

Worldwide AI



■ This column provides an encounter with the artificial intelligence research community in the state of Israel. The first section introduces this community and its special attributes. The second section provides an overview of some recent research projects done in Israel. The author serves as the chair of the Israeli Association for Artificial Intelligence.

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The Israeli AI Community

Israel is a young and a small country consisting of only approximately 20,000 square kilometers in area and a population of approximately 8 million. Since its establishment in 1948, The Israeli government has placed great importance on establishing excellent research institutions and universities.

As a consequence, there are eight universities in Israel, as well as a handful of research institutions and numerous colleges, and Israel has excelled in numerous fields of research. A clear sign of this is that Israel has produced eight Nobel laureates in the past 15 years, out of 154 worldwide. Computer science research in Israel dates back to the country's founding, and five Turing Award winners (out of 62) are Israelis. AI research in Israel has been firmly established since the 1980s, and there are currently quite a few AI research groups and labs in Israeli universities.

This column introduces the Israeli AI community and many of its unique attributes. It also covers a number of recent research projects in the field of AI that are done in different institutions within the country.

The Israeli Association for AI

The Israeli Association for Artificial Intelligence (IAAI),¹ a member of the European Association for Artificial Intelligence (EURAI), is an umbrella organization for AI researchers in Israel. The primary goals of the organization are to promote the study and research of AI in Israel, to encourage cooperation between Israeli AI researchers, and to promote collaboration with AI researchers worldwide.

Israelis are known to be very friendly and they like to socialize. In addition, Israel's small size means that its two most distant universities — Technion in Haifa (the north) and Ben-Gurion University of the Negev (the south) — are only 187 kilometers apart. As a result, many members of IAAI have strong personal and research relations throughout the country. Very often, Israeli AI researchers from throughout the country will organize mutual visits during which they hold research meetings, give talks at seminars, or participate in M.Sc. and Ph.D thesis defenses. Because of

the country's small size, these visits can often be done in a day, without requiring an overnight stay or taking a flight.

Israeli AI conferences and workshops have a very important role in creating the unique atmosphere of the Israeli AI community. They are organized by IAAI in an attempt to strengthen the interaction and collaboration between the various research groups. IAAI symposia are held once or twice a year in various research institutions in the country, where the different AI groups present their recent achievements to the entire Israeli AI community and have valuable time to meet and collaborate. Special attention is given to students and to young faculty members, thus affording them an opportunity to introduce themselves to the entire community. A special slot is reserved for young students who had papers accepted to one of the top tier international AI conferences. Such students then have the opportunity to present their talk to the smaller domestic audience. Roughly 100 researchers participate in these events, enabling them to familiarize themselves with the latest achievements of their peers from around the country, and enjoy the very warm atmosphere the IAAI events afford. Figure 1 was taken during the last IAAI symposium at Ben-Gurion University, on January 25, 2016. The focus of the symposium was Israeli AI and cyber security.

Ever since 1989, IAAI has also held the biannual Bar-Ilan Symposium on the Foundation of Artificial intelligence (BISFAI), which is traditionally hosted and organized by the devoted AI group of Bar-Ilan University. BISFAI usually lasts for a couple of days in June. As a mini AI conference, BISFAI holds sessions on all areas of AI, including poster sessions, panels, tutorials, and invited speakers both from inside and outside of Israel. The program committees for all these events select high-quality papers for presentation, but the papers are not archived. As a result, most of them later appear in top tier AI venues.

Relations with the International AI Community

Many Israeli AI researchers have strong collaborative relationships with other research groups and colleagues abroad; they coauthor many papers and jointly work on many research projects. Many Israelis spend the summer or at least a few weeks per year with their collaborators abroad. Naturally, the international colleagues always receive a warm invitation to visit the respective Israeli group; many of them indeed do come for a visit, often also taking a side visit to one or more of the other universities and enjoying a day of sightseeing.

As any other healthy AI community, Israeli AI researchers exercise important responsibilities in International AI organizations, in reviewing papers and in organizing and participating in all levels of program committees of conferences.

