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Hangul and the "Spring" of Artificial Intelligence Research in South Korea

Youjung Shin*

Artificial intelligence practitioners and commentators have regarded the late 1980s and early 1990s as an "Artificial Intelligence Winter" for the US, Europe, and Japan. However, this was a very prosperous period for South Korean researchers studying the brain, the computer, and artificial intelligence. As shown in Figure 1, the number of books and articles published in South Korea with keywords "brain," "neuro," and "artificial intelligence" grew steadily throughout this period.[1] In fact, starting in the late 1980s, brain researchers in South Korea began to produce and publish AI research with funding from the government and industry alike.

 Youjung Shin is a Ph.D. Candidate in the Graduate School of Science and Technology Policy at Korea Advanced Institute of Science and Technology and a Visiting Student in the Department of History of Science and Technology at Johns Hopkins University.

[1] The book was collected at the search engine of NAVER Book, the most widely used web portal in South Korea, whose coverage includes the book store of Yes 24, Bandi & Lunis, Aladin, Interpark, 11th street, Kyobo, Kangcom and Youngpoong. The article was searched at one of the major research databases, DBpia, managed by the Nurimedia, a South Korean company. Since the term, "neuro," was both used as the native word (신경) and the loanword (뉴로) in Korea, the author used both keywords for searching the literatures on "neuro."

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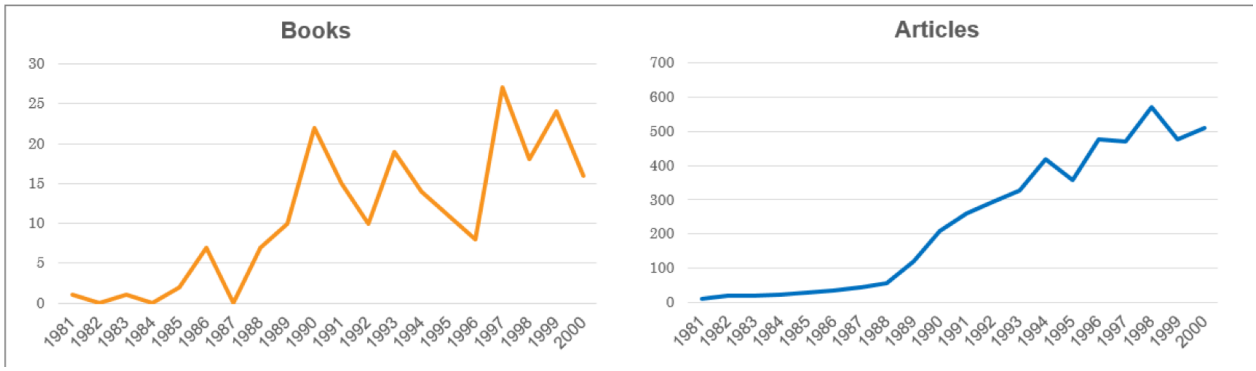

Figure 1. Number of books and articles published in South Korea with the keywords "brain", "neuro" or "artificial intelligence" from 1981-2000.

Scholars such as Colin Garvey have analyzed the story of AI in the twentieth century as a series of booms and busts. The first boom period started with the Dartmouth conference in 1956, followed by a "bust" (1974–80) that resulted from the inability to create artificially intelligent systems to handle complicated problems. The year 1980 was the start of a short boom period that resulted from narrowing their focus from solving general problems to a few very specific problems. By the end of the 1980s, many researchers found the results unsatisfactory, resulting in the second bust period or "AI winter" from 1987–93. However, when you look more broadly around the world, there is much more diversity in the ideas, projects, and practices than this "boom and bust" for which this story accounts. This paper explores how a group of researchers in the late 1980s lay the intellectual and social foundations of AI research in Korea by finding ways to process a Korean language, Hangul, using a computer (see Figure 2).

