TOWARDS ARTIFICIAL GENERAL INTELLIGENCE WITH APPLICATIONS

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THEMATIC EXCELLENCE PROGRAM 2019
INDUSTRY AND DIGITALISATION
APPLICATION DOMAIN SPECIFIC HIGHLY RELIABLE IT SOLUTIONS

PROJECT FINANCED FROM THE NRDI FUND
<table>
<thead>
<tr>
<th>Manpower</th>
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<tbody>
<tr>
<td>Doctor of the Academy</td>
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<tr>
<td>PhDs</td>
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<td>PhD students</td>
<td>9</td>
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<td>Programmer</td>
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<td>BSc and MSc students</td>
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Is it time to go for AGI?

- We have always been looking at neuroscience
  - to understand intelligence and cognition in mammalian evolution
  - to see missing components necessary for AGI
- Particular components
  - developing abstractions (e.g., 2D space for rodents, 3D space for bats)
  - developing metric in abstract spaces (hexagonal grid for rodents plus the numbers for humans)
  - goal oriented behavior and planning
  - columnar organization in the neocortex (none in rodents, abundant in primates)
- Evolution in deep learning follows intriguingly similar routes
  - in progress:
    - abstraction is called „disentanglement”, goal oriented behavior is called „learning to learn”
    - column-like structures overcome honoured convolutional neural networks – a breakthrough
From basic research to products

(a) Characterization of humans
  ➢ Intentions (gaze), activities (hand and body), content (speech and natural language processing), mood (facial expression, prosody, blinking).
  ➢ Joint work with Rush Medical School, Chicago and Argus Cognitive, Ltd (ELTE startup)

(b) Human-machine collaboration
  ➢ Interaction in diverse environments.
  ➢ HumanE-Al-Net is one of the five Flagship projects of the EU ICT-48 call. Starts in September 2020. It is led by DFKI and has 53 partners from Aalto to VW.
  ➢ SkinCare. Mobile application for Skin Cancer detection. EIT Digital project led by Degetel

(c) Industrial applications of AI
  ➢ Self-driving cars, image processing and others
  ➢ Bosch, Hungary supports the Department ➔ It is starting now
Example #1 – Bosch

• Detection of distance and speed of unknown objects
Example #1 – Bosch ➔ Safer products

(1,1) Depth+Optical Flow ➔ SuperVoxel
(2,1) 2D camera 3D depth estimation
(1,2) RGB
(2,2) Optical Flow
Example #2 – ELTE

Driver’s gaze
Front view from $360^\circ$ camera

$360^\circ$ camera
Back view from $360^\circ$ camera

More comfort

Visually enhanced speaker separation
Example #3 – Rush Med School

- Autism
- Quantifying diagnosis
  - interaction and
  - collaboration
Example #4

SkinCare: An EIT Digital project
Mobile application
Approach: Information Fusion

Leader: Degetel (France)
Partners
• DFKI Saarbrücken
• Semmelweis University

• **Diverse expertise are to be combined**
  • Data sharing is a critical bottleneck
  • Similar problems arise in many industrial applications

→ Next: Covid EU proposal
Example #5

- Combining expertise of
  - AI experts
  - Domain experts
  - Programmers

→ Bosch, Rush, Semmelweis
Underlying basic research

- Single network solves many tasks
  - One Network solves them all
- Single networks learns and solves many tasks
  - One Network learns them all

- **Ongoing and future directions**
  - Multi-Task Learning (1)
  - Meta-Learning
  - Reinforcement learning (2)

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**PID:** pixelwise inpainting

**BI:** blockwise inpainting

**SI:** scattered inpainting

**SR:** superresolution

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**PID**

**BI**

**SI**

**SR**

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**Diff. Unr. ADMM OneNet**

Original OneNet [3]
PLANS

WE JUST KEEP WALKING:

• Multi-Task Learning
  • single network – single architecture made of many subnetworks

• Meta-Learning
  • guessing novel networks from previously learned ones

• Seeking consistence among the networks of the architecture (1)

• Reinforcement Learning

https://tinyurl.hu/fduy/
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