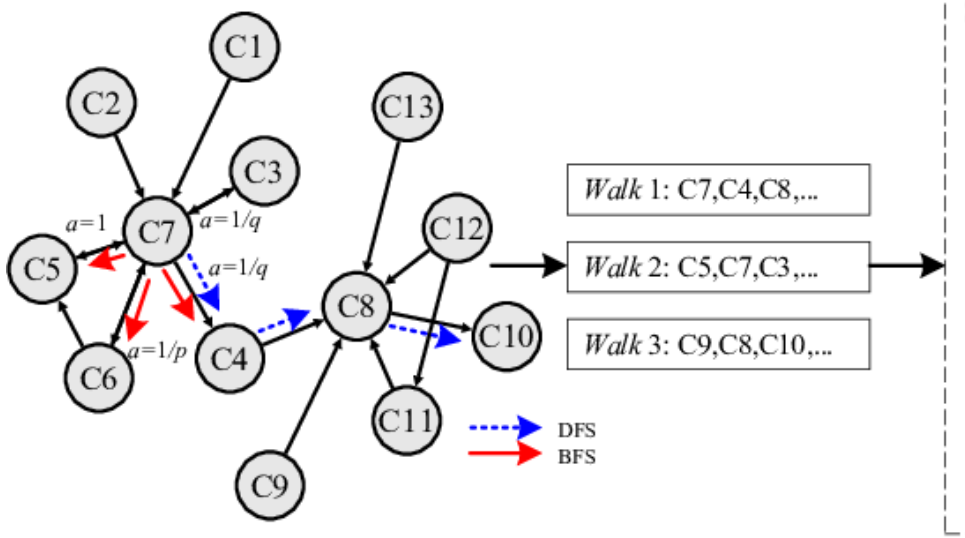
AI/ML kutatási kompetenciák és kapacitás ajánlat

Kutatási együttműködés, közös publikáció

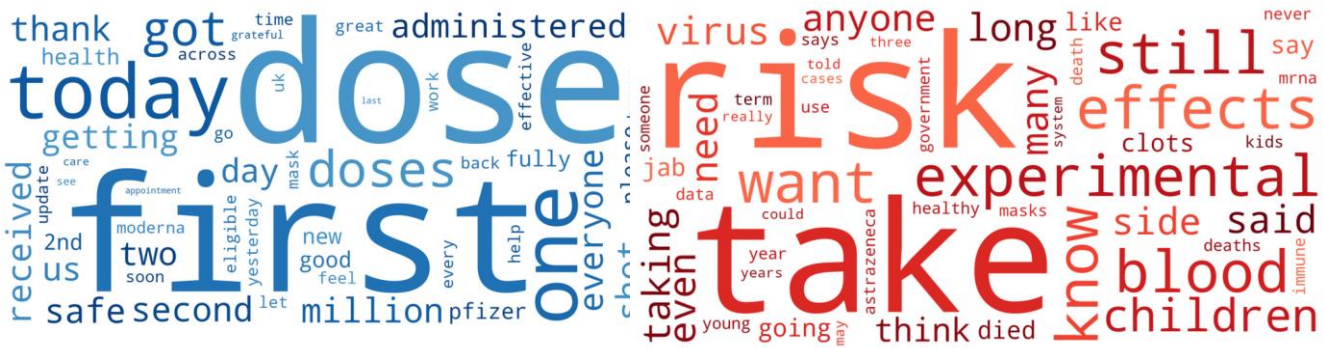
Networks, text, finance, …

- Béres et al. IEEE DAPPS 2021
- Blockchain deanonymization by protocol vulnerabilities and network embedding





- Béres et al, Applied Network Science 2023
- COVID anti-vaccination narrative analysis



FaRADAI

Frugal and Robust AI for Defence Advanced Intelligence

SELECTED PROJECTS EUROPEAN DEFENCE FUND (EDF) 2021

CALL TITLE:	Artificial intelligence
TOPIC TITLE:	Frugal learning for rapid adaptation of AI systems
DURATION OF THE PROJECT:	42 months
TYPE(S) OF ACTIVITIES:	Generating knowledge; Integrating knowledge; Studies
ESTIMATED TOTAL COST:	€ 18,498,239.16
MAXIMUM EU CONTRIBUTION :	€ 18,498,239.16

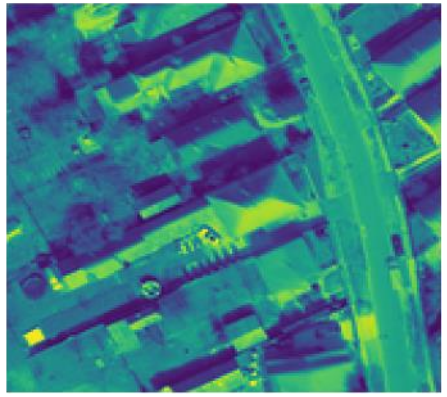
SHORT DESCRIPTION OF THE PROJECT:

FaRADAI will develop robust artificial intelligence for defence applications

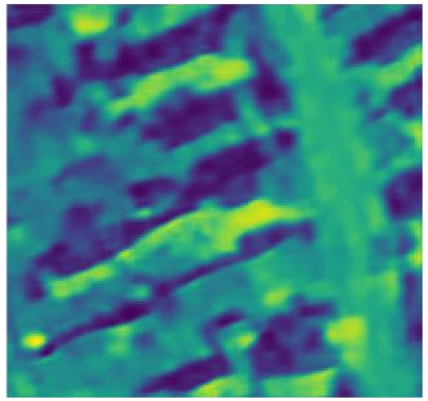
The project “Frugal and Robust AI for Defence Advanced Intelligence” (FaRADAI) focusses on frugal learning, i.e. the ability of a system to adapt and learn from its’ environment, including from user supervision, for a reasonable cost and without intervention from expert developers. Within the FaRADAI project, current advances in AI technologies will be thoroughly researched in parallel with a detailed study of the main challenges imposed by a defence system.

Hungarian Military Force Modernization Initiative

HUN REN | SZTAKI



Camera image

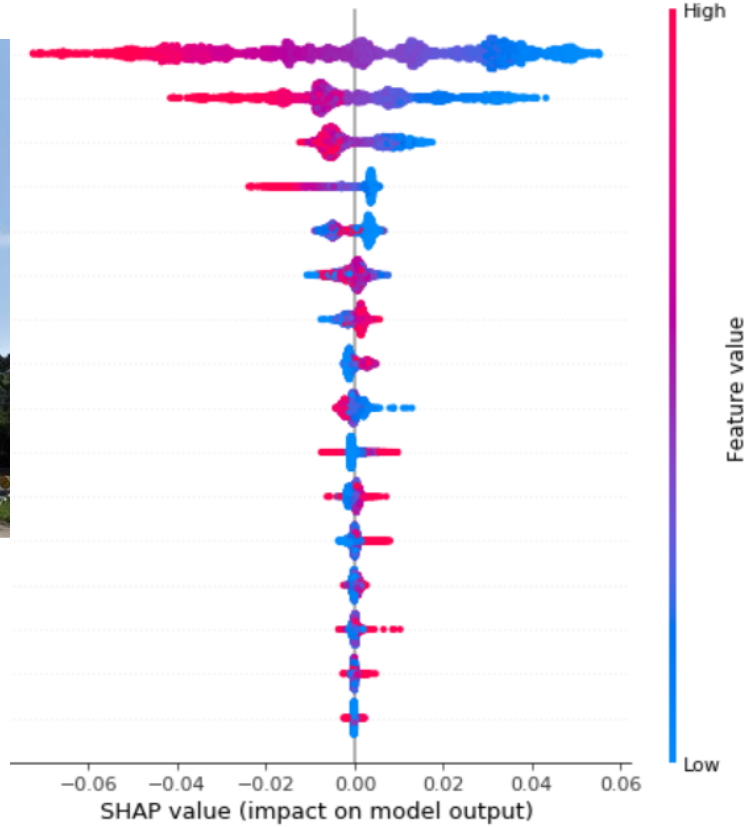


AI representation

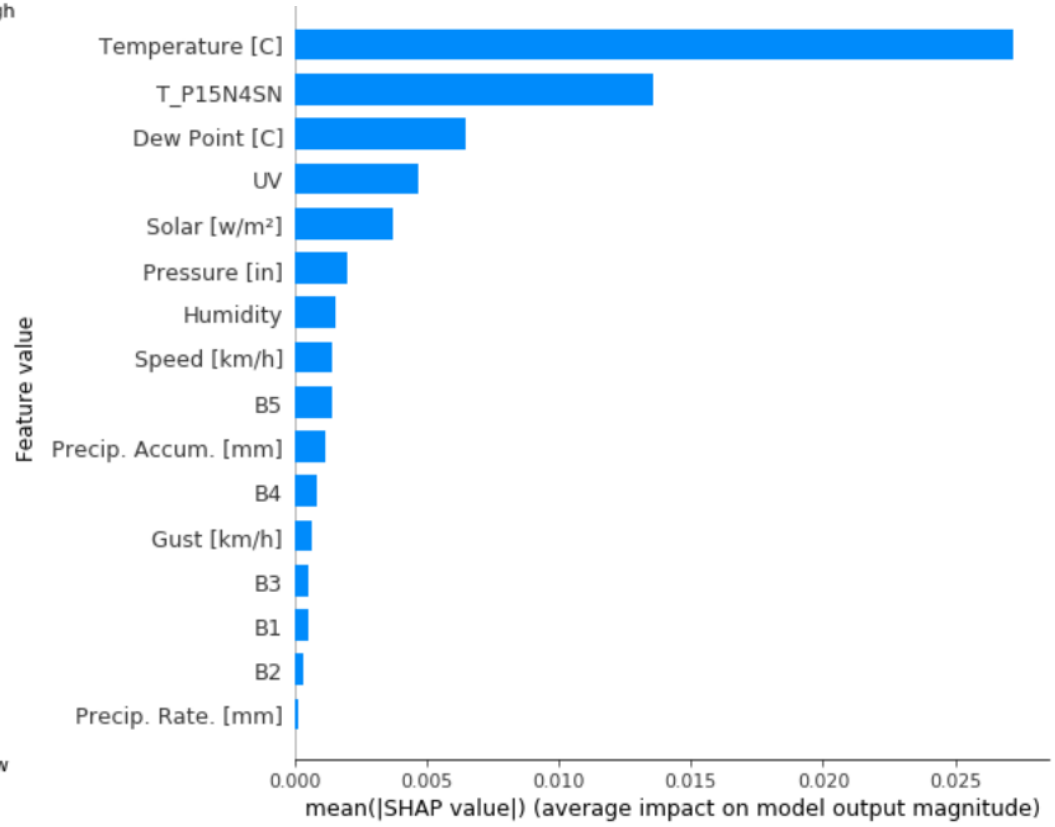
Drone navigation by onboard camera only

Data-driven explainable model for bridge monitoring, subtracting environmental effects

Ravbarkomanda highway bridge in Slovenia

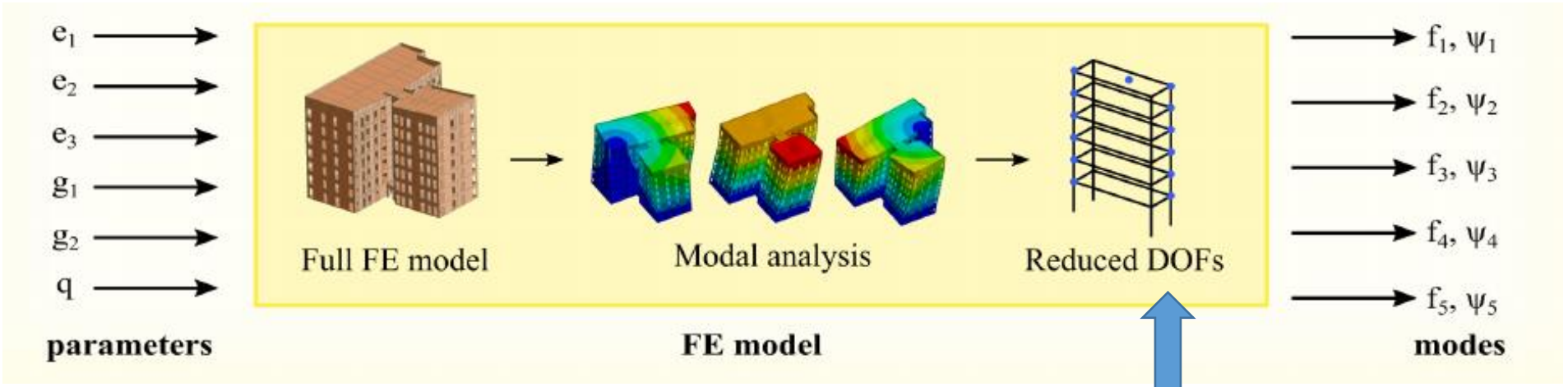


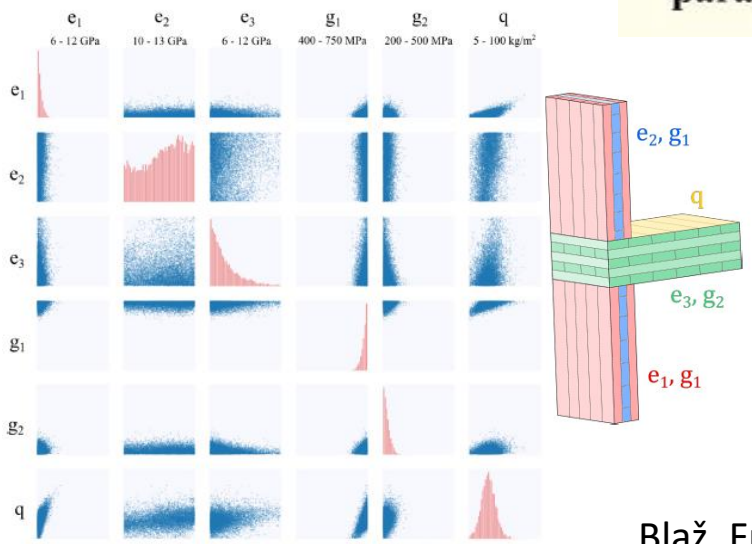
Local contributions of effects on eigenfrequency change of prestressed cables

