

Exploring the Mathematical Foundations of Artificial Intelligence

Balázs Szegedy - Dezső Miklós

National Excellence Programme (2018.1.2.1-NKP)

Horizon 2020 and beyond
Artificial Intelligence
2 July 2019, Budapest

GOALS

- Bridge the gap between theory and practice
- Firmly establish machine learning as a line of research in Hungary
- **Establish a competence centre** which integrates theoretical and applied research, providing the background for domestic practical applications

CONSORTIUM OF 5 MEMBERS



- Leader of the consortium: Rényi Institute
- Leader of the programme: Balázs Szegedy
- Started: September 2018, Duration: 3 years
- Funding by NKFIH, 3.1 M EUR
- Large portion of the funding spent on researcher wages

PROJECT HIGHLIGHTS: THEORY

- The theory of non-linear dimension reduction
- Holographic functions and neural nets
- Quadratic Fourier analysis
- Develop a notion and theory for natural datasets
- Tangential subspace of hierarchical models
- Tensor networks and Gibbs measures
- Quantum information

PROJECT HIGHLIGHTS: MODELS AND ALGORITHMS

- Interpretable models
- Natural Language Processing models
- Modeling complex distributions
- Adversarial robustness
- Training on small data
- Scalable architectures
- AI in multi-agent systems
- Automated theorem proving

PROJECT HIGHLIGHTS: APPLICATION SUPPORTING FUNDAMENTAL RESEARCH

- Projects supporting specific applications
- Natural language processing applications
 - With special focus on the hungarian language
- Object detection in autonomous vehicles
- Sense-and-avoid aircraft safety
- Sensor fusion
- Transfer learning, adaptation
- AI demonstration environments

PROJECT HIGHLIGHTS: EDUCATION AND DISSEMINATION

- Courses at ELTE (with Rényi and SZTAKI), PPKE, SOTE, SZTE
- Regular meetings for the project participants
- Seminars, Workshops

PROJECT HIGHLIGHTS: INFRASTRUCTURE

- Current AI technologies have high computational demand
- Infrastructure investments to accelerate research and education

INTERDISCIPLINARY PILOT PROJECT: Chronic Wound Therapy Suggestion



NEMZETI KUTATÁSI, FEJLESZTÉSI
ÉS INNOVÁCIÓS HIVATAL

AZ INNOVÁCIÓ LENDÜLETE

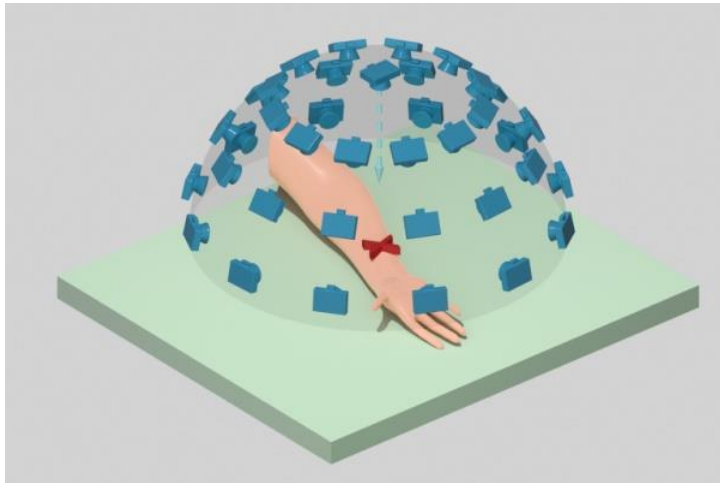
AZ NKFI ALAPBÓL
MEGVALÓSULÓ
PROJEKT

Chronic Wound Therapy Suggestion

- About 2% of the population of developed countries live with chronic (6+ weeks of healing time) wounds
- Untreated or mistreated these can lead to serious consequences such as amputations or even death
- The aim is an AI to recognize the status based on photographs and to give suggestions such as changing bandage type or sending the patient to surgery

3d Models of Wounds

- Since wound depth and tissue geometry can play a big part in the correct diagnosis, a 3d model of 5,000 wounds will be used as training set for the deep learning algorithm
- We cooperate with MedInnoScan Kft., an experienced AI team on this project and plan to make it available as a mobile application



¹Image included with patient approval for presentations. **No reproductions are allowed.**

THE FIRST STEP TOWARDS
building an AI Competence Centre in Hungary