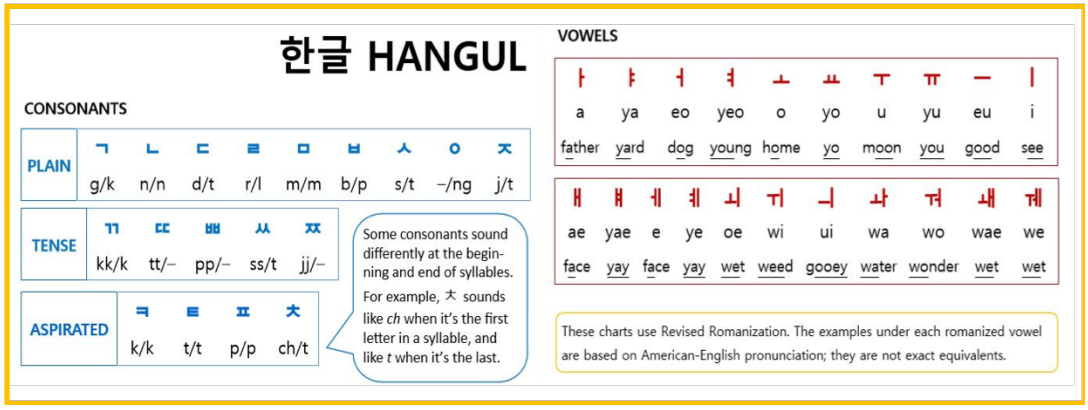

Figure 2. Characters in Hangul.

In AI research, the United States and Japan competed for primacy in the early 1980s, when the Japanese government launched their "Fifth Generation Computing Systems" national project in 1981. In the minds of some U.S. based researchers, the Japanese government's bold attempt to pursue AI posed a threat to U.S. dominance in high technology South Koreans,[2] geographically located near Japan, watched this global tension with interest, paying attention to how their East Asian neighbor appeared poised to become the most competitive stakeholder in this emerging area of science and technology research. Having long been portrayed (inaccurately according to most historians) in the American press as "skilled copyists and improvers" rather than innovators, this bold move shook American complacency and positioned Japanese researchers at the visible cutting edge of an important high-technology field. South Korean observers found these tensions intriguing, but having themselves just begun to produce computers in the early 1980s, AI research still seemed out of reach, more a concern for technologically advanced countries than for Korea. In the media, some argued that "Korea is not in the condition to think of such an advanced computer."[3]

This passive attitude began change in the mid-1980s when groups of scholars returned to Korea (mostly in 1985) after studying AI abroad. The reasons for their choice of AI as a field at this time are difficult to identify and generalize, as each individual had different motivations, but it seems that few went to the United States specifically to study AI, but rather went to the United States to pursue degrees in computer science. Nevertheless, having developed significant research capacity in this field while overseas, on their return they organized an association called the "Artificial Intelligence Research Association" under the auspices of the Korean Institute of Information

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[2] David H. D. Warren, "A View of the Fifth Generation and Its Impact," *AI Magazine* 3, no. 4 (Fall 1982): 34.

[3] Sin-Gu Kang, "A Fierce Competition on the 'Fifth Generation Computer'," *Kyung-Hyang Newspaper*, November 13, 1984; Edward A. Feigenbaum and Pamela McCorduck, The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World (Reading: Addison-Wesley, 1983); Tōru Moto-oka and Masaru Kitsuregawa, *The Fifth Generation Computer: The Japanese Challenge* (New York: John Wiley & Sons, 1985).

Scientists and Engineers. The chairman of this group, Kim Jin-Hyung, had returned to Korea in 1985 after earning his doctorate at UCLA and working as an engineer at the Hughes Research Center for four years. Significantly the vice-chairman, the secretary of academic affairs, and the secretary of liaison management were all returnees, coming back to Korea from the United States in 1985.[4] This association, regarded as the first AI community in Korea, aimed to be more than just an advocacy group. Having seen how the enthusiasm and support for AI in the U.S. during the 1960s turned to severe criticism and disappointment in the 1970s, the association cautioned against ambitious pipe dreams and attempted to discourage overblown expectations for AI and new technologies. In the first article of their newsletter, Chairman Kim stated:

> If you see most of the news and articles, you can find that they exaggerated some successful stories. . . . As a person who studies AI, whenever I encounter these reports, I am glad on the one hand, but on the other hand, I cannot help but also be sad ….I have been witnessing many failures that resulted from expecting too many achievements without sufficient investment, or attempting to solve complicated real world problems with immature technologies.[5]

The association also organized a series of workshops and public lectures to preach caution about the hype surrounding AI.[6] But then, how should Korean researchers focus

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[4] The vice-chairman of the association, Lim Young-Hwan, returned in 1985 to Korea after receiving a Ph.D. degree in Northwetern University and working as a researcher at the Argonne National Lab. Yoo Suk-In, the secretary of academic affairs, graduated from the University of Michigan in electrical and computer engineering and also came back to Korea in 1985. Lee Jae-Kyu, the secretary of liaison management at the association, returned to Korea in 1985 as well after graduating from the Wharton School of the University of Pennsylvania. Of course, there were researchers coming from domestic universities and industries, but it is hardly deniable that these researchers who just returned to the country influenced on the direction of the association.

[5] Jin-Hyung Kim, "Is AI Successful?" *Artificial Intelligence Newsletter* 2 (May 1986), 1–2.

[6] The list of gatherings organized in the late 1980s by the association includes: the first artificial intelligence lecture (KAIST, May 21, 1986), artificial intelligence lecture (Seoul National University, Nov 15, 1987), spring artificial intelligence conference (Yonsei University, March 28, 1987), the first natural language processing workshop (KAIST, July 7, 1987), autumn artificial intelligence lecture (KAIST,

their energies? That question had occupied Kim, who explained to his fellow researchers:

> To be honest at that time [when he was in the U.S], there was no question about how my studies would affect society. . . . I feel ashamed that I chose my research subjects without much consideration of their impact on society. Moreover, I had no sense of who provided research funding for me… Since my appointment as a professor at KAIST, I could enjoy the freedom of selecting research subjects and themes. My research subject selected after returning home was the problem of text and document recognition.[7]

Kim and other researchers began to focus on this problem in the late 1980s by studying AI technologies. The appeal of this work hinged not just on the particular research interests of computer scientists, but also in the larger context of Korean politics in the early 1980s. With the rise of a new regime in 1980, when Chun Doo-Hwan seized power in a military coup, the Korean government strongly emphasized the development of cutting-edge technologies. It was partly a means to assert the new regime's authority and political legitimacy.[8] Focusing primarily on information and communication technologies, the government began initiatives to produce and spread "the computer" across the country, since computers were expensive and only a few computers were utilized at that time. Special committees were organized and a plan to build and support all the infrastructure to expand a computer network was announced. The plan ultimately called for the era of "Teletopia," a word combining telecommunication and utopia. The concept of "Teletopia" was that everyone would be able to use computers in the near

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November 7, 1987), spring artificial intelligence conference (Soongsil University, March 26, 1988), artificial intelligence academic lecture (Seoul National University, November 19, 1988), spring artificial intelligence academic paper presentation (KAIST, April 29), Spring seminar on application system (Yonsei University, July 19, 1989), autumn AI lecture (KAIST, December 2, 1989).

[7] Jin-Hyung Kim, "A Concern of a Professor at Research-Oriented University," http://blog.daum.net/jkim.kaist/62 (accessed October 5, 2017).

[8] Hyang-Suk Shin, "The 5th Republic's Science and Technology Policy and the Transformation of Park Chung Hee's Legacy: The Technology Drive Policy and the Expanded Assembly for Technology Promotion," *Journal of the Korean History of Science Society* 37, no. 3 (December 2015), 519–53.

future and there would be no place in the country that these technologies could not reach.[9]

However, a group of AI researchers wondered whether it could really be a utopia for all people. Kim said, "if [the computer] is introduced as a magic box which can be used only by some experts or which requires special education to use it, as has been done so far, it would be a great obstacle for democratizing the uses of information."[10] Even if they could possess computers, the average South Korean citizens of the time still faced barriers in using them because they would have to learn not only difficult computer languages, but also English, rather than their native tongue. In short, although it was known as "the intelligent machine", because it could not communicate well in Korean, the computer did not seem to be intelligent enough for the people of Korea.

