



서울대학교 컴퓨터공학부



<https://cse.snu.ac.kr/>

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Seoul National University
Department of Computer Science and Engineering



서울대학교
SEOUL NATIONAL UNIVERSITY

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We strive to develop global leaders who will lead a safe and positive future through Computer Technology

The Department of Computer Science and Engineering at Seoul National University, with its 35 internationally renowned faculty members and high-tech facilities, provides a world-class learning and research environment for over 400 undergraduate and 350 graduate students. Our Undergraduate program offers courses from a wide range of fundamental topics in computer science, such as Computer Theory and Algorithms, Computer Hardware, Software Systems, Computer Networks, Artificial Intelligence, Databases, and more. Our wide coverage gives our students the option to pursue a career in any computer area of their choice. Our graduate program builds upon the fundamentals, educating students in the emerging and developing areas of computer science, such as Big Data, IoT, Deep Learning, Cloud computing, Virtual Reality, and Block Chain so that they can conduct world-class research.

Many of our professors conduct state-run large, long-term research projects, leading South Korea's future in computer technology. They also collaborate with the industry in many joint projects that apply the latest technologies in the real world. In addition, many professors and graduates are successfully creating startups with innovative ideas and technologies. Furthermore, as Korea's top educational institution, we place an emphasis on educating our students to become global leaders, as we want our students to become more than just computer scientists. Having established agreements with universities in the United States, Europe, Japan and Asia, we continue to support many talented exchange students and faculty every year. In addition, our graduate students consistently achieve great accomplishments in various international academic conferences and competitions. As the chair of the department, I will continue to pursue our department's 3 goals (ABC): Academic Excellence, the Best Education, and Collaboration with other fields and industry. Our department hopes to build a tradition of developing creative and talented individuals who have pride in their work.

The Department of Computer Science and Engineering at Seoul National University is looking forward to applications from outstanding students who wish to join our vision.

Thank you.

**Soon hoi Ha,
Chair of CSE Department**

A handwritten signature in black ink that reads "Ha. Soonhoi". The signature is written in a cursive, flowing style.

**Providing world class education and research
through ABC (Academic excellence, Best
education, Collaboration)**

**Developing global leaders with skills and
knowledge in all fields of computer technology**

**Becoming a world class research-oriented
department with research groups in core fields
through selection and concentration**

VISION



HISTORY

March 1975

Established the Department of Computational Statistics, College of Natural Sciences

December 1978

Established the Department of Electronic Computation, College of Engineering

January 1979

Renamed the Department of Electronic Computation as the Department of Electronic Computer Engineering

March 1989

Renamed the Department of Electronic Computer Engineering as the Department of Computer Science

March 1991

Separated the Departments of Computational Statistics, Computational Science, and Statistics

March 2000

Combined the Departments of Computational Science and Computer Science, creating the Department of Computer Science and Engineering, College of Engineering

We will lead the evolution of computer technology with knowledge and creativity.

Computer science is an essential and core field in the transitions to the society of information. By designing and fabricating high-performance computers and developing the software necessary for their operation, computer science makes the best computer technology available to the entire industry. Computer science is based on building the fundamentals through theoretical research and pursuing real life applications through applied research. As all modern industries gradually increase in complexity, computer science follows the pace to solve more complex problems. As such, computer science brings forth convergent thinking and research, and continues to expand its influence across the industry.



Education and research in the computer science field requires logical reasoning and creative thinking, as well as a solid understanding of the fundamentals of engineering and science. Since computer software and hardware have a very close relationship, the two are studied in conjunction. With this in mind, computer scientists study, hypothesize about, and research the topics of Computer Architecture, Operating Systems, Database Systems, Programming Languages, Computer Communication, CAD, AI, Machine Learning, Algorithms, Natural Language Processing, Distributed Systems, Real-time Computing, Computer Graphics, Human-Computer Interaction, etc.

As the foremost technology/brain intensive industry, the computer industry has been designated as one of the government-owned industries and is supported at the national level. New and promising technologies in computer science, such as artificial intelligence, high-performance computing, human-friendly intelligent software, next-generation internet and communication, are becoming increasingly important throughout the industry. For this reason, the demand for advanced computer professionals in the industry is rapidly increasing. The Department of Computer Science and Engineering at Seoul National University strives to become a center of advanced computer technology research and human resource development.

Globalization

We seek to reach out beyond Korea
and influence the world.

Beginning with the appointment of Robert Ian Mackay, the first foreign professor at SNU, in 2005, the Department of Computer Science and Engineering is recognized as the most globalized department at Seoul National University. Currently, two outstanding foreign professors are passionately providing education and research guidance for undergraduate students at SNU. Our department has 39 foreign undergraduate and graduate students, and more than 30% of the courses, including all mandatory core courses, are offered in English. The globalization of our department not only provides international students with the opportunity to study and research, but also establishes the foundation for Korean students to enter the global stage.

In order to minimize any inconveniences faced by foreign students in their learning and daily life, we have dedicated staff for foreign student care and undertaken various efforts at the undergraduate level such as holding a CSE Int'l Luncheon for the harmony of foreign students.

Prof. Bernhard Egger

Seoul National Univ

Prof. Srinivasa Rao Satti

Institute of Mathematical Sciences, India



The background image shows a spacious, modern computer science laboratory. In the foreground, there are several light-colored wooden tables and red mesh chairs. A large screen on the left displays code. In the background, students are working at computers, and a staircase leads to an upper level. The floor has circular logos with the text "Intelligent Computing".

Undergraduate Curriculum

We uncover the excellent potential of our undergraduates, developing them into exceptional computer scientists with leadership and a cutting-edge vision for the future.

In the freshman and sophomore years of the undergraduate curriculum, students learn about the theoretical background of computer technology, the basic principles of computer science, and the composition of computer systems. Starting from the second semester of their third year, students learn about various applications of computer technology.

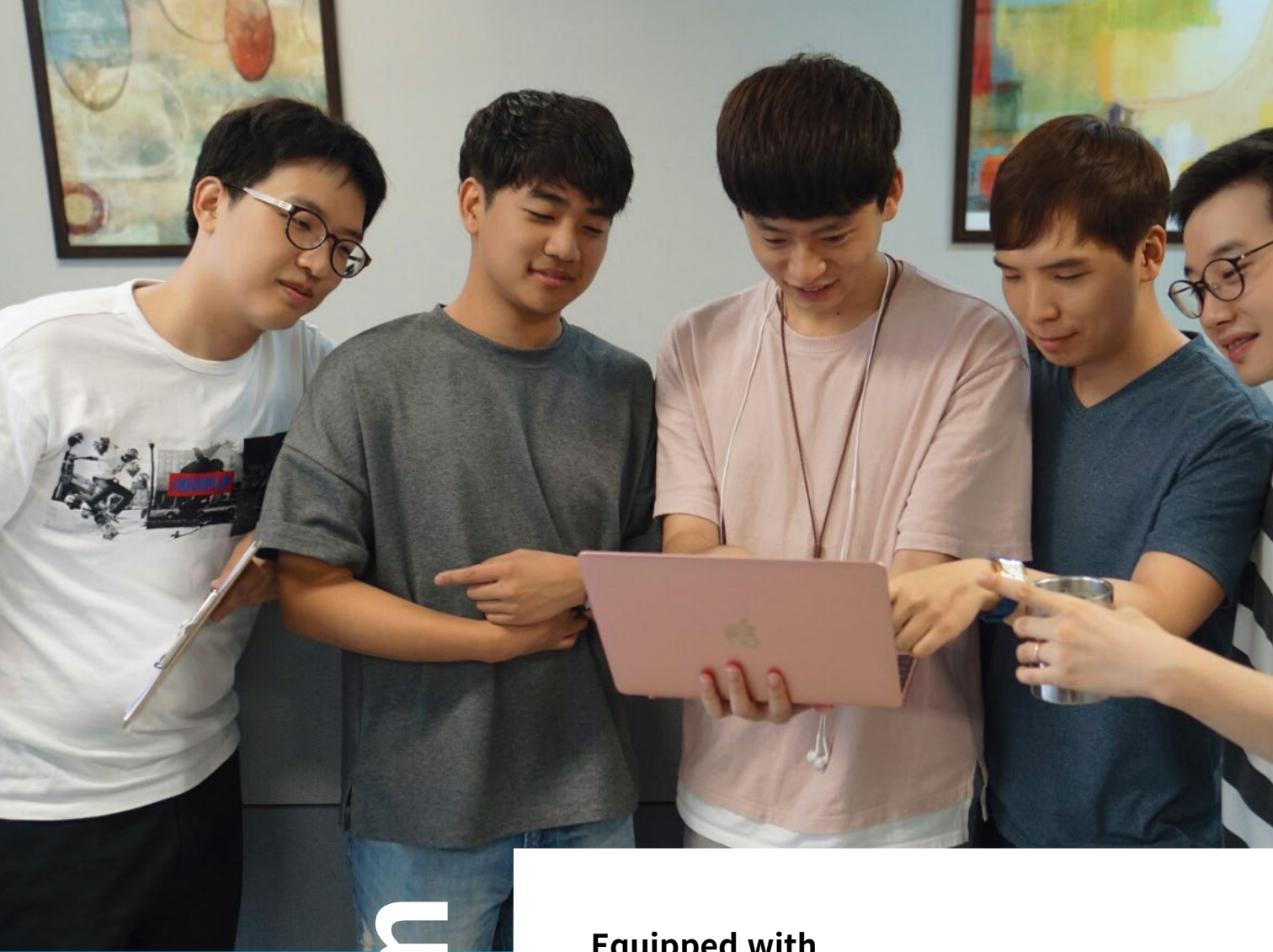
Recommended Tracks for Undergraduate Majors

	1 st Semester		2 nd Semester	
1 st Grade			4190.101* Discrete Mathematics	4190.103A Programming Practice
2 nd Grade	M1522.000600*	Computer Programming	4190.206A* Electrical Electronic Circuits	4190.209* Computer Engineering Seminar
	M1522.000700*	Logic Design	4190.210 Principles of programming	4190.308* Computer Architecture
	400.021	Information communication convergence	M1522.000900* Data Structure	()* College of Engineering Common Subjects
3 rd Grade	4190.306	Automata theory	4190.307 Operating Systems	4190.309A Hardware system design
	4190.313	Linear and Non-linear computation models	4190.310 Programming Language	M1522.000200* Creative Integrated Design 1
	4190.407*	Algorithms	M1522.001400 Introduction to Data-Mining	M1522.001800 Database
	4190.416A	Basic Digital Signal Processing	M1522.002100 Data Communication	M1522.002400 * Principles and Practices of Software Development
	M1522.000800*	System Programming	M1522.002700 Introduction of IT-Start up	
4 th Grade	4190.303C	Embedded System and application	4190.403 Software Application	4190.406B Mobile Computing and Its Application
	4190.402	Software Engineering	4190.412 Computer Modelling	4190.414A Multicore computing
	4190.408	Artificial Intelligence (AI)	4190.415 Computer Security	4190.423 Computer Convergence Application
	4190.409	Compiler	4190.426A Human-Computer interaction	4190.428 Introduction to Machine Learning
	4190.410	Computer Graphics	M1522.001000 Computer Vision	M1522.001200 Topics in New Computer Technology
	4190.411	Computer Networks	M1522.002300 Internet Security	
	4190.422*	IT-Leadership Seminar		
	4190.427	Social Network Analysis		
	M1522.000300*	Creative Integrated Design 2		
	M1522.002500	Introduction to Quantum Computing and information		
	M1522.002800	Understanding Block Chains		
	M2177.004300	Introduction to Deep Learning		

Departmental Course Requirements

* Requisite major * Requisite major by regulation

- ① ()* CoE (College of Engineering) common subjects
- ② Students must follow the Department Regulations
- Must complete 3 credits from all CoE common criteria
- 400.XXX or M2177.XXXXXXX subject can be approved maximum 9 credits(Integrated Nano system and Introduction to deep learning will be exempted from 9 credits limitation)



Graduate Curriculum

**Equipped with
excellence, creativity, and
communication skills, our
graduates ascend to new
heights as global leaders.**

Graduate courses cover in-depth details about specific fields through cutting-edge research, lectures, seminars and discussions.

Graduate Courses by Research Fields

Research	Subject
System Software	Advanced Operating Systems, Compiler Optimization, Distribution System, Multi-Processor Synchronization, Distributed Information Processing, AI and Big Data Systems, Topics in Computer Systems
Programming System and Software Engineering	Static Program Analysis, Topics in Programming Language
Information Systems	Database System, Unstructured Database System, Information Retrieval, Advanced Data Mining, Topics in Object-Oriented Systems, Topics in Big Data Analysis, Topics in Data Base
Graphics and Human-Centered Computing	Advanced Graphics, Computer Animation, Geometric Modelling, Information Visualization and Visual Analytics, Mobile and Ubiquitous Computing, Topics in Graphics
Networks	Advanced Computer Networks, Probability-based Network modelling, Wireless Network Protocol, On-line Social Media Analysis, Block Chain and Decentralized Internet, Internet Authentication and Anonymity, Topics in Internet Security, Topics in Computer Networks
AI	Machine Learning, Artificial Neural Networks, Probabilistic Graphical Models, Machine Learning for Bioinformatics, Advanced Artificial Intelligence, Natural Language Processing, Knowledge Representation and Reasoning, Deep Learning, Topics in Artificial Intelligence
Architecture and Embedded System	Advanced Computer Architecture, Real-time Systems, Digital Systems Design Methodology, Quantum Computing, Topics in Real-time Systems, Topics in Embedded System, Topics in Computer Architecture
Theory	Theory of Computation, Data Compression, Genetic Algorithms, Cryptology, Topics in Theory of Computation, Topics in Algorithms

Various Student-led Activities

Orientation Training for New Students

The Orientation Training for New Students, usually held two times in January and February, is the first official event for the new students to meet the returning students. The experienced students share their stories with new students and answer any questions they have. It is a great opportunity for the new students to form friendships.

Beginning of Semester Party and End of Semester party

Once at the beginning of a semester and once at the end of a semester, students from all grades gather and have a good time.

Dinner Gathering

During March, new students and experienced students gather to interact, similarly to the orientation training.

MT

Membership Training is a retreat-like event in which students hangout over-night, forming new friendships and making great memories. Sometimes MTs are conducted separately by grade, and other times it is mixed.

Clubs Introduction Session

The Clubs Introduction Session, which is held mid-March, gives students the opportunity to learn about CSE clubs and gatherings. The session gives new students the chance to think about which clubs and gatherings they would like to join.

Beo Deul Gol Outing (버들골 나들이)

This outing is a special CSE event in which students go out to Beo Deul Gol during spring. Unlike other events which are mainly conducted indoors, this event conducted outdoors allowing for a completely new experience. The fresh spring breeze energizes the students who may be worn out by their academic workload.

E-sports competition

A new event first started in 2019, the E-sports competition is an opportunity for students to compete in various E-sports such as League of Legends and Kart Rider with other departments or majors. This event develops team-work and friendship among the teammates and competitors.

CSE Night

Every November, CSE students gather in a wide lounge and enjoy performances prepared by student volunteers. The event includes band, choir, and magic performances, just to name a few.





Department events

ComSee - CSE Extracurricular Education

Students and professors gather and participate in physical outdoor activities such as soccer, football and badminton. Following that, professors introduce their research lab and courses. Students then get to have conversations with professors about topics such as University life, graduate programs, jobs and career development.

Distinguished Lecture Series

cse.snu.ac.kr/distinguished-lecture-series

Students get to interact with outstanding scholars from various fields of Computer Science and Engineering through seminars and discussions.

SNU CSE Industry Seminar Series

cse.snu.ac.kr/cse-industry-seminar

Influential people in the industry are invited to hold seminars and share their industry experience.

SNU CSE International Luncheon

This is an event for international students where they can get used to Korea by exchanging information and developing friendships. It consists of presentations of meaningful topics, discussions on lectures and scholarships, and a Q&A session.

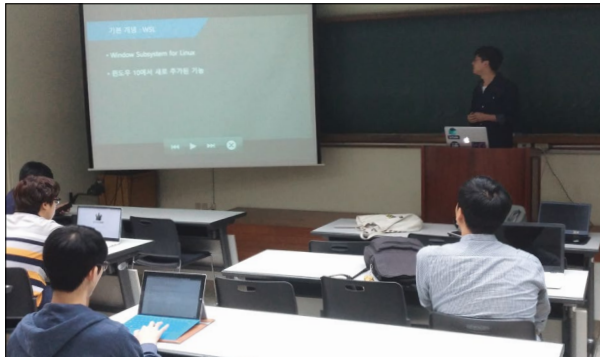
Career Exploration Mentoring Day

Mentoring day is an event where students share their concerns regarding their academic path and school life and look for solutions with the help of the numerous professors in the department.

University Life

Guardian (가디언)

Guardian is a club that was formed to research about [security](#), one of the most intriguing fields in Computer Science. The club conducts projects in small groups, and conducts seminars regularly to explore various topics. The club also regularly participates in big and small competitions, conducts projects through NAVER D2 Campus Partner, and collaborates with other clubs.



Bacchus (바쿠스)

Bacchus is a club that manages CSE [systems](#). Bacchus not only manages desktops and servers in the software/hardware labs, but also provides various computing services to CSE members. They provide a service that allows others to use lab PCs, Linux boxes, and the Department community site. Finally, Bacchus has also developed and is currently managing the CSE community site (www.snucse.org).

Soccer301 (사커301)

Soccer301 is a [soccer](#) club for students in the department who enjoy the sport. Founded in 2008, the club provides an opportunity for students to stay fit and make new friendships. The club meets every weekend for training and friendly games. Soccer301 also participates in various soccer competitions that are hosted on campus.



STEIN (슈타인)

STEIN is a CSE Band for students who are interested in [music](#). They recruit new members annually and regularly get together in group rehearsals. STEIN officially performs biannually during the school breaks and collaborates with bands from other schools.



SNUPS (스눅스)

SNUPS is an academic club centered on preparing for various programming competitions such as the ICPC by studying the computer science fields of problem solving and [algorithms](#). They organize various on-line and off-line study groups to study together, and annually hold an on-campus competition called SNUPC. This club won the ICPC Korea Competition for four years in a row, and had members win medals in the ICPC World Finals for three years in a row (1 gold, 2 silvers). Additionally, Club members have placed highly and sometimes first in other competitions such as SCPC or UCP.



Waffle Studio (와플 스튜디오)

Waffle studio is a [web-service](#) development club. The goal of this club is to create useful, experimental, and fun services for ordinary people whilst learning about the process of service development. Currently, they provide SNU students with a class evaluation site (SNUev.kr), an on-line scheduling service (SNUtt.kr), and an android meal menu APP (식사).

UPnL (유피넬)

UPnL is a club that develops [computer software](#). UPnL members work in teams to conduct projects and make useful software. The club holds regular member meetings and internal workshops where members can share their thoughts and ideas. The club has many servers for software development, and club members are given access to a source code management system and wiki service. Club members can carry out projects that require servers (i.e. games, web services). Finally, UPnL members also get access to several PCs, various equipment, and books/publications.



Scholarships

Our excellent Student Support System helps students concentrate on their studies without financial concerns

CSE provides the opportunity to receive various on-campus scholarships such as Merit-based scholarship, Teaching-research support scholarship, Labor scholarship and off-campus scholarships from outstanding foundations. Almost all students receive these scholarships. Graduate students also receive research funds from different services.

