

Worldwide AI



■ Artificial intelligence in Korea is currently prospering. The media are regularly reporting AI-enabled products such as smart advisors, personal robots, autonomous cars, and human-level intelligence machines. The IT industry is investing in deep learning and AI to maintain the global competitive edge in its services and products. The Ministry of Science, ICT, and Future Planning (MSIP) has launched new funding programs in AI and cognitive science to implement the government's newly adopted endeavor of building a creative economy and software-centered society. However, AI did not always flourish as it now does. Similar to the history of AI worldwide, AI research and industry in Korea have faced both ups and downs in their history.

Byoung-Tak Zhang

Humans and Machines in the Evolution of AI in Korea

This column recounts the evolution of AI research in Korea. I tell a story of agents, that is, humans and machines, that shaped the AI landscape. I sketch the formation and transformation of the AI communities from the 1980s to 2010s. The whole story consists of five periods: settlement, exploration, diversification, unification, and growth. I also describe recent activities in AI, along with governmental funding circumstances and industrial interest. The column does not intend to be complete though every effort will be made to strike a balance of coverage and depth in the limited space.

A History of AI in Korea

It took quite some time for AI to be established as a field in Korea. Only in the 1970s did the computer and electronics industry start and universities institute computer science departments. , software companies were founded in the early 1980s. The first AI organization in Korea was established in December 1985 as a special interest group of the Korea Society for Information Science (KISS), which is the precursor of the current Korea Artificial Intelligence Society (KAIS). Excited by the vision of AI, the major universities in the country had each created at least one AI group by

1990. One of the early AI groups was the Natural Language Processing and Artificial Intelligence Lab at Seoul National University (SNU) founded by Yung-Taek Kim in the early 1980s. This was followed by AI groups at KAIST by Jin-Hyung Kim and at other universities. Most of these first-generation AI researchers were newly graduated computer scientists who did their graduate studies abroad. The research topics were wide-ranging, including expert systems, machine translation, natural language understanding, heuristic search, logical reasoning, and knowledge representation (Kang et al. 1987, Yoo and Kim 1992).

Exploration (1990–1995)

It is ironic that the new AI groups were founded in Korea when, globally, the AI boom had begun to run out of steam. The worldwide AI winter affected Korea too. The term *AI* had adopted a new connotation of “too ambitious to be practical.” On one hand, this led the natural language processing (NLP) people to branch out of the special interest group (SIG) AI to form a SIG on Language Technology with an emphasis on technology. On the other hand, new approaches to AI were emerging that were complementary or an alternative to the traditional symbolic AI approach. These included the bioinspired AI models, such as neural networks, genetic algorithms, and fuzzy logic. “Neural,” “fuzzy,” and “genetic” have been the buzzwords for commercial advertisements of home appliance makers, such as Samsung, LG, and Daewoo. Much industrial research in the early 1990s focused on intelligent control, speech recognition, and handwritten character recognition using neural networks. In 1992, the SIG on Neurocomputing was established under the Korea Society for Information Science. Neurocomputing-based AI was considered as a new generation of AI and many universities established related labs. The Neurocomputing SIG also covered other nature-inspired approaches such as evolutionary computation, genetic algorithms, and artificial life.

Diversification (1995–2005)

During this period, AI research turned its focus onto problem solving from developing basic technologies. Two new SIGs were founded, the Computer Vision and Pattern Recognition SIG in 1997 and the Bioinformation Technology SIG in 2002, the latter being a follow-up and extension of the Neurocomputing SIG. Many IT startups were founded, and promoted in part by governmental funding strategies. Although not many of them eventually survived the 1997 financial crisis in Korea and Asian countries, the venture boom spurred the interest and importance of AI technologies for industries such as information retrieval, e-commerce, and data mining. In particular, the importance of machine learning was recognized for Internet business, text mining, customer

relationship management, and life sciences. As a result, the application platform/range of AI diversified in many different ways. A large number of intelligent agents were developed for information filtering, comparison shopping, recommender systems, and smart user interfaces (Lee 2007, Seo and Zhang 2000). Other AI funding included the three projects that started in 2002–2004 under the National Research Laboratory (NRL) Program of KOSEF that sponsored university research labs for five years. The topics of the three projects were machine learning for biodata mining, visual pattern recognition, and natural language processing, respectively. At the basic science level a closer collaboration between AI and cognitive science began by launching the International Conference on Cognitive Science ICCS (Zhang 1997).

