Contents & Contacts	E-mail	TEL	FAX
Research Collaboration (p. 26) Planning Division, Office for Social Collaboration, Collaboration Support Team	kaken@nii.ac.jp	03-4212-2170	03-4212-2150
Intellectual Property (p. 27) Planning Division, Office for Social Collaboration, Big Project and Intellectual Property Team	chizai_web@nii.ac.jp	03-4212-2124	03-4212-2150
TopSE (p. 31) GRACE Center	secretariat@grace-center.jp	03-4212-2729	03-4212-2697
Graduate Education (p. 45) Planning Division, International Affairs and Education Support Team	daigakuin@nii.ac.jp	03-4212-2110	03-4212-2150
International Exchange (MOU) (p. 28) Planning Division, International Affairs and Education Support Team	international@nii.ac.jp	03-4212-2165	03-4212-2150
International Exchange (Shonan Meeting) (p. 29) NII Shonan Meeting Administrative Office	shonan@nii.ac.jp	03-4212-2165	03-4212-2150
International Exchange (DAAD/JFLI) (p. 30) Planning Division, International Affairs and Education Support Team	international@nii.ac.jp	03-4212-2165	03-4212-2150
Science Information Network (p. 34) Academic Infrastructure Division, SINET Promotion Office	support@sinet.ad.jp	03-4212-2269	03-4212-2270
Supporting the Introduction of Cloud Computing (p. 38) Academic Infrastructure Division, Cloud Promotion Team	cld-office-support@nii.ac.jp	03-4212-2212	03-4212-2230
Authentication Infrastructure (p. 39) Academic Infrastructure Division, Academic Authentication Systems Office	gakunin-office@nii.ac.jp	03-4212-2218	03-4221-2230
Institutional Repositories (p. 41) Scholarly and Academic Information Division, Institutional Repository Desk	ir@nii.ac.jp	03-4212-2350	03-4212-2375
Catalog Information Service (NACSIS-CAT/ILL) (p. 42) Scholarly and Academic Information Division, CAT/ILL Desk	catadm@nii.ac.jp	03-4212-2310	03-4212-2375
Education and Training (p. 41) Academic Infrastructure Division	edu@nii.ac.jp	03-4212-2177	03-4212-2375
CiNii (p. 40) Scholarly and Academic Information Division, CiNii Desk	ciniiadm@nii.ac.jp	03-4212-2300	03-4212-2370
SPARC Japan (p. 43) Scholarly and Academic Information Division, SPARC Desk	sparc@nii.ac.jp	03-4212-2351	03-4212-2375
Public Relations/Media Relations (p. 52) Planning Division, Publicity Team	media@nii.ac.jp	03-4212-2164	03-4212-2150
NII Library (p. 32) Scholarly and Academic Information Division, Support Team, Library Desk	library@nii.ac.jp	03-4212-2142	03-4212-2180
Facilities/Location (p. 54) General Affairs Division, General Affairs Team	soumu@nii.ac.jp	03-4212-2000	03-4212-2120



National Center of Sciences Bldg. 2-1-2 Hitotsubashi, Chiyoda-ku, Tokyo 101-8430 TEL: +81-3-4212-2000 http://www.nii.ac.jp/



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Introduction

As Japan's only general academic research institution for informatics, the National Institute of Informatics (NII) promotes everything from fundamental research with a long-term perspective to practical research aimed at addressing social issues. At the same time, as an inter-university research institute, NII provides advanced academic information infrastructure, academic content, and services that are vital for the research and educational activities of the academic community as a whole.

NII engages in research and operations in tandem, and this fiscal year marked an important milestone for us. In April 2016, the Science Information Network (SINET), which connects universities and research institutes nationwide, was upgraded to SINET5, a 100 gigabit-per-second (Gbps) network throughout Japan, and between Japan and the United States.

Operation of SINET as a network supporting Japan's academic infrastructure began in 1992. In 2007, it was upgraded to SINET3 with a world-leading communication speed of 40 Gbps. In 2011, the reliability of the network was improved with the launch of SINET4, and the network's robustness was demonstrated when it withstood the Great East Japan Earthquake in the same year. However, over this time period, academic networks in Europe and the US have been widely upgraded to 100 Gbps, and SINET has paled in comparison. This makes the construction of a world-class, powerful network that connects all areas of Japan with a speed of 100 Gbps all the more significant for Japan's academic community.

Today, with the phrase "big data" in frequent use, environments easily capable of exchanging vast amounts of data are vital at the forefront of science. In big science, which involves dealing with large volumes of experimental data and requires enormous computing resources for the analysis of these data, international collaborations that exchange data across national and regional borders have become commonplace. The migration to SINET5 was strongly supported and endorsed by the Japan Association of National Universities (JANU), the Japan Association of Public Universities (JAPU), and the Federation of Japanese Private Colleges and Universities Associations (FJPCUA), and the Science Council of Japan (SCJ) also gave its recommendation. This upgrading of SINET to 100 Gbps is the result of support received from many people, for which we at NII are sincerely grateful.

Migration to SINET5 will also contribute greatly to the adoption of cloud computing by universities. Traffic flowing off-site will increase rapidly with the adoption of cloud computing, but this will be supported by the 100 Gbps SINET5. The consolidation of university computing resources resulting from introducing cloud computing could lead to large cost savings, and it is hoped that these cost savings will help to accelerate open science. New academic uses are anticipated, such as the distribution of teaching materials in medicine using 8K videos.

To promote the use of cloud computing as this new academic infrastructure, NII has started initiatives that support the introduction of cloud computing. GakuNin Cloud, launched last fiscal year, matches the needs of universities and research institutions with cloud services. We plan to develop GakuNin Cloud as a gateway connecting universities and research institutions with the Cloud.

NII established a new research center called the Center for Cloud

Research and Development in FY2015. In the United States, not only are cloud resources being acquired from cloud vendors but projects conducting research on the Cloud itself are also starting at universities. Cloud research can be said to have entered a new stage. At NII too, we want to promote a totally different kind of next-generation cloud research. Also, the Research Center for Cybersecurity was established this fiscal year. NII has a strong sense of duty to protect the security of academic networks, and so provides technical support and information concerning cybersecurity to universities and research institutions. NII also intends to become involved in the development of security personnel in the future.

Taking advantage of migration to SINET5, we will make increased efforts to implement various services that go beyond the level of simple network connections, in the spirit of "thinking together, creating together" with diverse academic institutions. We are also putting effort into industry-academia collaborative initiatives. In February 2016, NII established the Research Center for Financial Smart Data. The field of finance is not one that information-related research institutes have actively engaged in previously. However, we are attempting to process and analyze finance-related big data and convert it into useful information: "financial smart data". We have gained the opportunity to grapple with complex economic and social phenomena. This is the first research center at NII whose operation and research is funded entirely by the private sector. The Cognitive Innovation Center was also newly established to promote innovation that will revolutionize Japanese society and industry. NII intends to work to develop diverse solutions with businesses in the new stage of artificial intelligence (Al) made possible by deep learning.

NII is one of very few organizations worldwide that, in addition to services such as SINET, conducts both fundamental informatics research and practical research that is aimed at implementation in society and can contribute to societal development. Recently in the field of information technology, there has been a tendency to emphasize only a "by IT" approach, but we would like to balance this with an "of IT" approach and strengthen our agile research system.

The role of IT is highlighted in the Japanese government's Fifth Science and Technology Basic Plan. As well as steadily advancing fundamental research, NII intends to tackle solution-oriented IT that will help to realize "Society 5.0".

Finally, education is another field that is important to NII. We wish to implement "full use of IT and IT education" in Japan, and address measures that will lead to more students learning the fundamentals of IT. We are delighted that the introduction of education on computer programming from elementary school age, as in the United Kingdom, is starting to be discussed in Japan. One could say that the ultimate targets of IT are education and the understanding of human life.

Please take a look at NII's efforts regarding research and operations, and let us know what you think. We thank you for your continued support.

April 2016
Director General, National Institute of Informatics
Masaru Kitsuregawa



Weaving Information

Future Value Creation through Informatics by

The National Institute of Informatics (NII) is Japan's only general academic research institution devoted to development activities in a wide range of research fields, from the foundations of informatics to cutting-edge As an inter-university research institute, NII promotes the construction and operation of a state-of-the-art the broader academic community. It also focuses on partnerships and other joint initiatives with universities addition, NII engages in graduate education with the aim of promoting creative, international academic

into Knowledge Advancing Research and Operations in Tandem

creating future value in the new discipline of informatics. It comprehensively promotes research and themes such as artificial intelligence, big data, IoT, and information security.

academic information infrastructure to provide an essential resource for research and education within and research institutions throughout Japan, as well as private enterprises and social programs. In



research and developing pioneering disciplines.

Comprehensive Research: from Basic Methodology to State-of-the-Art

Informatics is a new academic discipline, based on computer science and information technology but also encompassing the human, social, and life sciences. The National Institute of Informatics (NII) comprises four research divisions and twelve research centers enabling everything from basic informatics methodologies to cutting-edge challenges such as artificial intelligence, big data, the Internet of Things (IoT), and cybersecurity to be tackled comprehensively. As part of this effort, NII also pursues informatics research through collaborations with industry and international research projects.

Graduate Education

The National Institute of Informatics mainly provides education to graduate students in three ways: (1) direct participation in education at The Graduate University for Advanced Studies (SOKENDAI); (2) cooperation with other graduate schools; and (3) hosting of special joint usage researchers. NII is the first graduate school in Japan that aims at promoting original, international academic research that transcends the boundaries of conventional academic disciplines and develops a leading academic discipline that creates new streams of science. The Department of Informatics in the School of Multidisciplinary Sciences at the National Institute of Informatics offers both five-year and three-year doctoral programs of graduate education. Including common foundational subjects, the educational activities of the Department of Informatics are focused on the following six fields of specialization: (1) foundations of informatics; (2) information infrastructure science; (3) software science; (4) multimedia information science; (5) intelligent system science; and (6) information environment science. In total, the department offers over 70 subjects. Since many of the subjects are offered in English, outstanding students from overseas are readly accepted. There are also many mature students; in fact, they account for around 30% of the department's students.

Services to Support Academic Research and Education

In partnership with universities and other institutions, NII is developing leading-edge academic information infrastructure. In FY2016, NII is launching the full-scale operation of the latest version of the Science and Information Network (SINET5), which connects all of Japan with super-fast 100 Gbps data network lines. On top of this, NII is working to develop academic authentication infrastructure, as well as vital, next-generation academic content infrastructure. In this manner, NII is working together with universities and research institutes to help both the academic community and society at large.

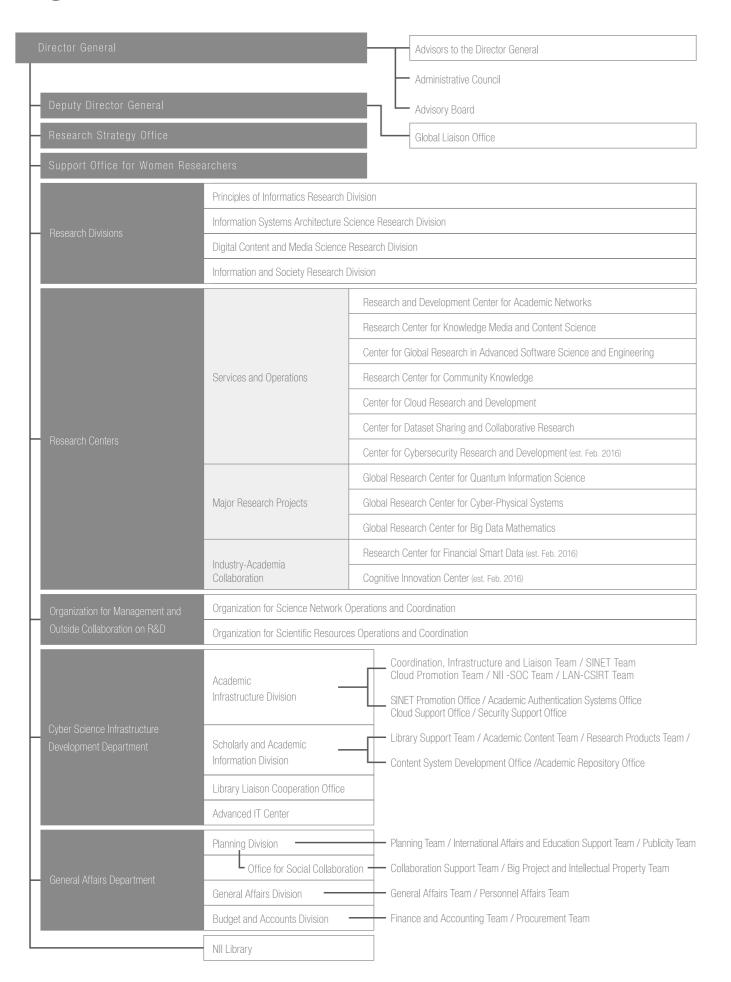
■ Industry Collaboration

In addition to forging alliances with universities, public research institutes, and private research centers to pursue joint research projects and human resource development, NII promotes the implementation of research findings for the benefit of the public. As examples of industry—academia collaborations, in February 2016, NII established two new research centers, the Research Center for Financial Smart Data and the Cognitive Innovation Center, with the aim of channeling research findings to socially valuable applications. The Research Center for Financial Smart Data is the first research center at NII whose operation and research is funded entirely by the private sector.