On-Campus	Grade-based scholarship, Teaching-research support scholarship, Work-study scholarship, Good-hearted student scholarship, International student scholarship, Overseas-study scholarship etc.
National	National scholarship type I, II
National Excellence	Engineering scholarship, President scholarship
Off-Campus	Engineering research education foundation, Gwanak society, Kwanjung educational foundation, Mediheal scholarship foundation, Bon-sol Kim Jong Hwan foundation, Sam Hwa foundation, SNU development fund, Songwon Kim Young Hwan scholarship foundation, Shin-la cultural scholarship foundation, Sin-yang cultural foundation, Yong-woon foundation, Yu-Han foundation, Jung Hun foundation, Cheonman scholarship, Chung-Hap scholarship, Hyundai CMK foundation, Hyun Song education foundation, KT group hope-sharing foundation, MBK scholars, OK Bae Jung foundation, Sam-il scholars, Farming and Fishing village foundation, The right hands, Gwang Ju citizen foundation, Korea scholarship foundation for the future leaders, Hyupsung cultural foundation, KangMinSung Scholarship foundation, Bodam scholars, Happy Young Do scholarship, KC future scholarship, Asan foundation, Doosan Yonkang foundation, Soul scholarship foundation, STX foundation, ILJU foundation, Miraeasset exchange scholarship, Seoam Yoon Se Young Foundation, Dong San scholarship, Nam Kang scholarship, Korea Association of University Women, Mongeun scholarship foundation, Lotte Scholarship foundation, Samsung dream scholarship foundation, Soondeuk scholarship foundation and many more

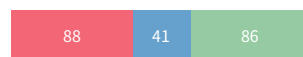
2019 Scholarship recipients (unit: person)

	1st semester		2nd semester	
Scholarship type	Undergraduate	Graduate	Undergraduate	Graduate
On-campus	75	88	87	102
Labor	18		12	
Monthly income based	18		12	
National type I, II	90		86	
National excellence	40		33	
Off-campus	87	41	77	49
BK Scholarship		86		109
Total recipients	328	215	307	260
Percentage of Scholarship Awardees	105%	96%	105%	110%
Percentage of Scholarship Award Amount	74%	86%	68%	103%

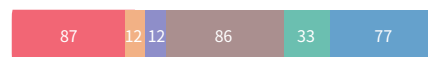
1st semester undergraduate students



1st semester graduate students



2nd semester undergraduate students



2nd semester graduate students



※ Scholarship benefit rate: Scholarship recipients for tuition/ registered students

Department Facts

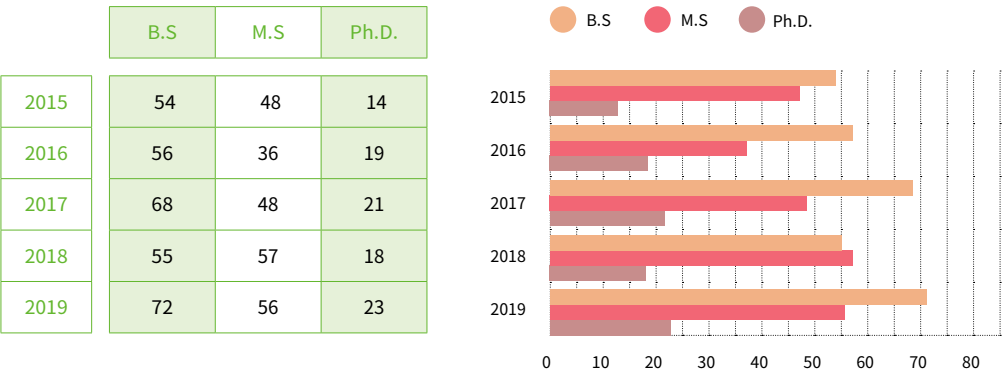
A great depth of opportunities open for our globally recognized graduates

About 35% of undergraduate graduates go on to graduate school. With the aim to develop professionals with high-level technical skills and excellent research capabilities, SNU is investing a great amount of attention in its graduate program. Within the graduate program, students can study and research in one selected research field in great depth. Once the students complete the program, they can enter the national/international industry or even create a startup with their innovative ideas.

2019 Student Status (unit: person)

	Major				Liberal studies	Double major	Minor	M.S	Combined M.S & Ph.D.	Ph.D.
	1 st Grade	2 nd Grade	3 rd Grade	4 th Grade						
Total	78	95	113	135	110	120	82	111	110	28

Number of Graduates (unit: person)



Graduate Careers (unit: person)

	Employment	Academia	Admission	Venture	Etc.
B.S	25	0	25	3	19
M.S	28	0	7	0	21
Ph.D.	12	6	1	1	3

Institute of Computer Technology and Research Centers

The best research facilities for
developing advanced computing
technology

The foremost research center for
leading computing technology

The home of innovative and
creative research projects



Institute of Computer Technology

Founded in 1989, Institute of Computer Technology is dedicated to developing new computer technologies and training professional researchers in computer science and engineering. The institute was founded through the cooperation of 20 domestic universities. By fostering the cooperation of universities and industries within the nation, the institute has been a pivotal center for raising IT professionals and developing cutting-edge information technology, and thus is central to the growth of the national computer industry. Currently, we are conducting research in various fields of computer science to develop innovative technologies that will become the foundation of the next-generation computers.



BK21 Plus program for pioneers in innovative computing bkcse.snu.ac.kr

BK21 Plus program for pioneers in innovative computing was established to educate advanced global computer science leaders and to systematically nurture talented professionals who can create innovative and outstanding academic value.

Our team operates a research empowerment program for CSE professors, graduates and new researchers. Through our great results in academic thesis presentations, new technology development, and industry-academic cooperation, we are leading the advancement of technologies in national and international computer science fields. Our team is conducting a broad and flexible human resource development program to consistently cultivate top software experts who fuel the IT industry, creative researchers to sculpt the future of computing, and entrepreneurs to create new computer related startups.

■ Scholarship support program

National Research Foundation of Korea/BK21 Plus business/Future based Creative talent business

SW Starlab

SW Star lab is a program that is led by government's "K-ICT" Global Leadership Strategy ". The project is operated with the purpose of improving the basic strength of national information and communication technology (ICT), especially in the software (SW) field to the global level. The program selects an outstanding university lab for each of the five main strategies for software development field (△Database Management Systems △Intelligent SW △Distributed Computing △Algorithms △User Interface(UI)/User Experience(UX)) and support their long-term research. Currently, a total of seven 7 research labs in our CSE department has been selected as SW Star labs and are carrying out committed research for the nation.

Prof. Je Hee Lee	Human body movement simulation based on Deep Learning
Prof. Chang Gun Lee	SW Development of Real System based on multi core and GPGPU for automated vehicle
Prof. Byoung-Tak Zhang	Development of cognition agent SW based on daily-life education
Prof. Byung-Gon Chun	Development of unified big data stack to operate high-speed various analysis
Prof. Jae Jin Lee	Development of CUDA programming environment for FPGA Cluster
Prof. Gun Hee Kim	Understanding on-line's different shapes and development of Communication AI that sympathize with people
Prof. Kun Soo Park	Practical Algorithm Framework for NP-hard graph problem

■ Research Support System

Ministry of Science and ICT/IITP Data Communication Broadcast technology development service

Video Intelligence Center

The Video Intelligence center of our department has been selected as a core part of the artificial intelligence research in the National Strategy Development Project, a project aimed to improve the quality of life of Korean citizens through technological strategy development.

Video Intelligence center develops human-level video interpretation intelligence technology and verify its effectiveness with the Video Turing Test (VTT). For this, the center has developed a high-capacity, high-quality video processing platform, a research multi-modal video story memory structure, and education technology to create a communication engine that understands the story to pass Video Turing Test. Then, they combined these technologies and established the VIP(Video Intelligence Platform). Now, they host the VTT competition using platform. The developed technologies are released as open-source packages along with the education data, allowing many research developers to use the information conveniently.

■ Research Support Program

Ministry of Science and ICT/IITP AI National Strategic Project Service

Samsung Electronics Incubation Center for Future Technology ICT Creativity project

Samsung Future Technology ICT Creativity project is a future technology program supported by Samsung Electronics Incubation Center. The three research fields of △Basic Science, △Material Technology, and △ICT have received funding of 1.5 trillion won during the last 10 years. The Samsung Electronic Incubation Center specifically selects Material Technology and ICT research projects to support. In CSE of SNU, a total of 6 assignments have been selected as an ICT creativity projects and are being rigorously carried out with the aim to lead the future industry.

Prof. Ji Hong Kim

AutoBox: Real time large capacity flash storage system for smart-automobiles.

Prof. Jae Wook Lee

Typed Architectures: Processor structure for ultra-light scripting

Prof. Chung-Kil Hur

Origin Technology research to remove compiler error perfectly with reasonable price.

Prof. Je Hee Lee

Body kinematic modelling to copy most realistic human movement and body musculoskeletal system simulation technology development.

Prof. Tae Hyun Kim

Development of new quantum algorithm and optimizing research for quantum hardware with high reliability.

■ Research Support Program

Ministry of Science and ICT/ICT Creativity project

Seoul National University's Center for Artificial Intelligence(SCAI) scai.snu.ac.kr

SCAI is the center of innovative research in Artificial Intelligence and Deep Learning. Here, the world's top next-generation AI researchers come together with the goal of shifting the global scientific, technological, and economical environment through revolutionary research. Other important members of the Center are the partnership companies and institutions that interact with the talents, collaborate with them, provide insights from the industry, and sponsor the Center's long-term endeavor.

The disciplinary backgrounds and skill sets of the SCAI researchers are wide-ranging, covering computer vision, speech recognition, natural language processing, robotics, personal digital assistants, deep neural networks, machine learning software, machine learning hardware, massively parallel computing, distributed systems, graphical models, probabilistic inference, Bayesian statistics, statistical physics, information theory, neuromorphic computing, brain science, and cognitive science.

■ Participating Professors

Byung-Tak Zhang(Center Manager), U Kang, Gun Hee Kim, Sun Kim, Chong-kwon Kim, Jihong Kim, Jin-Soo Kim, Byung-Ro Moon, Jinwook Seo, Hyun Oh Song, Hyeon Sang Eom, Heon Young Yeom, Sungjoo Yoo, Kwangkeun Yi, Sang Goo Lee, Young Ki Lee, Jae Wook Lee, Jae Jin Lee, Je Hee Lee, Chang gun Lee, Byung Gon Chun, Soonhoi Ha

Large-scale Collaborative Research Projects (Cluster Projects)

Through collaboration projects between various research fields of CSE, we try to achieve bigger innovation, encourage collaborative research projects with professors from different majors. We are working on the following Large-scale collaborative research project.

Ultra high-performance programming environment and development of calculation system

Professors: Taekyoung Kwon, Hyeon sang Eom, Heon Young Yeom, Sungjoo Yoo, Jae Wook Lee, Jaejin Lee

Neural Processor Research Center (NPRC)

Professors: Gunhee Kim, Hyun Oh Song, Sungjoo Yoo, Jae wook Lee, Jaejin Lee, Byung gon Chun, Soonhoi Ha, Bernhard Egger

Develop QnA technology based on video story understanding to pass Video Turing Test (VTT)

Professors : U Kang, Gunhee Kim, Byung-Tak Zhang, Byung Gon Chun

Develop Machine learning technology based on real-life interaction experience of brain-recognition development process on basic-infant level type

Professors: Hyun Oh Song, Young Ki Lee, Byung-Tak Zhang

■ Research Support Program

Ministry of Science and ICT/Development of next generation information computing technology, Samsung electronics Advanced Institute of Technology/ Neural Processing System research, Ministry of Science and ICT/Innovation Growth Project(AI) Service

Research Groups

In labs full of passion for creative research, we continue to conduct research that is the center of attention from all over the world.

Human-Centered Visual Computing Technology

Graphics and Human-centered computing research group

Computer Graphics and HCI Technologies seek flawless communication between humans and computers. Many complex problems in modern society can find clue for the solution on proper visualization and human visual perception. Human-Centered Visual Computing Technology seeks to be a computer that is convenient for humans, to utilize human abilities in computing, and ultimately to cooperate with humans and computers. More specifically, research is conducted on shape modeling, multi-dimensional information visualization, image processing/ analysis, motion analysis and synthesis, interactive avatar control, intelligent virtual character, user interface design, and information visualization

Movement Research Lab

mrl.snu.ac.kr

Professor

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Human-Centered Computer Systems Lab

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Computer Graphics and Image Processing Lab

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Professor

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Human-Computer Interaction Lab

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Professor

Jin Wook Seo

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E-mail

jseo@snu.ac.kr

3D Modeling and Processing Lab

3map.snu.ac.kr

Professor

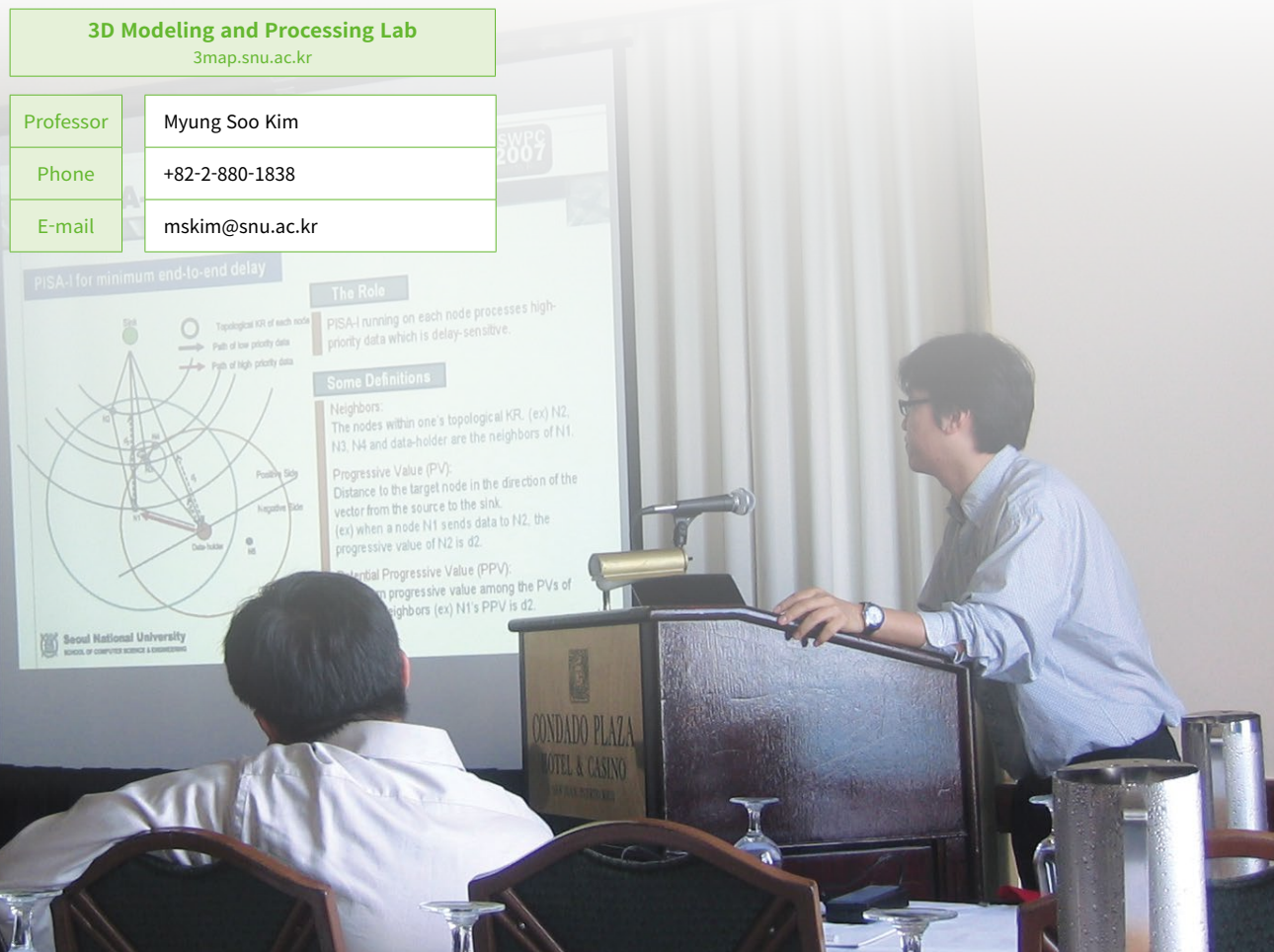
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The future internet will open the world of communication and exchange

Network Research Group

Research and Development of protocols and algorithms for all networks, including the internet, wireless networks, data center networks, and online social networks. Also recently researching about Internet security and privacy. More specifically, focusing on developing core technologies that will lead the future of telecommunication and internet services such as the architecture design of the Internet, the application of networking optimization of Artificial Intelligence technology, the development of network virtualization technology, the resource management of mobile / wireless communication, the development of IoT communication protocol and IoT system, the analysis of communication traffic, block chain, internet authentication, privacy protection technology.

Social & Computer Network Lab

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Professor	Jong Kwon Kim
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Mobile Computing and Communications Lab

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Professor	Wha Sook Jeon
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Network Convergence & Security Laboratory

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Professor	Tae Kyung Kwon
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Research that extracts value from Big Data

Database and Big Data Research Group

Our Research Group conducts research on Big Data, Databases, Data Mining, Machine Learning, and Deep Learning. Main Research subject is DBMS Support to improve Machine Learning performance, Data managing and saving technology for various Database application, Data Mining, Information Searching, Recommending System, Natural Language Processing, Deep Learning, Graph analysis such as Web/Social Network. Etc., Light weight and AutoML, Finance AI

Data Mining Lab

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Professor	U Kang
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Database System Lab

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Professor	Bong Ki Moon
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Internet Data Base Lab

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Professor	Hyung Joo Kim
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Intelligent Data Systems Lab

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Core Software System allows world-wide service

System Software and Distributed System Research Group

Facebook, Instagram, Youtube, Kakao Talk. System software enables services to run faster, use less energy, and perform more reliably and safely from unexpected errors, intrusions and attacks on modern hardware. More in detail, including research as Hardware resource management of single system that managed by operating system technology, compiler and software platform technology that make it easy to develop various services, distributed/parallel system technology to solve the scalability problem with increasing number of users, Artificial intelligence and big Research on data systems.

Multicore computing lab aces.snu.ac.kr		Software Platform Lab spl.snu.ac.kr	
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System Software and Architecture Lab csl.snu.ac.kr		Computer Systems and Platforms Lab csap.snu.ac.kr	
Professor	Jin soo Kim	Professor	Bernhard Egger
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Research where Theory meets reality

Theory and Financial Engineering research group

Computer Theory is the basic theory of computer science and has made a fundamental contribution to the development of computer science with efficient algorithm development, NP-completeness concept, and modern cryptology theory. Our research group basically studies efficient algorithm development.

Particularly, we are doing research on Big data analysis algorithms, practical algorithms suitable for multicore and cache structures, and genetic algorithms, and also working on applications such as security and financial engineering.

Computational Theory and Algorithm Engineering Lab

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Optimization and Financial Engineering Lab

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Professor	Byung Ro Moon
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Computer Theory and Applications Lab

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Computer that learns like human

AI Research Group

AI(Artificial Intelligence) is one of the computer science fields that studies how to solve problems efficiently by simulating human recognition, thinking, memory, and learning. Currently, we are working on various theories and applied studies such as machine learning theory, computer vision, text mining, video analysis, recommendation agent, brain neural network analysis and ecosystem modeling

Machine Learning Lab

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Biointelligence Lab

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Bio and Health Informatics Lab

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Vision and Learning Lab

vision.snu.ac.kr

Professor	Gunhee Kim
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Future controlled by Smart Embedded System

Computer Architecture and Embedded System Research Group

In the future, computing will not only be a PC on a desk, but will also provide convenience and safety in our lives, including smartphones, cars, aircraft, roads, buildings, and bridges. The core technology is to optimize and implement intelligent services for embedded computers with limited computing, memory and battery capacity. Embedded System Research Group conducts not only computer SW, but also CPU architecture, Memory Architecture, Memory architecture and multicore to optimize the system design considering the computer HW characteristics. These research will make possible of AI technology internalization to our lives.

