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FUTURE IS AI

The Artificial Intelligence National Laboratory (MILAB) aims to strengthen Hungary's position in AI.

mi.nemzetilabor.hu

Artificial Intelligence National Laboratory

„Security and Privacy” subproject

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November 11, 2021

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Cooperating MILAB partners

- **Budapest University of Technology and Economics – BME**
- **Special Service For National Security – NBSZ**
- **Institute for Computer Science and Control – SZTAKI**
- **University of Szeged – SZTE**
- **Centre for Social Sciences – TK**

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1996 NEMZETBIZTONSÁGI SZAKSZOLGÁLAT

SZTAKI

UNIVERSITAS SCIENTIARUM SZEGEDIENSIS · SZEGEDI TUDOMÁNYEGYETEM ·

tk

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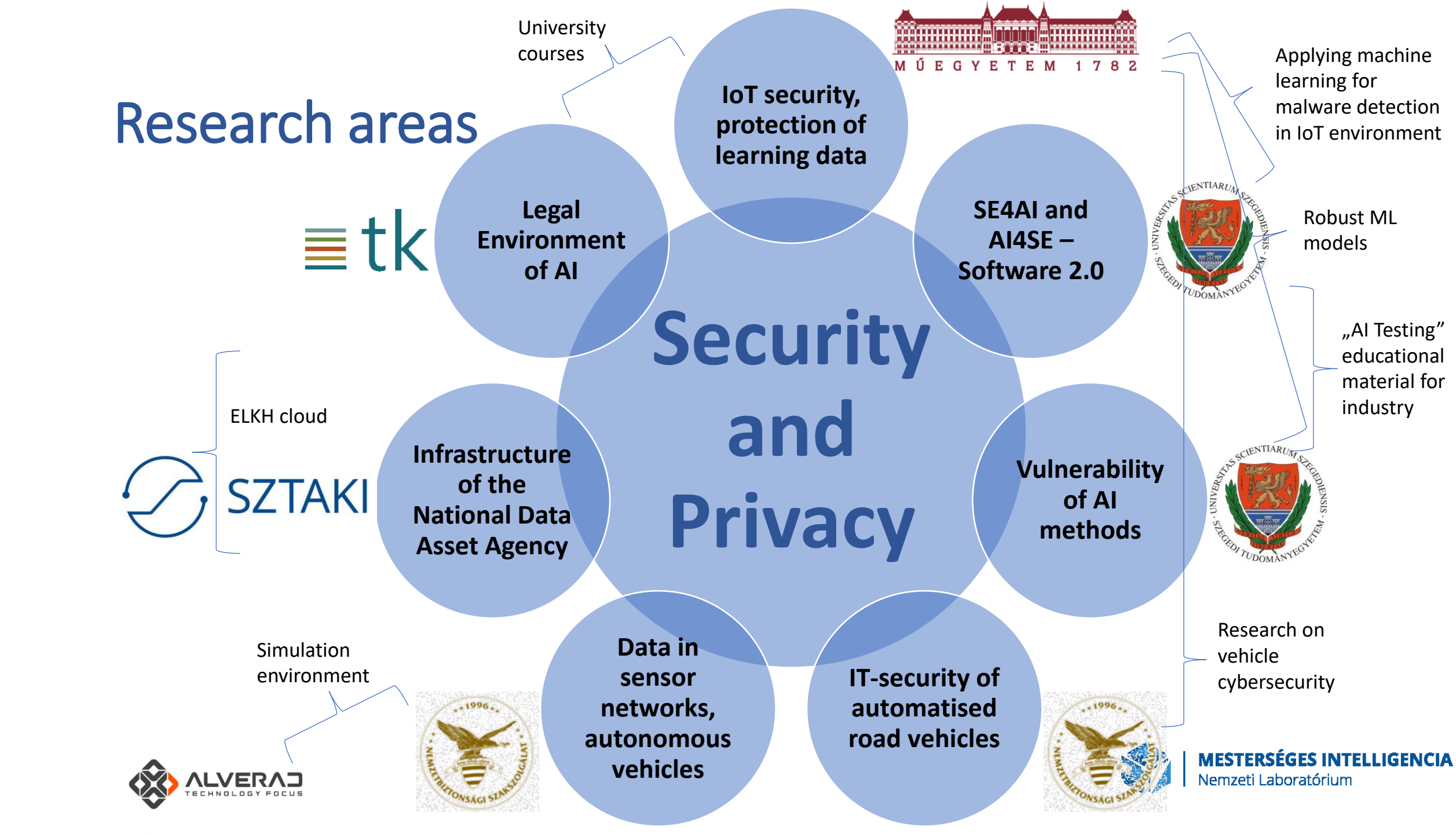
Research areas



