

## **Worldwide AI**

### **Switzerland**



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■ *Although Switzerland is a small country, it is home to many internationally renowned universities and scientific institutions. The research landscape in Switzerland is rich, and AI-related themes are investigated by many teams under diverse umbrellas. This column sheds some light on selected developments and trends on AI in Switzerland as perceived by members of the Special Interest group on Artificial Intelligence and Cognitive Science (SGAICO) organizational team, which for more than 30 years has brought together researchers from Switzerland interested in AI and cognitive science.*

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### **Artificial Intelligence Research in Switzerland**

Artificial intelligence research in Switzerland began about the same time as in other European countries. Various teams in academe and industry in Switzerland worked on practical and theoretical problems of interest to the worldwide AI community. During the prosperous phase in the 1980s, when expert system technology enjoyed its first wave of popularity, a lively Swiss AI community existed, organized under the umbrella of the Swiss Informatics (SI) society in the Swiss Group on Artificial Intelligence and Cognitive Science (SGAICO).<sup>1</sup> SGAICO pursued the ambitious mission of bringing together researchers, practitioners, and other parties interested in AI and cognitive science successfully during its first years. The society had more than 200 active members and held regular workshops, conferences, and other activities. A highlight of these years was the annual AI in finance conference, held amid the beautiful scenery of Lugano.

The AI winter hit the Swiss community rather hard. SGAICO membership declined heavily as artificial intelligence was considered to be a nonserious activity that made unreachable promises. As a result, AI activities faded away. For the next 15 years, SCAIGO and the Swiss AI community entered a hibernationlike state. SCAIGO

membership declined to about 40 members and most universities did not have an AI chair or offer AI courses in their curricula. One notable exception was École Polytechnique Fédérale de Lausanne (EPFL), where Boi Faltings and his team made significant contributions to the area of constraint optimization. Other research groups would also continue to work in areas such as robotics, computer linguistics, or search algorithms, but would often not see themselves as part of the worldwide AI community that gathers at conferences such as AAI, IJCAI, or ECAI.

The relative quietness of AI in Switzerland did not prevent companies looking at AI technology as a potential key driver for innovation. One example of this was Schindler, a worldwide maker of elevators. Schindler became interested in AI planning after the first AI planning competition in 1998 and soon after started to develop an AI-based control algorithm for its products based on destination control.<sup>2</sup> Today, these algorithms are the most sophisticated in the elevator market and made the company's destination-control products a huge commercial and award-winning success. Many other, smaller, technology-savvy companies and startups enjoyed similar successes, all of which have led to a growing need for AI specialists in Swiss industry.

## Current Lines of Research

With the recent AI-based technology successes, interest in AI in Switzerland has resurged. In the fall of 2012, the Swiss Informatics Society put SGAICO under direct guidance of the SI president to prevent the closure of this special interest group. A diverse team of researchers was asked to help revive the group and a small amount of money was granted to restart it. The organizing team included researchers from the University of Basel, EPFL Lausanne, and three universities of applied sciences in Zurich, Lucerne, and Western Switzerland (HES-SO), who brought in numerous academic and industrial contacts. The team has launched several successful events and continues to bring energy to the AI and cognitive science community. SGAICO puts specific emphasis on joining contacts between universities, applied research, and industrial applications and on reintegrating the AI and cognitive science communities within the country, where of course much remains to be done.

In the following paragraphs, we provide selected pointers to groups in Switzerland that work in specific subfields of AI.

### Planning, Scheduling, and Constraint Reasoning

The areas of planning, scheduling, and constraint solving are currently being studied at the Universi-

ty of Basel in the group led by Malte Helmert. A team at Lucerne University of Applied Sciences has a similar technology focus with a strong emphasis on embedding these technologies into product innovations for Swiss companies. Current projects in Lucerne include control algorithms for major Swiss players in the machine industry, applications in medical diagnosis, forensics, and social welfare.