Real-time Ubiquitous System Lab rubis.snu.ac.kr		Architecture and Code Optimization Lab arc.snu.ac.kr	
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Quantum Information and Quantum Computing Lab		Computer Architecture and Embedded Systems Lab davinci.snu.ac.kr	
Professor	Tae Hyun Kim	Professor	Ji Hong Kim
Phone	+82-2-880-1725	Phone	+82-2-880-8792
E-mail	taehyun@snu.ac.kr	E-mail	kjihong@snu.ac.kr
Computing and Memory Architecture Lab cmalab.snu.ac.kr		Co-Design and Parallel Processing Lab iris.snu.ac.kr	
Professor	Sung Joo Yoo	Professor	Soonhoi Ha
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Safe, Reliable, & Productive Programming Language and Software Engineering System

Software Foundation and Analysis Group

The current programming technology, even with all the hitherto thrilling advances, is still in infancy. The programming languages will constantly move to more convenient and higher levels. Programming tools will use more and more sophisticated logics and highly engineered implementations. Such tools will eventually reach to a point where ordinary programmers can daily use them without much effort. The cost of building secure and trustworthy software will be ever more decreased. We research on enabling technologies for such future: programming language theory, static analysis and verification, and software engineering applications and tools.

Software foundations lab sf.snu.ac.kr		Programming Research Lab ropas.snu.ac.kr	
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Laboratories

Our education and research for better future and better world continues.

Many noted computer science professors in the world are working actively as editors in world-famous computer science institutes such as ACM, IEEE , as chairs in international conferences, and as keynote speakers.

We have successfully carried out government-led projects and private industry-led research projects,

And today, we continue to change, innovate, research, and challenge for the positive better world that people dream of.



Prof. U Kang

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Education

2012 Ph.D., Computer Science,
Carnegie Mellon University

2009 M.S., Information
Technology, Carnegie Mellon
University

2003 B.S., Computer Science
and Engineering, Seoul National
University

Experience

2015-present

Full-time professor, Computer
Science and Engineering, Seoul
National University

2013-2015

Assistant Professor, Computer
Science, KAIST

2012-2012

Postdoctoral Fellow, Computer
Science Department, Carnegie
Mellon University

Data Mining Lab datalab.snu.ac.kr

How can we learn models for prediction and better understanding of data? How can we find useful patterns and anomalies in big data? How to handle data that are either too huge or too fast? In Data Mining Lab, we perform interesting research projects on key models, algorithms, and systems for artificial intelligence (AI), knowledge discovery, and machine learning.



Deep Learning



Graphs & Tensors



Recommendation



Financial AI

Deep Learning and Machine Learning

How can we learn from massive amount of data? We work on designing models, algorithms, and systems for deep learning and machine learning. We focus on autonomous machine learning (AutoML), lightweight machine learning, transferable machine learning, anomaly detection and prediction, and object detection and classification using sensors.

Graphs and Tensors

How to analyze graphs and/or multi-dimensional data? We develop models, algorithms, and systems for graphs and tensors. We focus on random walk with restart for ranking and relation inference, graph machine learning (to outperform recent works including graph convolutional networks), scalable graph mining, and scalable tensor mining.

Recommender Systems

Given who-watched-which TV transaction data, how can we recommend relevant TV programs for a given user? We work on designing and developing models, algorithms, and systems for recommendation. We focus on recommendation in multi-modality, sequence recommendation, active recommendation, and network based recommendation.

Financial AI

How can we design an AI that automatically trades stocks? How can we detect financial frauds? Financial AI aims to develop models, algorithms, and systems for financial applications. We focus on time series prediction, asset value prediction and algorithm trading, consumer analytics, and fraud detection and prediction.

Publications

- D-Tucker: Fast and Memory-Efficient Tucker Decomposition for Dense Tensors, ICDE 2020
- Sampling Subgraphs with Guaranteed Treewidth for Accurate and Efficient Graphical Inference, WSDM 2020
- Data Context Adaptation for Accurate Recommendation with Additional Information, Big Data 2019
- Knowledge Extraction with No Observable Data, NeurIPS 2019
- Belief Propagation Network for Hard Inductive Semi-Supervised Learning, IJCAI 2019

Projects

- **2019-present** Measuring transferability of heterogeneous datasets for automatic data analysis, Samsung Electronics
- **2019-present** Real-time lightweight multi-way data analysis using high-speed tensor stream analysis, MIST
- **2019-present** Personalized advertisement and recommendation, WeMakePrice



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Education

2000 Ph.D., Computer Science and Engineering, Seoul National University
1995 M.S., Computer Engineering, Seoul National University
1993 B.S., Computer Engineering, Seoul National University

Experience

2017-2018 Visiting Professor, University of Florida
2017 ACM CoNEXT General Co-Chair
2010 Visiting Professor, Rutgers University
2004-present Full-time Professor, Computer Science and Engineering, Seoul National University
2003 Post-doctoral Researcher, City University New York
2000-2002 Post-doctoral Researcher, UCLA
2000 Post-doctoral Researcher, Soongsil University
2000 Part-time lecturer, Hanyang University



Prof. Yanghee Choi

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Education

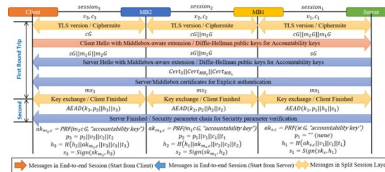
1984 Ph.D., Computer Science, Ecole Nationale Supérieure des Telecommunications
1977 M.S., Electronics Engineering, Korea Advanced Institute of Science
1975 B.S., Electronics Engineering, Seoul National University

Experience

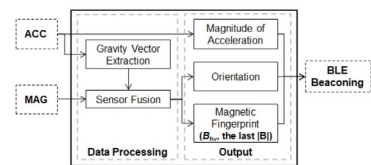
2014-2017 Minister of Ministry of science, ICT and Future Planning
2013-2014 Chairman of Samsung Science & Technology Foundation
2009 Head of the Advanced Institute of Convergence Technology
2009-2011 Head of Graduate School of Convergence Science and Technology, Seoul National University
2008 23rd President of the Korean Institute of Information Scientists and Engineers
1991 – present Full-time Professor, Computer Science and Engineering, Seoul National University
1984-1991 Director of the Center for Information and Communication Standards Research in ETRI

Network Convergence & Security Lab mmlab.snu.ac.kr

Our lab conducts research on the entire area of the Internet and network. In particular, we design various network architectures and communication technologies related to Software Defined Networking (SDN), Future Internet, Internet of Things (IoT), and security issues. We also analyze internet data to investigate networking and user behavior



maTLS Handshake



Indoor Positioning device overview

Internet Security and Privacy

There is an increasing demand for the security and preventing privacy leaks of network infrastructures. We analyze and resolve security vulnerabilities in the network infrastructure, such as DNS, design/development of protocols for security on CDN, and develop secure technologies for the user tracking.

Software Defined Networking (SDN) & Network Function Virtualization (NFV)

Our lab studies NFV that virtualizes the modules such as firewall and dynamic resource management in the network using SDN, and develops network congestion control technology in high-performance computing.

Mobile Computing

As the use of smart devices is rapidly increasing, studies are active to recognize the user's contexts and reflect them in services. We study a variety of applications, such as estimating location in an indoor environment or video streaming techniques based on user and network context.

Internet Data Science

There are many different types of information available through the Internet, such as web users' activity log, traffic, and SNS usage. We collect and use this information to model, analyze, and predict user behavior patterns and content propagation patterns.

Publications

- maTLS: How to Make TLS middlebox-aware?, NDSS 19
- An Energy-efficient and Lightweight Indoor Localization System for Internet-of-things (IoT) environments, ACM UbiComp 18
- Unveiling a Socio-Economic System in a Virtual World: A Case Study of an MMORPG, WWW 18

Projects

- 2016-2020 Developing high-performance programming environments and computing systems, NRF
- 2015-2020 Smart Campus: A research on Localization Scheme based on Multiple Sensors, Samsung Electronics
- 2014-2020 Versatile Network System Architecture for Multi-dimensional Diversity, IITP



Prof. Gunhee Kim

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Education

2013 Ph.D., Computer Science,
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2008 M.S., Robotics Institute,
Carnegie Mellon University

2001 M.S., Mechanical Eng., KAIST

1999 B.S., Mechanical Eng., KAIST

Experience

2015-present

Full-time Professor, Computer
Science and Engineering, Seoul
National University

2013-2014

Postdoctoral Researcher,
Disney Research

2011

Visiting Student, Stanford
University

2009

Visiting Researcher, CSAIL, MIT

2008, 2009

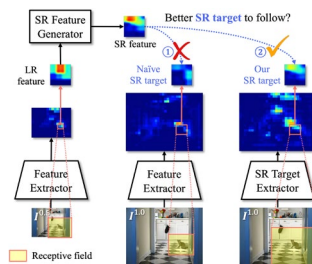
Research Intern, Honda
Research, Intel Research

2001-2006

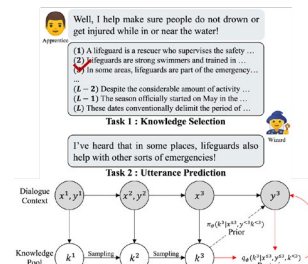
Research Scientist, KIST

Vision and Learning Lab vision.snu.ac.kr

Vision and Learning Lab develops machine learning and optimization techniques to solve various problems of computer vision and natural language processing. We currently work on technology development that enables conversational AI, summarization, and question-and-answer (QA) by understanding multi-format information such as image, video and text.



Video Question and Answering (QA)
and Object Detection



Conversational AI

Video Question and Answering (QA) and Object Detection

We develop a video question and answering system. To do this, we develop a method to represent the video in the form of a graph (e.g., causal relationship, physical interaction, commonsense). We also develop an object detection method that can even work in an extreme environment.

Conversational AI

We develop an AI agent that enables one-to-one conversations with users using multi-modal information such as image, video, text, and sound. By learning the personality and information of users, the agent forms its characteristic and makes personalized conversations with users. We newly proposed discriminative learning, reinforcement learning based on user feedback, and multitask learning to enhance the performance of the conversation engine. We also add response generation, which can model personality and control speech intent and emotion and integrate it with other question and answer systems.

Continual Learning

We develop a life-long learning method that can continually learn from new data without catastrophic forgetting. With life-long learning, we can make a dialogue system to evolve continuously through interaction with humans.

Publications

- Self-Routing Capsule Networks, NeurIPS 2019
- Curiosity-Bottleneck: Exploration by Distilling Task-Specific Novelty, ICML 2019
- Variational Laplace Autoencoders, ICML 2019
- Multi-task Self-Supervised Object Detection via Recycling of Bounding Box Annotations, CVPR 2019
- Abstractive Summarization of Reddit Posts with Multi-level Memory Networks, NAACL 2019

Projects

- **2019-present** Development of Conversational AI That Can Understand Online Multi-Modal Information and Emotionally Interacting With Human, Ministry of Science and ICT
- **2019-present** Development of AI Technology for Guidance of a Mobile Robot to its Goal with Uncertain Maps in Indoor/Outdoor Environments, Ministry of Science and ICT
- **2019-present** Development of Interpretable Neural Networks for Machine Learning Comprehension, SKT



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1985 M.S., Applied
Mathematics, Purdue
University

1982 M.S., Mathematics, Seoul
National University

1980 B.S., Mathematics
Education, Seoul National
University

Experience

2007-2008
CIO/Chair Information Systems
& Technology, Seoul National
University

2003-2005
Director, Institute of Computer
Technology, Seoul National
University

1999-present
Full-time Professor, Computer
Science and Engineering, Seoul
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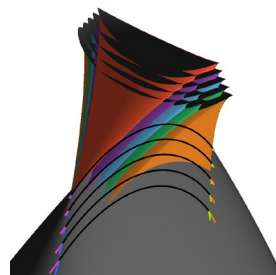
1989-1999
Assistant Professor/Associate
Professor, Computer Science and
Engineering, POSTECH

3D Modeling And Processing Lab 3map.snu.ac.kr

Even though advances in computer hardware technology have greatly increased data processing speed, transferring massive geometric data through current networks still has some problems unsolved. To solve this problem, while satisfying the user with realistic enough information, we need to focus on real-time processing and transfer of minimized geometric data on a mathematical viewpoint, rather than relying on hardware developments. 3d Modeling and Processing Lab develops software and researches precise mathematical methods and efficient algorithms for processing geometric data.



Measure Hausdorff distance between
triangular mesh and square mesh within
a high precision error range



Trimming by removing self-intersection of
free-form curve for various offset radius

Designing high precision algorithms for freeform geometric models

Freeform geometric models are defined with mathematical expressions. This allows the models to be more precise while being compact in data size, compared to polygon mesh models. We must develop precise mathematical algorithms which are essential in handling these models. For instance, computing intersections, bisectors, or Voronoi cells are considered.

Designing real-time algorithms for freeform geometric models

Modern computers have evolved to better process simple geometries, such as triangles, lines, and vertices. Consequently, processing freeform models is slower than polygon meshes. To solve this problem, we conduct research on real-time algorithms for freeform models. Researches on computing minimum distance, convex hull, Hausdorff distance are considered.

Publications

- "Trimming offset surface self-intersections around near-singular regions", Computers and Graphics, 82, 2019.
- "Minkowski sum computation for planar freeform geometric models using G1-biarc approximation and interior disk culling", The Visual Computer, 35, 2019.
- "Arc fibrations of planar domains", Computer Aided Geometric Design, 71, 2019. (GMP2019 Best Paper Award, Elsevier Science)
- "Fast and robust Hausdorff distance computation from triangle mesh to quad mesh in near-zero cases", Computer Aided Geometric Design, 62, 2018. (GMP2018 Best Paper Award, Elsevier Science)

Projects

- **2019-2021** All ON X Development of Dental Implant Prosthesis Solution", Ministry of Commerce Industry and Energy
- **2019-2022** Algorithms Acceleration using Torus-Based Bounding Volumes", NRF
- **2019-2023** Analysis, Design, And Manufacturing using Microstructures", Horizon 2020



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Education

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Experience

2011-present

Full-time Professor, Computer
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National University

2011-present

Director, Bioinformatics Institute

2009-2011

Faculty Division C Chair, Indiana
University School of Informatics
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2001-2011

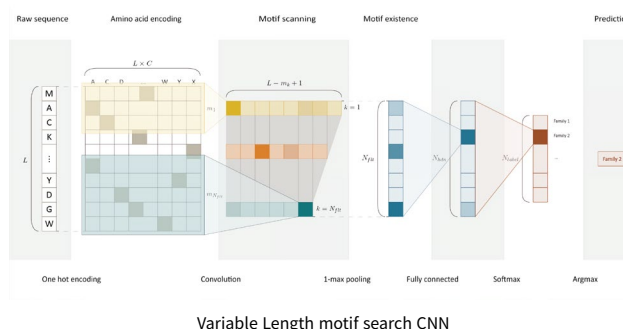
Assistant/Associate Professor,
Indiana University School of
Informatics and Computing

1998-2001

Senior Computer Scientist,
DuPont Central Research

Bio & Health Informatics Lab biohealth.snu.ac.kr

The Bio & Health Informatics Lab studies quantitative analysis of vital phenomena, incorporating computer algorithms into the vast amounts of biological data accumulated by the development of technology. Biological data consist of various kinds of data, such as gene expression, proteomics and methylation, and are large amounts of data and dimensionality. Also, vital phenomena are full of a wide range of topics to study with unsolved mysteries. Our lab focuses on computational methods such as AI, machine learning and RL, algorithms, and cloud computing, as well as topics such as cancer research, drug discovery, and genomic analysis through cooperation with external institutions to carry out research applicable to clinics and industry.



AI-driven Drug Discovery, Repurposing and Pharmacogenomics

Candidates for drugs should meet a number of conditions including ADME and toxicity. This can be seen as a problem of multivariate optimization, and virtual screening by computer can reduce its astronomical costs. Moreover, drug responses vary depending on individual's genomics and studying it leads to personalized medicine.

Data Mining Technologies for Heterogeneous Multi-omics Big data

Multi-omics data are highly complex and huge data with super dimensionality and heterogeneity. Thus it is hard to analyze the data with simple data mining approach. We study multi-omics with network mining, machine/deep learning with prior domain knowledge of genomics to deduce in biology and medicine.

Reinforcement Learning and Its Application to Medical Domain

Biological problems have vast exploratory space and constraints. Empirical characteristics of reinforcement learning can be useful for optimizing these problems. The method can be used to predict tertiary structure of proteins and understand convoluted health examination data and multi-omics.

Publications

- Cracking the code of personalized medicine. Nature Research 2019 (doi: 10.1038/d42473-019-00101-y)
- PRISM: methylation pattern-based, reference-free inference of subclonal makeup. ISMB(최상위 학술대회)/Bioinformatics, 2019 (doi: 10.1093/bioinformatics/btz327).
- mirTime: identifying condition-specific targets of microRNA in time-series transcript data using Gaussian process model and spherical vector clustering. Bioinformatics, 2019 (doi: 10.1093/bioinformatics/btz306).

Projects

- **2019-present** Development of a Personalized Prediction Model for Disease Occurrence and Complications using Artificial Intelligence Analysis Techniques for Longitudinal Electronic Health Records, Metagenomics and Phytochemical Data in Health Examination Recipients, SNU Bio-MAX Institute
- **2019-present** Development of Artificial Intelligence (AI) Technology and Prediction System for Drug Design and Candidate Discovery, Ministry of Science and ICT
- **2015-present** Development of high-precision and high-performance multiomics cancer genome analysis software for targeted therapeutics and certification for clinical application, Ministry of Health and Welfare



Prof. Chong-kwon Kim

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Education

1987 Ph.D., Computer Science,
University of Illinois

1982 M.S., Operations Research,
Georgia Institute of Technology

1981 B.S., Industrial Engineering,
Seoul National University

Experience

1991-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University

2014-2015
President of KCC / KSC

2013-2015
Member of ICT R & D Business
Division, Ministry of Science, ICT
and Future Planning

2011-2012
Member of Business
Deliberation Committee of Korea
Communications Commission

2010-2011
Project Planning Committee at
Ministry of Knowledge Economy

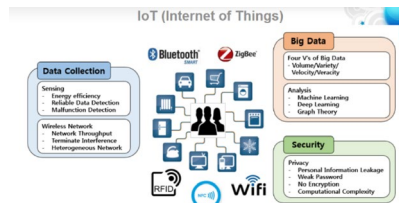
2005-2007
Director, Computer Research
Institute, Seoul National
University
Advisory/Planning/Deliberation
Committee of a number of
organizations including the
Korean Intellectual Property
Office, the Financial Supervisory
Commission, and the Ministry of
Science and Technology

Social & Computer Network Lab popeye.snu.ac.kr

Since its establishment in 1991, the Social & Computer Network Laboratory(SCONE Lab) has been researching various sources and application technologies for efficient info-communications. The current research focuses on social network analysis and application of wireless communication technology. We aim to improve the quality of life by creating a new paradigm of service technology through the convergence of the two technologies and advancing the implementation of innovative smart information society.



Elements of social network and details



3 core elements and details of IoT

Social Network

Social networks are theoretical data structure for analyzing individual, group, and social relationships in the social sciences, based on graph theory, balance theory, social comparative theory, social identity theory, and so on. Recently, with the increase of social network service (SNS), related information exploded and along with this trend, many domestic and foreign companies have improved the performance of various processes through social network analysis. In our lab, we investigate how information spreads within social networks and study techniques to maximize the impact of information. In addition, we are researching high-performance, high-efficiency social recommendation system and SNS spam detection technology using various social network analysis technologies.