International Exchange

In addition to communicating research findings internationally, NII actively works to promote international exchanges among its researchers and students and to make international collaboration a key element of its function as a center for informatics research. In these and other ways, NII strives to make an international contribution to the discipline of informatics. It seeks to create Memorandum of Understanding (MOU) agreements with overseas universities and research institutes and to engage in joint international research projects with such partners, thereby enabling researchers and students to benefit from deeper international exchange experiences. To make these kinds of international exchange efforts as effective as possible, NII has set up an international internship program and an MOU grants system to facilitate international research exchange in a wider range of fields.

Organization



Research

Promoting Comprehensive Informatics Research

Informatics is a new academic discipline concerning all aspects of society including economics and culture. The National Institute of Informatics (NII) engages in research from the perspective of creating future value through informatics, generating innovation through collaborations between industry, government, and academia, and promoting international research and operations. NII also promotes integration with a wide variety of other academic disciplines, including information and communication engineering, computer science, and other fields of science and engineering, as well as the humanities, social sciences, and life sciences.

NII advances research in the wide-ranging discipline of informatics around four core research divisions, which are the Principles of Informatics Research Division, Information Systems Architecture Science Research Division, Digital Content and Media Sciences Research Division, and Information and Society Research Division. NII also establishes research centers that explore specific fields of research in an intensive way to flexibly tackle important and urgent social issues. The Research Center for Financial Smart Data and the Cognitive Innovation Center were established in February 2016 through collaboration with industry and academia, and the Research Center for Cybersecurity was also newly established in FY2016. This brings the number of research centers set up by NII to twelve.

In addition, NII advances large-scale projects aimed at making contributions to society, such as research for indicating objective benchmarks for the evolution of artificial intelligence, research on cyber-physical integrated IT infrastructure on a societal scale, and development of high-speed algorithms that deal with the vast amount of information that swirls around in ever-expanding networks.

Research Divisions

Principles of Informatics Research Division

Takuya Akiba; Yoichi Iwata; Takeaki Uno; Ken-ichi Kawarabayashi; Masako Kishida; Ryota Kobayashi; Ken Hayami; Yuichi Yoshida Mathematical Informatics Mathematical Logic Makoto Kanazawa; Makoto Tatsuta Quantum Information Shoko Utsunomiya; Kae Nemoto; Keiji Matsumoto

Ryutaro Ichise; Tetsunari Inamura; Katsumi Inoue; Nobutaka Ono; Ken Satoh; Hideaki Takeda

Intelligent Informatics

Information Systems Architecture Science Research Division

Network Architecture	Shunji Abe; Kensuke Fukuda
Information Network	Shigeo Urushidani; Megumi Kaneko; Takashi Kurimoto; Yusheng Ji; Hiroki Takakura
Computer Architecture	Kento Aida; Michihiro Koibuchi; Masahiro Goshima; Atsuko Takefusa; Hiromichi Hashizume
Software infrastructure	Ichiro Satoh; Kanae Tsushima; Zhenjiang Hu
Software Engineering	Kazunori Sakamoto; Kenji Tei; Shin Nakajima; Shinichi Honiden; Nobukazu Yoshioka; Tomohiro Yoneda



Digital Content and Media Sciences Research Division

Foundations of Content Management	Fuyuki Ishikawa; Isao Echizen; Norio Katayama; Hiroyuki Kato; Yusuke Komiyama; Atsuhiro Takasu; Akihiko Takano; Kazutsuna Yamaji
Text and Language Media	Akiko Aizawa; Jun Adachi; Keizo Oyama; Teruhito Kanazawa; Yusuke Miyao; Junichi Yamagishi
Pattern Media	Ryoichi Ando; Asanobu Kitamoto; Kazuya Kodama; Imari Sato; Shin'ichi Satoh; Akihiro Sugimoto; Kenshi Takayama; Gene Cheung; Yinqiang Zheng; Hiroshi Mo; Duy-Dinh Le
Human and Knowledge Media	Kenro Aihara; Frederic Andres; Ikki Ohmukai; Helmut Prendinger; Mayumi Bono; Seiji Yamada; Yi Yu



Information and Society Research Division

Information Use	Noriko Arai; Kouichirou Ueki; Noriko Kando; Hironobu Gotoda; Takayuki Mizuno
Science Information	Yuan Sun; Masaki Nishizawa; Miho Funamori; Masako Furukawa
Information Public Policy	Hitoshi Okada; Noboru Sonehara

Research Centers

Services and Operations

Research and Development Center for Academic Networks http://www.nii.ac.jp/nwcenter/

This center develops and delivers new services and functions to enhance the capabilities and efficiency of the Science Information Network (SINET): a crucial backbone network for more than 800 universities and research institutes in Japan.

Director: Shigeo Urushidani, Professor, Information Systems Architecture Science Research Division

Center for Global Research in Advanced Software Science and Engineering

This center is dedicated to the integration of research, implementation, and education aimed at developing twenty-first-century software infrastructure, through collaboration with both Japanese and international research institutions, as well as through industry-academia collaborations. It also aims to cultivate world-class researchers and technologists to serve as a nucleus for next-generation efforts in this field. Director: Shinichi Honiden, NII Deputy Director General/Professor, Information Systems Architecture Science Research Division

Center for Cloud Research and Development

This center promotes research and education and the reform of universities through R&D aimed at providing state-of-the-art academic information structure utilizing cloud networks developed with the upgraded Science Information Network (SINET).

Director: Kento Aida, Professor, Information Systems Architecture Science Research Division

Research Center for Cybersecurity

(established April 2016)

Through R&D that leverages knowledge acquired from the creation and operation of academic information infrastructure, this center helps to ensure the security and operational efficiency of university research environments in cyberspace and to cultivate human resources in collaboration with universities. Director: Hiroki Takakura, Professor, Information Systems Architecture Science Research Division

Research Center for Knowledge Media and Content Science

This center pursues advanced research on the analysis and extraction of knowledge from academic papers and other academic content, as well as empirical R&D for promoting the distribution of academic knowledge

Director: Akiko Aizawa, Professor, Digital Content and Media Sciences Research Division

Research Center for Community Knowledge

This center pursues R&D on Net Commons, on the collection and analysis of shared knowledge creation processes, and on activities to promote the diffusion of research findings. It also supports the development of next-generation information and communications technologies and information sharing infrastructure systems.

Director: Noriko Arai, Professor, Information and Society Research Division

Center for Dataset Sharing and Collaborative Research

This center develops useful datasets for informatics research and makes them available to researchers. In addition, it conducts R&D on the creation of datasets and on systems for their utilization, and promotes joint usage and research in informatics.

Director: Keizo Oyama, Professor, Digital Content and Media Sciences Research Division

Big Research Projects

Global Research Center for Quantum Information Science

As an international hub for advanced research on quantum information science and technology, this center promotes quantum information science and explores the potential of quantum information technologies. Also educates international personnel who will lead medium- to long-term research focused on specific goals.

Director: Kae Nemoto, Professor, Principles of Informatics Research Division

Global Research Center for Big Data Mathematics

Research base for the JST ERATO Kawarabayashi Large Graph Project. This world-class hub for research on big data mathematics, with a central focus on developing high-speed algorithms, conducts advanced research and professional development.

Director: Ken-ichi Kawarabayashi, Professor, Principles of Informatics Research Division

Global Research Center for Cyber-Physical Systems

Cognitive Innovation Center

In collaboration with industry, government, and academia, this center researches and develops social cyber-physical systems (CPS) aimed at creating new value and addressing social issues by linking the real world with the cyber world.

Director: Jun Adachi, NII Deputy Director General/Professor, Digital Content and Media Sciences

Industry-Academia Collaborations

Research Center for Financial Smart Data

(established February 2016)

(established February 2016)

This center pursues the development of technology for financial information analysis by turning big data into "smart data", and through statistical analysis and modeling of economic and social phenomena, to enable more precise predictions of the future, natural language processing, and

Director: Masaru Kitsuregawa, NII Director General

This center strives to generate innovations to tie state-of-the-art cognitive technologies incorporating artificial intelligence techniques such as deep learning to social, industrial, and new business applications. It also works at raising awareness to promote social implementation of such technology. Director: Mitsuru Ishizuka, Visiting Professor, NII

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Close-Up on Researchers

"My job is to develop algorithms that speed up the processing of big data. I leave research on increasing the accuracy of processing to other people." Assistant Professor Takuya Akiba devotes all his abilities to the pursuit of algorithm speed.

He has had a general interest in computers since elementary school. "Perhaps because of the anime and films I liked." Upon starting junior high school, he discovered that his interests lay, not in the computing machines themselves but in the programs running inside. He enjoyed creating games with his friends but began to think, "What I really want to do is something different." When he encountered algorithms at university, the question of what he should do was settled. "An algorithm is like the idea behind a calculation, and algorithms are responsible for programs behaving cleverly."

He was obsessed with programming contests during his university days, ranking fourth in the world at one point. Like an athlete, he felt the rush of adrenaline and aimed ever higher. Wanting to help the younger generation to experience the same feeling, he even compiled a book on how to become a strong contestant. During this time, he developed a high level of ability in devising algorithms and writing programs to implement them. Now, as a researcher, he understands very well that the field in which he can make maximum use of his abilities is algorithm development.

The world has entered the age of big data. However, we are still at the stage of seeking ways of exploiting vast amounts of data effectively. Graph data, which deals with relationships between things, is a particularly underused form of big data because of its complexity. "Networks of human relations, routes, and so on, conceal important information, but we are unable to extract it." Moreover, "relationships that change from one minute to the next must be captured in realtime for them to have any meaning." Akiba therefore decided to research algorithms that make it possible to process graph data at high speed.

"If one calculation takes too long, divide it into two." He is devising a two-step method in which calculations are carried out after the data have been preprocessed, known as indexing. "It may be possible to increase processing speeds by ten-, one hundred-, or even one thousand-fold." He considers it his mission to make this idea a reality.

However, he also accepts that "what can be done with big data is beyond my own imagination." Which is why he actively interacts with other informatics researchers. Also, his reason for choosing NII as his destination after gaining his doctorate was its stimulating environment, where one encounters world-leading researchers. "My research is fundamental, but I am allowed to do it to my heart's content,"

Even now that he is working professionally as a researcher, Akiba finds the task of discovering and chipping away the calculation waste hidden in algorithms "enjoyable, like a math puzzle." His enthusiasm for programming remains the same as when he was a young boy.



Assistant Professor, Principles of Informatics Research Division

Takuya Akiba

Associate Professor Shoko Utsunomiya is engaged in research on "coherent computers" using laser networks. Coherence is a property of waves that interfere with each other. She is exploring the possibilities of new computers that efficiently solve combinatorial optimization problems using the speed of the elementary process of laser oscillation and the effects of optical interference. This research is one of the Japanese government's Impulsing Paradigm Change through Disruptive Technologies (ImPACT) programs, and Utsunomiya serves as a project sub-leader, carrying out joint research with institutions including the University of Tokyo, NTT, and Stanford University in the United States.

Many combinatorial optimization problems exist in our everyday lives, including areas such as drug discovery and distribution route optimization. However, deriving optimal solutions from vast numbers of combinations is extremely difficult even with the computing speed of a supercomputer. Therefore, ways of efficiently solving this problem using new computational principles and physical implementation are required.

Utsunomiya learned to program as a junior high school student and studied computer science at university. She was interested in artificial intelligence and machine learning, but wanted to expand the scope of her research, and so pursued basic research on quantum computers and quantum properties at graduate school. Through the Cooperative Graduate School Program, she studied at NII, and had "an advantageous start in that I was able to do research at NII while still a student." She was also able to build relationships with other researchers, and collaborate and carry out joint research with other research facilities. "Gaining experience at a top-class research facility right from my student days was extremely valuable." The opportunity to work in an international environment with many overseas students was also important. She had a desire to "create something that would actually be used in the world," and gradually decided that she wanted to make computers using physical phenomena a reality.

She enjoys making things. "Making cookies, cakes, and so on, resembles the process of making semiconductor chips that I learned as a graduate student." She finds making macarons especially difficult, but fun. Making ceramics at her travel destinations is another of her hobbies. Her usual life involves handling digital devices, so she sometimes feels the need to touch clay. She is interested in many things in both her research and hobbies, and that is why she tries to "steadily press on with what is right in front of me."

The research on coherent Ising machines that Utsunomiya is currently pursuing began with two lasers as a proof-of-principle experiment. Stanford University increased this to four lasers and the NII/RIKEN team increased it to sixteen. Now, the NTT team is working on basic research towards scaling up to 10,000 lasers. During FY2016, the plan is to complete a prototype with institutions including NTT and Osaka University in which 2,000 lasers are mutually connected.

As well as attempting to increase computing speeds, the project team believes that there are calculations that physical computers are particularly good at. One of the future goals is to find out what these are and how to make use of them. Utsunomiya's own research topics are in the interdisciplinary area of quantum physics, informatics, and statistical physics. She is interested in uniting these fields to open up new aspects of information processing. In the future, she would like to expand her research to include points of contact with the humanities, such as representing human perception and social phenomena using a natural computing approach.