The Latest International Conferences in Israel

In summer 2015, the Israeli AI community had the honor of hosting two international conferences: ICAPS-2015, which took place on June 7–11, 2015, in downtown Jerusalem, and SoCS-2015, which was held on June 11–13 in Ein-Gedi, an oasis on the shore of the Dead Sea. The two conferences had a joint session in Jerusalem on June 11, which included selected papers from both conferences and a great keynote talk by Stuart Russell on effective decision making. Aside from the great technical programs, attendees of these conferences were also able to also enjoy a number of social events. The 163 ICAPS participants were treated to a reception at the Tower of David in the old city followed by a spectacular sound and lights show, a walking tour of the old city of Jerusalem, and a banquet in a unique restaurant overlooking the old city of Jerusalem. The 62 SoCS participants were taken on a guided tour of Masada—an ancient fortification situated on top of an isolated mesa—which dates back to the first century BCE. Some of the attendees even climbed up by foot instead of taking the cable car (figure 2).

Thirty-three individuals attended both SoCS and ICAPS and had a full week of activities. This is great evidence for the strong connection between the search and planning communities.

Based on the strong success of these two conferences, IAAI is considering placing a bid to host larger AI conferences.

The Latest Israeli AI Achievements

There are many AI groups in Israel. This section overviews a few representative AI projects that took place in Israel recently, primarily focusing on the projects of young Israeli scientists.

Voting Systems for Bounded Rational Agents

Reshef Meir (Technion) and Yaakov (Kobi) Gal (Ben-Gurion University) are designing and analyzing voting systems for bounded rational agents. They combine tools from computational social choice with human-computer decision making to understand the voting behavior of human participants interacting with these systems.

Together with Maor Tal, a graduate student, they have implemented voting games that replicate two common real-world scenarios of group decision making (Tal, Meir, and Gal 2015). In the first, a single voter votes once after seeing a large preelection poll. In the second game, several voters play simultaneously and change their votes as the game progresses, as in small committees. The payment for participants is determined based on the candidate who has the most



Figure 1. The IAAI Symposium at Ben-Gurion University, January 25, 2016.

Moshe Vardi from Rice University in his invited talk on SAT solvers. Inset: Coffee break.

votes in the end. Thus far the voting behavior of hundreds of participants was recorded, both in the lab and through Amazon Mechanical Turk.

Analysis of the data reveals that people can be classified into at least three groups, two of which are not engaged in any strategic behavior. The third and largest group tends to select the natural default action when there is no clear strategic alternative. When an active strategic decision can be made that improves their immediate payoff, people usually choose that strategic alternative. The study provides insight for multiagent system designers in uncovering patterns that provide reasonable predictions of voters behaviors, which may facilitate the design of agents that support people or act autonomously in voting systems.

A chief contribution in this work is the release of VoteLib,² a database that contains all the collected data that is freely available to the research community. VoteLib allows researchers to test their own theories and train their models without incurring the overhead of collecting the data and will advance research in AI and computational social choice. The database is currently being extended to support large-scale experiments including potentially thousands of voters.

Bitcoin Research at the Hebrew University

Aviv Zohar and Jeffrey S. Rosenschein from the Hebrew University in Jerusalem have recently explored several issues related to the Bitcoin network. Bitcoin is supported by a P2P network of nodes that are spread around the globe. Each node is an economically driven agent that works with its peers

together to authorize transactions in the currency and to maintain the infrastructure required for the system's operation. The Bitcoin protocol awards these participants (which are often called miners) with rewards in exchange for investing computational effort in securing the system and processing transactions.

Work in the group on this topic has focused on the incentives of miners to act according to the rules of the system (Lewenberg et al. 2015), on mechanisms that utilize incentives to increase the transaction throughput of Bitcoin (Sapirshtein, Sompolinsky, and Zohar 2015), and on the use of cooperative game-theoretic models to analyze which coalitions of miners will form and how they will distribute rewards (Lewenberg, Sompolinsky, and Zohar 2015).

The underlying consensus mechanisms of Bitcoins can in many ways be explained as a voting process through which miners coordinate their actions and agree on the same set of accepted transactions. The group is currently exploring connections between computational social choice and cryptocurrencies. This research direction has interesting implications: it yields alternative mechanisms to the ones used by Bitcoin that can allow the system to scale to reach higher transaction volumes and faster processing times.