Computer Network & Internet of Things

Communication is the most fundamental element technology supporting the smart information age, and the expectation of users for wireless service is rapidly increasing due to the increase of mobile device users. In particular, the concept of the Internet of Things (IoT), which emerged with the rapid development of ICT, embodies a hyper-connected society where all things communicate with each other. Research on cellular technology and 802.11-based wireless LAN technology for fast and accurate wireless communication is being actively conducted, and IoT technologies such as RFID, Zigbee, LPWA, and Bluetooth are being spotlighted to realize smart home and smart life. We are researching core technologies to maximize the resource utilization efficiency and quality of mobile and IoT communications.

Adaptive Video Streaming

Adaptive video streaming is a technology for transmitting multimedia data over computer networks. In the past, most video streaming technologies used streaming protocols such as RTP with RTSP, but today's adaptive streaming technologies are mostly based on HTTP and are designed to work efficiently on large distributed HTTP networks such as the Internet. On the server side, media files are divided into segments at different bitrate levels for efficient transmission of video data. In our lab, we solve an optimization problem in which a client requests a segment to have an optimal bitrate according to environmental factors such as bandwidth and buffer level.

Publications

- ALICE: Autonomous Link-based Cell Scheduling for TSCH, IPSN, 2019.
- Distance-based customer detection in fake follower markets, Information Systems, 2019
- XMAS: An Efficient Mobile Adaptive Streaming Scheme based on Traffic Shaping, IEEE Transactions on Multimedia (TMM), 2018

Projects

- **2015-present** Resilient/Fault-Tolerant Autonomic Networking Based on Physicality, Relationship and Service Semantic of IoT Devices (Ministry of Science and ICT)
- **2016-present** Hybrid Device-based Circadian ICT Research Center (Ministry of Science and ICT)
- **2015-present** Sensor of Campus Level & Development of Beacon Network Technology (Samsung Electronics Co)



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<http://cares.snu.ac.kr>

Education

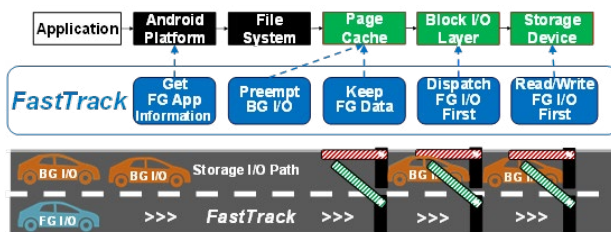
1995 Ph.D., Computer Science and Engineering, University of Washington
1988 M.S., Computer Science and Engineering, University of Washington
1986 B.S., Computer Science and Statistics, Seoul National University

Experience

1997-present
Full-time Professor, Computer Science and Engineering, Seoul National University
1995-1997
Technical staff, Texas Instruments

Computer Architecture & Embedded Systems Lab cares.snu.ac.kr

NAND flash memory has been widely adopted for high performance computing systems. Due to the multi-leveling technique and shrinking semi-conductor processes, the performance and lifetime of NAND flash memory have been significantly degraded. In order to overcome the limitation of NAND devices, we have developed various cross-layer optimization techniques that vertically integrate diverse optimization hints from all system layers.



Android I/O Stack vertical optimization technique (FastTrack)

Storage Systems for Future Applications

Flash storage devices for future environments such as smart automobiles or enterprise servers processing big data analysis have different characteristics compared to the previous storage devices. Research on future storage devices, such as a flash storage device that guarantees a real time processing and high reliability for the machine learning based autonomous driving or a flash storage device that effectively provides a Quality of Service(QoS) based on a user's need which is essential for big data servers, are actively being studied.

Secure Storage Systems

In a storage device system, security is one of the most important requirements as storage devices are mainly used to store important user data. We have proposed a system called Ransom Blocker which detects ransomware attacks, that encrypts the data stored in the storage device and makes the data unusable by exploiting the flash storage device's characteristics, on the SSD side and recovers the encrypted data. We also have implemented a new data sanitization technique that prevents one of the flash storage device's vulnerabilities that the user deleted data can still be recovered.

Cross-layer Flash Storage Optimizations

In order to fully exploit the potential of flash storage device, every I/O stack layer consists of application programs, operating systems and storage devices should be optimized altogether. For example, we have improved a storage device's write performance by a firmware optimization while exploiting the hardware characteristics that horizontal cells of a 3D flash exhibits similar characteristics. We also have proposed a technique called FastTrack which solved the problem of a degradation on the quality of user experience due to I/O priority inversion between foreground applications and background applications by avoiding such priority inversion problems in all I/O stack layers.

Publications

- Evanescio: Architectural Support for Efficient Data Sanitization in Modern Flash-Based Storage Systems, In Proceedings of the ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS '20)
- Exploiting Process Similarity of 3D Flash Memory for High Performance SSDs, In Proceedings of the IEEE/ACM International Symposium on Microarchitecture (MICRO '19)
- Automatic Stream Management for Multi-Streamed SSDs Using Program Contexts, In Proceedings of the USENIX Conference on File and Storage Technologies (FAST '19)

Projects

- **2018-present** A Study on Developing Optimization Techniques for Virtualized Cloud Storage Systems, Ministry of Science and ICT
- **2017-present** AutoBox: Real-Time High-Capacity Flash Storage System for Smart Cars, Samsung Electronics
- **2015-present** Study on Storage Systems for Exascale High Performance Computing Systems, Ministry of Science and ICT



Prof. Jin-Soo Kim

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Education

1999 Ph.D., Computer Science,
Seoul National University

1993 M.S., Computer Science,
Seoul National University

1991 B.S., Computer Science,
Seoul National University

Experience

2018-present

Full-time Professor, Computer
Science and Engineering, Seoul
National University

2008-2018

Full-time Professor,
Sungkyunkwan University

2002-2008

Associate Professor, Korea
Advanced Institute of Science
and Technology

1999-2002

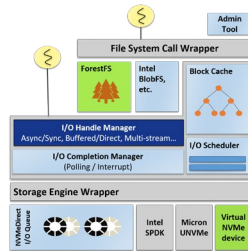
Senior research staff, Electronics
and Telecommunications
Research Institute

1998-1999

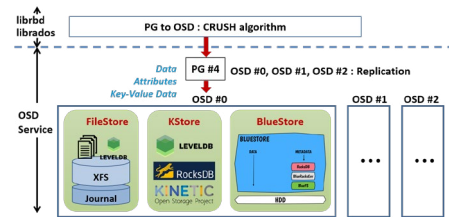
Academic visitor, IBM T. J.
Watson Research Center

Systems Software and Architecture Laboratory csl.snu.ac.kr

We focus on intelligent systems software and innovative architecture to improve the design and implementation of computer systems in terms of performance, cost, reliability, and energy efficiency. The main research goal is to bridge the gap between emerging applications (e.g. big data analytics and machine learning applications) and new breed of powerful hardware such as SSDs, GPUs, and accelerators.



NVMeDirect Framework structure



Ceph decentralized storage system structure

Faster, Smarter SSD Storage Systems

NVMeDirect is a novel user-space I/O framework which improves the performance by allowing the user applications to access the storage device directly. The performance of MongoDB is improved by 10.8% by running it on the recent NVMeDirect 2.0 framework without any code change.

Distributed Storage Systems

Ceph is a scalable, reliable and high-performance storage solution that is widely used in the cloud computing environment. Our goal is to develop a new storage engine that can get the most out of SSD's performance. In addition, we are optimizing the Ceph file system for HPC (High-Performance Computing) environment.

Lightweight Key-Value Store

ForesDB is a key-value storage engine we have developed in collaboration with Couchbase Inc. ForestDB uses a new hybrid indexing scheme called HB+Trie which allows for efficient indexing and retrieval of arbitrary length string keys. We are currently working on a version of ForestDB called ForestDB-raw that works on the raw block device. We plan to use ForestDB-raw in implementing a user-level file system for NVMeDirect and a storage engine for Ceph distributed storage system.

Publications

- Hyeon-Jun Kim and Jin-Soo Kim, "A User-space Storage I/O Framework for NVMe SSDs in Mobile Smart Devices," IEEE Transactions on Consumer Electronics, Vol. 63, No. 1, pp.28-35, February 2017.
- Jung-Sang Ahn, Chiyoung Seo, Ravi Mayuram, Rahim Yaseen, Jin-Soo Kim, and Seungryoul Maeng, "ForestDB: A Fast Key-Value Storage System for Variable-Length String Keys," IEEE Transactions on Computers, Vol. 65, No. 3, pp.902-915, March 2016.
- Daeho Jeong, Youngjae Lee, and Jin-Soo Kim, "Boosting Quasi-Asynchronous I/O for Better Responsiveness in Mobile Devices," Proceedings of the 13th USENIX Conference on File and Storage Technologies (FAST 2015), Santa Clara, CA, USA, February 2015.

Projects

- **2019-present** A Smart Distributed Key-Value System for Machine Learning Applications, Ministry of Scientist and ICT
- **2019-present** Storage System and Application Framework Optimization for Next-generation Computing Environment, Samsung Electronics
- **2016-present** Distributed File System for High-Performance Computing Systems, Ministry of Scientist and ICT



Prof. Taehyun Kim

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<http://sites.google.com/view/quantumcomputingatsnu>

Education

2008 Ph.D., Physics,
Massachusetts Institute of
Technology (MIT)
1997 M.S., Control and
Instrument Engineering, Seoul
National University, Seoul, Korea
1995 B.S., Computer
Engineering, Seoul National
University, Seoul, Korea

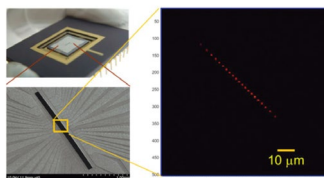
Experience

2018-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University
2011-2018
Project Leader, SK Telecom,
Quantum Tech. Lab
2008-2011
Postdoctoral Associate, Duke
University, Multifunctional
Integrated Sys. & Tech. Group
1997-2000
Instructor/Full-time
Instructor, Korean Air Force
Academy, Computer Science
and Statistics

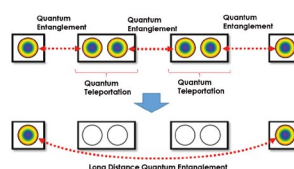
Quantum Information and Quantum Computing Lab

Theoretically, quantum computer can solve certain class of problems exponentially faster than classical computer as it uses quantum mechanical effects such as superposition, entanglement and interference. Using our own ion trap chip, we are developing quantum computing hardware and software interface for the system. We also studies quantum algorithms which can fully utilize the peculiar properties of quantum computer.

Quantum Key Distribution (QKD) can fundamentally assure secure cryptographic key distribution, using the quantum mechanical effect that measuring a quantum system disturbs the system. We also develop a long-distance solution for QKD system.



Our ion trap chip. Red dots in the right figure are trapped ions used as quantum bits.



Extending to long distance quantum entanglement using quantum teleportation.

Fabrication of Ion Trap Chip using MEMS Technology and Qubit State Control

We developed our own ion trap chip for quantum computing and quantum key distribution based on MEMS fabrication. With this chip we implemented 1-qubit quantum gate. We are currently working to implement two-qubit gate which is the most important ingredient of universal quantum gates in addition to single-qubit gate.

Quantum Key Distribution Based on Entanglement

We have been developing entanglement generator which can be used to extend the distance of the entanglement by using quantum teleportation protocol. We demonstrated Hong-Ou-Mandel interference which can generate entanglement between two ion qubits.

From SW interface to Ion Trap Quantum Computer

To use quantum computer, there are intermediate level components which can connect users to the actual quantum computer such as software interface, FPGA board which controls the physical hardware such as lasers and cameras to the local computer of users and quantum error correction code which reduces the errors at the physical level.

Quantum Algorithm

Quantum computer and classical computer are fundamentally different. We research on quantum algorithm to fully utilize the peculiar properties of the quantum computer and we are finding real world problems which can be solved by quantum algorithm.

Publications

- "Microelectromechanical-System-Based Design of a High-Finesse Fiber Cavity Integrated with an Ion Trap," Phys. Rev. Applied 12, 044052 (2019)
- "A New Microfabrication Method for Ion-Trap Chips to Reduce Exposed Dielectric Surfaces from Trapped Ions," J. of Microelectromechanical Systems 27, 28 (2018)
- "Guidelines for Designing Surface Ion Traps Using the Boundary Element Method," Sensors 16(5), 616 (online: Apr. 28, 2016)
- "High speed, high fidelity detection of an atomic hyperfine qubit," Optics Letter 38, 4735 (Nov. 15, 2013)

Projects

- **2019-present** Development of novel quantum algorithms and investigation of the optimized strategies for high-fidelity quantum hardware using machine learning technique, Samsung
- **2019-present** A Study on the Operation of International Cooperation Network for the Development of Ecosystem in Domestic Quantum Computing Convergence Research, Ministry of Science and ICT



Prof. Hyoung-Joo Kim

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Member:Hyoung-Joo_Kim

Education

1988 Ph.D., Computer Science,
University of Texas, Austin
1985 M.S., Computer Science,
University of Texas, Austin
1982 B.S., Computer Science,
Seoul National University

Experience

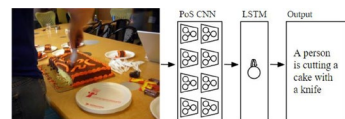
1991-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University
2018-present
Director of Samsung Data
Scientist Program
2007-2010
Head of Department of
Computer Science, Seoul
National University
1988-1990
Assistant Professor, Georgia
Institute of Technology

Internet Database Lab idb.snu.ac.kr

IDB research lab, started in 1991, has 21 Ph.D. graduates and over 80 Master graduates with more than a 100 research paper published domestically and internationally. In the past, DB Engine Development, XML Saving, Query Processing, Semantic Web, Web 2.0 research was conducted and now currently researching Big Data Processing and Machine Learning.



In-DB analysis of Multi-domain data



Creation of image caption based on
Encoder-Decoder structure

In-DB Analysis for Multi-domain Data

Google's announcement of Map Reduce focused the research regarding Big Data processing using system like Hadoop while also emphasized the importance of optimizing Big Data processing inside the database. Unlike before, data size is much larger while also have a wide variety of different data types like stream, graph, text and many more making the research into properly understanding, process, and analyzes the data important.

Image Data Description with Deep Neural Network

In this research, we aim to analyze an image and understand its content. The purpose is to not only detect objects but also the meaning of objects, their characteristics, and their relationship. Using these data's, our goal is to use a language model that can generated a caption that is grammatically and syntactically correct.

Graph Representation Learning for Graph Analysis

We attempt to improve graph analysis by researching different methods of expressing the graph data. Our research focuses beyond using adjacency matrix representation but by using a lower dimension embedding representation to express the graph. The lower dimension embedding approaches attempt to preserve the properties of the graph as much as possible.

Publications

- "Tensor-based tag emotion aware recommendation with probabilistic ranking, Transactions on Internet and Information Systems, 2019
- "Design and Implementation of Shortest Path Search Algorithm(ALT) for Relational Database), KIISE:Transactions on Computing Practices, 2019
- "An RDF Metadata-based Weighted Semantic Pagerank Algorithm," International Journal of Web & Semantic Technology, 7(2), 2016
- "Hadoop Mapreduce Performance Enhancement Using In-Node Combiners," International Journal of Computer Science & Information Technology, 7(5), 2015

Projects

- **2015-2019** Development of Large Transaction Processing and Real Time Analysis on All-In-One Data Engineering Technology, IITP
- **2017-2018** A Study on the Consumer-Centered Public Service Forecasting Using Public Big Data, SNU BD
- **2011-2018** General Visualization and Interaction Model Research for Data Analysis and Knowledge Creation, MSIT



Prof. Byung-Ro Moon

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Education

1994 Ph.D., Computer Science,
Pennsylvania State University,
University Park

1987 M.S., Computer
Science Dept., Korea
Advanced Institute of
Science and Technology

1985 B.S., Computer Science
and Statistics, Seoul National
University

Experience

2009-present
CEO, Optus Investment Inc.

1997-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University

1996-1997
Principal Research Staff, DT
Research Lab, LG Semicon

1994-1996
Postdoctoral Scholar, VLSI CAD
Lab, UCLA

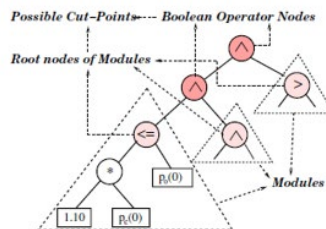
1992-1994
TA, Computer Science Dept.,
Pennsylvania State University

1987-1991
Associate Research Staff,
Central Laboratory, LG
Electronics

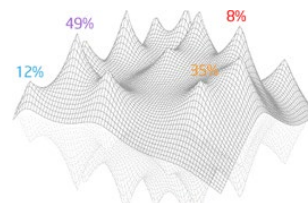
Optimization Lab soar.snu.ac.kr

Optimization & Financial Engineering Lab

The optimization & Financial Engineering laboratory aims at providing high-quality solutions to optimization problems around various academic fields and industries. We conduct theoretical, quantitative, and experimental studies to pursue maximal returns. We use a huge amount of data including financial statements, price and volume flow, economical indices of all the companies in the stock market.



GP Tree



Spatial Navigation

Optimization Theory and Applications

Our theoretical research on optimization techniques covers the efficient search in multi-dimension problem spaces, and the experimental study on problem space and various methods for problem space search. Based on robust theory, it expands into economic and industrial applications. Applications include financial investment optimization, semiconductor manufacturing process optimization, polymorphic malware detection, various scheduling optimizations, and several arrangement & partitioning problems.

Genetic Algorithm

A genetic algorithm is a problem solving technique which mimics the process of evolution. Despite its enormous search capability, the traditional model is not practically competitive. Thus we have studied and developed several methods that create a synergy effect combined with genetic algorithms. The methods include normalization of solution representation, designing operators, encodings and optimization algorithms. We have many benchmark records on various NP-hard problems

Financial Engineering

We establish a financial investment profit model by analyzing financial statements, stock patterns, economic indicators and more. Finding meaningful information and relations between them among lots of information leads to the optimal investment strategy. Beginning from the first level simple statistics, a level of abstraction determines rate of return. In each stage of abstraction, a mixture of techniques are utilized such as statistics analysis, factor characterization, factor distortion, local search algorithm, genetic algorithm.

Publications

- "Investigation of the Latent Space of Stock Market Patterns with Genetic Programming", Genetic and Evolutionary Computation Conference, pp. 1254-1261, 2018
- "A New Adaptive Hungarian Mating Scheme in Genetic Algorithms", Discrete Dynamics in Nature and Society, 2016.
- "Fast Knowledge Discovery in Time Series with GPGPU on Genetic Programming", Genetic and Evolutionary Computation Conference, pp. 1159-1166, 2015
- "On the Inequivalence of Bilinear Algorithms for 3 x 3 Matrix Multiplication", Information Processing Letters, Vol. 113, No. 17, pp. 640-645, 2013.
- A theoretical and empirical investigation on the Lagrangian capacities of the 0-1 multidimensional knapsack problem", European Journal of Operational Research, Vol. 218, No. 2, pp. 366-378, 2012.

Projects

- 2018-2019 Environmental Improvement of Game by Optimization, A Game Company
- 2016-2017 High Response Feature Selection, Hyundai Card
- 2014-2015 Geometric Optimization for Traditional Architectural Structure, ETRI



Prof. Bongki Moon

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<http://dbs.snu.ac.kr/bkmoon>

Education

1996 Ph.D., Computer Science,
University of Maryland,
College Park

1985 M.S., Computer
Engineering, Seoul National
University

1983 B.S., Computer
Engineering, Seoul National
University

Experience

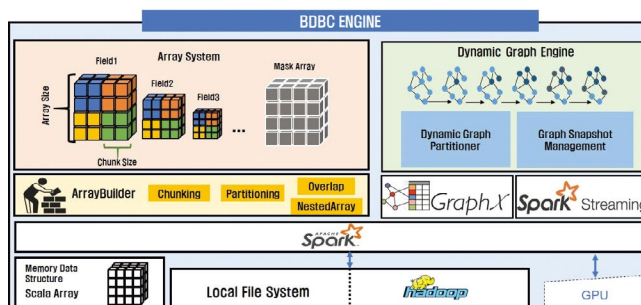
2013-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University

1997-2013
Professor of Computer Science
at the University of Arizona

2005-2010
Served on the Editorial Boards of
IEEE Transactions on Knowledge
and Data Engineering (TKDE) as
an Associate Editor

Database Systems Lab dbs.snu.ac.kr

The primary goal of the Database Systems Lab is to understand the need of data management and scalable strategies for a variety of traditional and emerging database applications. Emphasis is on the development of new indexing and query processing algorithms, disruptive storage paradigms with new storage media, and scale-out platforms for data services.