Associate Professor, Principles of Informatics Research Division

Shoko Utsunomiya

Close-Up on Researchers

Growing up with the evolution of computers and the popularization of the Internet, Professor Hiroki Takakura watched the spread of the "light" of user convenience and the "shadow" of threats posed to users. Today, as a leading expert in cybersecurity, he is confronting that shadow.

The word "cybersecurity" has become a thoroughly familiar one, and we now recognize its necessity and the seriousness of the situations that can arise when it is breached. "Cyberattacks have become more sophisticated, and their destructive power has increased. Devices of various sizes are connected to the Internet, and the Internet of Things (IoT) that carries out sensing and control is an unstoppable trend. We cannot afford to be complacent about the question of when and where in the world someone will find a 'hole' and launch an attack."

Takakura is currently involved in "developing a system to estimate the degree of risk from threats that are only fragmentarily visible." It is not particularly difficult to find and accumulate threat fragments. The difficulty is in judging when and to what degree of risk these fragments will develop. This is because, even if the level of threat is the same, the degree of necessity and urgency of the response will be completely different depending on whether it is one hour later or three years later, and errors of judgment can seriously affect organizational operations and corporate management.

Now an expert in risk management, Takakura did not necessarily aspire to enter into the field of security in the beginning.

He was "if anything, a humanities-type student" at high school, and obsessed with amateur radio. Wanting to be involved in "radio, above all else," he went on to study information engineering at university. However, his graduation project led him to become involved in computer research. Then, in 2000, he started research on security.

Many security experts pursue only the technology that they themselves specialize in. While acknowledging that, "Those kinds of specialists are also important," Takakura says, "Security requires extensive knowledge. Various lessons and experiences, including being a humanities-type student and being obsessed with radio, are proving useful to me now."

Takakura joined NII in April 2015. "At NII, the Director General and the Deputy Director General are at a close distance. I can talk to them directly about the research I want to do, and they'll say that it sounds interesting and be very supportive. I too want to continue to provide support and understanding to students and young researchers."

Takakura met NII's Director General Masaru Kitsuregawa in May of his fourth year at university. Takakura had just finished his very first presentation at an academic conference when he saw a hand go up with a question. At the time an Assistant Professor at the Institute of Industrial Science, University of Tokyo, Kitsuregawa asked him which he thought was faster, his method or Kitsuregawa's method. To which, Takakura intended to reply, "The methods are different, so they can't be compared," but what he actually said was, "There's no comparison." Provoked by this, Kitsuregawa fired off a barrage of questions, to which Takakura somehow responded despite being cornered. He held out until the time for questions was up. "I am sure his first impression of me was that I was an impertinent guy," Takakura reflects.

More than a quarter of a century later, Kitsuregawa invited him to NII, and he took on the role of Director of the Research Center for Cybersecurity, newly established in April of this year. In the cyber age, we are reminded once again of the importance of relationships between people.



Professor, Information Systems Architecture Science Research Division

Hiroki Takakura

Associate Professor Michihiro Koibuchi conducts research on supercomputers and data center networks. Specifically, he is working on new ideas for optimizing connections between supercomputer processors and connections in data centers.

Currently, supercomputer processors are connected in a regular manner. However, Koibuchi argues, "Connecting cores randomly could actually help to improve performance." This is because a greater the number of cores increases the importance of reducing communication delay. His new design concept arose as a result of looking at the problem from a different perspective.

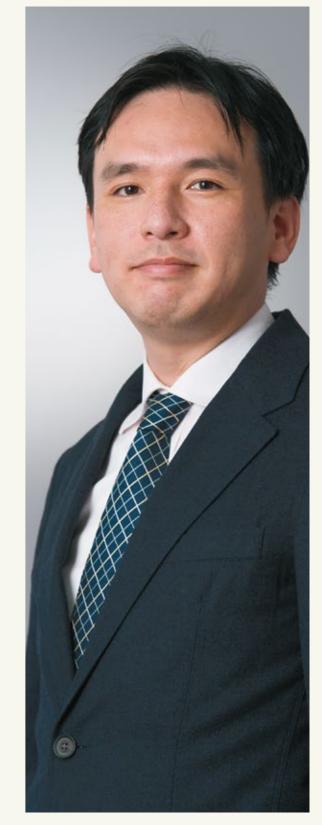
In regard to research on network connections in data centers, his thinking is different again. He aims to replace the extremely long cables, exceeding 1,000 km in length, that are used in data centers with optical wireless communication. "Optical wireless communication terminals are simply placed on top of racks. The wiring is confined to inside the racks, plus a little more. The network structure can be easily changed just by changing the direction of the beam." The source of the idea was the determination, "Craftsmanship should be beautiful." New devices appear in quick succession in the world of computer architecture, and therefore their design is often complicated and aesthetically displeasing. "First, I looked at the cables snaking around and thought that I'd like to make it look better."

Koibuchi's third research subject is also unique. This is a "submerged computer" in which the circuit boards are entirely submerged in water for cooling purposes. Cooling using water is not new, but what is new is the attempt to make direct use of tap water, river water, or even sea water as the coolant. "No one is operating circuit boards submerged in tap water, but it's undoubtedly extremely useful. That's why we're trying to do it." The demonstration motherboard is a commercially available circuit board with a special coating applied, and the water tank in which it is submerged also contains "my son's goldfish and my newts."

Koibuchi has a dream for the future of this seemingly surreal scene. If data centers could be installed underwater beside power stations built on waterfronts or coasts, as well as greatly reducing cooling costs, it would be possible to reduce losses due to power transmission and AC/DC conversion. "It is certainly possible to suspend computers in the sea, in a similar manner to the rafts used in oyster farming." As might be expected from someone who loves fish and went fishing as a young boy, Koibuchi has expanded his idea to consider that "the temperature of the seawater may increase slightly, but fish will be attracted, and it could have a secondary use as a reef for fish breeding." He plans to soon progress from the water tank to demonstration testing in the sea.

Koibuchi regards NII as a hub for the interchange of people and information. "When here, I come into contact with many people. I'm able to have little discussions with researchers from overseas, and that provides a good stimulus." Researchers with different approaches meet and cooperate with each other, and in this environment, Koibuchi discovers research that he finds exciting.

"My job is to discover seeds with the potential to produce results and to explore their validity. I think it suits my personality to be always seeking new things in what may appear at first glance to be a traditional field of research." Koibuchi's own principles coincide with NII's research policies.



Associate Professor, Information Systems Architecture Science Research Division

Michihiro Koibuchi

Close-Up on Researchers

Professor Imari Sato specializes in "computer vision", which captures objects from images taken by a camera. Her research focuses on analyzing the material perception of objects, including color, shape, and luster. Technologies for understanding the real world using reflection analysis and spectroscopic analysis are valued highly, and Sato is also participating in an ImPACT project titled "Innovative Visualization Technology to Lead to Creation of a New Growth Industry." This project is also attempting to apply the technology to the fields of health and medicine to enable non-invasive examinations for early detection of illnesses.

The true nature of color as seen by humans is "light". The light shining onto an object is absorbed or reflected by the object's surface and is seen as color. Meanwhile, there are also objects that emit light themselves by converting absorbed light into energy. While there are many frameworks that focus on reflected light in the field of computer vision research, Sato is pioneering the development of spectroscopic analysis technology that also considers these fluorescent components.

Sato's dream as a young girl was to be "a mom who could cook well". She focused on humanities until her third year at university. However, two encounters changed her life's path. At university, she consulted an advisor as she was worried "about the fact that my course was different from how I imagined it before I entered university. I wasn't excited about my studies, and I was wondering what I really wanted to study." That advisor was a computer science researcher and recommended that she go on exchange to Carnegie Mellon University (CMU) in the United States, a top school in the field of computer science. There, she studied artificial intelligence and automatic translation for a year, Ideas are often explained using diagrams in the sciences, and so she was able to understand despite the language barrier, After graduating, she returned to CMU, As a visiting scholar, she began working as an assistant to a world-renowned computer vision researcher. This researcher always spoke with such pleasure about research that she began to think, "Future technology is so interesting. It would be even more fun if I could do research myself." Then, a paper she had written, inspired by a class assignment, was selected for an award at a small international conference, and she was greatly encouraged by this achievement.

After returning to Japan, she acquired a doctorate in interdisciplinary informatics. She is now in her twelfth year as a researcher at NII. "At NII, the interests of individual researchers are respected, and so we're able to do the research that we want to do. Also, if we need information, we can consult immediately with specialists in the field."

In the new research area of "Brain and Information Science on SHITSUKAN (material perception)," which has attracted researchers in diverse fields from various organizations, there are repeated discussions that question existing concepts, and Sato realized, "I like carrying out research by working with other people to expand our ideas." Fluorescent color is another research topic that came about through such discussions. Having not been involved in the sciences from the very beginning, Sato has a flexibility that means "I can be anything, regardless of my background."

As a child, Professor Sato spent summer and winter vacations in Nagano, where she loved coming into contact with trees, river stones, and other aspects of nature. There are many objects in the natural world that emit fluorescent light, even leaves and stones, and "despite being invisible to our eyes, they actually contain fluorescent material that shines." In the future, "I want to carry out fieldwork to survey what fluorescent colors and reflected colors exist in the natural world using the analysis technology that we have developed so far. Then, I want to use the results to investigate the colors of living things and the reasons for their behavior."



Professor, Digital Content and Media Sciences Research Division

Imari Sato

Associate Professor Kazutsuna Yamaji is promoting open science through the management of institutional repositories, which serve as the infrastructure by which research and educational institutes collect, store, and disseminate their intellectual output.

Belonging to the operating division that offers services aimed at universities, he plays a role in providing advanced ICT infrastructure to universities and researchers, as well as conducting research and development. "You could say it's like being an engineer who also has a management role." It is his responsibility to take in new technologies and bring them to a state in which they can be employed as services, while striking a balance with mature technologies already in use.

Open access is a global trend toward making research reports available to the general public free of charge. Researchers carrying out research funded using public money, in particular, are increasingly obliged to make their reports available to the public. "We construct repositories (infrastructure for unified management of information) for this purpose, and make them available to universities. We will also support the movement for open science, which is attempting to make research data publicly available as well."

Yamaji has always been interested in mechanical control, and loved making and operating things. He pursued biomedical engineering, which deals with living systems in the field of engineering, and became a researcher in visual neuroscience. At that time, he was in charge of constructing a platform for sharing data between fellow researchers within neuroscience.

At NII, he is involved in developing the university authentication infrastructure aimed at sharing research findings. "Running a system that I have built is similar to mechanical control. Having people use the system is great." In medicine, for example, important targets can be set, such as saving lives, but in fields where that is difficult, there is a tendency to carry out research for the sake of research. NII's initiatives include a requirement to please the users. "In Japan, when something reaches a certain stage, it spreads horizontally very quickly. To have something that we made being used at universities nationwide is rewarding like nothing else."

The capability to develop technologies is important, but actually getting universities to use the technology requires trusting relationships. The key to success when trying to get something started is having the connections to quickly gather people together and move things forward. "NII has collaborated with university IT centers and libraries for many years, and so they feel confident about using NII's services." Because of this, NII takes care to listen to feedback from universities and make improvements.

A world in which open science is implemented is expected, not only to allow acceleration of research but also to facilitate interdisciplinary research by making it easier for researchers to connect with each other. "I want to build infrastructure that provides opportunities to young people in particular. Making research data available to the public is also a form of branding."

In open science, there is a tendency to focus only on the public portion, but Yamaji believes that it is necessary to create something that connects everything, including authentication and cloud computing. "The open science that we are talking about now is incomplete. The ideal would be a framework that integrates the public and the private, and I want to implement a cyberspace in which all researchers conduct their research." Yamaji is not just focusing on a single trend but looking ahead to the future of research work.



Associate Professor, Digital Content and Media Sciences Research Division

Kazutsuna Yamaji

Close-Up on Researchers

From foreign exchange transaction data, corporate financial data, and Internet shopping purchase histories to SNS posts, people's activities are recorded and stored as digital information day after day. Associate Professor Takayuki Mizuno is engaged in analyzing this vast amount of big data using techniques of statistical physics, and explaining phenomena called "booms".

When large numbers of people all buy a product, stock eventually becomes scarce and the price of the product increases. If investors all speculate excessively on the product, a bubble occurs. This kind of phenomenon, in which people's behavior interacts in complex ways to show an unusual bias, is widely regarded as a "boom". "When the big data that record people's behavior are analyzed in detail, we can see how people acted at the time and how the boom occurred." The mechanisms behind sudden rises and crashes in the financial markets are already becoming clear. Research has also successfully reproduced price fluctuations in the online consumer electronics market.

The big data that lie idle within corporations are crucial in this research. Taking advantage of the fact that NII is situated close to Otemachi, Tokyo, where many company headquarters are located, Mizuno is actively building connections with corporate management. "Only at NII could I concentrate on my research in such an advantageous location."

Mizuno specializes in econophysics. This is a new discipline that attempts to analyze economic and social phenomena by using methods from physics, in a similar way to explaining natural phenomena.

He has long been interested in how people behave, in the ways that they move randomly but with regularity. "The movement of people resembles the motion of particles in physical phenomena." He studied physics at university, where in his fourth year he encountered the brand new discipline of econophysics. "Physics dealing with people—the perfect discipline for me!"