### Machine Learning and Data Science

The Swiss IDSIA lab is a pioneer and major proponent of deep learning. Jürgen Schmidhuber's team at IDSIA recently won several prestigious pattern-recognition competitions using deep neural architectures.<sup>3</sup>

ETH Zurich has appointed several chairs working in machine learning and, for example, organizes the Zurich Machine Learning and Data Science Meetup, which easily attracts around 100 attendees for an evening of three technical lectures.

One possible explanation for the recent and very strong interest in machine learning might be the trend toward big data that has been widely recognized among industry and academic representatives alike. Much interdisciplinary work is done under the headline of data science. For example, the Datalab at the Zurich University of Applied Sciences is one of the first interdisciplinary groups in Europe devoted to the creation of data products for and with the industry. Recent results include medical applications, data-driven condition monitoring approaches, and specialized information retrieval systems.<sup>4</sup>

### Information Retrieval, Natural Language Processing, and Computer Linguistics

A lively and internationally well-connected information retrieval community exists with notable groups at the University of Geneva, the Universities of Applied Sciences of Western Switzerland (HES-SO) and Zurich, the University of Neuchatel, IDIAP (an Institute affiliated with EPFL), and the Università della Svizzera italiana (USI). As an example, we mention the CLEF and ImageCLEF yearly evaluation competitions,<sup>5</sup> in which Henning Müller and Martin Braschler are engaged.

Work in natural language processing and computer linguistics is also strong, in particular in Zurich and the IDIAP institute. An interesting application of natural language processing is, for example, the paperless parliament in the Canton of Valais, where all protocols are generated automatically based on algorithms developed at IDIAP.

### Multiagent and | Cognitive Systems, Robotics

Another subfield that has attracted both theoretical and practical research is multiagent systems. There are several Swiss research teams, such as

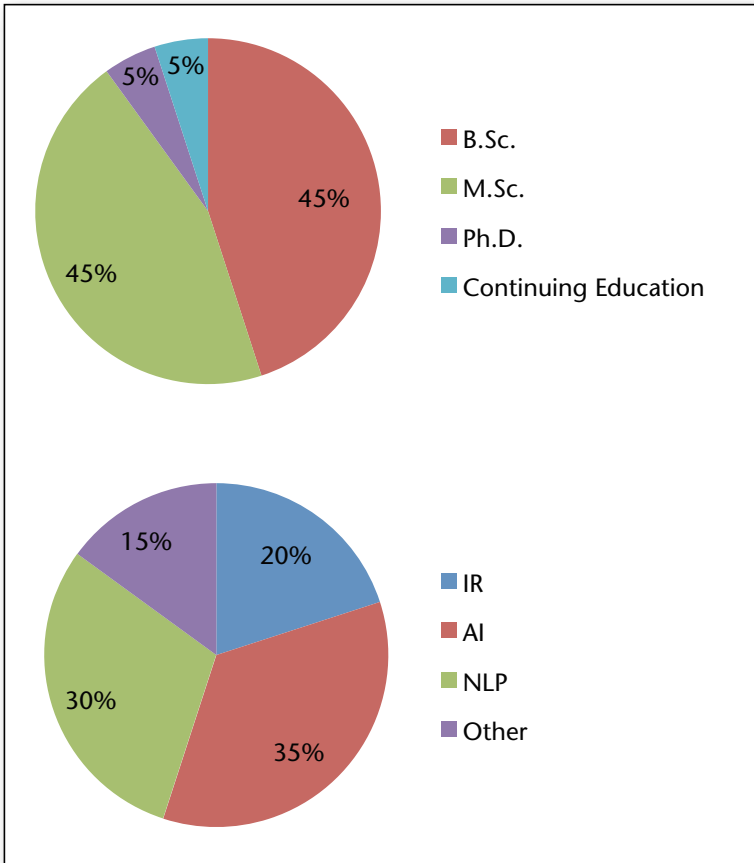


Figure 1. Distribution of AI Courses.

Organized by degree program (left) and subdiscipline (right). Overall, 21 courses by 8 Swiss universities have been surveyed.

those at EPFL, the University of Fribourg (the group of Beat Hirsbrunner) and HES-SO. Agent technologies are broadly investigated including interest in medical and social contexts, such as the Commodity 12 project or the Computational Social Science group of Dirk Helbing at ETH Zurich.