Unification (2005–2010)

By 2005 there were four AI-related SIGs under the Korea Information Science Society: SIG Artificial Intelligence, SIG Language Technology, SIG Computer Vision and Pattern Recognition, and SIG Bioinformation Technology. Each SIG was a closed circle and there was not much interaction between the SIGs. However, the emerging research field of machine learning provided a trigger to collaborate among the SIGs. This was clear when a machine learning tutorial was organized as the Joint Workshop ILVB (for Intelligence, Language, Vision, and Bioinformation) in 2005 at Seoul National University. It attracted more than 400 attendants, which was more than three times the number the organizers expected. Following the success of ILVB 2005, ILVB has been held annually. In November 2010, the annual ILVB led to the official establishment of the Korean Society for Computational Intelligence (KSCI), which was renamed in 2013 as the Korea Artificial Intelligence Society (KAIS). The first three presidents of KAIS are Byoung-Tak Zhang (2010-2013), Hyeran Byun (2013-2015), and Seong-Whan Lee (2015-). The founding of KAIS is an important event since the AI community now has an authoritative society.

Growth (2010~)

KAIS initiated a diverse range of efforts to promote interaction between AI researchers and collaboration between academia and industry. It launched new symposia, such as the Annual Symposium on Real-Life Intelligence since 2010, the Symposium on Cognition and Artificial Intelligence in 2012, and the Symposium on Brain and Artificial Intelligence in 2013. It also started the Winter School of Pattern Recognition and Machine Learning in 2011. In 2012 the first AI Expo was held and more than 50 AI labs in Korea presented their work and shared ideas. In 2013 the Global Frontier Forum on Human-Level Machine Learning in the Post Smartphone Era was