He already had generally decided to become a researcher as a child. Seeing scientists in TV dramas and anime giving protagonists accurate advice about what the enemy was going to do, he was attracted by the idea that "if I become a scientist, I'll know how people are going to act." Now as a researcher, he finds that "revealing people's actions from data is the most interesting thing."

For Mizuno, there is no line between his private life and his research activities. When he wants to do research, he immerses himself in it around the clock, and when there is a book that he wants to read, he continues reading without doing any research at all. When he is not researching, he naturally gets the urge to return to it. "I do research when I want to, and when I don't want to, I don't do it." This attitude is his secret for a stress-free life.

He has recently started working on a new research project that involves analyzing spatio-temporal big data, which include not only changes over time but also spatial changes. For example, how do the rare metals that are mined illegally in conflict areas spread around the world via corporate transactions? Mizuno would like to determine how people group together and spread out nonuniformly in space. He also intends to conduct analyses relating to the issue of refugees and security in the future. While gradually expanding the scope of his research, he is "ultimately aiming to derive universal formulas for booms by linking all of the analysis results."



Associate Professor, Information and Society Research Division

Takayuki Mizuno

Associate Professor Yuan Sun began her research career in psychological statistics and psychometrics, and now investigates education optimized for the individual and its support methods. She is concerned that "science has progressed well in modern times, but the advantages of the progress have not been enjoyed in the field of learning and education," and therefore regards this field as the last frontier where scientific solutions can be found.

She explains her research objectives by likening learning to mountain climbing: "A learning test is like a GPS device for ascertaining your own location. The goal is the top of the mountain, and there is never just one route leading there. I want to identify appropriate guides that will determine your current location and indicate the right route for you."

Conventional education is collective and uniform because its aim is to raise levels overall, and learning tests provide relative evaluations as students compete for marks. This situation is changing with the use of ICT in educational environments. Learning times and other circumstances are stored in cyberspace as log data (learning lifelogs), and it is now possible to obtain a wealth of information about individual students. By accurately diagnosing learning statuses using artificial intelligence technologies and big data, and feeding the information back to pupils individually, we are able to optimize learning support for the individual. "If we can create learning tests capable of ascertaining the level of understanding of each individual in a multifaceted way, we will be able to analyze the response patterns of students and determine where in the learning process they are failing and where they are lagging behind."

Sun aspired to be a scientist as a child. Her parents worked at a university, and she was brought up in the university environment. After considering physics and mathematics, she pursued psychology. "The psychology that I studied in the beginning involved the scientific analysis of people's states of mind, and the mission was to discover general rules. However, I considered the individual differences that were discarded as errors to actually be important and stepped into the field of psychological statistics."

Statistics and measurements in psychology produce indicators for measuring individual differences, and Sun's aim was to investigate the accuracy, objectivity, validity, and reliability of these indicators. However, her aim has changed. "Now, my aim is to understand how to capture human diversity and growth."

There are problems that go along with taking human beings as a research subject. "It's very complex and sensitive. People cannot be considered in a uniform way, like machines. There are also issues of privacy and ethics, so it is difficult to collect data on education and learning." Therefore, the verification of research results and effects also presents difficulties. Sun is concerned that this is difficult for people in engineering and information processing to understand. "Cooperation between experts from various fields, including psychology, cognitive science, statistics, mathematics, and computer science, is essential in education. NII's environment, in which diverse researchers meet, is good in this regard." Collaboration with educational settings is also crucial. Carrying out student-centered research is not easy. "The fact that feedback must be changed according to age too is also difficult." While facing the unique challenges involved in having people as a research subject, Sun is working to develop learning diagnosis and support methods in cyberspace.



Associate Professor, Information and Society Research Division

Yuan Sun

List of Researchers



Principles of Informatics Research Division

■ Mathematical Informatics

Assistant Professor Takuya Akiba	Algorithms and data structures for large-scale data processing; Algorithm engineering; Empirical algorithmics
Assistant Professor Yoichi Iwata	Exact algorithms; Parameterized complexity; Algorithms using real-world input structures
Professor Takeaki Uno	Efficient and practical fast algorithms for solving large-scale problems arising from data mining and genome sciences; Theory of complexity on discrete algorithms and enumeration algorithms; Practical efficient computational models and algorithms for industrial engineering such as scheduling, logistics, and vehicle routing problems
Professor Ken-ichi Kawarabayashi	Graph coloring problems in discrete math; Structural graph theory and its applications to algorithms; Network flow and disjoint paths problem
Associate Professor Masako Kishida	Control theory and optimization for uncertain systems and networked systems
Assistant Professor Ryota Kobayashi	Data mining; Computational neuroscience; Machine learning
Professor Ken Hayami	Numerical analysis and numerical linear algebra; Development and analysis of iterative methods for large systems of linear equations and least squares problems; Numerical solution of inverse problems
Associate Professor Yuichi Yoshida	Property testing; Sublinear time algorithm; Constraint satisfaction problem; Approximation algorithm

■ Mathematical Logic

Associate Professor Makoto Kanazawa	Lambda calculus and formal grammar; Logical semantics of natural language
Professor Makoto Tatsuta	Software verification; Separation logic; Theory of programs; Type theory; Constructive logic

Quantum Information

Associate Professor Shoko Utsunomiya	Coherent Ising machine using a laser network; Quantum information processing and quantum computing
Professor Kae Nemoto	Quantum information and computation; Quantum optics; Theoretical physics
Associate Professor Keiji Matsumoto	Quantum information and computation

■ Intelligent Informatics

Associate Professor Ryutaro Ichise	Machine learning; Knowledge Systems; Data mining
Associate Professor Tetsunari Inamura	Human-robot interaction; Synthetic study of robot intelligence based on stochastic information processing; Neurorehabilitation using VR
Professor Katsumi Inoue	Inference and knowledge representation; Hypothesis-finding based on induction and abduction; Systems biology; Systems resilience
Associate Professor Nobutaka Ono	Blind signal separation; Microphone array; Acoustic signal processing
Professor Ken Satoh	Multi-agent systems in incomplete information environments; Juris-informatics
Professor Hideaki Takeda	Knowledge sharing systems; Semantic Web; Design theory

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Information Systems Architecture Science Research Division

Network Architecture

Associate Professor Shunji Abe	Performance analysis based on communication traffic measurement and QoS control method; Photonic network architecture; Mobile IP communication
Associate Professor Kensuke Fukuda	Measurement and analysis of Internet traffic; Network science

■ Information Network

Professor Shigeo Urushidani	Dynamic resource optimization technologies for multi-layer networks; Universal switching system architecture
Associate Professor Megumi Kaneko	Wireless communication engineering; Wireless resource allocation; Protocol design for mobile communication systems
Associate Professor Takashi Kurimoto	Network system architecture; Network protocol
Professor Yusheng Ji	Resource allocation and quality of service in communication networks; Network traffic modeling and analysis; Wireless ad hoc and sensor networks
Professor Hiroki Takakura	Cybersecurity; High-reliability networks; Anomaly detection

Computer Architecture

Professor Kento Aida	Parallel and distributed computing; Cloud computing; Grid computing
Associate Professor Michihiro Koibuchi	Computer system networks; On-chip multiprocessor networks; Large-scale high-performance computing systems
Professor Masahiro Goshima	Processor architecture; Memory architecture; Digital circuit technology
Associate Professor Atsuko Takefusa	Parallel and distributed processing; Cloud infrastructure technologies; Intercloud technologies
Professor Hiromichi Hashizume	Visible light communication; Digital signal processing; Mobile device positioning and indoor navigation

Software infrastructure

Professor Ichiro Satoh	Professor Ichiro Satoh OS and middleware for distributed systems including cloud computing and IoT						
Professor Zhenjiang Hu Principles of programming: Functional programming and programming algebras; Software engineering: Dependable software construction and bid model-driven software development; Parallel programming: Skeletal parallel programming and automatic parallelization							
Assistant Professor Kanae Tsushima	Programming languages; Functional programming; Program debugging; Development support						

Software Engineering

Assistant Professor Kazunori Sakamoto	Software testing; Source code analysis and transformation; Programming language; Programming education					
Professor Shin Nakajima Software dependability; Formal methods; Automatic verification						
Professor Shinichi Honiden	Autonomous agents and multiagent systems; Ubiquitous computing; Software engineering					
Associate Professor Nobukazu Yoshioka Security software engineering; Software engineering; Cloud computing						
Professor Tomohiro Yoneda Dependable VLSI system implementation based on asynchronous circuit technology; Formal verification of realtime software						
Associate Professor Kenji Tei Software architecture; Self-adaptive systems						

List of Researchers



Digital Content and Media Sciences Research Division

Foundations of Content Management

Associate Professor Fuyuki Ishikawa	Description, analysis, and guarantee of functions and quality in the integration of Web services; Description, analysis, and verification of requirements and specifications in software development					
Professor Isao Echizen	Technologies and systems for multimedia content security; Integrity of multimedia content; Information hiding					
Associate Professor Norio Katayama	ssociate Professor Norio Katayama Data management technology for video corpus analysis					
Assistant Professor Hiroyuki Kato	Optimization for casual queries to database; Fundamental issues on optimizing queries to XML databases					
Assistant Professor Yusuke Komiyama	Open science; Semantic Web; Linked Open Data; Bioinformatics					
Professor Atsuhiro Takasu	Text and sensor data mining; Structural pattern matching; Cyber-physical database systems					
Professor Akihiko Takano	Informatics of association; Algebra of programming					
Associate Professor Kazutsuna Yamaji	Research data sharing and metadata management; Platform system activating the research community					

■ Text and Language Media

Professor Akiko Aizawa	Identification and linkage of text information; Statistical language analysis and automatic construction of linguistic resources; Language media and interfaces		
Professor Jun Adachi	Information retrieval and integration of heterogeneous data; Modeling and implementation of high-performance information retrieval systems; Text mining		
Professor Keizo Oyama	Data analysis of web user behavior and improvement of access to information; Web information retrieval technology; Full text search technology		
Associate Professor Teruhito Kanazawa	Construction of infrastructure for Open Science Repository; Bibliography and person identification; Machine learning; Big data processing; Integrated metadata for Linked Open Data		
Associate Professor Yusuke Miyao	Syntactic parsing and semantic parsing; Information extraction; Information retrieval		
Associate Professor Junichi Yamagishi Speech information processing; Speech-based human machine interaction; Speech-based assistive technology			

Pattern Media

Assistant Professor Ryoichi Ando	Computer graphics; Physical simulations; Computational fluid dynamics					
Associate Professor Asanobu Kitamoto Data-driven science; Humanities informatics; Big data analysis of global environment and disasters; Open science; Image analysis						
Associate Professor Kazuya Kodama	A study on structure of multi-dimensional image information and communication systems of distributed shared image environment with realtime quality control					
Professor Imari Sato Physics-based object shape and reflectance modeling; Creation of spatially immersive displays for human—computer interaction						
Professor Shin'ichi Satoh Video analysis, retrieval, and knowledge discovery based on broadcast video archives; Image retrieval						
Professor Akihiro Sugimoto Sensing and understanding human activities in daily life; Automatic modeling of 3D objects; Computer vision under the existence of digitization error						
Assistant Professor Kenshi Takayama	Computer graphics; User interfaces; Geometric modeling					
Associate Professor Gene Cheung 3D imaging; Graph signal processing; Sleep monitoring and analysis						
Assistant Professor Yinqiang Zheng	3D reconstruction, Photometric computer vision, Hyperspectral imaging					
Assistant Professor Hiroshi Mo	Case-based video indexing; Intelligent video structuring					
Associate Professor Duy-Dinh Le	Semantic representation for video indexing and retrieval; Advanced video search engines; Face annotation and retrieval; Video mining; Efficient methods for handling high-dimensional data					

■ Human and Knowledge Media

Associate Professor Kenro Aihara Computer-supported lifelong learning using digital archives about historical and artistic objects; Integration of user's context in real and virtual worlds						
Associate Professor Frederic Andres MindFlow; Opinion mining; Agricultural management based on collective intelligence; Image learning ontology; Social project management platfo						
Associate Professor Ikki Ohmukai Personal communication and interaction in Semantic Web environments; Information sharing and distribution based on personal networks						
Professor Helmut Prendinger Life-like characters and avatars in virtual worlds; Participatory science and collaboration in the 3D Internet; Automatic content creation; E sentiment recognition from text						
Associate Professor Mayumi Bono Understanding multimodal interaction; Understanding conversational structures in multi-party interaction						
Professor Seiji Yamada Human-agent interaction; Intelligent interactive systems						
Assistant Professor Yi Yu Multimedia content analytics; Multimedia service; Multimedia data mining						



Information and Society Research Division

■ Information Use

Professor Noriko Arai Designing collaborative learning environments; Knowledge sharing and distance learning; Mathematical logic					
Assistant Professor Kouichirou Ueki Development of next-generation information systems					
Professor Noriko Kando Evaluation of information access technologies; Exploratory search and user interface; Cognitive research for exploratory search; Extractive relations from text; Cross-lingual information access					
Associate Professor Hironobu Gotoda Stereoscopic displays; Acoustic rendering systems; Similarity search for 3D models					
Associate Professor Takayuki Mizuno Statistical analysis, modeling, prediction, and control of socioeconomic phenomena based on big data; Econophysics					

■ Science Information

Associate Professor Yuan Sun	Development of multidimensional assessment methods for university research and education evaluation; Research on how to diagnose and support learners in web-based learning environments
Associate Professor Masaki Nishizawa	Quantitative investigation of academic research findings in media reports; Investigation study on network structure of information sciences related research and its trends; Empirical analyses on network for industry—government—university cooperation in Japan
Assistant Professor Masako Furukawa	Learning analytics and standardization; Higher-level utilization of educational resources; Development and evaluation of MOOC and other e-learning materials
Associate Professor Miho Funamori	Multifaceted university IR systems; Open access in the digital age and interaction with physics world problems

■ Information Public Policy

Associate Professor Hitoshi Okada	Critical growth factors of e-commerce and e-money; University Information Security Policy Portal (UISPP)					
Professor Noboru Sonehara	Spatiotemporal privacy-protection framework; Human and society data commons					

Main Projects to promote

Al Project: Can a robot get into the University of Tokyo?