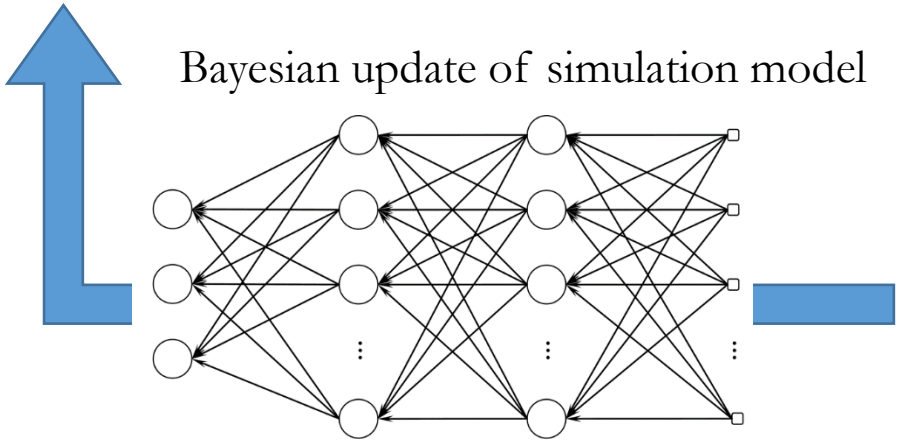


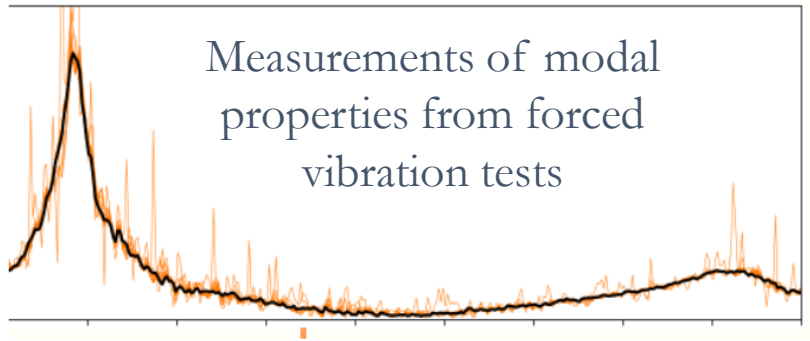
Influencing effects of cable eigenfrequency

Bayesian inference for design parameter update or digital twinning of building structures







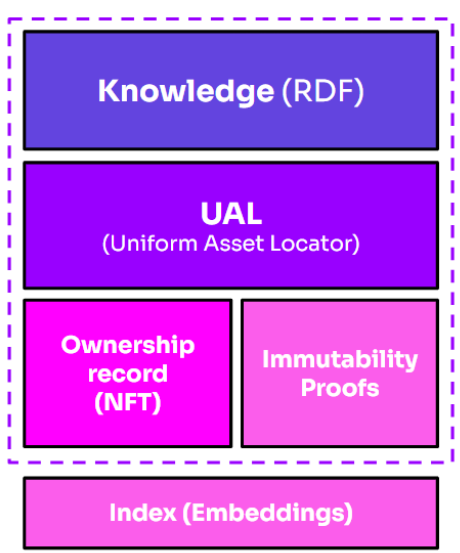


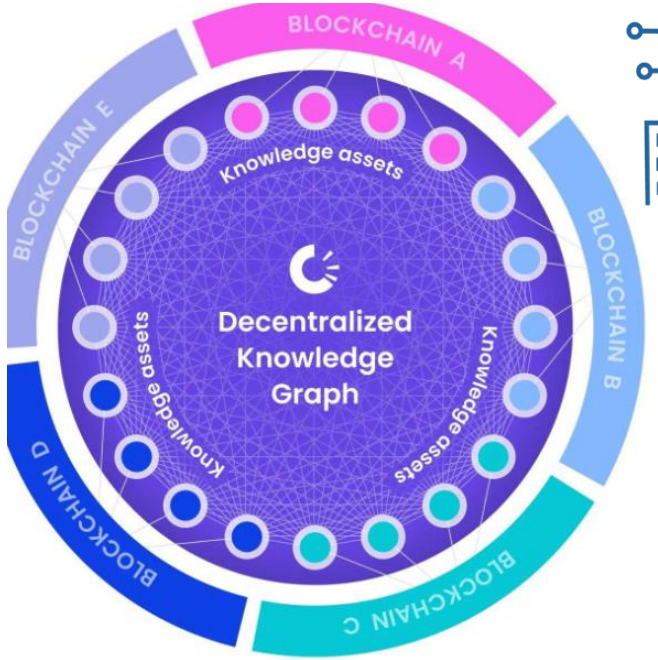
Blaž, Friedman et al. "Bayesian model updating of eight-storey CLT building using modal data." *Probabilistic Engineering Mechanics* 2024

Knowledge and data sharing by decentralized knowledge graphs – the BUILDCHAIN project