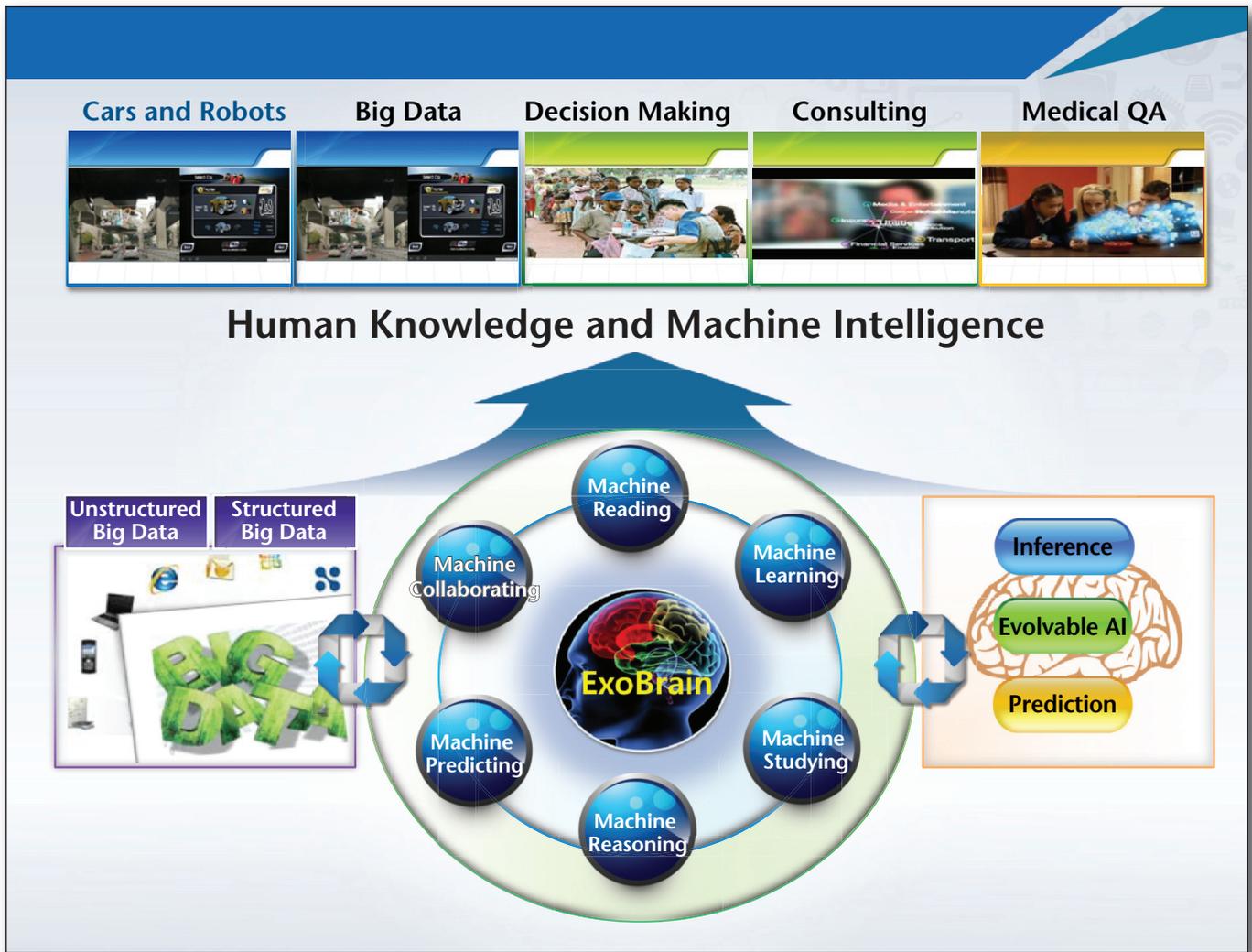


Figure 1. The ExoBrain Project.

held to promote the cross-fertilization of AI and related areas.

Currently, the demand of the industry for AI researchers is much bigger than the supply academia can provide. Global IT companies, such as Samsung, are looking for AI graduates in deep learning, dialogue understanding, computer vision, and context-aware services for smartphones, tablets, wearable devices, and home appliances. AI technology plays an increasing role in making differences among the competitive smart-device vendors. Recent examples of AI, such as Apple Siri, IBM Watson, Google Car, Facebook DeepFace, Microsoft Cortana, Amazon Echo, MIT Jibo, and SoftBank Pepper have drawn the attention of Korean companies to the importance of AI-enabled technologies. In addition to the IT companies, the global car companies like Hyundai and Kia had started to invest in smart cars. Telecom companies, such as SK Telecom, KT, and LG U+, build on

new businesses based on smart technologies. Web search and social media companies, like Naver, Daum, and Kakao are employing more and more AI experts. Game companies such as Nexon and NCSOFT are also active in recruiting AI researchers.

Contemporary Research Projects

Here I give a flavor of current AI activities in Korea by describing some sample projects. One is the ExoBrain project which started in 2014 with funding from the Ministry of Science, ICT, and Future Planning (web-page at exobrain.kr). It is planned for nine years and the total budget is \$90 million. The ExoBrain consortium consists of national research institutes (ETRI and KITECH), companies, and universities. The goal is to develop natural language dialogue systems for knowledge communications between humans and machines in specific domains. ExoBrain (see figure 1)