NII played a central role in launching this project in FY2011 with the aim of opening up new horizons in artificial intelligence (AI) research by reintegrating the field of AI, which had been fragmented since the early 1980s. University entrance exam questions are integrated problems that demand various skills, including natural language processing to analyze the problem text, and the results can be evaluated quantitatively using points and deviation scores. By challenging AI using university entrance examination questions with these characteristics, the project aims to pinpoint objective benchmarks for the evolution of AI that can be used as indices when considering the question, "What are the fields in which humans could be replaced by AI?"

Specific benchmarks of the project are achieving a high score on the National Center Test for University Admissions by FY2016 and passing the entrance examination for the University of Tokyo by FY2021.

In FY2015, the robot achieved good results with a deviation score of 57.8 in the National Center Test for University Admissions (8 subjects across 5 fields of study). By subject, the robot recorded deviation scores above 60 in three subjects: Math I A (deviation score 64.0), Math II B (65.8), and World History B (66.5). These results give the robot at least an 80% chance of being accepted by 1,055 departments in 441 private universities and 39 departments in 33 public universities.

Project Director: Professor Noriko Araj, Information and Society Research Division



The project's exam results attract a great deal of interest

(Appropriate of results in November 2015, Professor Arei is making the appropriate of the project of the proje

Benesse Corporation, FY2015 Shinken Simulated Exam, Comprehensive Academic Ability Multiple-choice Simulated Exam / June

		didat			

Japanese		Math		English			Geography/History		5 fields
	language	Math IA (*1)	Math IIB(*1)	English (Writing)	English (Listening)		Japanese History B	World History B	8 subjects Tota l
Point allocation	200	100	100	200	50	100	100	100	950
Todai Robot Project's mark	90	75	77	80	16	42	55	76	511
Average student mark	105.4	45.5	42.8	86.0	24.6	49.4	46.6	45.9	416.4
Todai Robot Project deviation score	45.1	64.0	65.8	48.4	40.5	46.5	54.8	66.5	57.8 (*3)

^{*1} In mathematics, some additions and modifications were made manually in the process of converting the problem text into a form that a machine could understand, only in areas currently under development and areas due to be developed in future (such as semantic interpretation of mathematical formulas and analysis of relations between sentences).

JST ERATO Kawarabayashi Large Graph Project

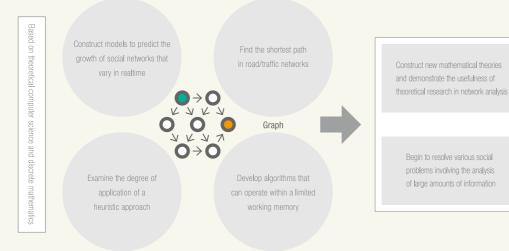
Large networks, such as the Internet web structure and social network services like Facebook and Twitter, are used by more than a billion people every day, and the volume of information is growing faster than the hardware is evolving. There is therefore an urgent need to develop algorithms capable of analyzing at practical speeds the vast amount of information that swirls around in ever-expanding large networks.

This project was selected as an Exploratory Research for Advanced Technology (ERATO) project of the Japan Science and Technology Agency (JST), and it aims to establish a mathematical foundation that will begin to resolve various social problems involving the analysis of large amounts of information. Considering ever-expanding networks as "large graphs" (big data) consisting of nodes connected by edges, the project makes use of advanced mathematical theories in areas such as theoretical computer science, discrete mathematics, optimization, and machine learning, and adjusts them for the rapid expansion of information to develop high-speed algorithms useful for solving various problems. As well as bringing the usefulness of fundamental research in mathematics to the attention of society through this research activity, the project gathers together excellent young researchers from all over Japan and develops them into personnel with the basic skills to allow them to play active roles in various fields.

Research Supervisor: Professor Kenichi Kawarabayashi, Principles of Informatics Research Division



The development of young researchers is also an important objective of the project Interim meeting in September 2015. Professor Kawarabavashi is at the center of the front row.



Social Cyber-Physical System Project

Research representative: Jun Adachi, NII Deputy Director General/Professor, Digital Content and Media Sciences Research Division

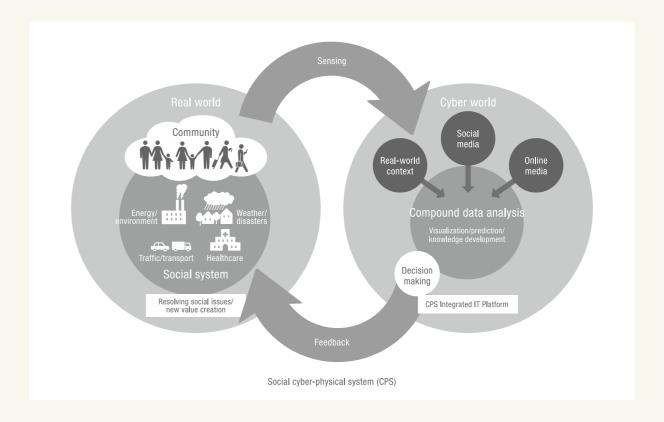
NII is working in collaboration with universities and industry to conduct research on cyber-physical systems (CPS) on a social scale. Cyber-physical systems link physical systems functioning in the real world with information (cyber) systems that collect and analyze data obtained from the real world through various sensors. They analyze the data and feed the results back to the real world. CPS are expected to increase the efficiency of social systems and services, and create new value.

Since 2012, NII has been investigating infrastructure for managing and processing the large amounts of CPS data derived from the real world, as well as visualization methods, as part of the "Cyber-physical Integrated IT Platform Project to Optimize Social Systems and Services" commissioned by the Ministry of Education, Culture, Sports, Science and Technology. Together with our collaborative research partners, Hokkaido University, Osaka University, and Kyushu University, we are carrying out empirical testing of new integrated IT platforms.

NII has also been involved since 2014 in one of the themes of the Strategic Innovation Promotion Program (SIP) implemented by the Cabinet Office titled "Technologies for maintenance/upgrading/management of infrastructures." Our aim is to make a specific contribution to society through information technology by cooperating with researchers in civil engineering to provide an integrated management platform for sensing data relating to bridges and other types of infrastructure.



NII held an international symposium that included presentations of demonstration test reports. (March 2016. Deputy Director General Jun Adachi sits at the right-hand end of the top table.)

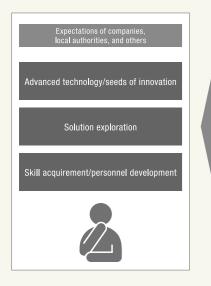


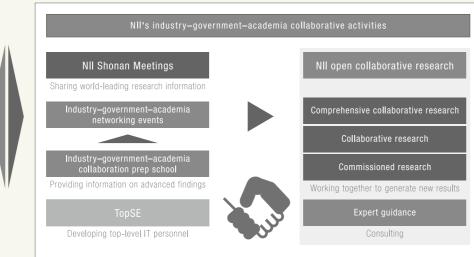
^{*2} In physics, the problem text was converted manually into a machine-processable form.

[&]quot;3 Aggregate deviation score for 116,000 candidates in 8 subjects across 5 fields of study for the humanities (Japanese language, 2 math subjects, English writing/Tetening, 2 geography/history subjects, 1 science subject).

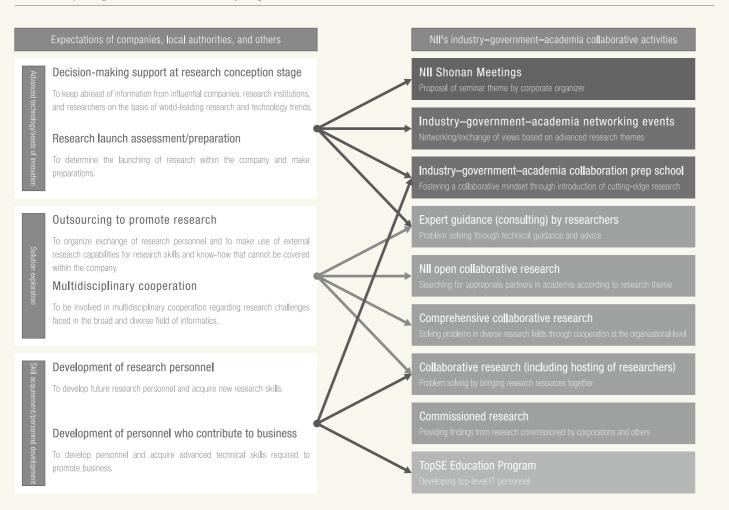
Industry-Government-Academia Collaboration (Practical R&D and Industry-Government-Academia Collaborative Activities)

NII conducts research in the field of informatics and engages in information infrastructure projects with the aim of furthering practical R&D that will help solve various problems facing society. Collaborations between industry, government, and academia are vital in achieving these goals. In order to further strengthen such collaborations, NII promotes activities that help ensure that we meet the requirements of companies, local authorities, and others.





Action program for industry-government-academia collaboration



Information on Expert Guidance (Consulting) by Researchers

NII offers a consulting service that aims to expand our industry—government—academia collaborative initiatives, explore possible collaborations with new partners, and contribute widely to society. Through communication between researchers and people involved in business, our consulting service supports startup companies by providing relevant policy advice from researchers on issues that are likely to lead to contributions to society or to the generation of innovation through industry—academia collaborations.







Contact information for expert guidance

We will ask you about the business issues on which you seek guidance, or discuss researchers whose research subjects relate to those issues, and coordinate the consulting. For details, please direct inquiries to the address below.

Research Strategy Office, National Institute of Informatics E-mail:nii-ura@nii.ac.jp

Main Projects to promote

NII actively promotes research funded by Grants-in-Aid for Scientific Research, joint research with private organizations, and externally funded research. We also accept proposals for and carry out open collaborative research, in an effort to pave the way for new collaborations.

Taking on various research challenges, from basic to applied research

Grants-in-Aid for Scientific Research (KAKENHI)

Grants-in-Aid for Scientific Research (KAKENHI) provide funding to support a wide range of academic research based on ideas devised freely by researchers, covering everything from basic to applied research. Staff and researchers actively apply for KAKENHI, and many have been successful.

NII also engages in collaborative research in which we allocate grants that we have acquired to researchers at other institutions (co-researchers).

At the same time, many NII staff members participate as co-researchers in projects funded by KAKENHI acquired by researchers at other institutions.

Applications accep	(FY2015)		
	No. of Applications Accepted	Amount (thousands of yen)	
Representative	90	336,622	
Co-researcher (Other institution > NII)	46	42,836	

Conducting a range of cooperative research with different companies

Cooperative research with private institutions and other external bodies http://www.nii.ac.jp/research/collaboration/kyoudou/

We take on researchers and receive research funding from private institutions and other external bodies, for the purpose of engaging in cooperative research with NII researchers. Research projects last for one year as a rule, but at the same time there is an option to extend some contracts over several years.

1 Receiving funding only

We receive funding required for cooperative research from private institutions and other external bodies. Cooperative researchers then work from their respective locations.

② Taking on researchers

We take on researchers from private institutions and other external bodies to carry out cooperative research at NII while continuing with their regular job. Essential overheads are covered under our research costs up to a certain limit.

3 Taking on researchers and receiving funding

We take on researchers and receive funding to carry out cooperative research.

	No. of Projects Accepted	Amount of funding received (thousands of yen)
FY2013	45	50,177

Status of implementation

FY2013	45	50,177
FY2014	49	108,391
FY2015	53	109,525

Taking on engineers and researchers from private institutions and other external bodies, and providing graduate level instruction

Cooperative researchers

http://www.nii.ac.jp/research/kenkyou/jyutakukenkyu

We take on engineers and researchers currently working for private institutions and other external bodies, providing that they have graduated from university or are deemed to have reached an equivalent academic level. Essential overheads are covered under our research costs up to a certain limit.

Research periods are up to one year, but can be extended to the following fiscal year and beyond if deemed necessary.

Status of implementation	(FY2015)
	No. of People Accepted
FY2013	42
Files	

Paving the way for wide-ranging collaboration with researchers and conducting research aimed at creating value

NII open collaborative research

http://www.nii.ac.jp/research/collaboration/kyoudou.

We accept proposals for collaborative research, with NII staff acting in a liaison capacity. We accept proposals every year for the following three types of open collaborative research.