HPC(High Performance Computer) task implementation

Big Data Big Computing Engine for High Performance Computer

The main purpose of this project is to develop Big Data Big Computing (BDBC) engine for massive application programs based on high-performance computing. It is aimed at overcoming the limit suffered from a long running time and the data size crucially accompanied by large-scale computation.

Development of an Algorithm System for Drug Repositioning Using Drug Adverse Event Bigdata

This project aims to develop a system for drug repositioning from bigdata by using techniques like matching algorithms, machine learning, and similarity analysis.

Construction and demonstration of fine particle monitoring system using scanning LIDAR

The project's goal is to develop a fine particle monitoring app that can efficiently store and visualize data from a LIDAR monitoring system. It will be served in a small village grained manner and will be proved by actually using this app in Siheung smart city area.

Publications

- SQLite Optimization with Phase Change Memory for Mobile Applications. PVLDB 8(12): 1454-1465 (2015)
- Durable write cache in flash memory SSD for relational and NoSQL databases. SIGMOD Conference 2014: 529-540
- Flash as cache extension for online transactional workloads. The VLDB Journal, 25(5): 673-694 (2016)
- SBH: Super byte-aligned hybrid bitmap compression. Information Systems: 62: 155-168 (2016)
- Selective Scan for Filter Operator of SciDB. SSDBM 2016: 28:1-28:4

Projects

- **2019-present** Construction and demonstration of fine particle monitoring system using scanning LIDAR
- **2017-present** Development of an Algorithm System for Drug Repositioning Using Drug Adverse Event
- **2016-present** Big Data Big Computing Engine for High Performance Computer



Prof. Kunsoo Park

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Education

1992 Ph.D., Computer Science,
Columbia University

1985 M.S., Computer
Engineering, Seoul National
University

1983 B.S., Computer
Engineering, Seoul National
University

Experience

1993.8-present
Full-time professor, Computer
Science and Engineering,
Seoul National University

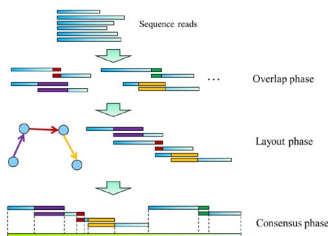
2005.1-2005.2
University of Marne-la-Vallee,
Institute Gaspard-Monge, Visiting
Professor

1995.7-1995.8
Curtin University, School of
Computing, Visiting Research
Fellow

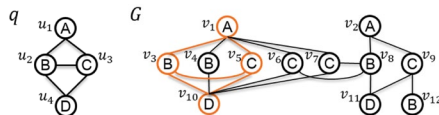
1991.11-1993.8
Lecturer(Assistant Professor),
University of London (Computer
Science), King's College

Computer Theory and Application Lab theory.snu.ac.kr

Algorithms are the foundation of computer science and important for optimizing computer programs. Our laboratory basically studies on algorithms. Specifically, we are working on the algorithms of string algorithm, graph algorithm, cryptography, bioinformatics, and finance engineering.



De novo sequence assembly



Subgraph Isomorphism

String Algorithms

String array is the simplest and the most natural way to represent information. Research on string algorithms, such as sorting, compression, and searching information represented by characters, and string data structures such as full-text index is taking place.

Graph Algorithms

Research on solving NP-hard graph problems such as subgraph isomorphism, super graph search etc. is ongoing.

Cryptography

Researching on various algorithms on homomorphic encryptions to compute encrypted data without decryption is ongoing

Bioinformatics

De novo sequence assembly is the reconstruction of DNA sequence fragments to single DNA sequence without the aid of the reference sequence. Among the De novo sequence assembly phases (Overlap, Layout, Consensus), the overlap phase takes up the most time. In computer theory, this overlap phase is defined as All-Pairs Suffix-Prefix problem and is being heavily researched.

Financial Engineering

It is our interest to develop algorithms to solve a variety of problems that arise in the financial world, and experiment with algorithms' performances on real data.

Publications

- Cartesian Tree Matching and Indexing, CPM, 2019
- Efficient Subgraph Matching: Harmonizing Dynamic Programming, Adaptive Matching Order, and Failing Set Together, SIGMOD, 2019
- A fast algorithm for the all-pairs suffix-prefix problem, Theoretical Computer Science, 2017

Projects

- **2018-present** (SW STARLAB) Framework of Practical Algorithms for NP-hard Graph Problems, Ministry of Science and ICT
- **2014-present** Development of algorithms and platforms for the analysis of multi-omics data, Ministry of Science and ICT
- **2016-present** Efficient Index Key Search Consulting, SAP



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jinwook-seo

Education

2005 Ph.D., Computer Science,
University of Maryland,
College Park

1997 M.S., Computer Science,
Seoul National University, Seoul,
Korea

1995 B.S., Computer Science,
Seoul National University, Seoul,
Korea

Experience

2009-present

Full-time Professor, Computer
Science and Engineering, Seoul
National University

2006-2008

Assistant Professor, Children's
Research Institute & George
Washington University School
of Medicine

2005-2006

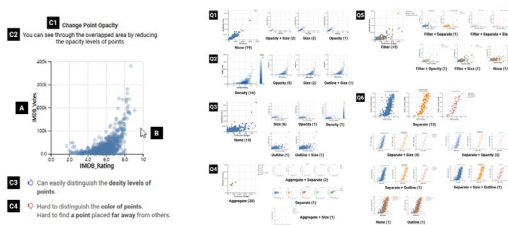
Research Associate, Children's
Research Institute

1997-2000

Instructor/ Full-time Instructor,
Korea Air Force Academy,
Computer Science and Statistics

Human-Computer Interaction Lab hcil.snu.ac.kr

We are interested in designing, developing, and evaluating user interfaces and interaction techniques to help users solve their challenging problems in everyday life. We believe that understanding people's needs is vital to developing successful future computing technologies. We are actively participating in designing and developing interactive user interfaces and visualization systems. We aim for excellence in transforming novel ideas into successful research projects and into technology innovations, which contributes to improving quality of life.



Examples of visualization recommendation

Understanding Representation Methods in Visualization Recommendations

We investigated the effectiveness of three representation methods (i.e., previews, animated transitions, and textual descriptions) under scatterplot construction tasks. Our results show how different representations individually and cooperatively help users understand and choose recommended visualizations. Based on our study results, we discuss the design implications for visualization recommendation interfaces.

Understanding How Knowledge Workers Define, Evaluate, and Reflect on Their Productivity

We investigated how knowledge workers conceptualize personal productivity and delimit productive tasks in both work and non-work contexts, using a 2-week diary study. Based on the findings from the study, we discuss the design of a comprehensive productivity tracking system that covers a wide range of productive activities.

Wall-based Space Manipulation Technique for Efficient Placement of Distant Objects in AR

We designed a wall-based space manipulation (WSM) technique that enables users to efficiently select and move distant virtual objects in augmented reality by dynamically squeezing their surrounding space.

Progressive Algorithm for Indexing and Querying Approximate k-Nearest Neighbors

We devised a progressive algorithm for approximate nearest neighbor indexing and querying. Following the progressive computation paradigm, the operations can be bounded in time, allowing analysts to access running results within an interactive latency.

Publications

- Toward Understanding Representation Methods in Visualization Recommendations through Scatterplot Construction Tasks, Computer Graphics Forum. Vol. 38. No. 3. John Wiley & Sons, Ltd (10.1111), 2019
- Understanding Personal Productivity: How Knowledge Workers Define, Evaluate, and Reflect on Their Productivity, Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. ACM, 2019
- Wall-based Space Manipulation Technique for Efficient Placement of Distant Objects in Augmented Reality, The 31st Annual ACM Symposium on User Interface Software and Technology. ACM, 2018.

Projects

- **2019-present** Design and Development of a Trust-based Analytics Platform for Perceptual Exploration of Big Data, Ministry of Science and ICT
- **2019-present** XAI-based Analysis Platform for Stimulus-Response Neuro Data, Ministry of Science and ICT
- **2018-present** Concept Development, Prototype Implementation and Verification of a Novel AR/MR based UX/UI, Samsung Electronics



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Education

2014 Ph.D., Computer Science,
University of California, Berkeley

2013 M.S., Computer Science,
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2008 M.S., Mechanical
engineering, Stanford
University

1999 B.S., Mechanical engineering,
Hanyang University, Korea

Experience

2017-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University

2016-2017
Google Research(Research
Scientist)

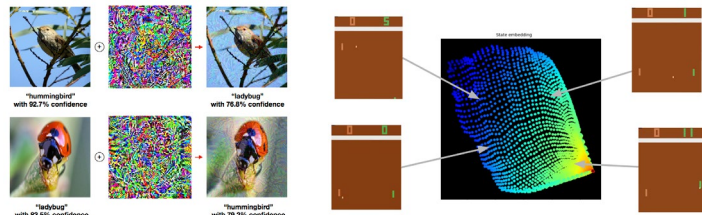
2014-2016
Stanford University(Postdoctoral
fellow)

2013
INRIA Grenoble(Visiting
researcher)

2013
IBM Research(Research intern)

Machine Learning Lab mllab.snu.ac.kr

Our research interests are in machine learning, deep learning, optimization, and algorithms. Broadly we are interested in solving complex and challenging problems in artificial intelligence. We are developing deep learning algorithms that can deliver breakthrough performance. Key projects include adversarial attacks, reinforcement learning, and representation learning.



Defense against adversarial attacks on neural networks

Neural networks with human-level classification accuracy have near 100 percent error rate on adversarial examples which are generated by adding small noise to original images. This project aims to develop algorithms to restore the original images from adversarial images. The aim is to improve the defense against malicious attacks and to make deep learning architectures handle more general input images by improving their robustness.

Abstractions for reinforcement learning

In many challenging reinforcement learning tasks, especially in environments with sparse rewards, agent policies can be highly improved by employing auxiliary signals. By mapping states and actions into a joint embedding space, we can leverage the dynamics of the new space.

Learning Discrete and Continuous Factors of Data via Alternating Disentanglement

Learning representation which embeds useful information of data without supervision is a crucial task for representation learning with vast applications such as object recognition, image generation, and domain adaptation. We devised an alternating algorithm for disentangling discrete and continuous factors of data in several dataset.

End-to-end learning to hash for efficient retrieval via combinatorial optimization

In industry, practitioners resort to post-processing technique to boost the retrieval speed. We design and implement end-to-end optimization algorithms for learning to build hash tables for efficient and accurate hash tables for data retrieval via combinatorial optimization.

Publications

- EMI: Exploration with Mutual Information, Proceedings of the 36th International Conference on Machine Learning, 2019.
- Parsimonious Black-Box Adversarial Attacks via Efficient Combinatorial Optimization, Proceedings of the 36th International Conference on Machine Learning, 2019.
- Learning Discrete and Continuous Factors of Data via Alternating Disentanglement, Proceedings of the 36th International Conference on Machine Learning, 2019.

Projects

- **2019-present** Infant-Mimic Neurocognitive Developmental Machine Learning from Interaction Experience with Real World, Korea government(MSIT)(babymind)
- **2019-present** Deep adversarial reinforcement learning via expert video demonstrations, Samsung Advanced Institute of Technology
- **2017-present** Deep Metric Learning for Universal Similarity Inference, National Research Foundation(NRF) of Korea



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<http://dcslab.snu.ac.kr/~hseom>

Education

2003 Ph.D., Computer Science,
University of Maryland, College Park

1996 M.S., Computer Science,
University of Maryland, College Park

1992 B.S., Computer Sci. &
Statistics, Seoul National Univ.

Experience

2005-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University

2003-2005
Senior Research Engineer,
Samsung Electronics



Prof. Heonyoung Yeom

+82-2-880-5583
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<http://dcslab.snu.ac.kr/~yeom>

Education

1992 Ph.D., Computer Science,
University of Texas A&M

1986 M.S., Computer Science,
University of Texas A&M

1984 B.S., Computer Sci. &
Statistics, Seoul National Univ.

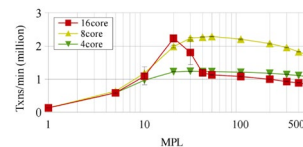
Experience

1993-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University

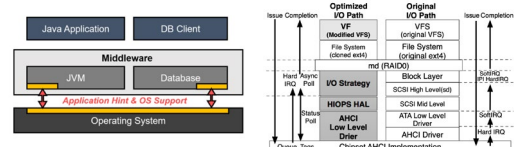
1992-1993
Research Scientist, Samsung
Data Systems

Distributed Computing Systems Lab dcslab.snu.ac.kr

We research a broad spectrum of issues to enhance the performance of I/O and the reliability of data in single or distributed systems. By bridging the gap between OS storage stack and storage device, we make the best use of the new features of recent storage devices. Intelligent resource-scheduling enables a distributed system to process data with high resource utilization. In addition, our research focuses on applying protection mechanisms to various software layers to prevent critical data loss. The direction of our work will lead to high-performance/high-reliability computer systems and satisfy the diverse requirements of users.



Multi-core scalability problem



Cross-layer optimization

Multi-core scalability

As many-core machines prevail, the scalability issue is getting important. The problem is that the performance of an application is not proportionally increased to the increase in the number of cores. This problem is due to the lock contention for shared resources. To mitigate these lock contentions, we are focusing on improving scalability by utilizing lock-free data structures and algorithms.

Reducing the information gap between the OS stack and the storage device

Recently, modern storage devices are getting faster in terms of I/O performance. However, there are several problems where these storages are integrated into the existing operating systems. We focus on analyzing the characteristics of new storage devices and reflecting them to various operating system stack (e.g., File Systems, I/O Scheduler, and Device drivers) to achieve the best performance.

Removing duplicate calculations and data from a distributed data processing framework

In the distributed filesystems such as Lustre and Ceph, there are many duplications in terms of calculation and data, which may lead to higher latency for data processing and waste of storage. Thus, we focus on minimizing the duplicate of calculation and data and reducing data processing time and storage usage to achieve high performance and energy efficiency.

Publications

- GCMA: Guaranteed Contiguous Memory Allocator, IEEE Transactions on Computers, 2019
- High-Performance Transaction Processing in Journaling File Systems, USENIX Conference on File and Storage Technologies (FAST), 2018
- Design of Global Data Deduplication for A Scale-out Distributed Storage System, IEEE International Conference on Distributed Computing Systems (ICDCS), 2018
- Efficient Memory-mapped I/O on Fast Storage Devices, ACM Transactions on Storage, 2016
- OS I/O Path Optimization for Flash Solid-State Devices, USENIX Annual Technical Conference (ATC), 2014

Projects

- 2015-2020 Study on System Software Technologies for Exascale High Performance Computing Systems, (NRF)
- 2015-2019 High Performance Big Data Analytics Platform Performance Acceleration Technologies Development, (IITP)
- 2015-2018 Optimization of cloud I/O software stack on fast storages, (NRF)



Education

1992 B.S., Electronics, Seoul
National University

Experience

2015-present

Full-time Professor, Computer
Science and Engineering, Seoul
National University

2008-2015

Assistant/Associate professor
POSTECH

2004-2008

Principal Engineer, System LSI
Division, Samsung Electronics

2000-2004

Researcher, TIMA Laboratory

Value-awareQuantization



Our goal is to minimize computation required for deep neural networks. Our research covers a variety of vision tasks (e.g., object detection, segmentation, depth estimation, and colorization), recommendation system, and natural language processing tasks, etc. Our approach is to exploit inherent redundancy in the neural network. Our algorithm optimizations, exploiting various methods including reinforcement learning, generative adversarial network, etc., judiciously take advantage of high-level correlation information, e.g., object class in previous frames. In software optimization side,

our research focuses on realizing the potential of reducing computation while preserving output quality.

Memory-centric Efficient AI Chip Architecture

Recently, hardware acceleration of neural networks started to be applied to both servers, e.g., Google’s TPU and mobile devices. We aim at devising accelerator architectures which offer orders of magnitude larger performance/area-watt than the current accelerators. Especially, our goal in training is 100X smaller memory and 5X faster computation. We will achieve this by co-design of algorithm (e.g., quantization-aware network architectures and training methods), software (dynamic quantization methods) and hardware (Efficient AI accelerator on the edge, server, and auto).

Processing-In-Memory

In the era of Big Data, increasing energy cost due to ever-increasing volumes of data poses a challenge in data center. Processing-In-Memory is an emerging technology that moves processing of data closer to memory. It can be used for alleviating increasing memory cost of AI applications. Based on the deep understanding of DRAM and Flash memory, we have carried out research on running some AI tasks within an in-memory AI accelerator and inventing novel memory system for it.

Publications

- H. Kim, H. Jhoo, E. Park, S. Yoo, "Tag2Pix: Line Art Colorization using Text Tag with SEcat and Changing Loss," International Conference on Computer Vision (ICCV), Oct. 2019.
- E. Park, S. Yoo, P. Vajda, "Value-aware Quantization for Training and Inference of Neural Networks," European Conference on Computer Vision (ECCV), 2018.
- W. Kang, S. Yoo, "Dynamic management of key states for reinforcement learning-assisted garbage collection to reduce long tail latency in SSD," Proc. Design Automation Conference (DAC), June 2018.

Projects

- **2017-present** Ultra High Performance Programming Environment and Computing System Development, Ministry of Science and ICT
- **2017-present** [Neural Processing System Research/7세부] Dynamic Reconfiguration Neural Processor Architecture and its Optimization Technique., Samsung Electronics
- **2016-present** Deep Learning-based Acceleration of Video Recognition, Samsung Electronics



Prof. Kwangkeun Yi

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<http://kwangkeunyi.snu.ac.kr>

Education

1993 Ph.D., Computer Science,
University of Illinois, Urbana-
Champaign

1987 B.S., Computer Science
& Statistics, Seoul National
University

Experience

2008-2015

Director, ROSAEC Center
(Research On Software Analysis
for Error- free Computing),
Engineering Research Center of
Excellence

1998-2003

Director, ROPAS Center
(Research On Program Analysis
System), National Creative
Research Initiative Center

2003 – present

Full-time professor, Computer
Science and Engineering, Seoul
National University

1995-2003

Assistant/Associate Professor,
KAIST

2016-2016

Research Scientist, Facebook
London

1993-1995

Member of Technical Staff, Bell
Labs, Murray Hill, USA

2017-2018

Vice Dean, Planning & Strategy,
College of Engineering, Seoul
National University

2017

Excellence in Education Award,
Seoul National University

Visiting Professor

Stanford(2017), MIT(2012, 2008),
École Normale Supérieure,
Paris(2016, 2002), CMU(2008),
Bell Labs(1998)

Programming Research Laboratory ropas.snu.ac.kr

The current programming technology, even with all the hitherto thrilling advances, is still in infancy. The programming languages will constantly move to more convenient and higher levels. Programming tools will use more and more sophisticated logics and highly engineered implementations. Such tools will eventually reach to a point where ordinary programmers can daily use them without much effort. The cost of building secure and trustworthy software will be ever more decreased. We research on enabling technologies for such future: programming language theory, static analysis and verification, and software engineering applications and tools.