Funded by the European Union

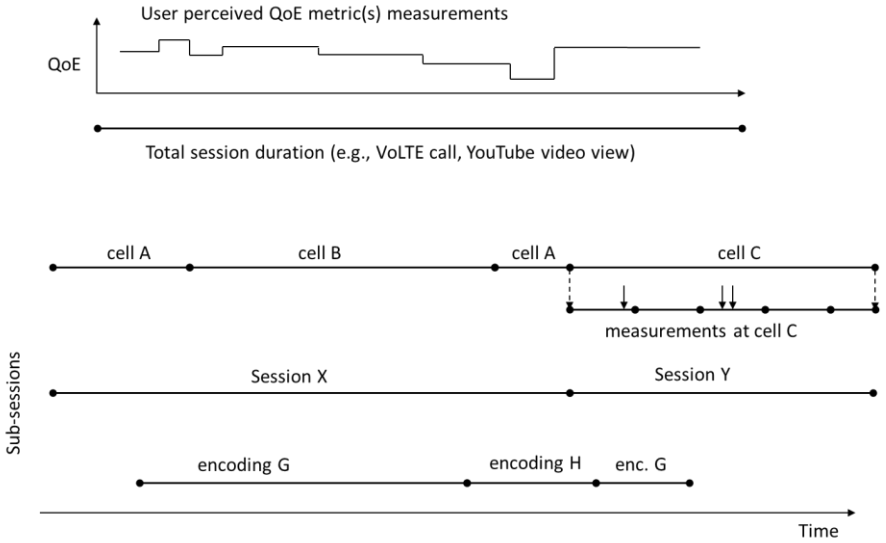
Knowledge assets live across chains and systems





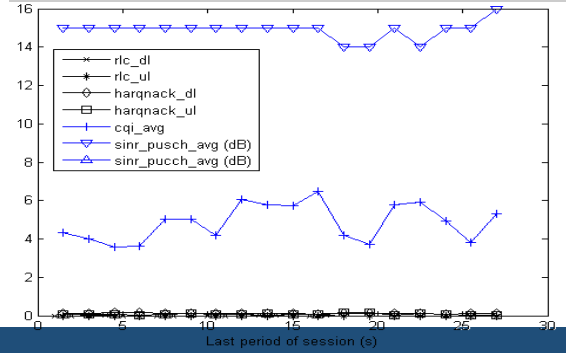
DKG platform will include specific **building-related ontologies**, so that the whole knowledge base about the life-cycle of the building can be logged and by that **continuously updated**, providing mechanisms and interfaces for the relevant stakeholders, to **publish, trace, share, tokenize**, end even **trade** models in a market economy.

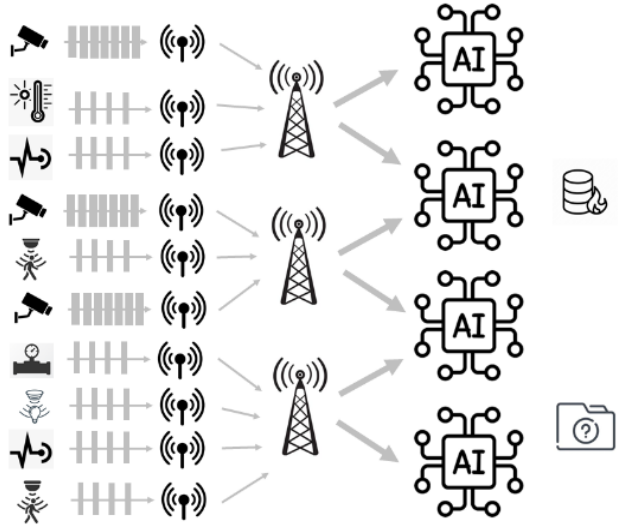
Data driven analysis in mobile networks



Session drop prediction

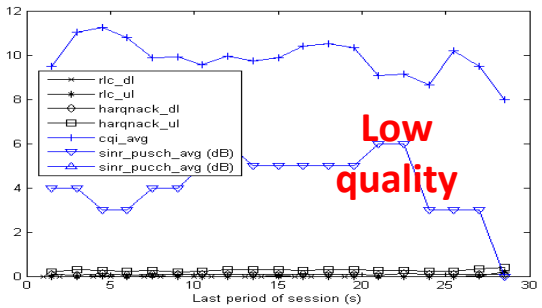
Daróczy, Vaderna, Benczúr. "Machine learning based session drop prediction in LTE networks and its SON aspects." VTC Spring 2015

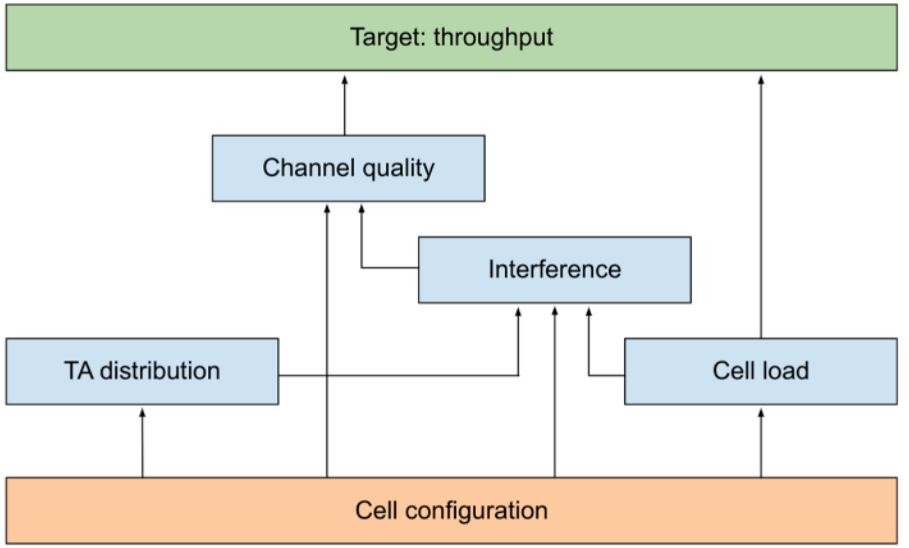




Dynamic load balancing

Merluzzi, Borsos, Rajatheva, Benczúr, ..., Uusitalo. The Hexa-X project vision on Artificial Intelligence and Machine Learning… *IEEE Access*, *2023*.