Protection of learning data

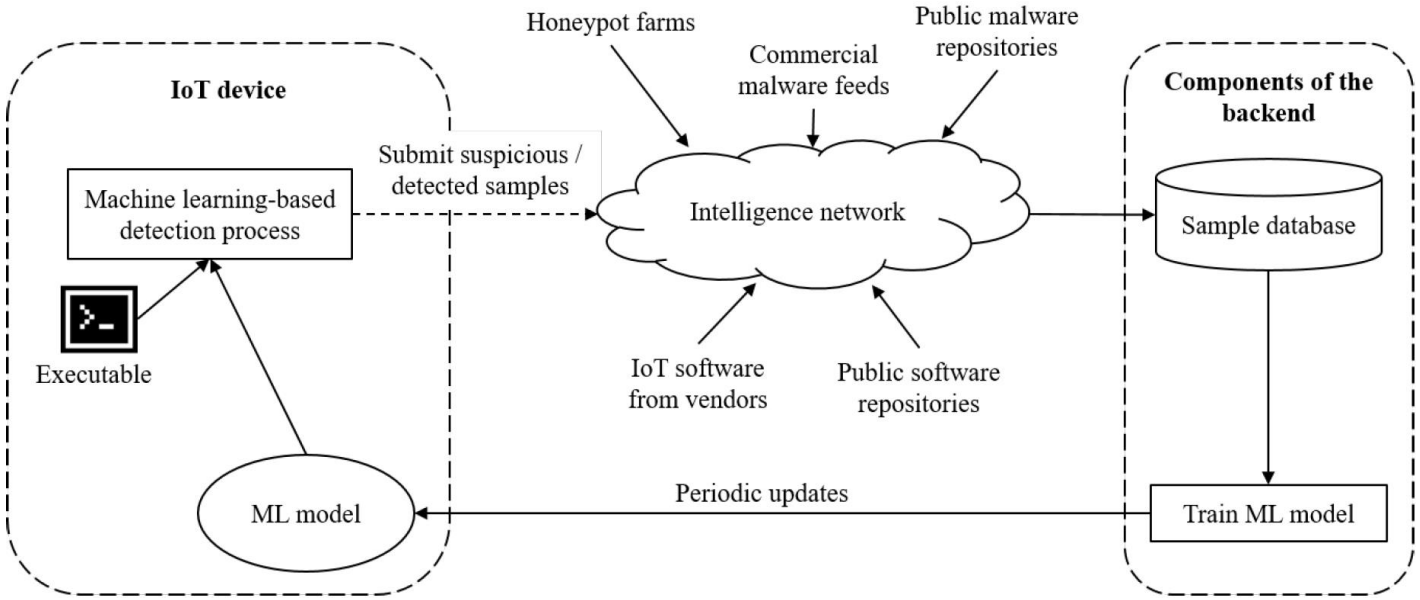
- Data protection in federated learning
  - Recovering gradients from aggregated gradients
  - Plans
    - ***Measuring contribution of participants*** – detecting free-riding and poisoning
    - ***Designing safe aggregation protocols*** – implementing weighted sum
- Anonymization of location data
  - Plans
    - ***Applying neural generative models***
- Robust ML models, detecting adversarial patterns
  - Plan
    - ***Detect robust features*** and use these during classification
    - [Possible cooperation with SZTE]

IoT security

- SIMBIoTA – malware detection method for IoT devices
  - Based on binary similarity instead of traditional signature database
  - Representative samples from clustered malware dataset
  - Database composed of fuzzy hash codes of the representative samples (size ~10 KB)
  - If a new file's fuzzy hash is similar to fuzzy hash in the database -> malware
  - 90% true positive detection, 0% false positives
- Plans
  - ***Develop SIMBIoTA/ML – Applying machine learning for malware detection***
  - ***Create adversarial examples for SIMBIoTA and SIMBIoTA/ML***
  - ***CFG-based malware detection with ML***