This critical reception of the computer was tied directly to the politics of the time. The 1980s was an era of democratic movements in South Korea, reaching a peak in June 1987, when a nation-wide movement protested autocratic and authoritarian regimes, specifically Chun's government, and argued for a constitutional amendment for a direct presidential election system. This movement was also tied to an anti-U.S. movement in Korea, which cited U.S support for Chun's government as the basis of their protest. Amid these calls for democratic change, there was a growing demand for the use of science and technology "for the people and for our nation."[11] At this moment, AI researchers raised their voices, arguing that "now is time to develop a computer that fits into our culture and that we can easily use."[12]

This was not the first time that efforts had been made to mechanize the writing of Hangul in Korean history. For example, when the typewriter was being developed there

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[9] Su-Man Park, "Ignition of 'the Third Fire' toward Communication Welfare: the 21st Era of Tele-topia," *Kyung-Hyang Newspaper*, January 7, 1988.

[10] Jin-Hyung Kim, "What is Artificial Intelligence," *Information Society* 14 (January 1989), 13.

[11] Jin-Hee Park, "Discussions on the Democratization of Science & Technology in Korea," *Quarterly Review of Korean History* 87 (March 2013), 169–200.

[12] Jin-Hyung Kim, "Let's Develop the Computer that Fits Well with Hangul Culture," *Dong-Ah Science* 46 (October 1989), 146–48.

were controversies as to what form of Korean character should be displayed and how they should be organized. These disputes were never resolved, even after the government announced a standardized typewriter in the early 1980s.[13]

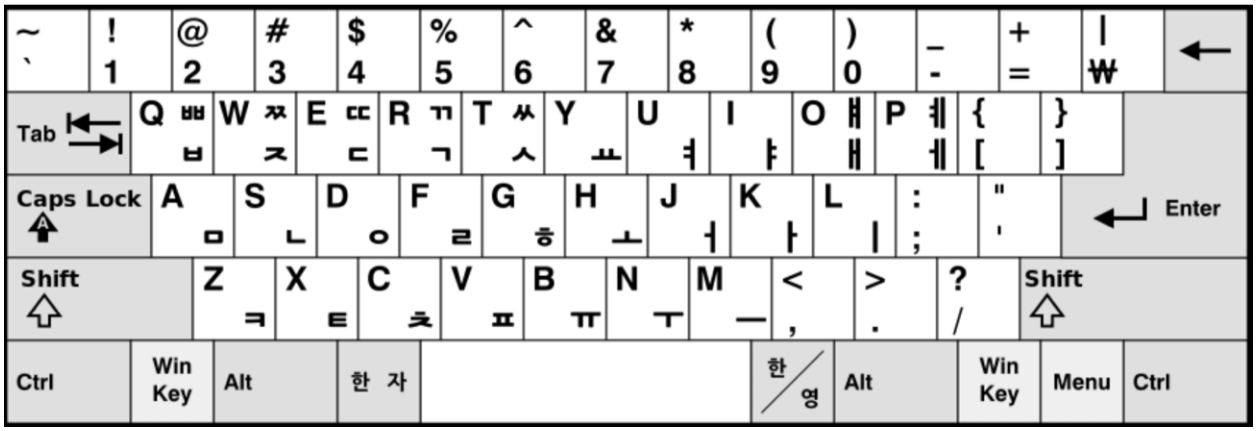

Figure 3. A contemporary standardized keyboard for Hangul.