- Strategic research proposals based on strategic themes set out by NII
- Proposals for research planning meetings aimed at paving the way for new collaboration or furthering existing research, through meetings at International Seminar House in Karuizawa
- Free proposals in which the applicant is free to set their own research subject

Researchers affiliated with a wide range of domestic institutions are eligible to apply for open collaborative research. This includes the option for staff members and graduate students to become collaborative researchers, as well as staff from private companies, universities, and technical colleges (although the applicant may not be a graduate student). We are particularly interested in proposals for research planning meetings, so please collaborate with us in taking things to the next level.

Status of implementation	(FY2015)	
	No. of Proposals Accepted	
Strategic research proposals	21	
Proposals for research planning meetings	16	
Free proposals	27	
Total	64	

Intellectual Property

NII creates, acquires, and manages intellectual property, and promotes the use of this intellectual property in industry-academia-government collaborations that contribute to society.

Number of Invention Reports, Applications for Patents, and Registrations (total number since FY2004)

■Number of Reports

Attribution: Organization Attribution

■ Number of Applications

Number of Registrations

	———————————————————————————————————————				
1	192	000	Domestic	179	
	13		223	Foreign	44

Number of Registrations		
70	Domestic	58
70	Foreign	12

List of Japanese patents owned

Attribution: Individual Attribution

(as of March 2016

(as of March 2016)

Title of invention	Registration	Joint application
Image information retrieval and display apparatus, and method and program for retrieving and displaying image information	4441685	- upplicacioni
Quantum key delivering method and communication apparatus	4231926	
Time-series data analysis device and time-series data analysis program	4734559	
Information-sharing system, information-sharing server, information-sharing method, and information-sharing program	4799001	•
Ultrasonic distance measurement system and method	4041899	
Sequential content delivery device, sequential content receiving device, and method thereof	4734563	
Contents presentation apparatus, contents presenting method, and contents presentation program	4403276	
Text content presentation apparatus, text content presentation method, and text content presentation program	4143628	•
Method and apparatus for evaluating communication traffic that uses fragmentary self-similarity process	4081552	
Imaging device and imaging method using out-of-focus structure	4437228	
Information resource retrieval device, information resource retrieval method, and information resource retrieval program	4324650	
Active content distribution system, active content distribution program, and active content distribution method	4392503	
Device and method for generating traffic congestion prediction information, and route search system	4729411	•
Content selling device and method	4304278	
Document indexing device, document retrieval device, document classifying device, and method and program thereof	4362492	•
Video provision device and method	4359685	
Projection image correction system and correction information generation program	4982844	
Digital content registration distribution apparatus, system, and method	4956742	
Communication path apparatus for data driven processor having tree-type diversion paths and merging paths, and packet transfer mode for data driven processor	5115922	•
Airing structure of three-dimensional integrated electrical circuit and layout method thereof	5024530	
Quantum key distribution method, communication system, and communication device	4862159	
Time reference point information transmitting system and receiver	4621924	
Quantum repeater	5082039	•
Method and device for searching ambiguous frequent itemset	5267847	
Collection/delivery route selection system	4374457	
Device and method for learning data management, and vehicle air-conditioning device and equipment control device	5224280	•
Air conditioner for vehicle and its control method	5177667	•
Route Switching method, server apparatus, boundary node apparatus, route switching system, and switching program	5062845	•
Direct path establishing method, server device, sender network node device,	4999112	

Title of invention	Registration no.	
Virtual stereoscopic image display device and method of displaying virtual stereoscopic image	5263960	•
Path management control method, path management control program, path management controller, and path management controllsystem	4806466	•
Intramemory data structure of finite automaton, memory storing data with the structure, and finite automation executing apparatus using the memory	5063780	•
Emission allowance trading system and emission allowance trading method	5207195	
Quantum repeater, and system and method for generating extended entanglement	5296924	•
Distance measuring method, distance measuring receiving station equipment, and position measurement system	5305324	
Quantum computing device and method for Ising model	5354233	
Video display device	5373662	
Method and device for accelerating speed of successfully generating entanglement, and quantum repeater that uses the method and device	5414006	•
Quantum repeater, and system and method for generating extended entanglement	5414007	•
Information processing device, method, program, and recording media	5424306	•
Spoken language estimating device, method, and program	5544575	•
LSI arithmetic device and failure detection method for the same	5582472	
Measurement device, measurement system, and measurement method	5593062	
Information retrieval display device, method, and information retrieval display program	5599068	
Information retrieval display device, method, and information retrieval display program	5608950	
Information search display device, method, and information search display program	5608951	
Information providing device, method, and program	5614655	•
Control server, control method, and control program	5682932	•
Doppler radar system, Doppler radar transmission device, and method for optimizing transmission wave	5704695	
Image collation device, image collation method, and computer program	5713398	
Speed/distance detection system, speed/distance detection device, and speed/distance detection method	5739822	
Information processing device, schedule determining method, and computer program	5733722	
Search tree drawing device and search tree drawing method and program	5754676	•
Encoding device, method, program, and recording media	5789816	•
Word reordering device, translation device, translation model learning device, method, and program	5800206	•
Acoustic signal analysis device, method, and program	5807914	•
Data delivery system and data delivery device and method	5818262	•
Distributed data management system and device, method, and program	5818263	

List of registered trademarks

NII 4811291 Net Commons 4832775 図形+NET 4934163 NAREGI 4952143 トップエスイー 4943324 スマーティブ 4976131 WebELS 4980388 Net Commons 5182361

Trademark mode	Registration no.
n c net commons	5152641
Commons Partners	5208443
neXt commons	5191260
researchmap	5261160
GRACE+picture	5275386
Picture (Grace)	5261216
Picture (Grace/NPO)	5279082
edubase	5296963

Trademark mode	Registration no.
学認/GAKUNIN	5341899
NetCommons Ready	5369242
遷画	5490233
Picture (パレット)	5498318
Picture (学認/GakuNin)	5498319
情報犬	5538785
Picture (情報犬)	5538784

	(as of March 2016)
Trademark mode	Registration no.
Picture (サイニィ/CiNii)	5580217
Picture (ミカエル)	5600802
meQuanics	5622078
Picture (GeoNLP)	5645544
SIGVerse	5649553
PrivacyVisor	5653596
WillingRing	5789533

*SIGVerse (International Registration No. 1203063) and PrivacyVisor (International Registration No. 1208262) are also registered trademarks in Europe, the United States, and China.

International Exchange (Contributing to Internationalization of Informatics)

Overview

NII established its Global Liaison Office (GLO) in order to actively promote international exchange activities with prominent overseas institutes. The GLO concludes International Exchange Agreements (MOU) and implements a variety of measures to promote the exchange of researchers and students, including the NII International Internship Program and MOU Grants/Non-MOU Grants.

Research Exchange with Universities and Institutions (FY2018

	(1201)				
	NII International Internship Program	122 students from 20 countries			
	MOU Grants/Non-MOU Grants	13 people to 6 countries			
	moo drants/Non moo drants	38 people from 14 countries			

Acceptance of Foreign Researchers

(as of April 2016)

	Program	No. of researchers
	Postdoctoral Fellowships for Foreign Researchers	1
Japan Society for the Promotion of Science (JSPS)	Postdoctoral Fellowships for Foreign Researchers (Short-term; for researchers from Western countries)	3
	Invitation Fellowship Program for Research in Japan	1
Other researchers (visiting researchers and full-time visiting professors)		14

Country	Organization
	Department of Automation, School of Information Science and Technology, Tsinghua University
	Institute of Computational Mathematics and Scientific/Engineering Computing, Academy of Mathematics and System Sciences, Chinese Academy of Sciences
People's	Tongji University
Republic of	School of Electronics Engineering and Computer Science, Peking University
China	Hong Kong University of Science and Technology (HKUST)
	The School of Electronic, Information and Electrical Engineering, Shanghai Jiao Tong University
	University of Science and Technology of China
Taiwan	College of Electrical Engineering and Computer Science, National Taiwan University
Kingdom of	Chulalongkom University
Thailand	Asian Institute of Technology
	Kasetsart University
	International Research Center MICA, Hanoi University of Technology
Socialist	Hanoi University of Science and Technology
Republic of	Vietnam National University of Ho Chi Minh City
Vietnam	Vietnam National University, Ho Chi Minh City, University of Science
	Vietnam National University, Hanoi, University of Engineering and Technology
People's Republic of Bangladesh	University of Dhaka
r ookto a richantic ni nariAtanggii	"Department of Computer Science and Engineering, Seoul National University"
Republic of Korea	Korea Education & Research Information Service
	School of Computing, National University of Singapore
Republic of Singapore	Institute for Infocomm Research
	The Australia-Japan Research Centre, The Australian National University
Australia	National ICT Australia Limited (NICTA)
Australia	The Faculty of Engineering, Physical Sciences and Architecture, The University of Queensland
	Faculty of Engineering and Information Technologies, The University of Sydney
	Department of Computing & Information Systems, Melbourne School of Engineering, The University of Melbourne
	Department of Computer and Information Science, University of Michigan—Dearborn
	College of Engineering, University of Washington, Seattle
	Department of Computer Science, University of Maryland
	New Jersey Institute of Technology
United States of America	International Computer Science Institute
	Reischauer Institute of Japanese Studies, Harvard University
	University of Southern California
	North American Coordinating Committee on Japanese Library Resources
	Institute for Scientific Information, Inc.
	New Venture Fund (NVF)
	Faculty of Mathematics, University of Waterloo
	University of Alberta
Canada	School of Computer Science, McGill University
	Simon Fraser University (SFU)
	Polytechnique Montreal
Argentina	Faculty of Exact and Natural Sciences, University of Buenos Aires
Ireland	University of Limerick (LERO)
	Computer Laboratory Nantes Atlantique, University of Nantes
	National Institute for Research in Computer Science and Control (INRIA)
	Grenoble Institute of Technology (INPG)
	Joseph Fourier University (UJF)
French Republic	"Laboratory of Computer Sciences, Paris 6 (LIP6), Pierre and Marie Curie University"
	National Polytechnic Institute of Toulouse (INPT)
	National Center for Scientific Research (CNRS)
	Paul Sabatier University (UPS)

Country	Organization	
	Claude Bernard University Lyon 1	•
	The University of Paris-Sud	
	The Electronics and Information Technology Laboratory (LETI)	•
French Republic	University of Nice Sophia Antipolis	
	The Centre de Recherche en Informatique de Lens (CRIL)	•
	The University Blaise Pascal of Clermont-Ferrand (School of Engineering ISIMA, Faculty of Sciences, LIMOS Laboratory)	•
	The French National Audiovisual Institute (INA)	•
	Department of Computer Science, Faculty of Engineering Science, University College London	
	Faculty of Mathematics and Computing, Open University	
	University of Bristol	•
United Kingdom	University of Bath	•
of Great Britain	Department of Computing, Imperial College London	•
and	The Computing Laboratory, University of Oxford	•
Northern Ireland	School of Computer Science & Electronic Engineering, University of Essex	•
	School of Informatics, The University of Edinburgh	•
	Newcastle University	•
	Faculty of Sciences, School of Computing, The University of Kent	•
	Department of Theoretical and Applied Linguistics, University of Cambridge	•
	Faculty of Applied Informatics, University of Augsburg	•
	German Research Center for Artificial Intelligence (DFKI)	•
	Faculty of Applied Science, University of Freiburg	•
	Faculty of Mathematics, Computer Science and Natural Sciences, RWTH Aachen University	•
	German Academic Exchange Service (DAAD)	•
	Saarland University	•
Federal Republic	Faculty of Mathematics, Informatics and Statistics, University of Munich	•
of Germany	Technical University Berlin	•
	Fraunhofer Institute for Open Communication Systems (FOKUS)	•
	Braunschweig University of Technology	•
	The Technische Universitat Munchen (TUM)	•
	Goora-August-Universitat Gottimgen	•
	Information Science Group, Department of Computer and Information Science, University of Konstanz	•
	University Library Center of North Rhine-Westphalia (HBZ)	
	German National Library of Science and Technology	0
	German National Library of Medicine	0
Kingdom of the Netherla	ands Faculty of Civil Engineering and Geosciences, Delft University of Technology	•
Republic of Austria	Vienna University of Technology	•
	Department of Informatics, Torino University	•
Republic of Italy	Electronics, Information and Bioengineering, Politecnico di Milano	•
	University of Ferrara	•
Switzerland	Institute of Electrical Engineering, Ecole Polytechnique Federale de Lausanne	•
	The Idiap Research Institute (Idiap)	•
Finland	The Aalto University, School of Electrical Engineering	•
Czech Republic	Czech Technical University, Prague	•
	Polytechnic University of Valencia (UPV)	•
Spain	Technical University of Madrid	•
	Polytechnic University of Catalonia (UPC)	•
Portuguese	Institute for Systems and Computer Engineering: Research and Development (INESC-ID), Lisbon	•
Republic	INESC Technology and Science (INESC TEC)	•
Arab Republic of Egypt	Egypt-Japan University of Science and Technology	•
Kingdom of Morocco	Rabat International University	•
EU	Delivery of Advanced Network Technology to Europe (DANTE)	0

Research cooperation: 94 organizations
 Development and operational cooperation: 8 organizations

NII Shonan Meeting

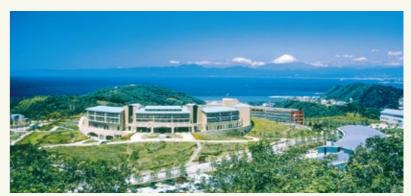
http://www.nii.ac.jp/shonan/

In February 2011, NII launched the NII Shonan Meetings, the first Dagstuhl-style seminars* held in Asia. The purpose of the NII Shonan Meetings is to attack various challenges in the field of informatics by assembling the very best researchers from around the world to engage in intensive discussions in a retreat-style atmosphere. The meeting is hosted in collaboration with Kanagawa Prefecture based on a partnership agreement. The meeting's venue, the Shonan Village Center, offers an environment in which participants can focus on research activities in a setting that provides both spectacular natural beauty and easy access from Narita Airport. Seventy-three seminars have been held to date, and August 2014 saw the launch of the NII Shonan School, intended primarily for top-level students and young researchers in the field of informatics.