Applying machine learning for malware detection

- *[BME-SZTE common project]*
- Instead of using traditional malware signature-based database
- Train a ML model on the back end on both malicious and benign samples
  - Dataset needs to be created
- Transfer the model to the IoT device
- Detect malware using the ML model
- Plans
  - ***Create dataset***
  - ***Perform thorough ML process to find the best ML model using the Deep-Water Framework***



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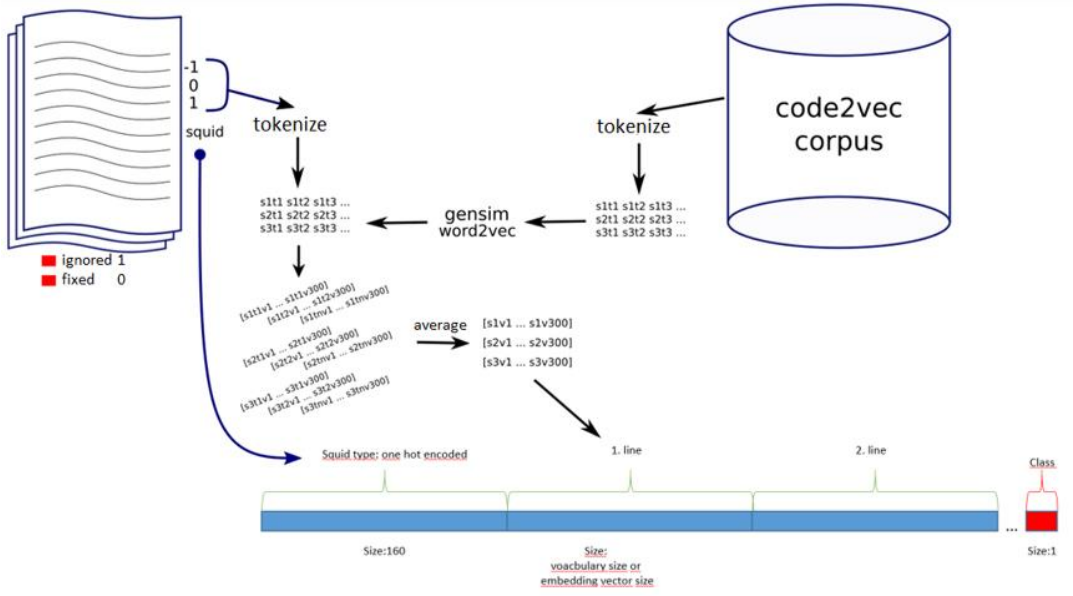
SE4AI and AI4SE – Software 2.0

- SE4AI – **S**oftware **E**ngineering methods for **AI**
  - Development tools, testing tools, ML Ops workflow, …
- AI4SE – **AI** methods for **S**oftware **E**ngineering
  - Bug prediction, automatic error correction, …
- AI4SE project:
  Applying NLP methods for programming languages
  - Large corpus of Java programs
  - Java language model based on embedding
  - Filtering the results of static code analyser tools
  - Train ML model on true and false positives
  - Plan
    Improve ML model which already filters
    78% of false positives and keeps almost all true positives



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„AI Testing” educational material for industry

- *[SZTE-SZTE common SE4AI project]*
- <u>SE4AI project:</u>
- Plan
  - ***Create a thorough educational material (lecture and practice) for „AI Testing” suitable to hold courses for the industry and at the same time useful for university courses***