AI researchers proposed to solve this problem by discarding the computer keyboard altogether. Believing that "by moving beyond the era of keyboards which were the only means of communicating between humans and computers for decades," Kim aimed to use AI technologies to realize the "revolution in input devices that enable the computer to make a conversation directly with humans."[14] He and his colleagues noted that "while people use very simple gestures, pictures, languages, and words to communicate with each other, the way a person communicates with a computer is still dependent on a rudimentary input device such as a keyboard." They instead imagined a computer that Koreans could easily communicate with by talking to or by supplying hand-written input, rather than typing.[15]

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[13] Tae-Ho Kim, "Pressure, Mutation, and Evolution: Various Hangul Machines in the 1960s through the 1980s," *Dong-ak Society of Language and Literature* 68 (November 2016), 111–44.

[14] Hak-Jin Kim, "Keyboard Disappears…Voice Recognition, A New Input System of Recognizing Characters," *Dong-Ah Ilbo*, November 15, 1994.

[15] Woon-Jae Sung, Young-Hwan Oh, and Jin-Hyung Kim, "Online Hand-written Hangul Recognition Using Hierarchical Curve Representation," *Korea Institute of Communication Sciences Workshop*, 215–22.

On October 9, 1989, on the official anniversary day of the invention of *Hangul*, the association organized the Hangul and Korean Language Information Processing conference in partnership with the Korean Society for Cognitive Science.[16] Researchers with diverse backgrounds gathered with the goal of finding ways to recognize and process Hangul, especially hand-written Korean texts. Speech recognition was regarded as a far more difficult subject. As it turned out, however the recognition of hand-written Korean text was also a tricky subject. Since Hangul is basically a phonetic alphabet that combines 14 consonants and 10 vowels to form a meaningful character, it shows a high level of structural similarity between different characters (See Figure 4). This structural similarity, stemming from the distinctive linguistic characteristics of Hangul, posed a particular problem for AI researchers in Korea.[17]

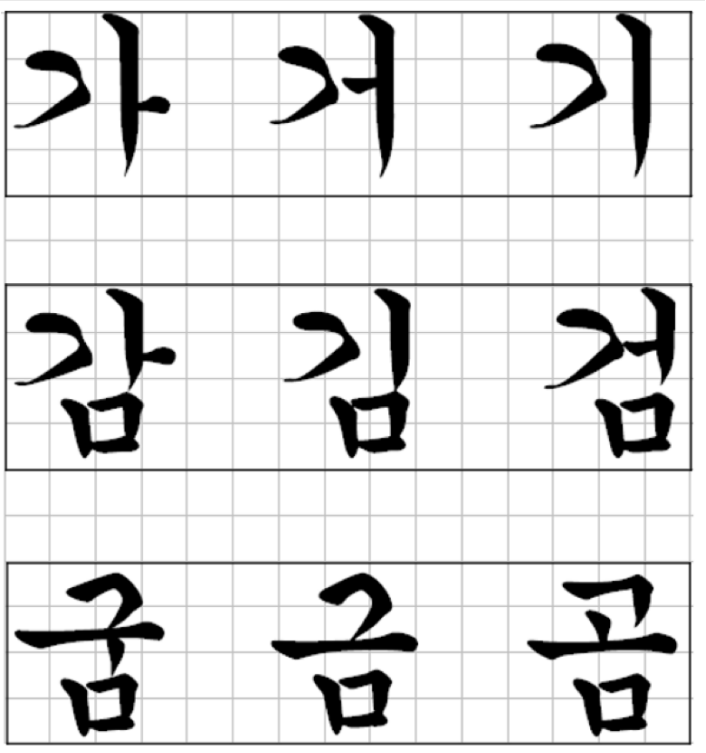

Figure 4. Structural similarities between different characters in Hangul.

[16] Hangul was invented by King Sejong (1397–1450) in the mid-fifteenth century. For now, October 9 is the official Hangul Day in South Korea and North Korea celebrated it on January 15.

[17] Gil-Rok Oh, Key-Sun Choi, and Se-Young Park, *Hangul Engineering* (Seoul: DaeYoung, 1884), 368.