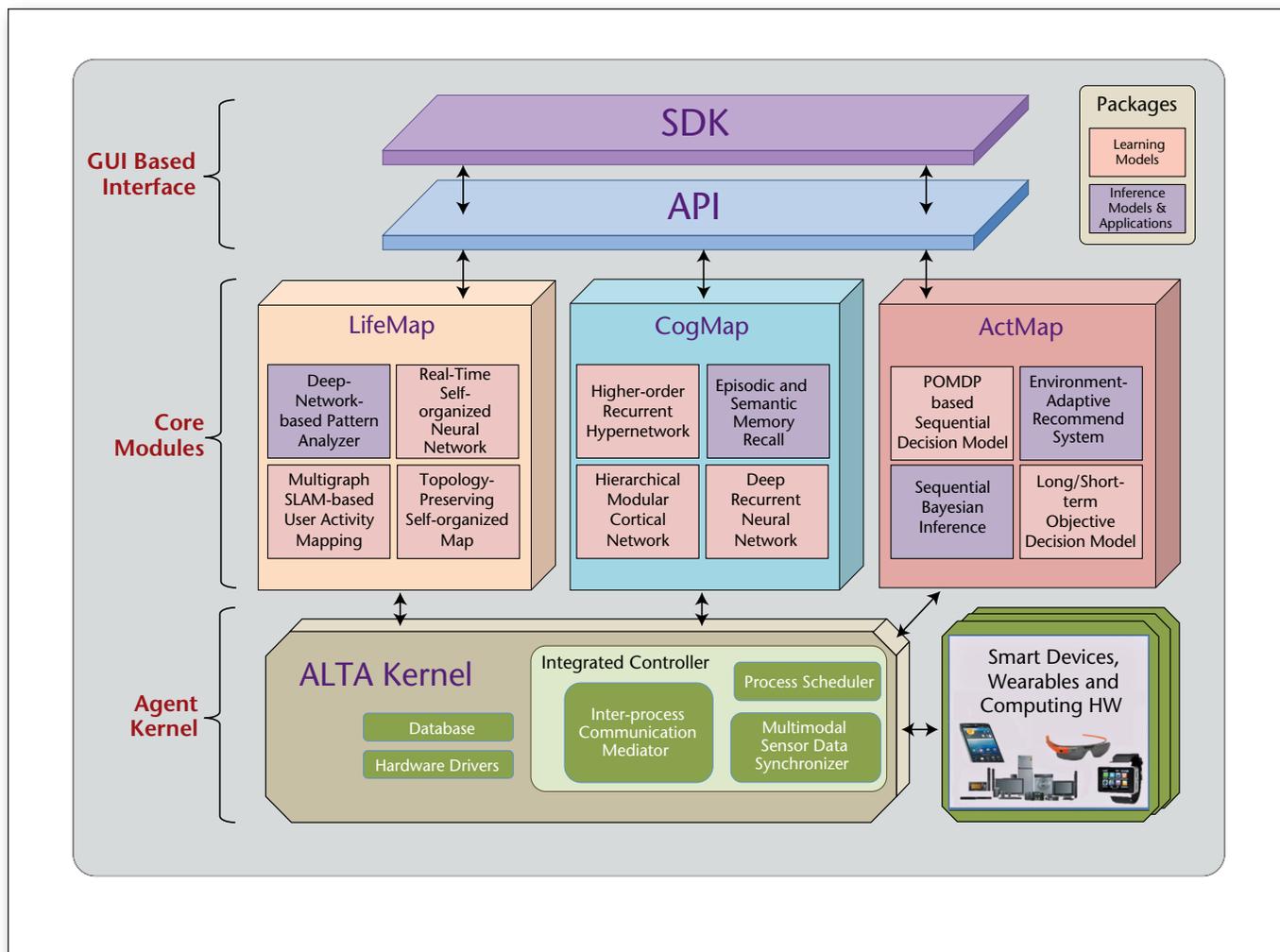


Figure 2. The Autonomous Learning and Thinking Agent (ALTA) Project.

is a digital extension or augmentation of the biological brain. It contains knowledge of deep understanding, question and answering, and knowledge production in natural languages (Ryu, Jang, and Kim 2014). Applications include call center Q&As, healthcare advisors, and big data consultants. ExoBrain will also be used for natural language communication with humanoid robots, smart cars, digital signage, and wearable devices. The project develops technologies for machine reading, machine learning, machine reasoning, and machine collaborating. The first phase investigates core technologies for conversations with general knowledge. The second phase concentrates on developing applied technologies for consulting in medical, legal, financial domains. The third phase develops multilingual systems.

Another nine-year AI project started in 2015. This project, named DeepView, aims to understand visual data from surveillance cameras. Some other projects deal with integrated vision-language problems. For

example, the Videome project investigates technologies for automatically building knowledge bases from digital videos. A deep learning technique was developed to build hypernetwork models of concept hierarchies from the pictures and sentences in video data (Ha, Kim, and Zhang 2015).

In 2015 the Ministry of Science and Technology (MSIP) launched the Software Star Lab Program, and AI was chosen as one of the five thrust areas. In the long run, a total of five AI projects (AI Star Labs) will be selected and sponsored for eight years. In the first year (2015), two projects (labs) were selected. One is the Autonomous Learning and Thinking Agent (ALTA) project (see figure 2), which aims to develop open source cognitive agents that learn and think autonomously based on wearable devices that are part of the Internet of Things (IoT). The ALTA AI kernel is a neurocognitive memory system that integrates perception, action, and cognition components coupled organically in a cognitive cycle and supports

autonomous learning of and inference on three levels of knowledge maps (LifeMap, CogMap, and ActMap) for personalized lifelong services. Potential service scenarios include cognitive advisors, life companions, home robots, autonomous cars, and health care. A world-wide consortium of Open Source Cognitive Architecture (OSCA) is being established to collaborate on developing the ALTA cognitive agent.

Prospects

I have reviewed the history of AI research in Korea and some contemporary research projects. Starting from the formation of SIG AI in 1985, AI in Korea was diversified into four SIGs on intelligence, language, vision, and bio, and grown separately. The SIGs were then unified in 2010 to form the Korea Artificial Intelligence Society. Recently, the learning-based AI approach has gained in importance. In recognition of it, in 2014 the Ministry of Science, ICT, and Future Planning funded a machine learning center. A total of 12 researchers participate in the center project from 5 universities: Seoul National University, Korea University, Yonsei University, KAIST, and Postech. The focal topic is human-level lifelong machine learning (Zhang 2013). Spurred by the Center, KAIS launched a new SIG for Machine Learning.