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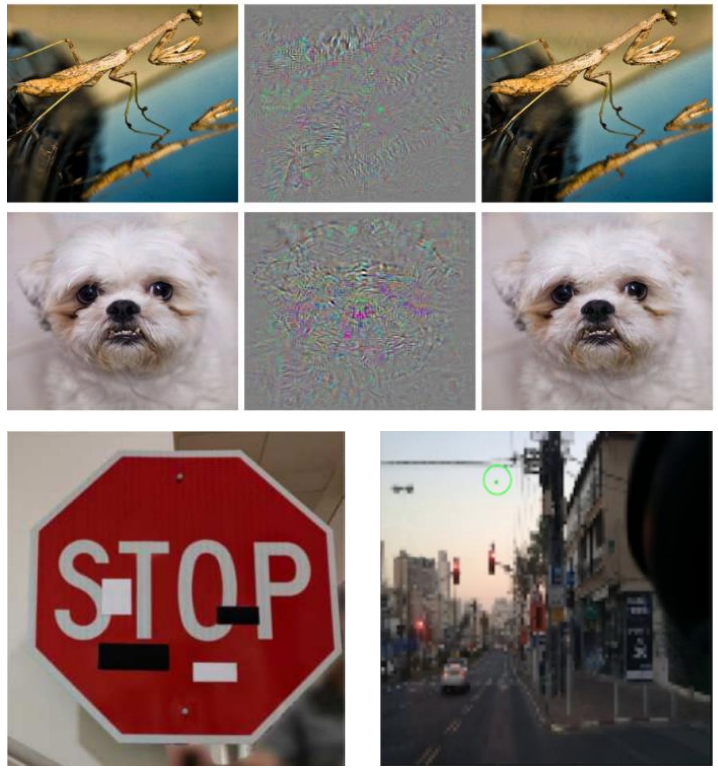
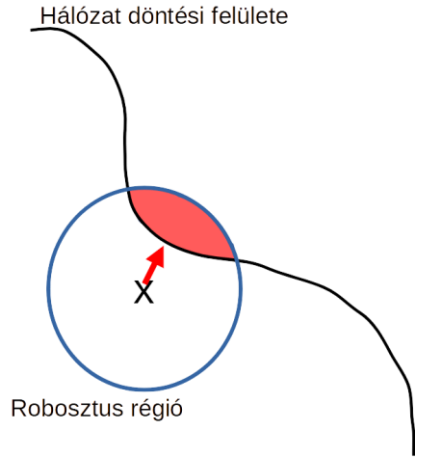
Vulnerability of AI methods

- Adversarial perturbations
  - The rightmost column is Ostrich
  - Stickers: 45 mph speed limit
  - One pixel: Green light
- Formal verification
  - Improve known formal verification methods
    - Optimisation methods, interval methods
  - Vulnerabilities of formal verification
    - Complexity, number representation
    - Adversarial models against formal verification





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Vulnerability of AI methods

- Heuristic verification
  - Vulnerabilities (unreachable adversarial subspace)
  - Attacks against heuristic verification
  - Innovative heuristic searches (matching subspaces)
    - Also for the “nothing” (OOD) and “something” (ID) examples
- Characteristics of robust networks, knowledge representation
  - The evolution of the neural network during learning
  - Characteristic structural features
  - Increasing the effectiveness of robust teaching
  - [Possible cooperation with BME]