Lab Development Analyzer

Academic publication

Programming language theory and applications

Rigorous reasoning about software borrows techniques from programming language research: proofs techniques, semantic formalisms, problem formulations, and etc.

Static analysis theory and applications

Static analysis is a technique for soundly estimating the run-time behaviors of programs without executing them. It plays an important role in all phases of software development: software quality assurance, bug-finding, verification, synthesis of optimized code, software maintenance, and etc.

Program synthesis and applications

Machines can generate better code than humans. Program synthesis is a technique to automatically generate software from formal or informal specifications. We work on demonstrating that machine generated programs shine in non-conventional optimizations, program fixes, program de-obfuscation, and etc.

Publications

- "Adaptive Static Analysis via Learning with Bayesian Optimization", ACM TOPLAS, Vol.40, Issue 4, Article No.14, 2018
- "Selective Context-Sensitivity Guided by Impact Pre-Analysis", PLDI 2014: ACM Conference on Programming Language Design and Implementation
- "Design and Implementation of Sparse Global Analyses for C-like Languages", PLDI 2012: ACM Conference on Programming Language Design and Implementation
- "The Implicit Calculus: A New Foundation for Generic Programming", PLDI 2012: ACM Conference on Programming Language Design and Implementation

Projects

- **2008-2015** ROSAEC Center (Research On Software Analysis for Error- free Computing), Engineering Research Center of Excellence, Korea Science & Engineering Foundation
- **2004-2017** Memory Error Analyzer Sparrow Development and Industrialization (Samsung, Fasoo.com), Facebook Inferbo Development (Facebook code Buffer Overrun Analyzer)
- **1998-2013** ROPAS Center (Research On Program Analysis System), National Creative Research Initiative Center, Korea Science & Engineering Foundation

Books

- **Introduction to Static Analysis: an Abstract Interpretation Perspective**, Xavier Rival and Kwangkeun Yi, MIT Press, 2020
- **컴퓨터과학이 여는 세계(World Opened by Computer Science)**, Kwangkeun Yi, 인사이트(insite), 2015



Prof. Sang-goo Lee

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Education

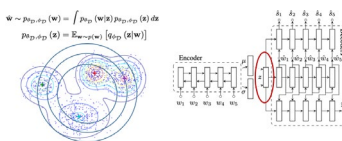
1990 Ph.D., Computer Science,
 Northwestern University
1987 M.S., Computer Science,
 Northwestern University
1985 B.S., Department of
 Computer Science, Seoul
 National University, Seoul, Korea

Experience

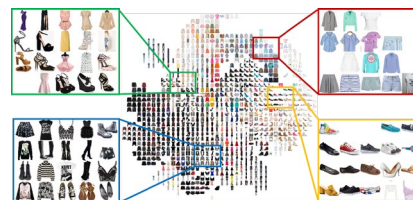
1992-present
 Full-time Professor, Computer
 Science and Engineering, Seoul
 National University
2014-2018
 Vice Director, Big data Institute,
 Seoul National University
2012-2014
 CIO, Information Systems &
 Technology, Seoul National
 University
2012-2014
 Director, SNU-Samsung SW co-
 research Center
2002-2010
 Director, Center for e-Business
 Technology, Seoul National
 University

Intelligent Data Systems Laboratory ids.snu.ac.kr

Members of the Intelligent Data Systems Lab. conduct research on managing massive data and uncovering the hidden “intelligence” underneath. To realize intelligent data systems, IDS Lab. explores various research areas from fundamental data engineering to its application to industry.



Joint Language Understanding
 Variational Autoencoder (JLUVVA)



Fashion Item Recommendation
 Research

Natural Language Processing for virtual assistant

We research on Natural Language Processing methods that are required for developing a virtual assistant that can interact with people in natural language. Specifically, based on recent advances in artificial intelligence and NLP, we deal with a variety of NLP problems, such as intention classification, dialog management, question answering, and knowledge base construction.

Fashion Recommendation

We develop a recommendation system that is fitted into the fashion domain. We manually collect fashion images and auxiliary information from online and utilize them to enhance our system. Moreover, we are actively working on developing graph-based and vector-based recommendation methods in addition to fashion item image generation methods using deep learning.

Natural Language Processing in general

We research on methods that are devised for understanding natural language text. To be specific, we focus on obtaining effective representations for natural language with the aid of syntactic and semantic properties of natural language.

High Performance Computing & Stream Data Processing

We focus on how to better utilize high-performance computing (HPC) systems for more effective online data analysis and natural language processing.
 We are also interested in effective streaming data processing systems.

Publications

- Kang Min Yoo, Youhyun Shin, and Sang-goo Lee. "Data augmentation for spoken language understanding via joint variational generation." Proceedings of the AAAI Conference on Artificial Intelligence. Vol. 33. 2019.
- Taeuk Kim et al. "Dynamic Compositionality in Recursive Neural Networks with Structure-Aware Tag Representations." Proceedings of the AAAI Conference on Artificial Intelligence. Vol. 33. 2019.
- Jihun Choi, Taeuk Kim, and Sang-goo Lee. "A Cross-Sentence Latent Variable Model for Semi-Supervised Text Sequence Matching." Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics. (ACL) 2019
- Jihun Choi, Kang Min Yoo, and Sang-goo Lee. "Learning to compose task-specific tree structures." Thirty-Second AAAI Conference on Artificial Intelligence. 2018.

Projects

- **2017-present** A study on spoken language understanding for intelligent virtual assistant, Hyundai
- **2016-present** Global Internet Big Text Data Real-time Monitoring, National Research Foundation of Korea
- **2015-present** Multi-modal generative model, Samsung



Prof. Youngki Lee

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<http://youngkilee.blogspot.com/>

Education

2012 Ph.D., Computer Science,
 KAIST, Daejeon, Korea

2004 B.S., Computer Science,
 KAIST, Daejeon, Korea

Experience

2018-present

Full-time Professor, Computer
 Science and Engineering, Seoul
 National University

2013-2018

Assistant Professor, Singapore
 Management University,
 School of Information Systems

2015-2019

Affiliated Faculty, KAIST,
 Computer Science Department

2007-2007

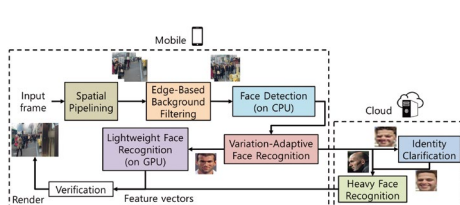
Research Intern, Microsoft
 Research Redmond

2006-2007

Research Intern, Microsoft
 Research Asia

Human-Centered Computer Systems Lab hcs.snu.ac.kr

We work in the intersection of mobile and pervasive computing, applied machine learning, and human-computer interaction. We aim at building innovative and experimental human-centered software systems with multi-dimensional considerations across systems, applications, and users. More specifically, we design and develop mobile, IoT, and machine learning systems to enable always-available and highly-enriched awareness on human behavior, emotion, and surrounding contexts. Also, we are interested in building life-immersive sensing applications in various application domains such as daily healthcare, childcare, education, and retails in collaboration with domain experts.



Mobile AR Deep-Learning System structure



Example of virtual agent training environment

Mobile Deep Learning Platforms

With the advent of smartphones and other mobile devices, efficient and secure on-device deep learning systems have been gaining attention. We investigate high-latency mobile DL models in works such as DeepMon (2017), and privacy preserving systems in Silverstone (2019).

Systems for Emerging AR & VR Applications

Mixed / Extended Reality systems are becoming increasingly popular in a wide array of applications including accessibility, entertainment, and education. In projects such as EagleEye (2019), we explore creative AR and VR systems with a focus on both usability and technical efficiency.

Sensing & Analytics of Human Behavior, Emotion, and Wellness

The proliferation of ubiquitous devices such as wearables is producing novel sources of information about human behavior. We analyze diverse signals to gain an understanding of both individual and societal behaviors, and to design systems that improve human well-being.

VR-based Toolkits for Data Collection & Augmentation

Data collection in the real world is limited by many constraints including scarcity, time, and privacy concerns. We explore VR-based toolkits that aid data collection and training for both virtual cognitive agents as well as traditional real-world settings.

Publications

- EagleEye: Wearable Camera-Based Person Identification in Crowded Urban Spaces, Proceedings of the 26th Annual International Conference on Mobile Computing and Networking (To Appear). ACM. 2020.
- VitaMon: Measuring Heart Rate Variability Using Smartphone Front Camera, Proceedings of the 17th Conference on Embedded Networked Sensor Systems. ACM. 2019.
- DeepMon: Mobile GPU-based Deep Learning Framework for Continuous Vision Applications, Proceedings of the 15th Annual International Conference on Mobile Systems, Applications, and Services. ACM. 2017.
- SmrtFridge: IoT-based, User Interaction-driven Food Item & Quantity Sensing, Proceedings of the 17th Conference on Embedded Networked Sensor Systems. ACM. 2019.

Projects

- **2019-present** Infant-Mimic Neurocognitive Developmental Machine Learning from Interaction Experience with Real World (BabyMind), Institute of Information & Communications Technology Planning & Evaluation
- **2019-present** Low-Power and Privacy-Aware Mobile Deep Learning Platform, National Research Foundation of Korea
- **2019-present** Wi-Fi based Device-Free Home Activity Recognition and Person Identification Algorithm, Samsung Electronics



Prof. Jae Wook Lee

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<http://people.csail.mit.edu/leejw>

Education

2009 Ph.D., Computer Science, MIT

2002 M.S., Electrical Engineering, Stanford University

1999 B.S., Electrical Engineering, Seoul National University

Experience

2016-present

Full-time professor, Computer Science and Engineering, Seoul National University

2011-2016

Assistant professor, Semiconductor Systems Engineering, Sungkyunkwan University

2011

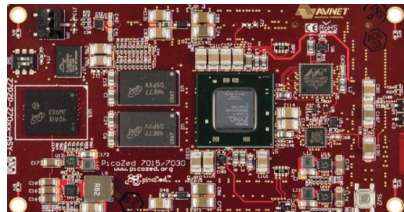
Research Associate, Computer Science Dept., Princeton University

2009-2011

Researcher and Engineer, Parakinetics, Inc.

Architecture and Code Optimization Lab arc.snu.ac.kr

We are interested in designing, developing, and evaluating user interfaces and interaction techniques to help users solve their challenging problems in everyday life. We believe that understanding people's needs is vital to developing successful future computing technologies. We are actively participating in designing and developing interactive user interfaces and visualization systems. We aim for excellence in transforming novel ideas into successful research projects and into technology innovations, which contributes to improving quality of life.



Examples of Script Language Acceleration



Data Center for Big Data Application

Processor Architecture for Script Language Acceleration

Script languages such as JavaScript, Python, Lua are widely used in various applications such as web, machine learning, game programming due to their convenience. However, they involve much overhead for both performance and memory than conventional native languages do. This project studies a new architecture of lightweight processor or accelerator, software optimization technology that can run these high-level scripting languages.

Accelerator Architecture and System Software for Deep Learning

This project designs and implements the architecture of accelerator and memory to maximize the performance and energy efficiency of recently emerging deep learning applications, and the software framework to improve the system scalability and programmer productivity.

Optimize Big Data Applications with New Memory Devices

This project studies techniques to improve the performance and energy efficiency of large-scale big data application frameworks such as Apache Spark, with SSD storage and new memory devices (3D Xpoint, Z-NAND, PRAM, STT-RAM, etc.) which overcome the shortcomings of existing flash and DRAM devices.

Heterogeneous Processor and Memory Architecture

This project studies the heterogeneous processor architecture that aggregates CPU, GPU, FPGA, ASIC, etc. into single or several chips, efficient memory architecture using heterogeneous memory devices such as 3D stacked DRAM, eDRAM, PRAM, STT-RAM, etc., and software optimization technology for it.

Publications

- IIU: Specialized Architecture for Inverted Index Search. ASPLOS 2020: 25th ACM Architectural Support for Programming Languages and Operating Systems.
- A³: Accelerating Neural Network Attention Mechanism with Approximation. HPCA 2020: 26th IEEE International Symposium on High-Performance Computer Architecture.
- Charon: Specialized Near-Memory Processing Architecture for Clearing Dead Objects in Memory. MICRO 2019: 52nd IEEE/ACM International Symposium on Microarchitecture.
- SSDStreamer: Specializing I/O Stack for Large-Scale Machine Learning. IEEE Micro (Volume: 39, Issue: 5, Sept-Oct, 1 2019)
- Practical erase suspension for modern low-latency SSDs. ATC 2019: 2019 USENIX Annual Technical Conference.

Projects

- **2017-present** Revisiting Demand Paging for Emerging Low-Latency Storage Devices, Samsung Electronics
- **2017-present** Neural Processing Research Center, Samsung Electronics
- **2016-present** Next Generation information computing development, National Research Foundation of Korea



Prof. Jaejin Lee

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<http://aces.snu.ac.kr/~jlee>

Education

1999 Ph.D., Computer Science,
University of Illinois, Urbana-
Champaign

1995 M.S., Computer Science,
Stanford University

1991 B.S., Physics, Seoul
National University

Experience

2019
IEEE Fellow

2002-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University

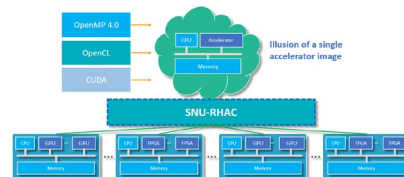
2000-2002
Assistant Professor, Dept.
of Computer Science and
Engineering, Michigan State
University

Multicore Computing Research Lab aces.snu.ac.kr

The Multicore Computing Research Laboratory is a research group in the Department of Computer Science and Engineering at Seoul National University. Its goal is to overcome the programming wall by means of a compiler, runtime system, architecture, and operating system techniques at various levels taking a pragmatic approach.



High-Performance Computing System
'Thunder'



General Programming model 'SNU-RHAC'

High-Performance Computing Systems

Chundoong is a heterogeneous supercomputer designed and built by the Center for Manycore Programming. It is used to evaluate parallel programming models (e.g., SnucL), software techniques, and applications developed in Seoul National University. The design of Chundoong is focused on achieving low cost and low power consumption. It has opened its CPU & AMD GPU services to domestic users for research and educational purposes since April 2013.

Framework for Heterogeneous Systems

Heterogeneous clusters can deliver higher performance and energy efficiency than CPU-based HPC systems. However, programming them is not that easy. Application developers for the clusters must use OpenCL/CUDA combined with an inter-node communication library, such as MPI. RHAC (Runtime for Heterogeneous-Accelerator Clusters) extends SnucL to support various heterogeneous programming models such as CUDA, OpenCL, and OpenMP 4.0. It provides an illusion of a single compute device image to the programmer to improve programmability; multiple devices in multiple nodes can be programmed exactly in the same way as a single device.

Deep Learning Programming Models

Due to the significant progress in recent parallel architectures, especially GPUs, DL has become feasible with relatively cheap workstations and high-end desktop PCs. However, deep learning frameworks still do not scale well in a multi-GPU or multi-node environment. We try to achieve scalability in a large-scale cluster by analyzing computation and memory access patterns of deep learning applications.

Quantum Computing

Quantum computing is a ground-breaking computing paradigm that exploits quantum mechanical phenomena, such as quantum superposition and entanglement. Quantum software technologies, as well as hardware technologies, are required to achieve quantum supremacy in real-world applications. We are developing a whole software stack for quantum computers including programming models, compilers, runtimes, and classical simulators to make efficient quantum computing feasible in the near future.

Publications

- FA3C: FPGA-Accelerated Deep Reinforcement Learning, ASPLOS '19: Proceedings of the 24th International Conference on Architectural Support for Programming Languages and Operating Systems
- SNU-NPB 2019: Parallelizing and Optimizing NPB in OpenCL and CUDA for Modern GPUs, IISWC '19: Proceedings of the 2019 IEEE International Symposium on Workload Characterization
- A Distributed OpenCL Framework using Redundant Computation and Data Replication, PLDI '16: Proceedings of the 37th Annual ACM SIGPLAN Conference on Programming Language Design and Implementation

Projects

- **2019-present** Ministry of Science and ICT / National Research Foundation / End-to-End Quantum Software Stack for Virtual Execution
- **2018-present** Ministry of Science and ICT / Institute for Information & communications Technology Promotion / CUDA Programming Environment for FPGA Clusters
- **2016-present** Ministry of Science and ICT / National Research Foundation / Developing high-performance programming environments and computing systems



Prof. Jehee Lee

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<http://mrl.snu.ac.kr/~jehee>

Education

2000 Ph.D., Computer Science,
KAIST

1995 M.S., Computer Science,
KAIST

1993 B.S., Computer Science,
KAIST

Experience

2003-present

Full-time Professor, Computer
Science and Engineering, Seoul
National University

2019

Co-chair, Pacific Graphics

2018

Co-chair, ACM SIGGRAPH
conference on Motion.
Interaction and Games

2014

Associate editor, IEEE
Transactions on Visualization
and Computer Graphics

2012

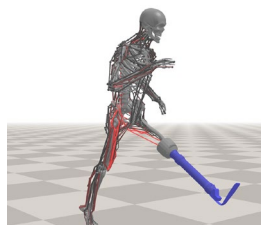
Co-chair, ACM/EG Symposium
on Computer Animation (SCA)

Program committee

ACM SIGGRAPH, ACM
SIGGRAPH Asia, Eurographics,
ACM/EG Symposium on
Computer Animation, Pacific
Graphics, CGI, and CASA

Movement Research Lab mrl.snu.ac.kr

Our research group explores new ways of understanding, representing, and animating human movements.



Reproducing Complex human
musculoskeletal model movements
designed to resemble reality



Characters controlled
in real-time physical
environment



Given to the vast motion database,
Dribbles created to meet control
objectives

Interactive control of physically based simulation

Controlling physically simulated characters is a topic that has long been studied in robotics and computer graphics. Recently, control methods of biped walking models using artificial neural networks and reinforcement learning have been proposed, but control of sophisticated musculoskeletal systems to perform various movements or the creation of controllers that respond responsibly to a given control objective remains a difficult problem. We study ways to physically simulate and interactively control not only human movements but also various characters such as birds and octopus.

Data-Driven Animation

Acquiring motion data through methods such as motion capture and reproducing human motion from a large amount of motion data in a computer is a popular method of computer animation. We study how to generate natural and diverse repertoire of human movements that meet the various objectives given in the large-scale motion database. It is also our interest to learn the subspace that humans can take from vast amounts of motion data or to generate complete motions from data that is only partially present.

Human motion analysis

The movement of a human is a phenomenon composed of various factors such as the human skeleton, muscle, and control method. We study new ways to understand, represent, and animate this movement. This includes research on 3D human skeleton reconstruction from bi-planar X-ray images, controllable 3D volumetric muscle model generation using FEM, and sophisticated foot models consisting of multiple segments.

