

Worldwide AI



■ This column explores the emergence of AI in Portugal, its blossoming AI community, including the association supporting it, and briefly surveys AI topics currently and historically explored in the country.

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Four Decades of AI in Portugal

The emergence of AI in Portugal results from the contact between Luís Moniz Pereira and Helder Coelho in the Centro de Estudos de Cibernética (center for studies in cybernetics) created in the Instituto Superior Técnico (IST), now a school of Universidade de Lisboa. They then moved to Laboratório Nacional de Engenharia Civil (National Laboratory of Civil Engineering) in the early 1970s where early work in AI was initiated, together with Fernando Pereira (currently research director at Google). Some of this work included problem solving and reasoning using logic programming (Coelho 1982). They pursued their Ph.D. degrees abroad (Luís Moniz Pereira at Brunel University, London, and Helder Coelho and Fernando Pereira at University of Edinburgh), as did most of the Portuguese researchers of their generation. This early connection with universities abroad contributed to a continued high degree of internationalization of AI research in Portugal.

The association representing the Portuguese AI community is called the Associação Portuguesa Para a Inteligência Artificial (APPIA). It was founded July 31, 1984, and currently has 620 active members. Four of its members have been awarded the ECCAI fellowship (Luís Moniz Pereira in 2001, Helder Coelho in 2002, Pavel Brazdil in 2008, and José Júlio Alferes in 2012). APPIA's main scientific event is a biennial international conference, the Portuguese Conference on Artificial Intelligence (Encontro Português de Inteligência Artificial) or EPIA. The first EPIA conference was held in 1985 in Oporto. Since then, the conference has grown from approximately 50 submissions at its launch to 150–200 submissions in recent years, with an acceptance rate of about 30 percent (see, for example, Pereira et al. [2015]).

Most of the funding for APPIA comes from public sources, as technology transfer is not widespread across Portuguese industry. However, there are a large number of technology-based companies, (such as university spin-offs), most of them founded by people coming from academe. Public funding sources include both European projects and national projects, managed by the Fundação para a Ciência e a Tecnologia (FCT), the national funding agency for science and technology. About a decade ago FCT initiated a set of international partnerships connecting Portuguese and North American universities, namely with the Massachusetts Institute of Technology, Carnegie Mellon University, the University of Texas at Austin, and the Harvard Medical School. These partnerships have contributed to further deepen the internationalization level of the Portuguese research community.

Current Topics

The Portuguese AI research community covers a broad range of topics. It has strong connections to industry, as well as other disciplines such as the social sciences, biology, neurosciences, robotics, linguistics, and mathematics. This column aims at providing a brief (unavoidably incomplete) survey of some of these topics.

The Centre for Artificial Intelligence (CENTRIA) was the first AI research center in Portugal. Founded by Luis Moniz Pereira — one of the pioneers of AI in Portugal — CENTRIA research focuses on using logic methods for knowledge representation and reasoning. CENTRIA has performed foundational research on logic programming. Recently, besides advancing the state of the art in logic-based reasoning, it has studied related topics such as ethics, morality, and tolerance in the context of AI (Pereira and Saptawijaya 2016).

Another AI pioneer in Portugal is Helder Coelho, who has made many relevant contributions to several AI areas, including foundational issues, distributed AI, and its applications to biology, education, and economy. He also has contributed significantly to the dissemination of AI in Portugal, not only to the scientific community but also to the general public through his writings of 35 books of different kinds, including those targeted toward general dissemination, education, and the scientific community.

Emerging from the Grupo de Inteligência Artificial (GIA) group at the Instituto Superior Técnico (IST), the SISCOG company, founded in 1986, is a software company that provides decision support AI solutions to transportation companies, helping with resource planning and management. In the 1990s the group developed a solution for train crew scheduling that was implemented in the Dutch Railways (Morgado and Martins 1998). The solution was honored with an Innovative Applications of Artificial Intelligence

award in 1997. Ever since, the group has been focusing on providing innovative solutions to the transportation industry.