To solve this particular problem, they began to think of the brain, rather than traditional computing technologies, as the main resource. Regarding the Hangul processing problem, Park Sang-Tae and Bang Sung-Yang from Pohang University of Science and Technology wrote:

> It has occurred to researchers that existing approaches are very much wrong or at least that previous approaches of AI might not be the only solution. Then what is the new method? How do we have to approach it? Many people think that the clue of the solution lies in the human brain itself.[18]

Arguing that "the human brain is far superior to any existing computer system in recognizing texts or images as well as a learning language," they increasingly emphasized the importance of "modeling the functions of human brain" to improve Hangul recognition.[19]

Indeed, the idea of emulating the brain in developing an algorithm was not totally new in the history of AI, as researchers had in the 1980s explored the idea of "artificial neural networks," an approach that connected numerous processing elements together in mimickry of neurons in the brain to accomplish learning tasks, especially learning to recognize objects. However the neural network approach was less popular than the symbolic logic which took its place as the dominant paradigm of AI.[20] Yet some researchers found problems with symbolic logic too. Han Il-Song from Korea Telecom argued that "so far, the computer has been dealing only with meaningless symbols which fits quite well with the analytical rational thinking in Western cultures. . . . [In comparison, neural networks] seem confusing at first glance but they emphasize the need for multiple-simultaneous reasoning and judgment." Therefore, not only was the problem they focused on very much based upon local Korean concerns, they also made

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[18] Sang-Tae Park and Sung-Yang Bang, "Introduction of Neural Network," *Communications of the Korean Institute of Information Scientists and Engineers* 10, no. 2 (April 1992): 5.

[19] Kyung-Hee Lee and Won-Don Lee, "Application of Coulomb Energy Network to Korean Recognition," *1989 Hangul and Korean Language Information Processing Conference* (1989), 267.

[20] Mikel Olazaran, "A Sociological Study of the Official History of the Perceptrons Controversy." *Social Studies of Science* 26, no. 3 (August 1996): 611–59.

use of a distinctive method which seemed far from the "analytical rational thinking of Western cultures."

In this context, totally new algorithms were made, such as Lee Yil-Byung's *Sejong Net*. Lee was inspired by the observation that the animal optic nerve selectively received not only the spatial but also temporal signal to identify an object. He tried to imitate this structure and use temporal information in his algorithm. He named the layer of his algorithm such as "simple cell," "complex cell," and "photoreceptor." The algorithm itself ("Sejong") was named after the king who invented Hangul in the fifteenth century.[21]

Of course, promising attempts did not always result in valuable outcomes. Lee and other researchers blamed their problems on the design of computer hardware. Lee in particular noted that existing hardware was unfit for the task "because von Neumann computers cannot support the full parallelism of neural networks." In response, a group of electrical engineers began exploring new architectures in conjunction with the algorithm-making group.[22] This increased attention to modeling computer processing on the brain encouraged Korean researchers to host the first International Conference on Neural Information Processing in 1994. Over the course of four days, presenters from twenty countries delivered 300 papers. This was very productive for the Korean AI research community, as it enabled the examination of local problems using cutting-edge technologies.

This story shows that not all AI researchers experienced an "AI winter" period in the late 1980s and early 1990s, and that this period was formative for AI researchers in South Korea. During the Western "winter" period, AI began to "spring" in South Korea, as rising emphasis on democratization gave an impetus to the localization of the computer. Regarding Hangul processing, a unique and urgent local problem prodded researchers to think about the distinctive approaches and methods through which the human brain could be an important resource. The brain itself became a valuable scientific object and information technology. In the 1980s, South Korea was not at the

[21] Yill-Byung Lee, "Status of Research on Neuro-Chip," *Yonsei Nonchong* 31, no. 1 (1995): 19.

[22] Ibid.,3–27; Hyun-Suk Kim, *Neural Network: Computer Preparing the Future* (Seoul: Crownbook, 1994).

forefront of computer technology development, but the desire to create a “Teletopia” (along with the concern to make computers truly accessible to all citizens) spurred important AI research characterized by distinctive approaches, ideas, and methodologies.