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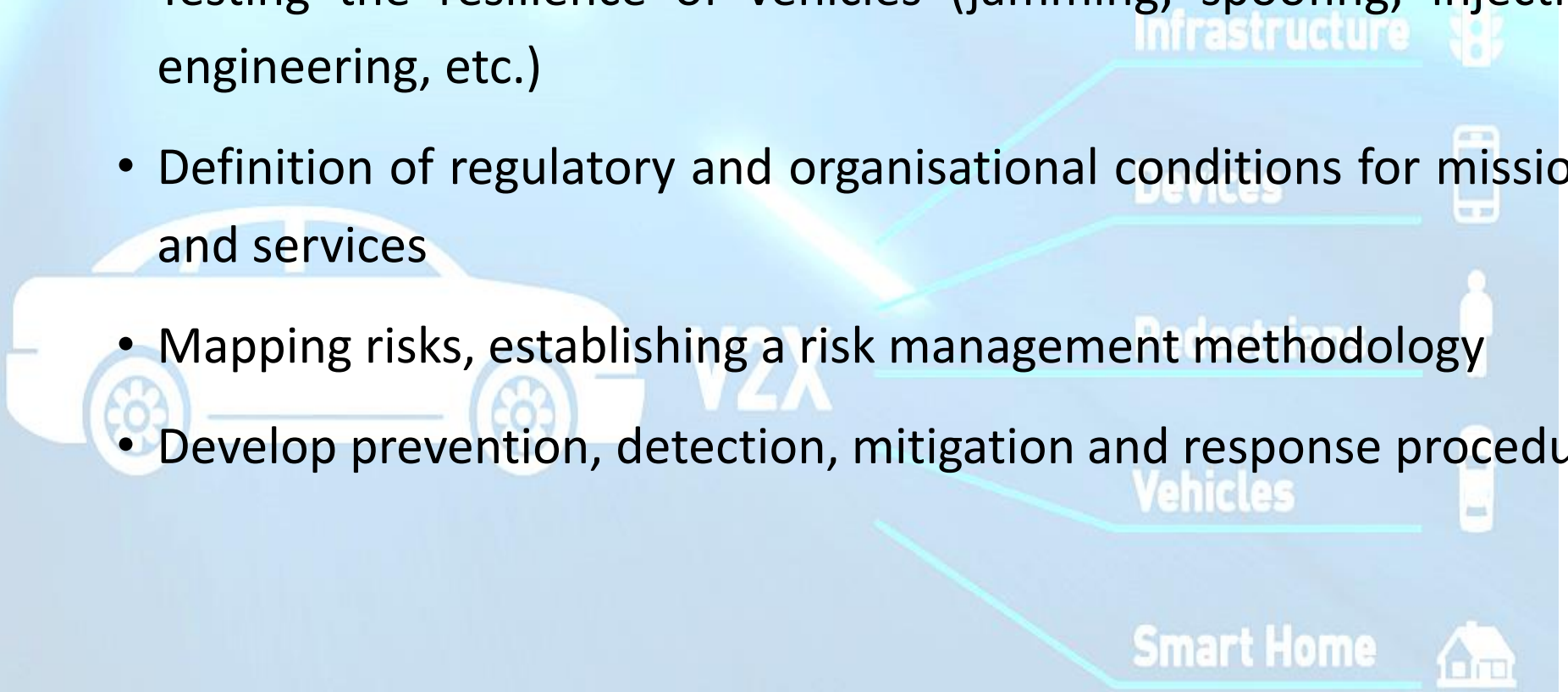
IT-security analysis of automatised road vehicles

- Identification of risk-critical system components
- Testing the resilience of vehicles (jamming, spoofing, injection, DoS, reverse engineering, etc.)
- Definition of regulatory and organisational conditions for mission-critical systems and services
- Mapping risks, establishing a risk management methodology
- Develop prevention, detection, mitigation and response procedures