There are new developments. The AI community starts to investigate the agents that deal with physical sensor data in addition to the traditional text-based data. This trend is accelerated by the wide spread of mobile computing, wearable devices, autonomous robots, and smart cars. This is especially remarkable in Korea since much of its economy relies on the electronics and car industries. The coming age of smart machines and the Internet of Things (IoT) is expected to rely more on physical AI systems.

Another development is the transition from machine-oriented AI to human-oriented AI and humanlike machine intelligence. Scientists talk, more often than before, to each other to find common interests between AI and cognitive science. The National Association of Cognitive Science Industries (NACSI) was founded in 2014 to promote industry-related convergence R&D at the intersection of artificial intelligence, brain science, and cognitive science. An international forum is being organized to establish a master plan for the so-called Mind Machine Project that aims to innovate core technologies for integrative intelligence systems such as personal robots and cognitive agents. The Korean Institute of Information Scientists and Engineers (KIISE) has recently organized the First International Symposium on Perception, Action, and Cognitive Systems (PACS-2015). The PACS will serve as a global venue for frontier research in embodied cognitive systems, human cognition, and machine cognition to achieve human-level artificial intelligence.

References

- Ha, J.-W.; Kim, K.-M.; and Zhang, B.-T. 2015. Automated Construction of Visual-Linguistic Knowledge via Concept Learning from Cartoon Videos. In *Proceedings of the Twenty-Ninth AAAI Conference on Artificial Intelligence* (AAAI 2015). Palo Alto, CA: AAAI Press.
- Kang, S.-S.; Shim, K.-S.; Zhang, B.-T.; Kwon, H.-C.; Woo, C.-S.; and Kim, Y.-T. 1987. An English-Korean System for Human Assisted Language Translation. In *Proceedings of the 1987 IEEE Region 10 Conference (TENCON'87)*, 509–515. Piscataway, NJ: Institute for Electrical and Electronics Engineers.
- Lee, J. 2007. A Data-Centered Integration Framework for Intelligent Service Robots. In *Proceedings of the 16th IEEE International Symposium on Robot and Human Interactive Communication (ROMAN 2007)*, 357–362. Piscataway, NJ: Institute for Electrical and Electronics Engineers. dx.doi.org/10.1109/ROMAN.2007.4415109
- Ryu, P. M.; Jang, M.-G.; and Kim, H.-K. 2014. Open Domain Question Answering Using Wikipedia-Based Knowledge Model. *Information Processing & Management* 50(5): 683–692. dx.doi.org/10.1016/j.ipm.2014.04.007
- Seo, Y.-W., and Zhang, B.-T. 2000. Learning User's Preferences by Analyzing Browsing Behavior, In *Proceedings of International Conference on Autonomous Agents (Agents 2000)*, 381–387. Richland, SC: International Foundation for Autonomous Agents and Multiagent Systems.
- Yoo, S., and Kim, I. K. 1992. DIAS1: An Expert System for Diagnosing Automobiles with Electronic Control Units. *International Journal of Expert Systems with Applications* 4(1): 69–78. dx.doi.org/10.1016/0957-4174(92)90042-Q
- Zhang, B.-T. 1997. Active Learning Agents with Artificial Neural Brains. Paper presented at the First International Conference on Cognitive Science (ICCS'97), Seoul National University, Seoul, Korea.
- Zhang, B.-T. 2013. Information-Theoretic Objective Functions for Lifelong Learning. In *Lifelong Machine Learning: Papers from the 2013 AAAI Spring Symposium*. Technical Report SS-13-05. Palo Alto, CA: AAAI Press.

Byoung-Tak Zhang is a professor of computer science and director of the Institute for Cognitive Science (ICS) and the Cognitive Robotics and Artificial Intelligence Center (CRA-IC), Seoul National University, Seoul, Korea. He has worked as a research scientist at the German National Research Center for Computer Science (1992–1995) and a visiting professor at MIT CSAIL and Department of Brain and Cognitive Sciences (2003–2004) and Samsung Advanced Institute of Technology (2007–2008). Zhang served as the founding president of the Korea Artificial Intelligence Society (KAIS) for 2010–2013. He received his Ph.D. in computer science from University of Bonn, Germany, in 1992 and his B.S. and M.S. in computer science and engineering from Seoul National University, in 1986 and 1988, respectively.