Publications

- Scalable Muscle-actuated Human Simulation and Control, ACM Transactions on Graphics (SIGGRAPH 2019)
- Learning Predict-and-Simulate Policies From Unorganized Human Motion Data, ACM Transactions on Graphics (SIGGRAPH Asia 2019)
- SoftCon: Simulation and Control of Soft-Bodied Animals with Biomimetic Actuators, ACM Transactions on Graphics (SIGGRAPH Asia 2019)
- Learning Body Shape Variation in Physics-based Characters, ACM Transactions on Graphics (SIGGRAPH Asia 2019)
- Figure Skating Simulation from Video, Computer Graphics Forum (Pacific Graphics 2019)

Projects

- **2018-present** Patient-specific gait and surgery simulation, Samsung Electronics y Samsung Research Funding Center
- **2017-present** Deep learning based human motion simulation, Ministry of Science and ICT/IITP SW Starlab
- **2015-present** Development of biokinetic modeling and human musculoskeletal simulation technology for realistic human behavior simulation in virtual environment, SNU-Samsung Electronics Smart Campus



Prof. Chang-Gun Lee

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Education

1998 Ph.D., Department of Computer Science, Seoul National University, Seoul, Korea

1993 M.S., Department of Computer Science, Seoul National University, Seoul, Korea

1991 B.S., Department of Computer Science, Seoul National University, Seoul, Korea

Experience

2006-present
Full-time Professor, Computer Science and Engineering, Seoul National University

2002-2006
Assistant Professor, Electrical and Computer Engineering, Ohio State University

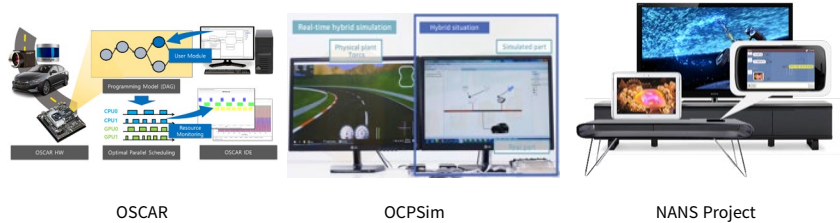
2000-2002
Postdoctoral Researcher, Computer Science at University of Illinois

1998-2000
Senior Researcher, LG electronics

Real-time Ubiquitous System Lab rubis.snu.ac.kr

The convergence of computing, communication and sensing technologies allows us to build a ubiquitous computing environment where we go and whenever we want. As this technology converges continues, it will become possible that computers integrated with sensing and communication can interact with humans and environments in fine-granular real-time. To realize such real-time ubiquitous systems, we are conducting theoretical and practical researches including temporal behavior analysis of interconnected heterogeneous resources, real-time packet delivery in wireless sensor networks, performance measurements for QoS provisioning.

Projects related to autonomous vehicles, which are the topic of current topic, are being supported with the support of Hyundai NGV and SW Starlab.



OCPSim(Open-Cyber-Physical-System-Simulator)

The development process of automotive cyber systems is largely divided into design-implementation-verification phases, and proceeds in the form of verifying and designing the system's performance. However, in even the state-of-the-art CPS simulators, the temporal aspects are not taken into account, then there is a difference between the predicted performance and the verified performance, resulting in additional design costs. We research and develop OCPSim, a simulator that ensures functionally and temporally correct correctness for self-driving systems, to reduce design costs. We also researches several technologies such as real-time hybrid simulation which runs with real-working plant and real-time scheduling diagrams, parameter monitoring/tuning, static/dynamic memory usage monitoring, and automatic ECU-level code generation for target ECU.

OSCAR (Open-Source Self-Driving CAR)

Development of technologies related to self-driving car is moving fast as vehicles and ICT technologies are becoming more active in accordance with the fourth industrial revolution. As a result, demand for self-driving car is increasing, but the cost of research environment is high, making it difficult for researchers to participate in development. OSCAR is an open-source project that provides hardware platforms and APIs for self-driving car. It also provides step-by-step instructions for hardware assembly and software installation for building the HW environment for researchers and developers and using remote laboratory to provide remote development environment and plug&play module implementation which improve research and development convenience.

NANS (N-App N-Screen) Project

The advance of recent display interface technologies such as Miracast and HDMI have led to increased demand for using a single mobile platform in multiple display devices. However, most of the existing traditional multi-display technology focuses on mirroring a single application to multiple display devices. The NANS project enables launching and displaying multiple applications on multiple display devices for Android mobile platforms. It improves user convenience by multi-screen control method using multi-touch input and voice recognition and optimize power consumption of mobile devices and total QoS of multiple applications under thermal constraint. This project have outstanding achievement in many open-source contents. (Minister's Award at Open Source Software World Challenge 2016 , OSS Award at Northeast Asia OSS Promotion Forum 2017)

Publications

- Youngeun Cho, Do Hyung Kim, Daechul Park, Seungsu Lee, and Chang-Gun Lee, **Conditionally Optimal Task Parallelization for Global EDF on Multi-core Systems**, in IEEE Real-Time Systems Symposium (RTSS), Dec. 2019.
- Kang-Wook Kim, Youngeun Cho, Jeongyoon Eo, Chang-Gun Lee, and Junghee Han, **System-wide Time vs. Density Tradeoff in Real-Time Multicore Fluid Scheduling**, in IEEE Transactions on Computers (TC), Vol. 67, Issue 7, pp. 7, July 2018.
- Kyoung-Soo We, Seunggon Kim, Wonseok Lee, and Chang-Gun Lee, **Functionally and Temporally Correct Simulation of Cyber-Systems for Automotive Systems**, in IEEE Real-Time Systems Symposium (RTSS), Dec. 2017.

Projects

- **2016-present** CPS-Sim Project: End-to-End Tool for Developing CPSs, Hyundai NGV
- **2015-present** Real-Time System SW on Multicore and GPGPU for Unmanned Vehicles, SW Starlab



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Education

1992 Ph.D., Computer Science
(Informatik), University of Bonn

1988 M.S., Computer Science
and Engineering, Seoul National
University

1986 B.S., Computer Science
and Engineering, Seoul National
University

Experience

2019.8-present
Director, SNU AI Institute (AIIS)

2017-present
Director, Video Intelligence
Center (VIC)

2016-present
Chair Professor, POSCO

1997-present
Full-time Professor, Computer
Science and Engineering
Adjunct Professor, Cognitive
Science and Brain Science, Seoul
National University

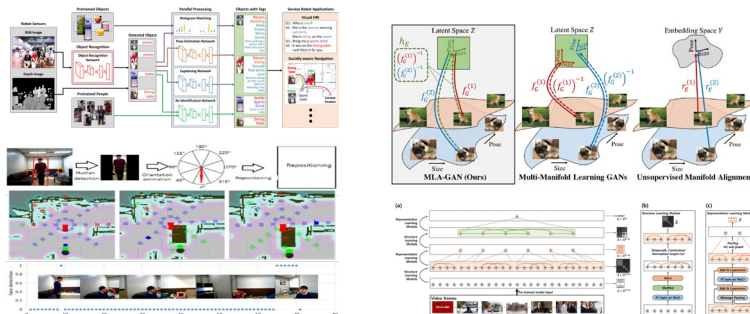
2013-2014
Visiting Professor, Princeton
Neuroscience Institute (PNI)

2003-2004
Visiting Professor, MIT AI Lab
(CSAIL)

1992-1995
Research Fellow, German
National Research Center for
Information Technology (GMD,
now Fraunhofer Institutes)

Biointelligence Lab bi.snu.ac.kr

The research at the Biointelligence Lab focuses on human-level AI technologies based on brain-like cognitive systems. We develop learning and inference models at the molecular, neural, and brain levels using mathematical modeling, computer simulation, robotics, and cognition neuroscience. We recently won or ranked top at very-competitive international AI challenges, including RoboCup@Home, Visual Question Answering (VQA), Visual Storytelling, and Visual Dialog.



Cognitive agent software based on daily learning

Data Manifold Learning and Embedded Structural Learning

AUPAIR: Autonomous Personal AI Robots for Home Services

Cognitive robotic AI technologies are developed for personal services in home environments. The sensors and motors of the humanoid robots are used to watch and learn from human everyday behaviors and, eventually, to serve humans better. We develop the autonomous learning and thinking agent (ALTA) platform that integrates perception, cognition, and action capabilities for autonomous navigation, manipulation, and interaction with the world through vision and language.

Video Turing Test: Towards Human-Level Video Story Understanding

We develop human-level video understanding technology and validate this through the human-AI competition called the Video Turing Test (VTT). For this purpose, we investigate neuro-symbolic memory architectures for video story and novel “long” learning algorithms that continually build models of multimodal video stories based on human episodic and working memory organizations. A video question-answering system is also developed for communication with the humans.

Baby Mind: Infant-Mimic Neurocognitive Developmental Machine Learning

We aim to imitate the step-by-step development of cognitive abilities in the human brain and examine novel machine learning models which can grow continuously through real-world interactions and tutoring. In particular, we seek to develop a Cognitive Neural Intelligence Architecture (COGNA) that can learn embodied concepts through learning-by-doing, based on the infant-level self-development mechanism and the perception-action-cognition cycle.

Publications

- Cut-Based Graph Learning networks to Discover Compositional Structure of Sequential Video Data (AAAI 2020)
- Dual Attention Networks for Visual Reference Resolution in Visual Dialog (EMNLP 2019)
- Answerer in Questioner's Mind: Information Theoretic Approach to Goal-oriented Visual Dialog (NeurIPS 2018)
- Bilinear Attention Networks (NeurIPS 2018)
- Perception-Action-Learning System for Mobile Social-Service Robots using Deep Learning (AAAI 2018)

Projects

- **2019-present** Infant-Mimic Neurocognitive Developmental Machine Learning
- **2017-present** Development of QA system for Video Story Understanding to Pass the Video Turing Test
- **2015-present** Cognitive Agents That Learn Everyday Life (SW Star Lab)



Prof. Byung-Gon Chun

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<https://bgchun.github.io/>

Education

2007 Ph.D., Computer Science,
University of California,
Berkeley

2002 M.S., Computer Science,
Stanford University

1996 M.S., in Electronic
Engineering, Seoul National
University

1994 B.S., in Electronic
Engineering, Seoul National
University

Experience

2019-present

Vice president, Seoul National
University AI

2016

Research Scientist, Facebook
Menlo Park

2013-present

Full-time professor, Computer
Science and Engineering, Seoul
National University

2012-2013

Principal Scientist, Microsoft
Silicon Valley

2011-2012

Research Scientist, Yahoo!
Research Silicon Valley

2008-2011

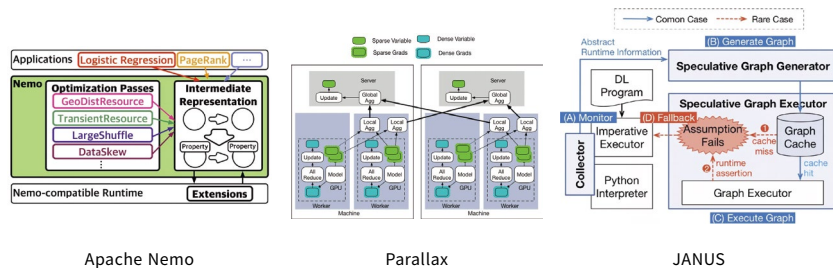
Research Scientist, Intel Research
Berkeley

2007-2008

Postdoctoral Researcher,
International Computer Science
Institute

Software Platform Lab spl.snu.ac.kr

Software Platform Lab (SPL) performs research on artificial intelligence systems, big data systems, and datacenter software. We actively contribute to open-source software projects. SPL is sponsored by the Ministry of Science and ICT, Samsung, Microsoft, Amazon, and Facebook.



Artificial Intelligence Platform: Machine Learning Training and Inference

In recent years, many systems for machine learning (e.g., TensorFlow, PyTorch, MXNet) have been proposed to support sophisticated deep learning models and a large amount of data. Yet, such systems lack parallelizing machine learning models easily, handling complex neural networks intuitively, tuning system configurations automatically, etc. We perform research on improving the performance and expressiveness of machine learning frameworks.(read more: <https://spl.snu.ac.kr/portfolio-items/artificial-intelligence-platform/>)

Apache Nemo: A Flexible Data Processing System

<https://spl.snu.ac.kr/portfolio-items/big-data-processing/>

The data processing system domain has evolved for a wide variety of resource and job characteristics. However, it is hard to evolve current data processing systems to adapt to applications with new resources and job characteristics. To address this problem, we are building a flexible and extensible data processing system, and design various instantiation policies for the system.

Apache REEF: Retainable Evaluator Execution Framework

<https://spl.snu.ac.kr/portfolio-items/apache-reef/>

Apache REEF is a library that simplifies development of applications running on cluster resource managers. REEF is an Apache Software Foundation (ASF) Top-Level Project (TLP) and being actively developed by committers from many institutions including Microsoft and Seoul National University.

Publications

- Apache Nemo: A Framework for Building Distributed Dataflow Optimization Policies. 2019 Annual Technical Conference (ATC 2019), July 2019.
- Parallax: Sparsity-aware Data Parallel Training of Deep Neural Networks. 14th European Conference on Computer Systems (EuroSys 2019), March 2019.
- JANUS: Fast and Flexible Deep Learning via Symbolic Graph Execution of Imperative Programs. 16th USENIX Symposium on Networked Systems Design and Implementation (NSDI 2019), February 2019.
- PRETZEL: Opening the Black Box of Machine Learning Prediction Serving. 13th USENIX Symposium on Operating Systems Design and Implementation (OSDI 2018), October 2018.

Projects

- 2018-present Neural Processing System, Samsung Advanced Institute of Technology
- 2017-present Development of QA systems for Video Story Understanding to pass the Video Turing Test, Ministry of Science and ICT
- 2015-present Development of a Unified High-Performance Stack for Diverse Big Data Analytics, Ministry of Science and ICT (SW Star Lab)



Prof. Wha Sook Jeon

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Members01.htm](http://mccl.snu.ac.kr/Members01.htm)

Education

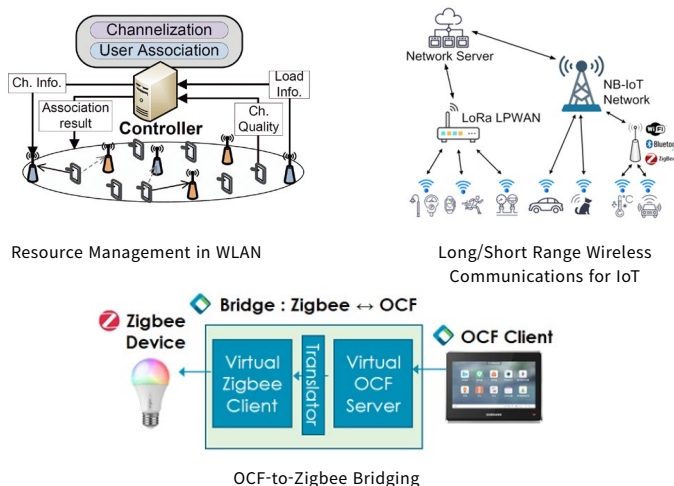
1989 Ph.D., Computer Engineering, Seoul National University
1985 M.S., Computer Engineering, Seoul National University
1983 B.S., Computer Engineering, Seoul National University

Experience

1999-present
Full-time Professor, Computer Science and Engineering, Seoul National University
1989-1999
Associate Professor, Computer Engineering, Han sung University

Mobile Computing & Communications Lab mccl.snu.ac.kr

Since 1999, mobile computing and wireless networking technologies which are core technologies for the next generation have been actively researched. For example, main research issues are as follows: radio resource management, relay-based communications, cognitive radio, green communications, network protocols, network performance evaluation, etc. Lately, IoT-related wireless communications such as WiFi, LoRa, and BLE, have been researched. Also, we recently contribute to constructing an unified IoT ecosystem by participating in the development of OCF standard.



Technologies for resource management in wireless communication systems

Core technologies for resource management of wireless communication systems (WLAN, 4G/5G cellular systems) in the various environments (densely populated, vehicular, closed construction) are researched.

IoT-related wireless communications and standard technologies

To realize IoT which is the core of next generation communications, IoT-related wireless communication systems are actively researched. Research areas are various from short range communication systems (BLE, WiFi, UWB) to long range communication systems (LoRa, NB-IoT). Furthermore, OCF (Open Connectivity Foundation) standard specification that is an international IoT standard has been developing.

Publications

- User association for load balancing and energy saving in enterprise WLANs, IEEE Systems Journal, vol. 13, no. 3, pp. 2700-2711, Sept. 2019.
- A graph-based handover scheduling for heterogeneous vehicular networks, IEEE Access, vol. 6, pp. 53722-53735, Sept. 2018.
- Effective frequency hopping pattern for ToA estimation in NB-IoT random access, IEEE Transactions on Vehicular Technology, vol. 67, no. 10, pp. 10150-10154, Oct. 2018.
- Enhanced channel access for connection state of Bluetooth Low Energy networks, IEEE Transactions on Vehicular Technology, vol. 66, no. 9, pp. 8469-8481, Sept. 2017.
- Performance analysis of neighbor discovery process in Bluetooth Low Energy networks, IEEE Transactions on Vehicular Technology, vol. 66, no. 2, pp. 1865-1871, Feb. 2017.

Projects

- **2019-2020** Development of effective indoor positioning technique in steel mill environment, POSCO
- **2017-2020** Research of E-LoRa (Enhanced LoRa) for efficient long-range IoT, National Research Foundation of Korea
- **2015-2020** Development of core technologies for smart wireless networking, Samsung Electronics



Prof. Soonhoi Ha

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<http://iris.snu.ac.kr/sha>

Education

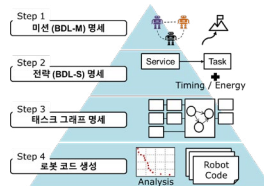
1992 Ph.D., Electrical Engineering and Computer Science from University of California, Berkeley
1987 M.S., Department of Electronic Engineering, Seoul National University, Seoul, Korea
1985 B.S., Department of Electronic Engineering, Seoul National University, Seoul, Korea

Experience

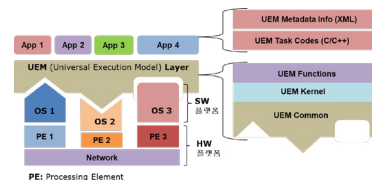
2017-present
IEEE Fellow
2011-2012
Visiting Professor, Georgia Tech(ECE)
1994-present
Full-time Professor, Computer Science and Engineering, Seoul National University
1993-1994
Senior Researcher, Industrial Electronics Lab of Hyundai Electronic Industry Co.
1992-1993
Post-doctoral research fellow, University of California of Berkeley

Co-Design and Parallel Processing Lab iris.snu.ac.kr

Co-design and Parallel Processing Laboratory conducts research on fast and correct design methodology for increasingly complex embedded systems. With HW/SW Co-design methodology, We develop system design techniques and tools based on model to design robust embedded software regardless of system environment or hardware platform. We are also developing service level programming technologies for managing next-generation IoT platforms and collaborate robots. In addition, we study HW and SW optimization techniques for deep learning application in embedded systems.



SeMo: Software framework for cooperating robots



HOPES: Hardware – Software Integrated Design Tool

Hardware-Software Co-design / Embedded Software Design Methodology

Based on the HW/SW co-design methodology, which develops hardware and software concurrently, we study how to design an embedded system quickly and correctly. HOPES is being developed and released as a software development environment that specifies system behaviors regardless of hardware platform by using formal models of computation such as dataflow and finite state machine, and it automatically generates software from high-level specification. Core technologies of the HW/SW co-design methodology include system simulation, scheduling optimization, and performance estimation.

Embedded Deep Learning

As deep learning applications are widely used throughout the industry, acceleration and optimization of deep learning applications are also required in performance-restricted edge devices such as smartphones. To this end, our lab designs energy efficient neural processors and conducts research to find effective hardware structures through virtual prototyping(simulation). In addition, we also conduct research on NAS (Neural Architecture Search), which uses deep learning to search a suitable neural network structure for specific hardware.

Software Framework for Collaborative Robots and IoT Platform

We are researching the software framework for easily programming various kinds of robots and IoT devices. The proposed framework abstracts the unit tasks that can be performed by IoT devices or robots into services, and then the user can express the desired tasks as a sequence of services. To this end, we are developing a service-based scripting language and developing a technology to automatically generate programs for each device from that language. We will develop a technology to automatically convert voice commands to a scripting language in the future. Also, we are developing an edge-based next-generation IoT platform that makes it easy to specify IoT applications based on services.