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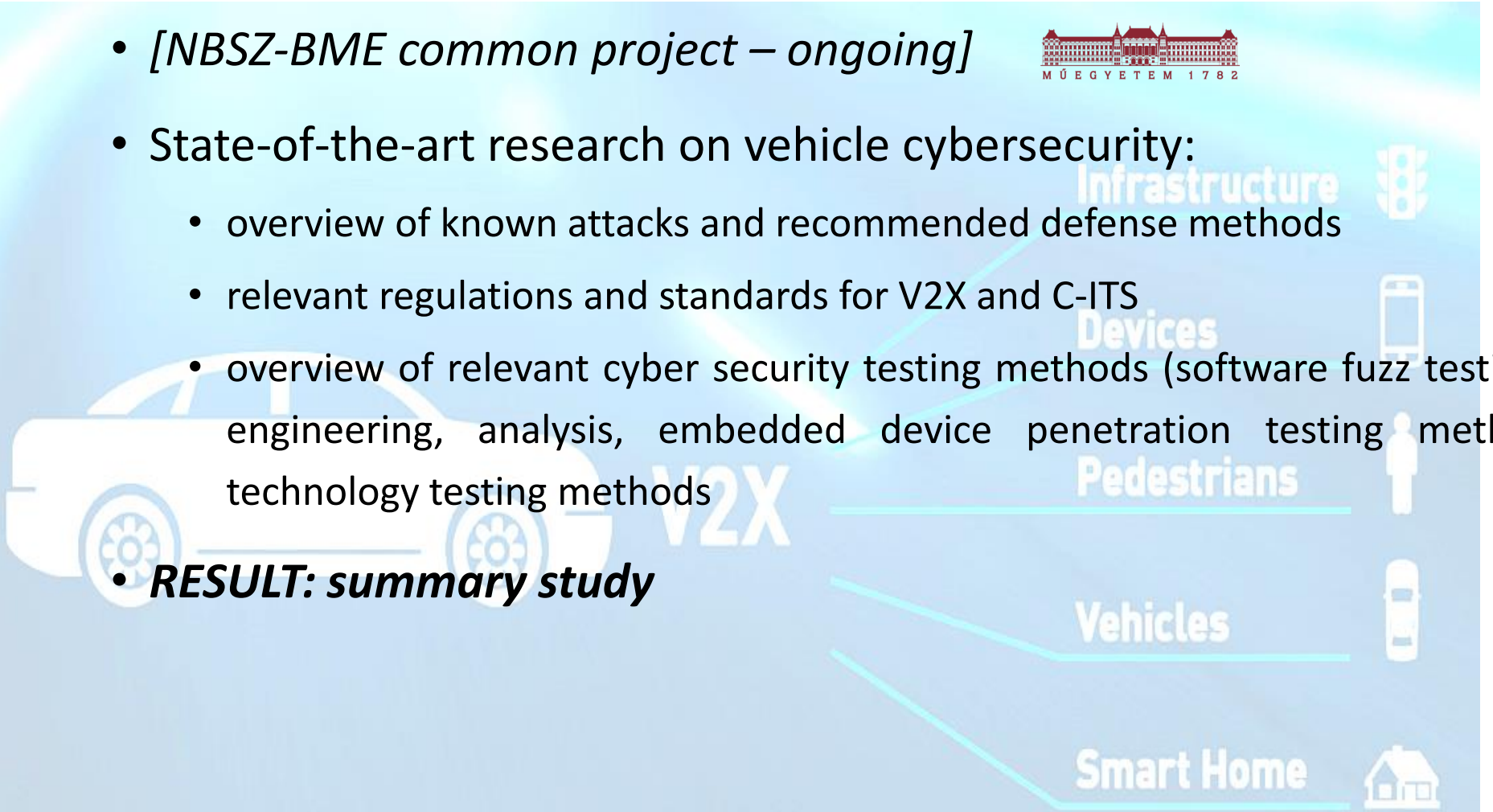
IT-security analysis of automatised road vehicles

- *[NBSZ-BME common project – ongoing]*
- State-of-the-art research on vehicle cybersecurity:
  - overview of known attacks and recommended defense methods
  - relevant regulations and standards for V2X and C-ITS
  - overview of relevant cyber security testing methods (software fuzz testing, protocol reverse engineering, analysis, embedded device penetration testing methods, V2X security technology testing methods
- ***RESULT: summary study***