Additional work is focused on the creation of the P2P overlay network itself. Bitcoin's network must allow its nodes to broadcast messages to their peers, but the lack of strong identities in the system implies that it is difficult for nodes to tell if they are indeed connected to other honest participants or if they are only connected to attackers that have created multi-



Figure 2. SoCS-2015 Participants on a Guided Tour of Masada.

The intrepid participants climbed up to the top of Masada. *Inset:* Those who took the cable car waited for them.

ple fake identities. Indeed, Bitcoin is vulnerable to attacks on its overlay infrastructure (Heilman et al. 2015), and the team is exploring ways to model network formation as a game that is played between nodes and their attacker.

Teams of Robots at Bar-Ilan University

A primary strength of the AI group at Bar Ilan University (BIU) is intelligent robotics, in particular the study of teamwork in multirobot and multiagent systems (Gal Kaminka), adversarial robotics (Noa Agmon), and human interaction with multiple agents and robots (David Sarne, Sarit Kraus). Kaminka and Agmon's research on multirobot patrolling, exploration, and formations was highly publicized; some of it resulted in patents and technology transfer projects, as well as two spin-off startups.

Over the last six years the BIU team have combined their expertise into a project that allows a single human operator to interact effectively with a team of robots to conduct an urban search-and-rescue operation. Specifically, the goal is to combine the best technology in robotics, teamwork, agent-based, and intelligent interfaces to alleviate the cognitive load on the operator in this important task. Unlike

competing projects outside of Israel, the assumption is of a quick setup, with only a single operator working from a laptop.

Initially, the project focused on intelligent user interfaces and multirobot collaboration in the mapping process. One specific challenge in the user interface rose because the initial requirement was for the human operator to do the visual search — the robots were there just to provide videos. This meant that an operator was still required to watch all imagery taken by all the robots. Kosti, Kaminka, and Sarne (2014) developed a novel user interface that allowed the user to view images in context of their location on the map, automatically selecting the best image showing a given location.

The focus shifted, however, to how a mediating agent can assist in the visual search process, drawing the operator's attention to robots requiring assistance, and to locations suspect of containing potential victims. Here, the agent uses learning to optimize what advice to provide to the operator, and when (Rosenfeld et al. 2015).

Automated Negotiation at Ariel University

One of the recent research efforts in the newly found-

ed Ariel University was on the problem of automated negotiation with the development of DoNA, a domain-based automated negotiator that won second place out of 21 teams in the 2015 Automated Negotiation Agent Competition (ANAC) (Erez and Zuckerman 2016). ANAC is a yearly competition that pits automated negotiation agents against one another in a series of negotiation sessions with various parameters and rules.

DoNA is extremely simple: while most agents in the competition today are using complex strategies, learning algorithms, and opponent modeling techniques, DoNA looks only at two domain parameters: the reservation value and the time discount factor (hence, the name of DoNA is domain-based agent). DoNA uses these two values in order to decide between four heuristics that are based on cognitive behavior in negotiations. DoNA does not do any optimization or learning nor any form of opponent modeling, yet it managed to beat all the opponents in the 2013 and 2014 competition. DoNA was also enrolled in the 2015 competition (which also had nonlinear domains for the first time), and it managed to attain the second place in the individual utility category, with statistically insignificant difference from the first place.

A joint team from Ariel, Bar-Ilan, and the Jerusalem College of Technology (JCT) led by Inon Zuckerman, Noa Agmon, and Avi Rosenfeld developed NegoChat, the first chat-based automated negotiation agent (Rosenfeld et al. 2014). The project started with an effort to adopt the state-of-the-art human-agent automated negotiator from a menu-based interface to a chat-based interface. This required a new negotiation strategy as humans who are using a chat interface tend to negotiate in a step-by-step manner and not deal on the complete set of issues (Zuckerman et al. 2015). With that in mind, the group developed NegoChat (Rosenfeld et al. 2014), and later an extension by the name of NegoChat-A (Rosenfeld et al. 2016), which deviates from the rational Pareto-optimal, and offers strategy to a new cluster-based strategy that constructs the offers in a stepwise manner inside its current

cluster of possible offers. This leads to offers that are more successful when negotiating with humans who are using chat-based interfaces.