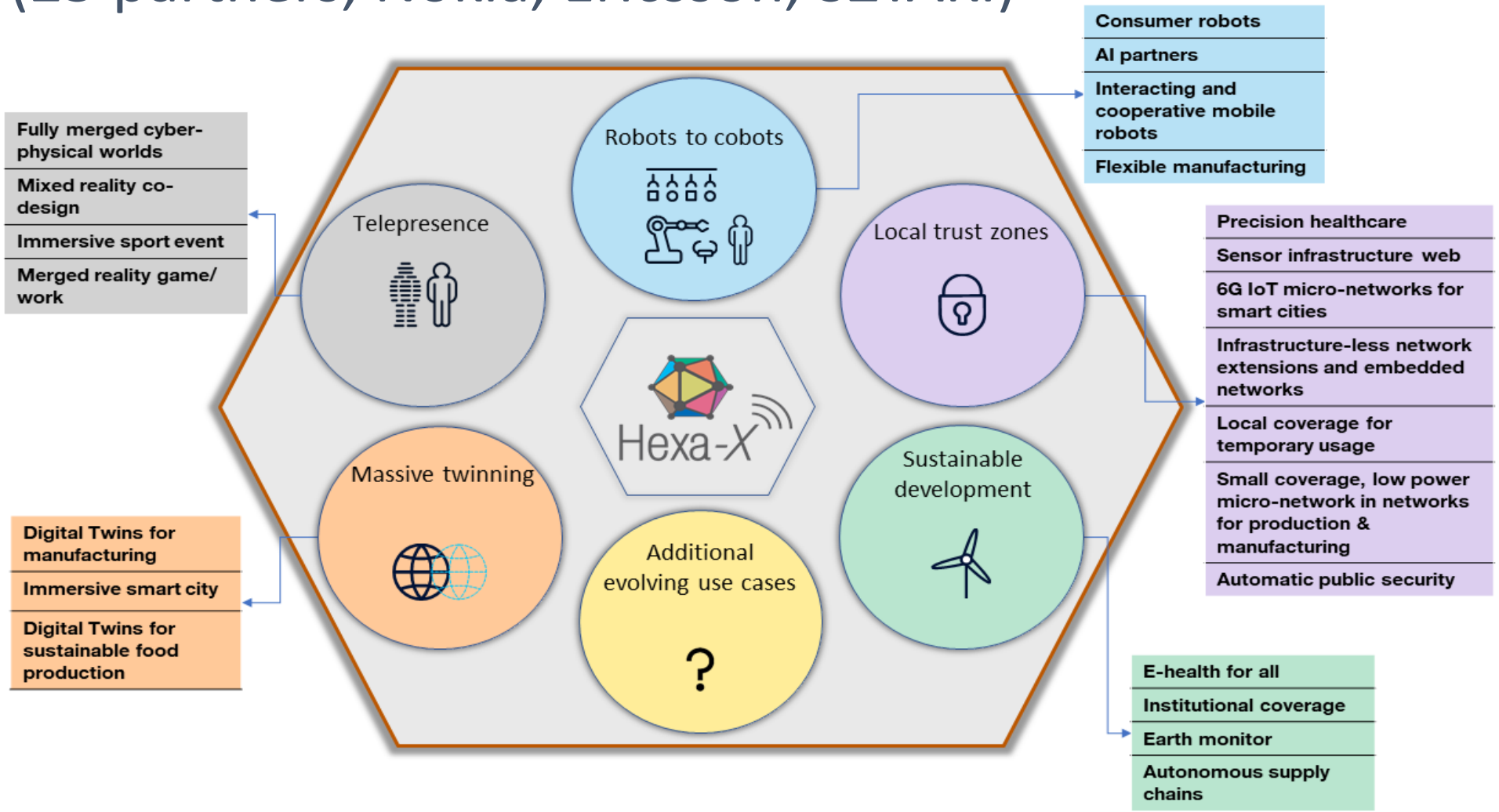


- Timing advance (TA): distance measured by radio
- Cell load: number and volume
- Interference: measurement
- Channel quality: delay, loss

Kelen et al. "Theoretical Evaluation of Asymmetric Shapley Values for Root-Cause Analysis." ICDM 2023.