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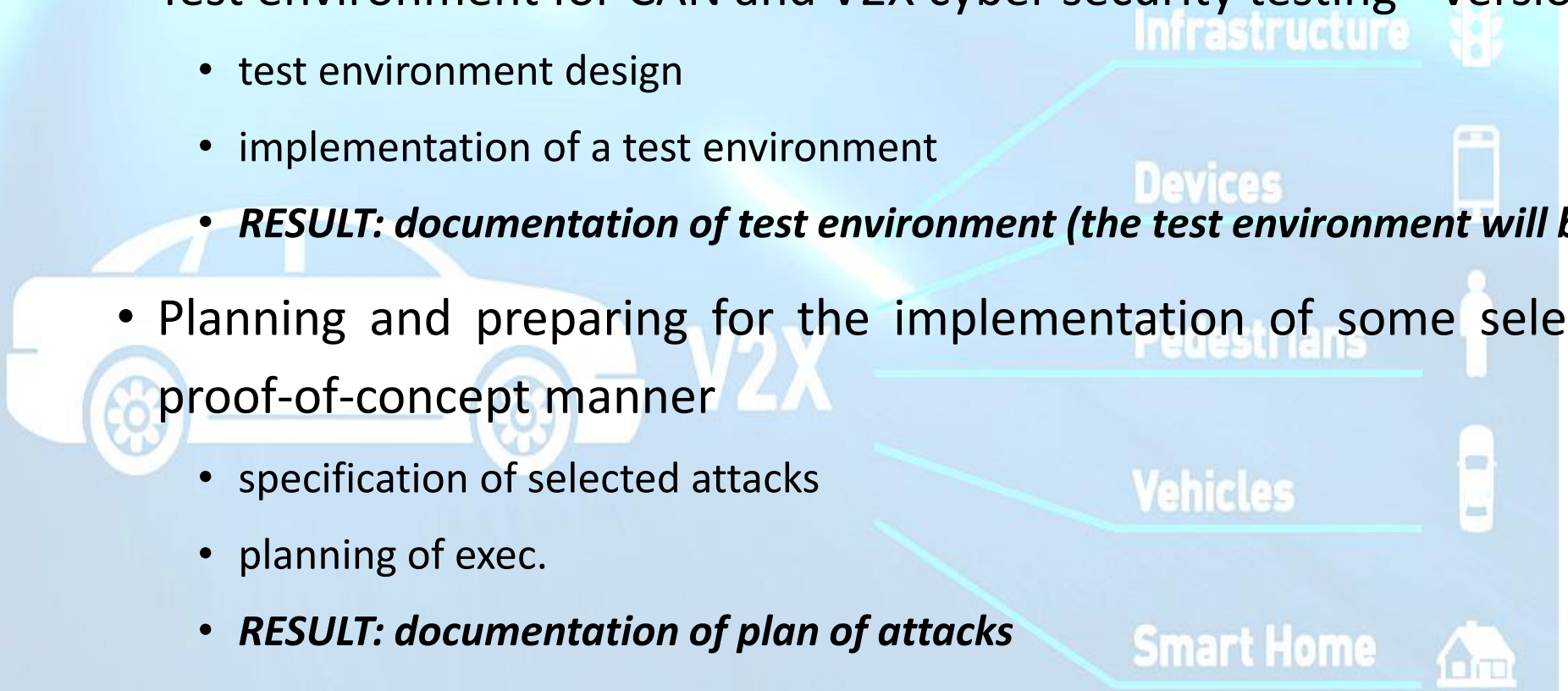
IT-security analysis of automatised road vehicles

- *[NBSZ-BME common project – 2021 plan]*
- Test environment for CAN and V2X cyber security testing - Version 1
  - test environment design
  - implementation of a test environment
  - ***RESULT: documentation of test environment (the test environment will be set up at BME)***
- Planning and preparing for the implementation of some selected attacks in a proof-of-concept manner
  - specification of selected attacks
  - planning of exec.
  - ***RESULT: documentation of plan of attacks***