In 1988 the Artificial Intelligence and Computer Science Laboratory (LIACC) was founded at the University of Porto). The lab focuses on multiagent systems, machine learning, data mining, and meta-learning, among other areas. One of the founders was Pavel Brazdil, one of the ECCAI fellowship holders. This research center, which has now been integrated into the Institute for Systems and Computer Engineering, Technology, and Science (INESC-TEC) at the University of Porto's Faculty of Engineering, has made relevant contributions in the previously mentioned areas (Reis, Lau, and Oliveira 2000; Brazdil, Soares, and Da Costa 2003).

The Intelligent Agents and Synthetic Characters group (GAIPS) at the Instituto de Engenharia de Sistemas e Computadores – Investigação e Desenvolvimento (INESC-ID) in Lisbon has been very active in the area of intelligent agents, namely in the area of synthetic characters, serious games, and affective computing (Prada and Paiva 2009; Dias and Paiva 2005). One of the group's applications was featured in the EXPO'98 international exhibition in Lisbon. The group has been involved in many European projects and has strong ties with many international partners. The group has extended its area of research out from purely virtual agents toward real physical robots. One of its research projects, for example, is an empathic social robot, based on the iCat platform, that plays chess with kids. This research has been evaluated in a series of long-term experiments (Leite et al. 2014). Recently, the group has extended its areas of interest to reinforcement learning in the context of social agents.

Also from INESC-ID, the Software Algorithms and Tools for Constraint Solving group (SAT) led by João Marques-Silva and Inês Lynce has produced extensive research in the area of Boolean satisfiability (including MaxSAT problems). The well-known GRASP solver was pioneered by João Marques-Silva (Marques-Silva and Sakallah 1999). Since that pioneering effort, the group has contributed to the state of the art on efficient SAT solvers (Lynce and Marques-Silva 2005), as well as their applications, namely in the area of computational biology (Lynce and Marques-Silva 2006).

With strong connections to robotics, the IEETA research center, based in Aveiro, has targeted a broad range of areas, namely biomedical informatics, intelligent robots, and information systems. It should be noted that it has been quite successful in international RoboCup scientific events. The CAMBADA team achieved top ranks in several leagues (Lau et al 2011).

Estela Bicho, from the University of Minho, has been involved in many European projects focusing on the problem of cognitive robotics. She has done

relevant contributions in this area, in particular exploring the usage of dynamical systems and dynamical neural field theories (Bicho, Mallet, and Schöner 2000).

Research in AI at the Institute for Systems and Robotics (ISR-Lisboa), one of the research centers of the Instituto Superior Técnico (IST) of the University of Lisbon, holds strong connections with the fields of robotics and systems and control theory. ISR-Lisboa was a partner in the European project RobotCub from which the well-known iCub humanoid robot was developed, and it has participated in many subsequent projects, always with a strong component on cognitive robotics (Montesano et al. 2008). They have participated in RoboCup events since the second edition of the RoboCup in 1998. This involvement included not only the participation in robot soccer, robot rescue, and @Home leagues, but also in the organization of RoboCup 2004 in Lisbon. The institute's research includes decision-theoretic methods under uncertainty, multirobot systems, cognitive robotics, and emotion-based agents (Spaan and Lima 2009; Custódio, Ventura, and Pinto-Ferreira 1999). The institute holds strong connections with other disciplines, namely neurosciences, philosophy, and linguistics.

Conclusion

This column has provided a brief summary of some of the current research activity in AI in Portugal. There is a strong, internationally connected research community that has been growing since the early 1970s. The community has conducted research that crosses the borders of multiple disciplines including robotics, cognitive science, linguistics, and philosophy, among others. Some of this research has been adopted by industry, leading to successful companies. Nevertheless, the vast majority of the AI research community is supported by public funding, at both the national and European levels.

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