AI in B5G / 6G Mobile Radio Networks

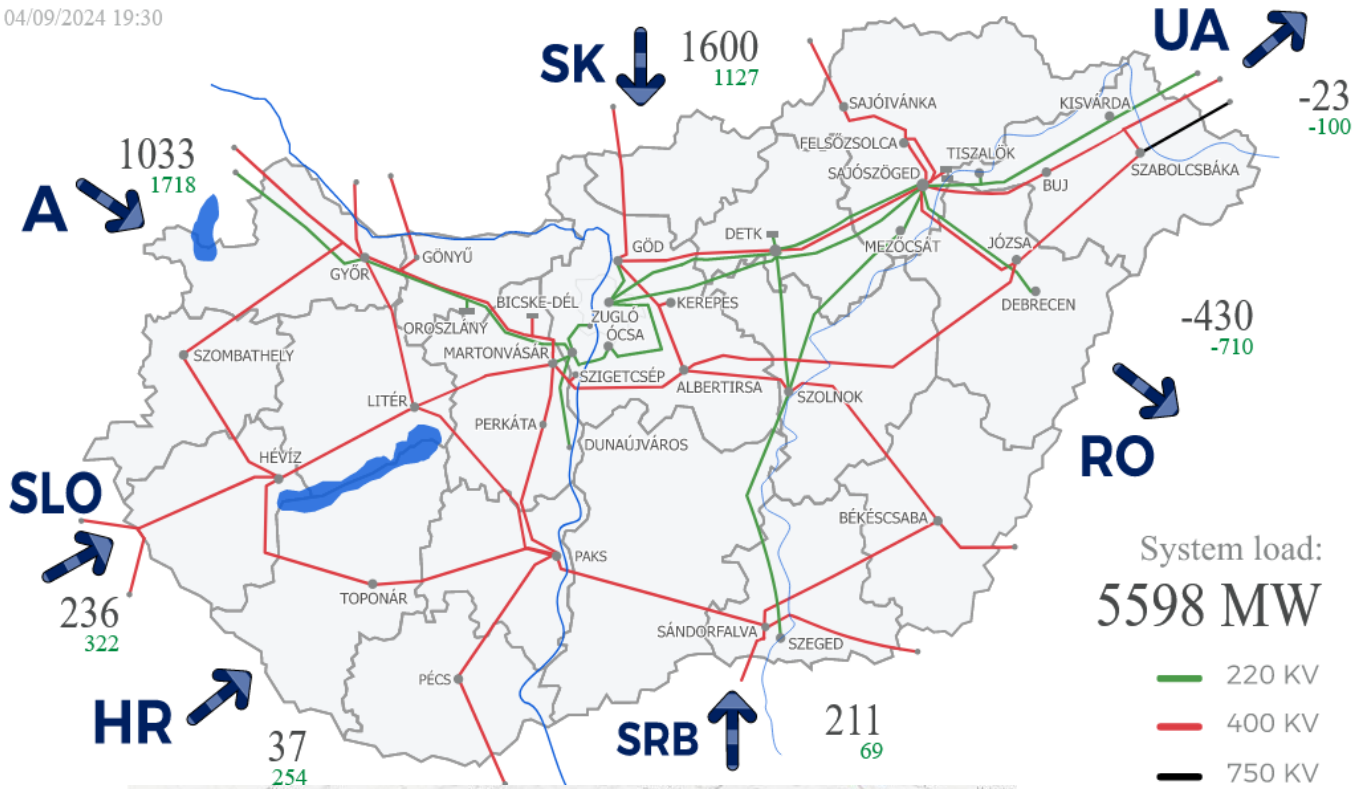
(25 partners, Nokia, Ericsson, SZTAKI)