Summary

This column gave a brief encounter with the Israeli AI community and some of the research that was conducted recently. The Israeli AI community hopes to continue with its traditions and events and hopes to continue to be a solid member in the international AI community. On top of all, the Israeli AI community hopes to continue and conduct high-quality research in the field of AI.

Notes

1. www.ise.bgu.ac.il/iaai/.
2. www.votelib.org.

References

- Erez, E. S., and Zuckerman, I. 2016. Dona — A Domain-Based Negotiation Agent. In *Next Frontier in Agent-Based Complex Automated Negotiation*, Studies in Computational Intelligence, volume 638, ed. N. Fukuta, T. Ito, M. Zhang, K. Fujita, and V. Robu. Berlin: Springer.
- Heilman, E.; Kendler, A.; Zohar, A.; and Goldberg, S. 2015. Eclipse Attacks on Bitcoin's Peer-to-Peer Network. Paper presented at the 24th USENIX Security Symposium, USENIX Security 15, Washington, D.C., USA, August 12–14.
- Kosti, S.; Kaminka, G. A.; and Sarne, D. 2014. A Novel User-Guided Interface for Robot Search. In *2014 IEEE/RSJ International Conference on Intelligent Robots and Systems*. Piscataway, NJ: Institute for Electrical and Electronics Engineers. [dx.doi.org/10.1109/IROS.2014.6943022](https://doi.org/10.1109/IROS.2014.6943022)
- Lewenberg, Y.; Bachrach, Y.; Sompolinsky, Y.; Zohar, A.; and Rosenschein, J. S. 2015. Bitcoin Mining Pools: A Cooperative Game Theoretic Analysis. In *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems, AAMAS 2015*, 919–927. New York: Association for Computing Machinery.
- Lewenberg, Y.; Sompolinsky, Y.; and Zohar, A. 2015. Inclusive Block Chain Protocols. In *Financial Cryptography and Data Security — 19th International Conference, FC 2015, Revised Selected Papers*, 528–547. Berlin: Springer. [dx.doi.org/10.1007/978-3-662-47854-7_33](https://doi.org/10.1007/978-3-662-47854-7_33)
- Rosenfeld, A.; Agmon, N.; Maksimov, O.; Azaria, A.; and Kraus, S. 2015. Intelligent Agent Supporting Human-Multirobot Team Collaboration. In *Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence, IJCAI 2015*, 1902–1908. Palo Alto, CA: AAAI Press.
- Rosenfeld, A.; Zuckerman, I.; Segal-Halevi, E.; Drein, O.; and Kraus, S. 2014. NegoChat: A Chat-Based Negotiation Agent. In *International Conference on Autonomous Agents and Multi-Agent Systems, AAMAS-14*, ed. A. Bazzan, M. Huhns, A. Lomuscio, and P. Scerri, 525–532. New York: Association for Computing Machinery.
- Rosenfeld, A.; Zuckerman, I.; Segal-Halevi, E.; Drein, O.; and Kraus, S. 2016. NegoChat-A: A Chat-Based Negotiation Agent with Bounded Rationality. *Autonomous Agents and Multi-Agent Systems* 30(1): 60–81. [dx.doi.org/10.1007/s10458-015-9281-9](https://doi.org/10.1007/s10458-015-9281-9)
- Sapirshtein, A.; Sompolinsky, Y.; and Zohar, A. 2015. Optimal Selfish Mining Strategies in Bitcoin. In *Financial Cryptography and Data Security — 20th International Conference, FC 2016, Revised Selected Papers*. Berlin: Springer.
- Tal, M.; Meir, R.; and Gal, Y. K. 2015. A Study of Human Behavior in Online Voting. In *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems, AAMAS 2015*, 665–673. New York: Association for Computing Machinery.
- Zuckerman, I.; Segal-Halevi, E.; Rosenfeld, A.; and Kraus, S. 2015. First Steps in Chat-Based Negotiating Agents. In *Next Frontier in Agent-Based Complex Automated Negotiation*, Studies in Computational Intelligence Volume 596, 89–109. Berlin: Springer. [dx.doi.org/10.1007/978-4-431-55525-4_6](https://doi.org/10.1007/978-4-431-55525-4_6)

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