*Dagstuhl Seminar: A key seminar series in the field of informatics, held roughly every week in Dagstuhl, Germany. The series is based on a structure whereby participants live in close quarters for one week for intensive discussions on various topics under a specified theme for each seminar.

■ Support System

The NII Shonan Meeting Administrative Office and Shonan Village Center staff handle various activities on behalf of the seminar management team, including dispatching invitations, providing information on lodging and accommodations, and preparing venues on meeting days. The program also includes various activities intended to promote interaction between participants, including hikes in nearby natural areas and historical walking tours of Kamakura.







The Recent Topics of the NII Shonan Meetings

- 1. Dimensionality and Scalability II: Hands-On Intrinsic Dimensionality, June 29 July 2, 2015, 26participants
- 2. Synchronous Machine Translation, August 3 6, 2015, 15participants
- 3. Engineering Adaptive Software Systems (EASSy), September 7 10, 2015, 23participants
- 4. Challenges for Real-Time Human Activity Recognition, September 14 17, 2015, 22participants
- 5. Semantics and Verification of Object-Oriented Languages, September 21 25, 2015, 20participants
- 6. Validated Numerics Meets Reachability Analysis for CPS Design, September 28 October 1, 2015, 29participants
- 7. Mobile App Store Analytics, October 19 22, 2015, 28participants
- 8. Logic and Verification Methods in Security and Privacy, October 26 29, 2015, 32participants
- 9. Big Data Visual Analytics, November 8 11, 2015, 21 participants
- 10. Putting Heterogeneous High-Performance Computing at the Fingertips of Domain Experts, November 17 20, 2015, 26participants
- 11. Analytics on Complex Networks: Scalable Solutions for Empirical Questions, February 8 11, 2016, 19participants
- 12. Immersive Analytics: A New Multidisciplinary Initiative to Explore Future Interaction Technologies for Data Analytics, February 15 18, 2016, 25participants
- 13. Mining & Modeling Unstructured Data in Software Challenges for the Future, March 7 10, 2016, 27participants
- 14. Higher-Order Model Checking, March 14 17, 2016, 28participants
- 15. Architecture-Centric Modeling, Analysis, and Verification of Cyber-Physical Systems, March 21 24, 2016, 22participants
- 16. Big Data: Challenges and Opportunities for Disaster Recovery, March 28 31, 2016, 19participants

28 I National Institute of Informatics National Institute of Informatics | 29

International Exchange (Contributing to Internationalization of Informatics)

■NII Shonan Meeting Memorial Lectures

In partnership with Kanagawa Prefecture and the Shonan Village Program Promotion Committee, and with assistance from Village Shonan, Inc., we have organized NII Shonan Meeting Memorial Lectures on five occasions to date as part of our NII Shonan Meeting outreach activities. We invite researchers with links to NII Shonan Meetings or NII itself to serve as guest speakers, delivering public lectures on the very latest research in the field of informatics.



NII Shonan Meeting Memorial Lectures

Academic procedure Administrative procedure Administrative procedure Administrative procedure Administrative procedure Request for review result Organizing Committee General and academic lason Shonan Village Arrangement of accommodation registration Request for accommodation registration

Call for proposals

We welcome proposals throughout the year. There are three annual deadlines for submission: June 15, September 15, and December 15. Individuals submitting proposals will be notified as to whether their proposal has been accepted following a review by the Academic Committee.

Contact: The Office of NII Shonan Meetings shonan@nii.ac.jp

Agreement with German Academic Exchange Service (DAAD)

http://glo.nii.ac.jp/

The special agreement between NII and German Academic Exchange Service (DAAD) allowing German postdoctoral researchers to conduct research at NII under the guidance of NII faculty has been renewed until 2017. Under the framework of the agreement, German postdoctoral researchers are able to stay at NII with support from DAAD for a minimum of three months (six months is recommended), up to a maximum of two years. During this time, they will carry out an independent project that has relevance to their mentor at NII. Postdoctoral researchers are also able to take in master's and doctoral students and researchers to help them execute their project. NII is an inter-university research institute, and postdoctoral researchers can visit NII's partner universities and research institutions in Japan to strengthen their network in the country.

Japanese-French Laboratory for Informatics (JFLI)

multimedia, and (5) quantum computing.

The Japanese-French Laboratory for Informatics (JFLI) was created in 2009 as a hub for collaboration on informatics research between Japan and France, comprising five organizations: the French National Center for Scientific Research (CNRS), Pierre and Marie Curie University (UPMC, Paris 6), The University of Tokyo (Graduate School of Information Science and Technology), NII, and Keio University. The laboratory became an International Joint Unit (UMI) operated by CNRS in 2012, and in October 2012, INRIA and University of Paris-Sud joined as new partners on the French side.

The partners' main research topics are (1) next-generation networks, (2) grid computing and high performance computing, (3) software, programming models, and formal methods, (4) virtual reality and

Signing ceremony for the agreement establishing UMI-JFLI (December 2011)

Education Services for Developing Top-Level IT Personnel

TopSE

The GRACE Center offers the TopSE education program for working adults in order to develop world-class IT personnel capable of contributing to the field with specialized IT knowledge, the ability to put their knowledge into practice, and the foresight to deal with a changing society. Built on the idea of "intellectual manufacturing education based on science", TopSE is a practical education program that aims to cultivate software engineers with highly advanced development skills. Designed primarily for young corporate engineers and researchers, the program provides hands-on education centered on practical exercises.



To provide practical education and widely disseminate technology, the Center offers (1) a lecture/seminar environment suitable for group exercises, (2) the use of the Cloud for education, and (3) a service for distributing lectures.

TopSE completion award

Lecture/seminar environment suitable for group exercises

The lecture room is equipped with numerous projectors and a whiteboard wall for group exercises. There is also a terminal pre-installed with the software required for the lecture, as well as a server for recording and distributing lectures. Students can watch lecture videos at home or at work, and can remotely access the same terminal environment as the lecture room.



edubase Space classroom, equipped with the latest IT

Use of the Cloud for education

NII's Cloud can be used in lectures and seminars. It is built entirely using open source software, and students can also study the cloud infrastructure itself.



Cloud server room

Distribution service of lectures

TopSE lectures and software technology-related seminars are distributed using the "devshinchi.jp" website. The site synchronizes the lecturer's video and slides, and makes TopSE lectures available for anyone to watch for free.



"devshinchi.jp" website (http://devshinchi.jp)

NII Library (Contributing to Informatics Research and Education)

The NII Library holds online journals, books, and periodicals on informatics as part of its role as an informatics research/education center. The library collaborates with the nearby Meiji University Library to provide access to academic materials for students of the Graduate University for Advanced Studies.

Number of books/journal titles

(as of the end of March 2016)

Document type	Book	Bound journal	Journal (title)
Japanese	15,947	9,935	192
Foreign	13,377	8,305	13
Total	29,324	18,240	205



Major online journals and databases

Service	Publisher
ACM Digital Library	Association for Computing Machinery
APS online	American Physical Society
IEL	IEEE, IEE
MathSciNet	American Mathematical Society
Springer Link	Springer
Science Direct	Elsevier B.V.
Wiley Online Library	John Wiley & Sons.
IEICE	The Institute of Electronics, Information and Communication Engineers
IPSJ Digital Library	Information Processing Society of Japan



Facilities and equipment

Service	Reading room	Stack room
Area	140	271
Seats	8	3
Catalog PCs	2	
	Automatic lending and returning machine	
Other equipment	Microreader printer	
	Copier	



Subscribed journals

Operations

Establishing Academic Information Infrastructure

The National Institute of Informatics (NII) establishes academic information infrastructure in collaboration with universities and other institutions. This research and education infrastructure allows universities and research institutes nationwide to share the vast amounts of computing resources (computer equipmentand software infrastructure), academic information (databases and other content), personnel, research groups, and so on, that they possess with the entire academic community on a high-speed network. NII is focusing its efforts on the following two areas in particular.

- 1. Establishing the Science Information NETwork (SINET) and authentication infrastructure, and providing a cloud computing support environment, in collaboration with university IT centers and research institutes.
- 2. Establishing next-generation academic content infrastructure essential for research and education, in collaboration with university libraries and academic societies.

NII works closely with universities and research institutions to strongly promote each operation together with the academic community.

SINET5 (Science Information NETwork): Available at High Speed and Low Latency Throughout Japan

100Gbps, full-mesh network opens up new possibilities

The Science Information NETwork (SINET) is an information communication network built and operated by NII as academic information infrastructure for universities and research institutions throughout Japan. The network has nodes (network connection points) nationwide, and it provides universities and research institutions with an advanced network that supports the formation of communities among the many people involved in education/research and encourages the circulation of a wide range of academic information.

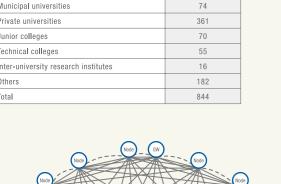
SINET is also interconnected with many overseas research networks, such as Internet2 in the U.S. and GÉANT in Europe, to facilitate the circulation of research information across borders, which is essential in advanced international research projects.

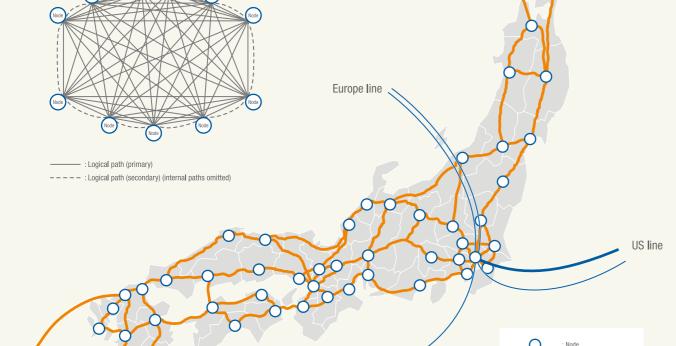
The previous SINET4 was upgraded to SINET5, and full-scale operation of the upgraded network began in April 2016.

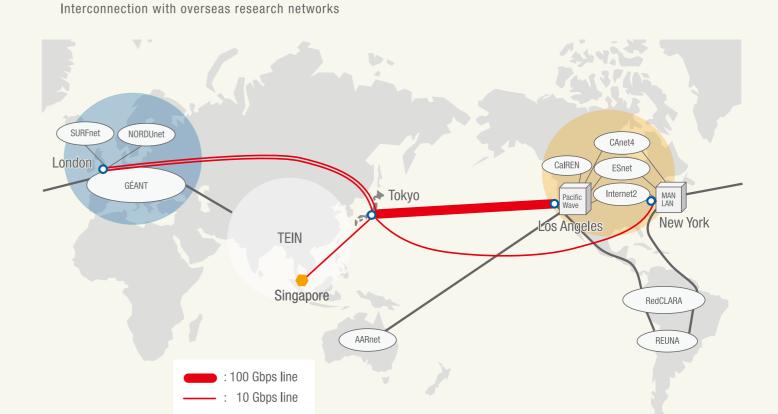
SINETS connects all areas of Japan in an organic way at 100Gbps, and provides more than 800 universities and other institutions with high-level academic information infrastructure, including cloud computing, security, and academic content.

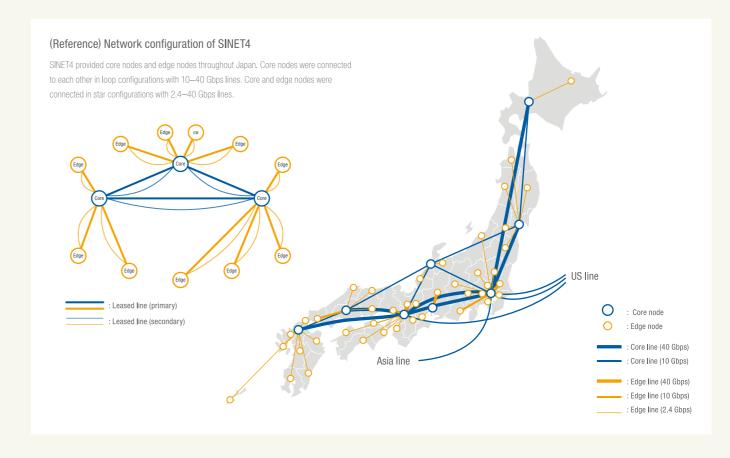
Numbers of institutions participating in SINET (as of March 31, 2016)

86
74
361
70
55
16
182
844









National Institute of Informatics | 35 34 | National Institute of Informatics

International line (100 Gbps)

: International line (10 Gbps)

Operations

SINET5: Features and Services

Features of SINET5

① Maximum communication performance

SINET5 utilizes 100 Gbps technology throughout Japan. It is an ultrahigh-speed network capable of supporting Japan's academic pursuits and accommodating the nation's increasingly sophisticated supercomputers and large experimental equipment.