Publications

- "SeMo: Service-oriented and Model-based Software Framework for Cooperating Robots," IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD), Vol. 37, Issue 11, 2018
- "A Novel CNN(Convolutional Neural Network) Accelerator That Enables Fully-pipelined Execution of Layers," 37th IEEE International Conference on Computer Design, 2019.
- "Fast Performance Estimation and Design Space Exploration of Manycore-based Neural Processors," Proceedings of the 56th Annual Design Automation Conference, 2019.
- "Embedded Software Design Methodology Based on Formal Models of Computation," Lecture Notes in Computer Science, Vol. 10760, pp. 306-325, 2018.

Projects

- **2019-present** Software Design and Code Generation for Smart Embedded Systems, Ministry of Science and ICT
- **2017-present** Simulation and Software Optimization for Edge Neural Processors, Samsung Electronics
- **2013-present** Research for Bio-mimetic Description Language Technology, Agency for Defense Development



Prof. Chung Gil Hur

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<http://sf.snu.ac.kr/gil.hur>

Education

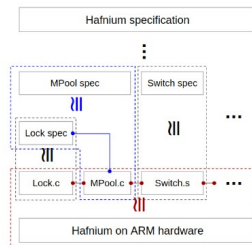
2009 Ph.D., Computer Science,
University of Cambridge
2000 B.S., Mathematics and
Computer Science at KAIST

Experience

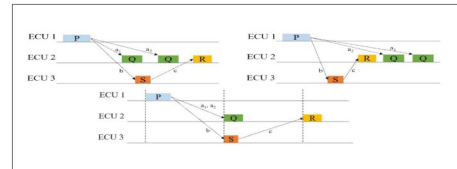
2013-present
Full-time Professor, Computer
Science and Engineering, Seoul
National University
2012-2013
Post-doctoral researcher,
Microsoft Research
2010-2012
Post-doctoral researcher, Max
Planck Institute for Software
Systems
2009-2010
Post-doctoral researcher,
Laboratories PPS, CNRS &
University Paris Diderot

Software Foundations Lab sf.snu.ac.kr

Our research focuses on theoretically interesting software problems that are also practically useful. In particular, we focus on foundations of software to improve the safety of software systems.



Modular Verification of Software



Formal Verification of a PALS Middleware

Relaxed-Memory Concurrency

We develop Promising Semantics, the first successful relaxed memory model for concurrent programming languages. Furthermore, based on this model, we develop program logic and a verification technique for concurrent programs.

A Verified Compiler Supporting Multi-Language Linking and Modular Verification of Software

CompCert is a formally verified compiler for the C programming language. We develop CompCertM, a full extension of CompCert supporting multi-language linking. For this purpose, we develop a novel verification technique, called RUSC (Refinement Under Self-related Contexts). Moreover, we improve the RUSC technique for verification of realistic programs.

Formal Verification of a PALS Middleware for Distributed Cyber-physical Systems

We formally verify the PALS (Physically-Asynchronous Logically-Synchronous) middleware for distributed cyber-physical systems, such as avionics systems or medical systems. The formal verification guarantees that the middleware implementation behaves according to its functional specification, thus greatly improving the reliability of safety-critical systems.

Publications

- A Promising Semantics for Relaxed-Memory Concurrency, POPL 2017: ACM Symposium on Principles of Programming Languages
- CompCertM: CompCert with C-Assembly Linking and Lightweight Modular Verification, POPL 2020: ACM Symposium on Principles of Programming Languages
- Taming Undefined Behavior in LLVM, PLDI 2017: ACM conference on Programming Languages Design and Implementation
- Promising-ARM/RISC-V: a simpler and faster operational concurrency model, PLDI 2019: ACM conference on Programming Languages Design and Implementation
- Lightweight Verification of Separate Compilation, POPL 2016: ACM Symposium on Principles of Programming Languages

Projects

- **2019-present** Verification of Security properties of a Hypervisor, Google Research
- **2019-present** Establishing Solid Foundations for Relaxed Memory Concurrency: Principles, Tools and Verification, Samsung Research Funding & Incubation Center for Future Technology
- **2017-present** Formal Verification of Correctness of PALS (Physically Asynchronous Logically Synchronous) Middleware for Cyber-Physical Systems, National Research Foundation of Korea



Prof. Bernhard Egger

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 bernhard@csap.snu.ac.kr
<http://csap.snu.ac.kr/bernhard>

Education

2008 Ph.D., Department of Computer Science and Engineering, Seoul National University, Seoul, Korea

2001 Dipl. Ing. ETH, Computer Science, Swiss Federal Institute of Technology (ETHZ)

Experience

2013-2015, 2017-present

Director for Information Technology, College of Engineering, Seoul National University

2013-present

Director for International Affairs, College of Engineering, Seoul National University

2011-present

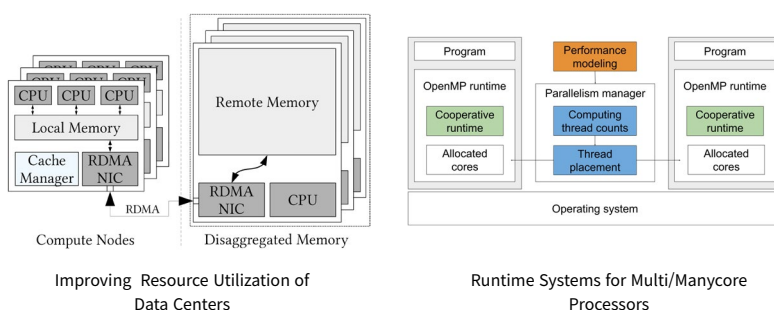
Full-time Professor, Computer Science and Engineering, Seoul National University

2008-2011

Senior Researcher, Samsung Advanced Institute of Technology (SAIT), Samsung Electronics

Computer Systems and Platforms Lab csap.snu.ac.kr

We focus on future computer systems and platforms. As embedded systems and servers integrate more and more cores into a single chip, the architectural changes not only require new operating system structures but also compilers and programming languages that enable developers to exploit the computing power of the chip while providing an efficient development environment. In the CSAP lab, we develop new runtime systems and propose architectural changes for systems ranging from embedded processors, FPGAs, to high-end servers.



Improving Resource Utilization in Data Centers

Modern data centers are poorly utilized due to lack of intelligent resource management software. To improve data center utilization, the resource manager needs to find proper placement of applications on servers that minimize interference and maximizing performance. Our research topics include efficient interference management technique using machine learning and dynamic relocation of applications with load prediction. Also, we leverage a high-speed network device, Infiniband, for Resource Disaggregation that allows fine-grained resource management and performance improvement in data centers.

Runtime Systems for Multi/Many core Processors

Managing a large number of heterogeneous cores with the goal to provide maximal performance at a minimal energy consumption poses lots of interesting new challenges for runtime systems. To address this issue, we are conducting research on runtime system-level techniques that allocates separated H/W resources for applications for maximal system utilization.

Optimizing Neural Processing on NPU

We develop and study algorithms and compilers that can efficiently process various neural networks on NPU. In addition, we develop and study algorithms to learn general data set with high accuracy and to learn a model tailored to the user when the learning model is used by an individual.

Publications

- Performance Modeling of Parallel Loops on Multi-Socket Platforms using Queueing Systems, In IEEE Transactions on Parallel and Distributed Systems TPDS'20
- Maximizing system utilization via parallelism management for co-located parallel applications, In Proceedings of the 27th International Conference on Parallel Architectures and Compilation Techniques (PACT '18)
- On-The-Fly Workload Partitioning for Integrated CPU/GPU Architectures, In Proceedings of the 27th International Conference on Parallel Architectures and Compilation Techniques (PACT '18)
- Improving Energy Efficiency of Coarse-Grained Reconfigurable Arrays through Modulo Schedule Compression/Decompression, In ACM Transactions on Architecture and Code Optimization TACO'18

Projects

- **2019-present** Advanced AIX Accelerator, SKT
- **2018** Next Generation AI Accelerator, SKT
- **2017-present** H/W-Compiler Vertically Integrated Optimized Embedded DNN Processor, Samsung Electronics



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ssrao@tcs.snu.ac.kr
<http://tcs.snu.ac.kr/members/ssrao>

Education

2002 Ph.D., The Institute of
Mathematical Sciences(IMSc)

**1997 M.S., The Institute of
Mathematical Sciences (IMSc)**

1995 B.S., National Institute of Technology Warangal(NITW)

Experience

2009-present

Full-time Professor, Computer
Science and Engineering, Seoul
National University

2007-2009

Research Assistant Professor,
MADALGO

2006-2008

Adjunct Assistant Professor,
University of Waterloo

2005-2007

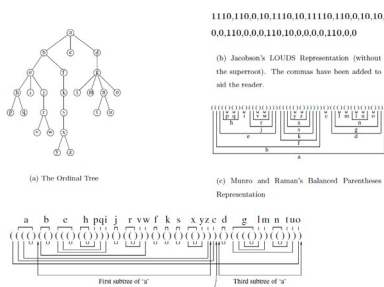
Research Assistant Professor,
University of Copenhagen

2002-2005

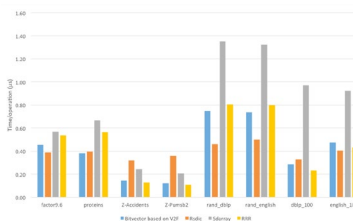
Post-doctorate Researcher,
University of Waterloo

Computational Theory and Algorithm Engineering Lab tcs.snu.ac.kr

In the Computational Theory and Algorithm Engineering lab, our main focus is on the design and implementation of efficient data structures and algorithms for theoretical as well as practical problems. Our emphasis is on reducing the space occupancy of data while still supporting efficient access to it. We aim to design efficient algorithms and various models of computation that capture the essential features of traditional and emerging memory technologies. In addition, we focus on the implementation of these structures to evaluate their practical performance.



Examples of representative structures of
concise data structures



Bitvector Algorithm Code and Performance Measurement

Succinct Data Structure

Succinct Data Structure provides data operations on the data while compressing data size. We do this by designing space-efficient structures for bit vectors, trees, graphs, and range minimum(or maximum) structures.

Algorithm Engineering

The purpose of Algorithm Engineering is to implement efficient bit vectors, strings, and algorithms. Implementation of compressed bit vectors and strings will reduce space requirement of data. Devising more efficient sorting, selection and searching algorithms is also essential since they are the most fundamental operations to data. Implementation of security algorithm can improve safety among networks.

Memory Models

Improving memory model can reduce space requirement of data. Memory models can be classified into Internal(RAM) and External(I/O and Flash) memory models. Efficient models for recent technologies will also be required.

Publications

- Two Dimensional Range Minimum Queries and Fibonacci Lattices Theor. Comput. Sci. 638: 33-43 (2016)
- SBH: Super Byte-aligned Hybrid Bitmap Compression Inf. Syst. 62: 155-168 (2016)
- Succinct Dynamic Cardinal Trees Algorithmica 74(2): 742-777 (2016)
- Biconnectivity, st-numbering and other applications of DFS using $O(n)$ bits J. Comput. Syst. Sci. 90: 63-79 (2017)
- Space efficient linear time algorithms for BFS, DFS and applications Theory of Computing Systems 62 (8), 1736-1762 (2018)

Projects

- **2011.09-2014.08** Design and Implementation of Succinct Data Structures for Flash Memories
Funded by NRF
- **2010.11-2011.10** Succinct Data Structures for Flash Memories, Funded by SNU
- **2009.04-2010.03** Succinct Tree Representations and Their Implementation, Funded by SNU



HOW TO USE

SNU Gwanak campus has more than 200 buildings, all of which have their own numbers.

The map is divided into 11 zones, using area codes A-J.

If you have a building number, find its area code under 'Buildings', and locate the place. If you only have a name of the place, find the number under 'Category'.

Note that some buildings are not shown on the map.

- Gate to parking area
- Open parking area
- Bus stops
- Airport Limousine
- Roadway
- Health care
- Dining
- Cafés

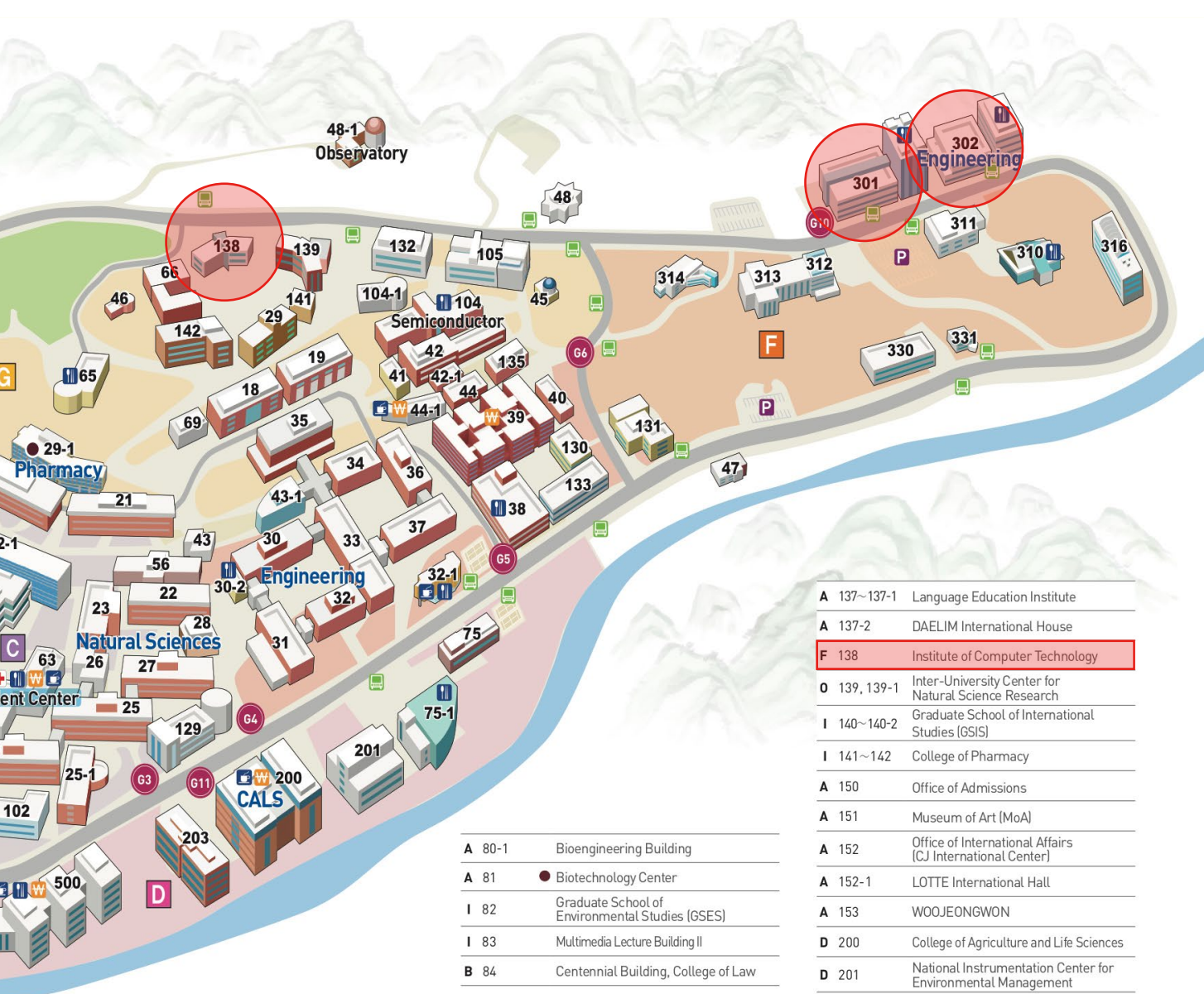
BUILDINGS

H	1~3	College of Humanities
H	4	SHINYANG Hall II
H	5~7	College of Humanities
H	8	DOOSAN Humanities Hall
H	9~10	College of Education
H	10-1	Education Information Hall
H	11	College of Education
H	12	Teacher Training Enrichment Hall
H	13	College of Education
H	14	College of Humanities
B	15	College of Law
B	15-1	College of Law
B	16	College of Social Sciences

● Under construction

B	16-1	SHINYANG Hall III
B	17	College of Law
G	18~19	College of Natural Science
C	20~21	College of Pharmacy
C	22~28	College of Natural Science
G	29	College of Pharmacy
G	29-1	College of Pharmacy
E	30~32	College of Engineering
E	32-1	HAEDONG Student Center
E	33~37	College of Engineering
E	38	Global Education Center for
E	39	College of Engineering
E	43	College of Engineering
E	43-1	Multimedia Lecture Building
G	44-1	SHINYANG Hall I
G	45~48-1	Observatories
I	49	Design Center & Concert
I	50~52-2	College of Fine Arts
I	53~55	College of Music
C	56	College of Natural Science
I	57~57-1	Graduate School of Public Administration (GSPA)

<http://map.snu.ac.kr/web/main.action>



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r Engineers
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t Hall
ces
ic

I 58	College of Business Administration
I 59	Graduate School of Business
C 60	Administration Building
H 61	Center for Teaching and Learning & Faculty of Liberal Education
C 62	University Library
C 62-1	● KWANJEONG Library
C 63	Student Center
B 64	● IBK Communication Center
G 65	Faculty Club
B 67	Dure Cultural Center
G 69	Institute of Laboratory Animal Resources
I 70	University Museum
I 71, 71-1	● Gymnasium
I 71-2	POSCO Sports Center
B 72	Law Library
B 73	University Cultural Center
I 74	● Arts Research Center
D 75	University Newspaper
D 75-1	3rd Cafeteria
H 76	4th Cafeteria
A 80	SNU Veterinary Medical Teaching Hospital

A 80-1	Bioengineering Building
A 81	● Biotechnology Center
I 82	Graduate School of Environmental Studies (GSES)
I 83	Multimedia Lecture Building II
B 84	Centennial Building, College of Law
A 85	College of Veterinary Medicine
A 86	● Center for Dental Research and Clinic
A 97~98	Institute of Environmental Protection and Safety
B 101	Asia Center
C 102	Office of Information Systems and Technology
B 103	Kyujanggak Archives
G 104	Inter-University Semiconductor Research Center
G 105	Institute for Molecular Biology & Design
H 109	Cafeteria Jahayon
H 111	Café PASCUCCI
I 113	Dongwon Dining Hall
K 121	Presidential Residence
K 122	Faculty Apartments
K 125~125-2	HOAM Faculty House
K 126~127	Guest House
C 129	Sangsan Mathematical Science Building
E 130	Electrical Engineering & Science Research Institute
F 131	Research Institute of Advanced Materials
F 132	Institute of New Media and Communications
F 133	Automation and Systems Research Institute
F 135	Research Institute of Energy and Resources

A 137~137-1	Language Education Institute
A 137-2	DAELIM International House
F 138	Institute of Computer Technology
O 139, 139-1	Inter-University Center for Natural Science Research
I 140~140-2	Graduate School of International Studies (GSIS)
I 141~142	College of Pharmacy
A 150	Office of Admissions
A 151	Museum of Art (MoA)
A 152	Office of International Affairs (CJ International Center)
A 152-1	LOTTE International Hall
A 153	WOOJEONGWON
D 200	College of Agriculture and Life Sciences
D 201	National Instrumentation Center for Environmental Management
D 203	SPC Research Building
I 220	College of Liberal Studies
I 221	Graduate School of Public Health (GSPH)
I 222	College of Human Ecology
F 301~302	College of Engineering
F 310	Engineer House
F 311	Institute of Chemical Processes
F 312~313	Institute of Advanced Machinery and Design
F 314	Advanced Automotive Research Center
F 316	Structure Experiment Building
D 500	College of Natural Sciences
J 900~906, 918	Gwanak-sa Graduate House
J 919	Gwanak-sa Undergraduate House
J 920	Gwanak-sa Student Center
J 921~926	Gwanak-sa Undergraduate House
J 931~935	Gwanak-sa Family House
J 936	Staff Apartments
K 940	Main Research Center
K 941~941-1	Child Educare Center
K 942~945	R&D Centers
K 946	BK International House
K 950	International Vaccine Institute