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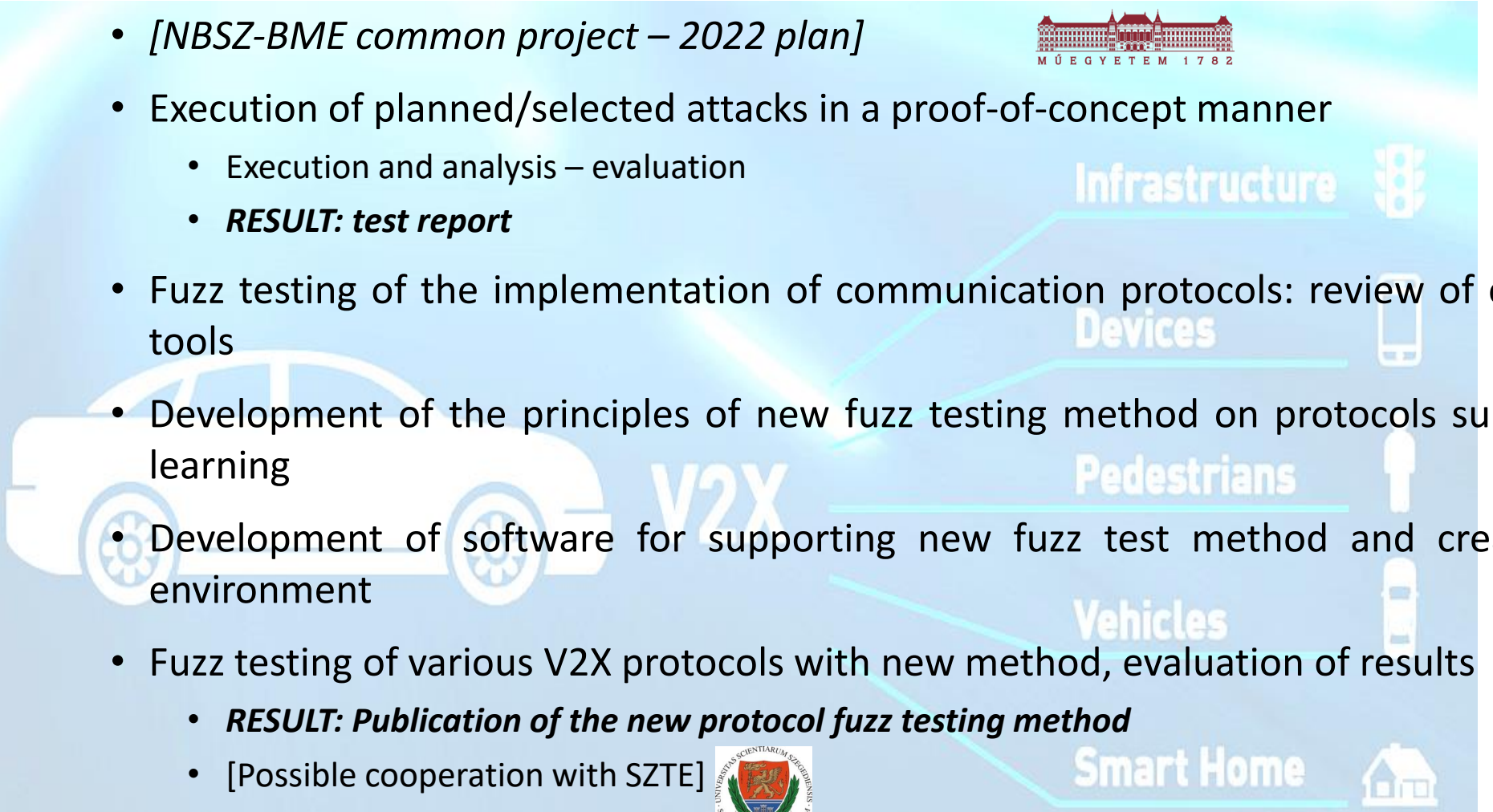
IT-security analysis of automatised road vehicles

- *[NBSZ-BME common project – 2022 plan]*
- Execution of planned/selected attacks in a proof-of-concept manner
  - Execution and analysis – evaluation
  - ***RESULT: test report***
- Fuzz testing of the implementation of communication protocols: review of exiting methods and tools
- Development of the principles of new fuzz testing method on protocols supported by machine learning
- Development of software for supporting new fuzz test method and creation of application environment
- Fuzz testing of various V2X protocols with new method, evaluation of results
  - ***RESULT: Publication of the new protocol fuzz testing method***
  - [Possible cooperation with SZTE]



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Data in sensor networks, autonomous vehicles

- Subsequent extraction of forensic data from computers in self-driving or smart vehicles
- Define environment for modelling C-ITS (Cooperative Intelligent Transport Systems)
  - Components, data communication, protocols, data categories (creates, stored, sent, …)
- Plan:
  - ***Identification of possible ways of extracting data***
    - Data stored by vehicles using C-ITS technology
    - Tools for data extraction (non-destructive and destructive)
    - Intentionally malicious communications
  - ***Establish simulation environment***
    - Own or rented
- [Cooperation with Alverad Technology Focus Kft.]
- [Possible cooperation with another company]

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Infrastructure of the National Data Asset Agency

- Participation in the design and prototyping of the public data portal and the academic-public administration hybrid cloud
- [Cooperation with National Data Asset Agency]

Legal Environment of AI

- Identification of problems in the current and future legal environment related to AI
- Carrying out basic legal research with the aim of mapping out possible directions using legal comparison methods, in particular the legal framework developed by the EU
  - protection of basic human rights
  - data protection and cybersecurity
  - liability issues and intellectual property law
  - EU and international law, Artificial Intelligence Act
- Formulation of concrete, enforceable and textual legal recommendations for the legislator in line with international law practice
- National and international programme series (AI and Law)
- [Possible cooperation with BME – University courses for IT students]

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Thank you very much for your attention

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