For several decades, Rolf Pfeifer and his AI laboratory at the University of Zurich contributed to various research themes in robotics. However, upon Pfeifer's recent retirement, the university decided to discontinue robotics as one of its fields of activity.

At ETH Zurich, the large Institute of Robotics and Intelligent Systems has many activities, a highlight of which are the flying robots developed in the group of Raffaello D'Andrea (who is also a cofounder of Kiva Robots).

At EPFL, we find robotics research across several groups. Originally mostly addressing the industrial sector, the teams of Christof Burckhardt and Frédéric de Coulon made contributions to microtechnologies and signal processing, respec-

tively. Today, research has further diversified and includes a broad range of industrial robotics as well as biorobotics research.

Other robotics groups are active at the various sites of HES-SO in Neuchâtel, Geneva, Fribourg, Yverdon-les-Bains, and Sierre in the French-speaking part of Switzerland. These groups mostly focus on industrial applications and contribute to robotics education initiatives. For example, the PIAGET platform<sup>6</sup> successfully participates in international robotic competitions.

A special phenomenon of the Swiss research scene is the connection of technically oriented subfields of AI such as robotics and computer vision to the electrical and mechanical engineering departments at Swiss universities. This leads on the one hand to a very thorough investigation of robotics technology within the electrical and mechanical engineering communities, but on the other hand also causes a partial disconnect to other methods developed in AI and computer science, making areas such as cognitive robotics follow different development paths in Switzerland when compared to other countries.

Finally we want to draw attention to the Blue Brain project — an FET flagship project of the European Union that is led by the team of Henry Markram at EPFL. The ultimate goal of the Blue Brain Project is to reverse engineer the mammalian brain. To do so, the project combines many disciplines around a neuroscience and cognitive science core to develop models of the human brain that can be used for simulation and for example to understand the mechanisms behind diseases such as Alzheimer's.

### AI Education

Recently, several Swiss universities appointed professors with an AI background and added AI-related lectures to their curricula, such as the Universities of Basel and Zurich and ETH Zurich, which focus strongly on machine learning. Last year, SGAICO conducted a survey on AI education in Switzerland, which showed an impressive increase and richness of AI-related courses at Swiss universities (figure 1).

At the bachelor and master's level, various courses are taught in classical AI, information retrieval, natural language processing, and other subdisciplines, notably robotics. Additionally, two complete programs exist that specialize in an M.Sc. in AI and a professional education diploma in data science. However, the survey also illustrated that the community was split. No courses from computer vision, machine learning, or data mining were submitted to this survey. Although such courses exist at many universities, they are not considered to be part of the AI community and field.

Robotics plays an important role in education

and often serves as a means to attract young people to technical subject fields and computer science. However, no robotics courses were submitted to our survey as these are not considered as part of AI. Robotics is an excellent domain for education purposes for at least three complementary reasons. First, there is the richness in number and diversity of technical components involved. Second, to succeed in building a robotic system, a natural form of teamwork is necessary. Finally, robots ground cognition in the real, physical world and they act in this world and thereby interact with human beings.

Robot-CH is an association that promotes robotics in Switzerland. It has been leading initiatives in robotic competitions and in robotic education for more than 10 years. For example, Bricobot is an example of an elementary platform for robotic education that has been developed in Switzerland. Swiss teams also participate in international competitions such as for example the FIRST Lego League, Eurobot, or RoboCup at Home. The International Conference on Robotics in Education was also held in May at Yverdon-les-Bains in Switzerland.<sup>7</sup>

