

Institutional Cooperation

National Institute of Informatics (NII) ⇔ TU Wien

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Institute of Logic and Computation
Knowledge-Based Systems Group
Vienna University of Technology (TU Wien)

Japanese Science Day, October 5, 2024, Vienna



Informatics



National Institute of Informatics (NII)

Inter-University National Research Institute dedicated to Informatics

- ~ 350 researchers
- ~ 130 graduate students
- ~ 150 clerical & support staff

Research areas

- *Principles of Informatics*
Mathematical Informatics, Intelligent Informatics, Quantum Information, Mathematical Logic
- *Information Systems Architecture*
Information Network, Computer Architecture, Software infrastructure, Software Engineering
- *Digital Content and Media Sciences*
Foundation of content management, Text & Language Media, Pattern media, Human & Knowledge media
- *Information and Society*
Information use, Science Information, Information Public Policy



Memorandum of Understanding (MoU) NII ⇔ TU Wien

MoU: foster NII international research exchanges towards excellence

- Formalize cooperation at the institutional level
- Signed between TUW and NII 2009

Main actors

- Faculty of Informatics
- Atomchip Group (Faculty of Physics, TU Wien)
& Quantum Centre

Topics

- Privacy, security, and Risk Management Technology (2009)
- Knowledge Representation and Reasoning Methods (2015)
- Quantum Physics (2015)
- Inconsistency Management in Reasoning Systems (2009-2015)
- Verification and Formal Methods (2022)
- Artificial Intelligence and Web (2022)

Exchange program

- Researchers
- NII International Internship Program (MSc / PhD students), since 2010
 - 39 internships so far



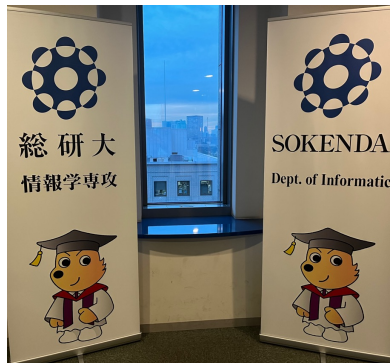
austrian signatories: BP Fischer, Minister Hahn, VR Kaiser

Security, Privacy & Risk Management Technology

Long term collaboration between Prof. Isao Echizen and Prof. Edgar Weippl (Secure Business Austria Center/TU Wien)

Joint research topics combining **NII** and **TU Wien** expertise

- **Multimedia Security**
multimedia forensics and security in distributed systems to detect forgery and protect privacy in multimedia
- **QR Code Security**
robust message hiding within QR codes intersecting QR code security
- **Privacy in Electronic Health Records**
privacy concerns in electronic health records privacy resp. broader information security
- **Blockchain and Cryptocurrencies**
connect expertise in cryptography with blockchain technologies, esp. for security in distributed systems
- **Obfuscation and Detection Techniques**
complement forgery detection using neural networks with software obfuscation



Security, Privacy & Risk Management Technology, cont'd

- Annual lab visits of Prof. Weippl
- Visiting Professor at NII
- Collaboration on a number of PhD theses, several NII Internships



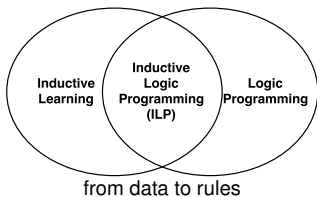
Edgar Weippl at Isao Echizen's Lab – discussion on ongoing PhD theses

Future Possible Joint Research Topics

- *Privacy-preserving AI and Machine Learning*
preventing data leaks, ensuring ethical AI use, secure training algorithms
- *Digital Watermarking and Information Security*
techniques for embedding and protecting data in media files, prevent piracy and unauthorized distribution

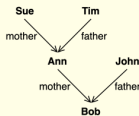
Knowledge Representation & Reasoning

Inductive Logic Programming



Meta-interpretative Learning

Example



Meta-Rules:

$P(x, y) \leftarrow Q(x, y)$
 $P(x, y) \leftarrow Q(x, z), R(z, y)$

Background Knowledge (B):

$mother(ann, bob)$ $mother(sue, ann)$
 $father(john, bob)$ $father(tim, ann)$

Positive Examples (P^+):

$ancestor(sue, bob)$ $ancestor(john, bob)$
 $ancestor(tim, bob)$ $ancestor(ann, bob)$

Negative Examples (P^-):

$ancestor(bob, tim)$

Hypothesis:

$p1(x, y) \leftarrow mother(x, y)$
 $p1(x, y) \leftarrow father(x, y)$
 $ancestor(x, y) \leftarrow p1(x, y)$
 $ancestor(x, y) \leftarrow p1(x, z), ancestor(z, y)$

Reference system: Metagol (Imperial College)

- limit search space by rule patterns
- powerful learning (predicate invention, recursive rules)

Contributions

- Use Answer Set Programming (ASP, aka declarative combinatorial search)
- Provide techniques to leverage ASP solvers
- Achieve performance boost

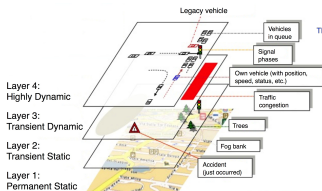
- Prof. Katsumi Inoue, Tobias Kaminski
- ICLP 2018 Best Paper Award

Semantic Web

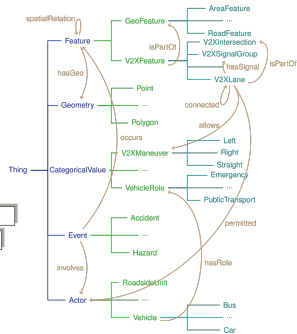
Cooperative Intelligent Transportation Systems



V2X Technology



Local Dynamic Map



Ontology

Detect events, e.g. vehicle breakdown, by semantics-enhanced query answering

- classes and relationships
- spatio-temporal relations

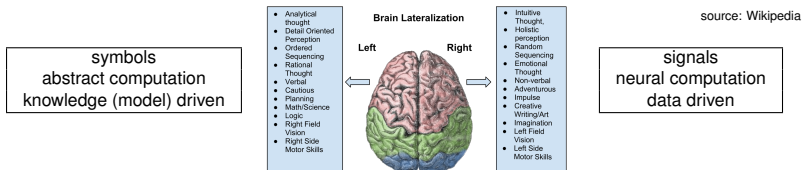
vehicle breakdown | vehicle x has stopped for longer than 30s, while it is located inside an intersections y , but not on one of the park lanes

$q_{2.4}(x, y) : \text{Vehicle}(x), \text{speed}(x, r)[\text{avg}, 30s], (r < 1), \text{inside}(v, u), \text{pos}(x, v)[\text{line}, 15s], \text{hasLoc}(y, u), \text{Intersection}(y), \text{during}(v, r), \text{disjoint}(v, z), \text{hasLoc}(p, z), \text{ParkLane}(p)$

- Prof. Ryutaro Ichise, Patrik Schneider
- EKAW 2018 (runner up), Semantic Web Journal 2020

Artificial Intelligence

Neurosymbolic AI: Reconcile Symbolic and Subsymbolic AI



Visual dataset generation using ASP



- Images to test the capabilities of neurosymbolic systems on constrained data

- Prof. Katsumi Inoue, Nelson Higuera
- In progress (2024)

Neurosymbolic AI for autonomous driving



- NII's MWIT Team won the ROAD-R challenge 2023 (annotated videos, knowledge like “a traffic light cannot be red and green at the same time”)