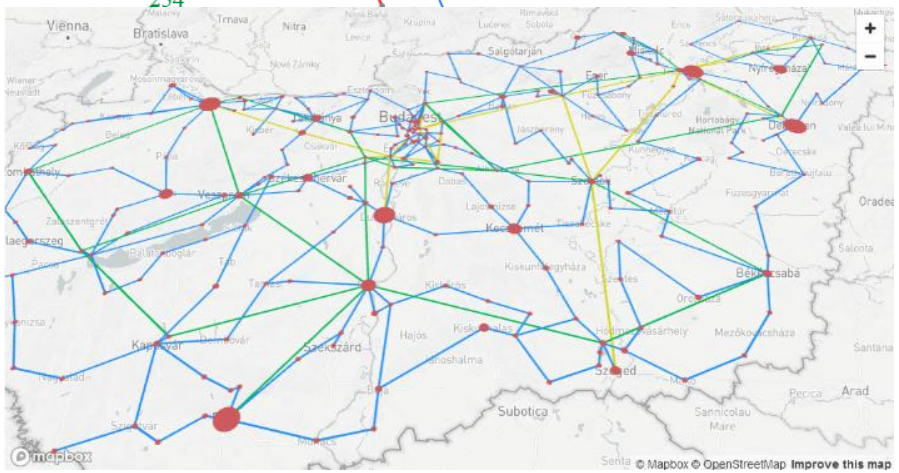


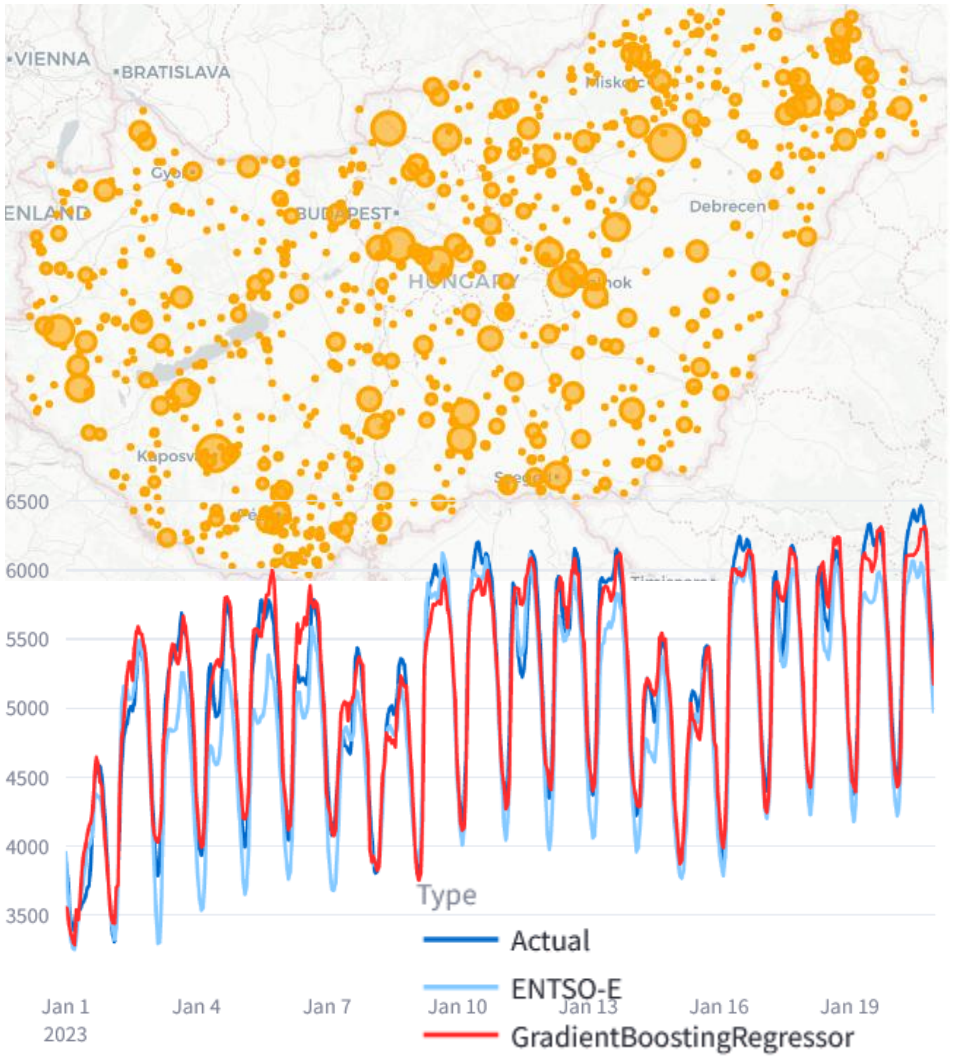
Hexa-X

H2020 B5G/6G Flagship

MAVIR Energy prediction







HUN-REN 2026-os AI stratégia– kidolgozás alatt

HUN-REN AI virtual institute

- Trustworthy and Sustainable Machine Learning - NTU Singapore collaboration
  - Theoretical guarantees; interpretable ML
  - Better energy efficiency by algorithmic improvements
- Generative AI for Science and Innovation - GenAI4Science, AI First Science
- AI in Medicine and Healthcare
  - Medical imaging: microscopy, CT, MRI, X-Ray, ultrasound, tumor diagnosis (chest, mammography, colorectal, prostate, etc), dental implants, etc
  - Computational biology: molecular evolution, insertion-deletion process (statistical alignment), RNA folding
  - Neuroscience: cognitive functions, brain disorders, neuro-inspired computation
- Industry, Vision and Robotics
  - Computer vision: object detection, classification, scene identification, video event detection
  - Robotics: reinforcement learning, human-machine interaction, cooperative robots

AI Mission topics

- Foundations of Machine Learning: Statistical machine learning; Uncertainty quantification; Representation learning; Information Geometry; Security, vulnerability, verifiability of AI models
- Generative AI
  - Foundation models for time series, tabular data, medical data
  - Credibility, verifiability and security of GenAI systems
  - Logical reasoning in GenAI
  - Hungarian Large Language Models, RAG systems
  - Security of generated software
- Data driven healthcare
  - Tumor biology; Electronic health records; Ageing research; Medical image processing
- Industry collaboration
  - Simultaneous localization and mapping, sensor fusion, model predictive control
  - Optimization, scheduling, path planning
  - Data driven methods: Root cause analysis, Predictive maintenance, failure and quality prediction
  - Manufacturing (Audi, Bosch), Telecommunications (Ericsson, Nokia), Finance (KSH, NAV, Treasury)

Thank you!

ARTIFICIAL INTELLIGENCE
National Laboratory

HUN REN | SZTAKI