## For More Information

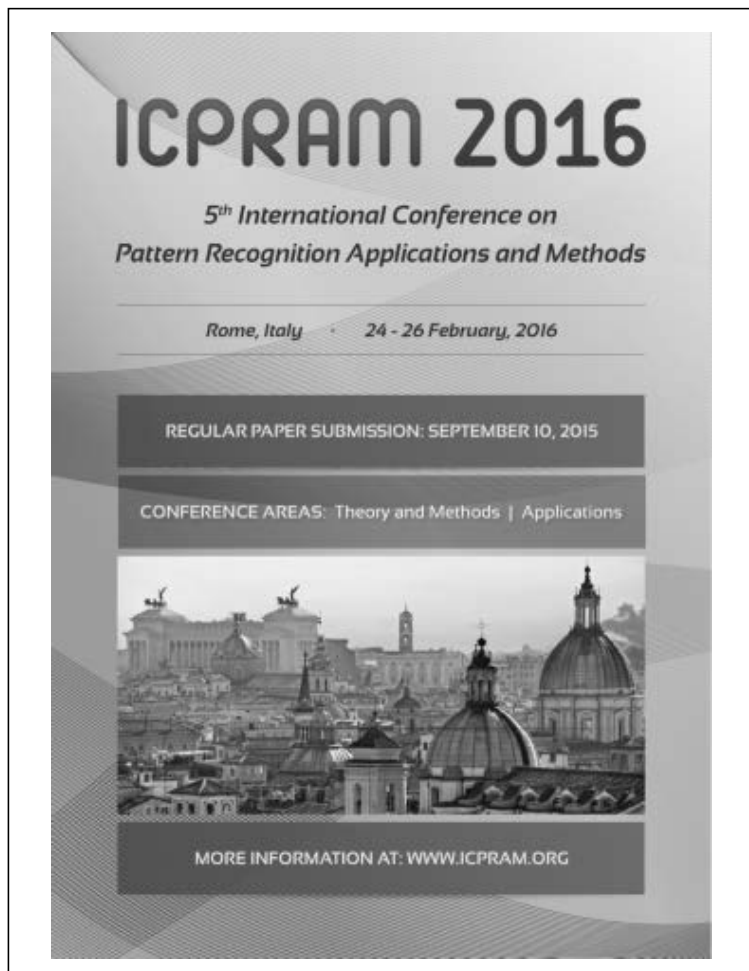
This short column highlights a few of the numerous activities in AI-related research that are conducted in Switzerland. With the diversity of the field and the rich research landscape in Switzerland in general, we cannot be complete, but we hope to have provided the interested reader with initial pointers into Swiss research. Beyond this article, we would like to invite international AI researchers to contact SGAICO when traveling to Switzerland. We can establish contacts to AI/CO researchers and we offer the SGAICO Forum lecture series, where we can organize or announce your talk given at a specific Swiss institution to the nationwide SI communities spanning several thousand members.

## Acknowledgement

We would like to thank René Schuhmann and Boi Faltings for valuable input and comments on a draft of this article.

## Notes

1. The SI is one of the major IT/computer science organizations in Switzerland. The homepage of SI and SGAICO can be found at [www.s-i.ch/fachgruppen-und-sektionen/sgaico](http://www.s-i.ch/fachgruppen-und-sektionen/sgaico).
2. For more information, see the 2002 article by J. Koehler and D. Ottiger: An AI-Based Approach to Destination Control in Elevators, *AI Magazine* 23(3): 59–78.
3. See the 2015 paper by J. Schmidhuber. Deep Learning in Neural Networks: An Overview. *Neural Networks*, Volume 61 (January 2015): 85–117.



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4. See, for example, the 2014 paper by K. Stockinger and T. Stadelmann. 2014. Data Science für Lehre, Forschung und Praxis. *HMD — Praxis der Wirtschaftsinformatik, Springer Fachmedien Wiesbaden* 51(4) (August 2014): 469–476.

5. See the 2010 paper by H. Müller, P. Clough, Th. Deselaers, and B. Caputo. 2010. ImageCLEF — Experimental Evaluation in *Visual Information Retrieval*. Springer Information Retrieval Series, Vol. 32. Berlin: Springer.

6. See the 2013 paper by Hayato Omori, Jean-Daniel Dessimoz, Hiroki Tomori, Taro Nakamura, and Hisashi Osumi. Piaget for the Smart Control of Complex Robotized Applications in Industry. *ICINCO* (2) 2013: 528–535.

7. [rie2015.org/](http://rie2015.org/).

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