2 Full international connectivity

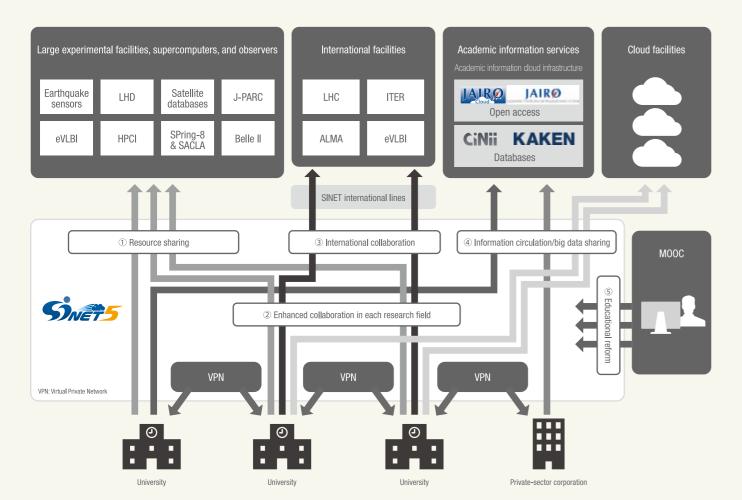
To accommodate Japan's increasing telecommunication needs and to enable the country to maintain its prominence in international joint research projects, SINET5 not only enhances connections with the U.S. and Asia but newly establishes a high-speed international connection with Europe.

3 Cloud infrastructure provision

With the aim of addressing the urgent issue of offering a cloud usage environment, SINET5 provides and implements the use/application of a cloud infrastructure that takes full advantage of the characteristics of the ultrahigh-speed network.

4 Secure, advanced research environment

To coincide with the provision of cloud infrastructure, security and authentication are enhanced for safe and convenient use of the cloud on SINET. SINET5 also establishes, in conjunction with advanced IT R&D, infrastructure for retrieving and utilizing academic information, which has traditionally been provided by universities and other institutions and which will rapidly increase and diversify in the future.



SINET5 Services

SINET5 provides ultrahigh-speed interfaces, such as 100GE and 40GE. Along with expanding the network service features, more user-focused services such as virtual university LAN and L2 on-demand are being added to the service menu to allow secure, advanced research environments to be built in universities and research institutions.

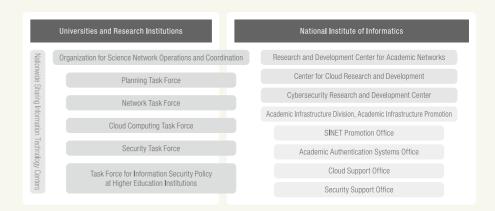
Network services

*Integrated with L2 on-demand due to upgrade to 100 Gbps

Service menu		SINET5	SINET4
	"Internet Access (IPv4 & IPv6)	0	0
	Option QoS	0	0
	Option Full Routes	0	0
	Option Multihoming	0	0
L3 service	Option IPv6 TunneI"	\triangle	0
	IP Multicast (IPv4 & IPv6)	0	0
	Option QoS	0	0
	L3VPN	0	0
	Option QoS	0	0
	Option VXLAN Access New	Planned	×
	L2VPN VPLS	0	0
	Option QoS	0	0
L2 service	Option VXLAN New	Planned	×
	L2 On-Demand	0	Trial
	Virtual University LAN New	0	×
L1 service	L1 On -Demand	×*	0
LI SEIVICE	Lambda Leased Line New	0	×

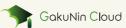
Organization for Science Network Operations and Coordination

The Science Information Network is operated by the Organization for Science Network Operations and Coordination, a joint organization between universities, research institutions, and NII. Three of NII's research and development centers and entities such as the IT centers of university and research institutions collaborate together under this organization to operate the network.



Operations

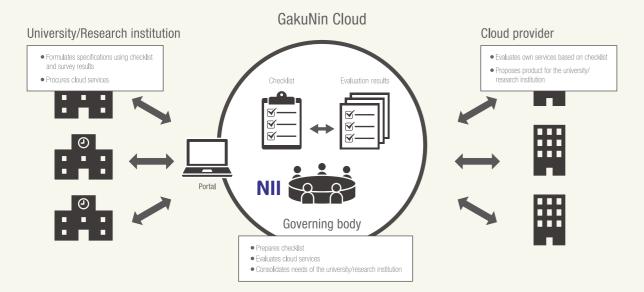
Supporting the Introduction of Cloud Computing at Universities and Research Institutions (GakuNin Cloud) GakuNin Cloud



GakuNin Cloud http://cloud.gakunin.ip/

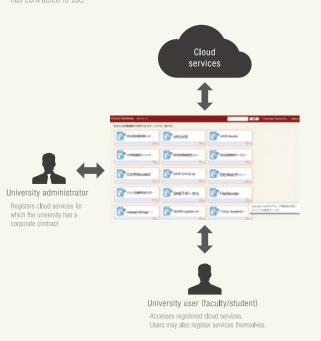
Many universities and research institutions have high expectations of cloud computing in terms of improving the efficiency and user-friendliness of systems operation. NII provides the support service GakuNin Cloud to make it easier for universities and research institutions to introduce and use services that suit their needs from among the many cloud services available.

GakuNin Cloud provides a checklist of items that must be confirmed when universities and research institutions introduce cloud computing, and NII verifies and publishes the evaluation results based on this checklist. Not only does this allow universities and research institutions to understand where they should focus attention when introducing cloud computing but it also makes it possible to compare multiple cloud services using the same benchmarks, thereby allowing universities and research institutions to introduce and use the services that are appropriate for their needs.



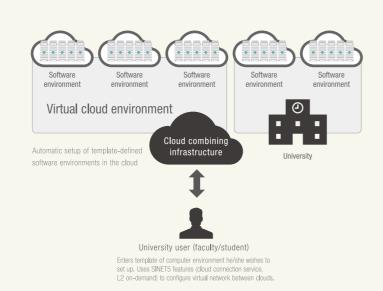
Cloud Gateway

NII provides Cloud Gateway, a portal for one-stop access to cloud services needed for research and education. Users at universities and research institutions simply log into Cloud Gateway for quick and easy access to the services that the university or research institution has contracted to use.



Provision of Cloud Combining Infrastructure

NII is preparing to provide a feature for building cloud environments connected using the safe, high-speed network that SINET5 provides. Users at universities and research institutions will be able to use this feature to easily install and configure software in the cloud. They will also be able to construct multiple cloud environments connected to SINET5 and Intercloud environments consisting of the university's/research institution's computers on demand, and make use of them in research, education, and IT systems operation.



Establishment of Authentication Infrastructure (Academic Access Management Federation in Japan "GakuNin") GakuNin



Academic Access Management Federation in Japan "GakuNin"

https://www.gakunin.jp

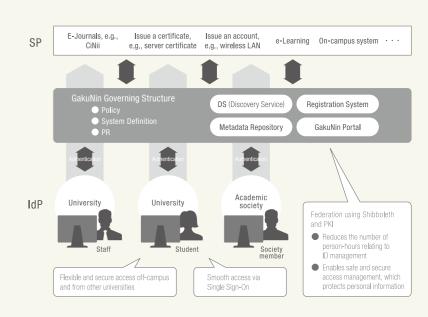
Aiming to improve usability and to cut the operation cost of internal systems, many universities are now switching to cloud services. The Academic Access Management Federation "GakuNin" is a structure that allows the use of a university's authentication infrastructure not only for internal services but also for other collaborating universities and commercial services including the cloud, thus facilitating the safe and secure use of academic services on the Internet by identifying individuals and organizations. With Single Sign-On, users can seamlessly and automatically log into multiple internal and external services with a simple logon procedure. For universities, building an authentication infrastructure compatible with GakuNin raises the baseline of security measures and reduces the cost of ID management.

Participants (as of the end of March 2016 User organization (IdP: Identity Provider) 181 User organization (IdP: Identity Provider) 144

(Features)

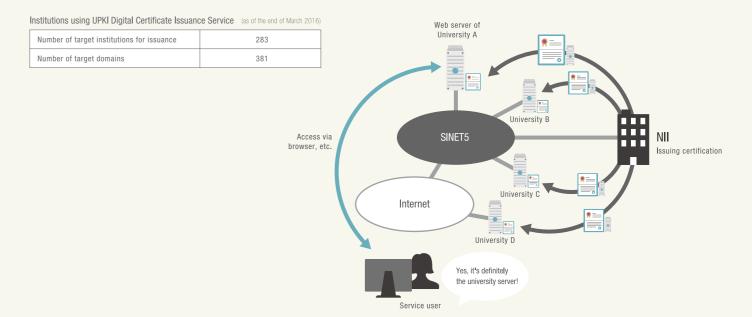
- Only one ID/password to remember
- Single Sign-On (SSO)
- Accessible from anywhere in the world (remote access)
- Need no other software than a web browser
- Supports client certificate authentication and multi-factor authentication (integrated management of security level)

GakuNin strives to maintain reliability by annual assessment of the IdPs operated by universities and institutions. GakuNin also provides LoA1 (Level of Assurance 1) certification services specified in the trust framework of the Federal Identity, Credential, and Access Management (FICAM) in the United States. Universities that have been certified for this high level of authentication infrastructure are able to use the US government services, including the databases of the National Institutes of Health (NIH)



Digital certificates: UPKI Digital Certificate Issuance Service

NII started the UPKI Digital Certificate Issuance Service, a business issuing digital certificates aimed at universities and research institutions, in January 2015. In addition to the server certificates issued before, NII now also issues client certificates and code signing certificates. As before, the server certificates issued by NII are highly secure and conform to the unified international Web Trust for CA (WTCA) standard. The use of server certificates improves web security by proving that the provider of a web server (domain name and organization name) is legitimate and, for example, making them easy to distinguish from phishing websites. NII also issues client certificates to members of institutions for authentication and signing emails, and these can be used for purposes such as multi-factor authentication and preventing identity theft. Additionally, signing software using code signing certificates confirms the existence of a developer and guarantees that the software is not fake. This gives users peace of mind when using the software. By providing these certificates at a low price and having them put into use, the UPKI Digital Certificate Issuance Service will improve the security of universities and research institutions across the board.



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Publishing and Communicating Academic Information (CiNii)



NII accumulates and structures the education and research results produced at universities and research institutions, and provides access through a user-friendly interface.

CiNii

This is a database service that can be exhaustively searched for academic information such as articles, books, journals, and doctoral dissertations. NII is expanding the pool of data available and improving text hit rates by linking various database services.

In addition, NII is promoting intersystem links with university libraries and other facilities by providing search APIs (application program interfaces) such as OpenSearch.

The service also offers a dedicated smartphone display so that the database can be searched with ease using a smartphone.

CiNii Articles: Searching for Japanese research papers

Contains more than 19 million information items on Japanese academic articles including academic society publications, research bulletins, and the Japanese Periodicals Index of the National Diet Library. Most article searches and full texts are available to anyone free of charge (some require payment).

■NII Electronic Library Service (NII-ELS)

Offering texts in academic society publications and research bulletins in electronic form through CiNii Articles.

Collection status

(as of the end of March 2016)

	NII-ELS			
No. of article information items	No. of full-text articles	No. of periodicals	No. of full-text a	articles
19.27 million	4.16 million	4,933 (with full text)	Academic societies	440
19.27 1111111011	4.10 1111111011		Universities, etc.	829





CiNii Books: Searching for books in university libraries http://ci.nii.ac.jp/books/

This service allows searching of information on books and journals held by university libraries in Japan. Contains more than approximately 11 million bibliographic records of books and authors held by university libraries nationwide and accumulated through the Catalog Information Service (NACSIS-CAT) operated by NII. Available to anyone free of charge.

Collection status

(as of the end of March 2016)

No. of bibliographic information	No. of holding information	134.35 million
11.2 million	134.35 million	1,274





CiNii Dissertations: Searching for Japanese doctoral dissertations http://ci.nii.ac.jp/d/

Allows comprehensive, centralized searching of Japanese doctoral dissertations. In addition to dissertation texts digitized by the National Diet Library, it is also possible to search and view dissertation texts published in the institutional repositories of universities and research institutes

Available to anyone free of charge.

Collection status

(as of the end of March 2016)

Total number of doctoral dissertations	Number of full texts
580,000	130,000





Support for Construction and Linkage of Institutional Repositories (JAIRO Cloud)

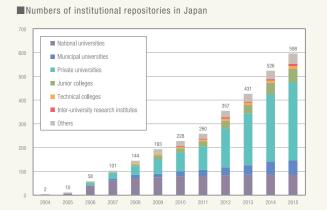
To contribute to the establishment of next-generation academic content platforms, NII supports the construction and linkage of institutional repositories to communicate university education/research results and promotes open access. NII has so far supported content enrichment, system linkage, and community formation at academic institutions in Japan, and institutional repositories have been built and are in operation at nearly 600 institutions.

JAIRO Cloud (shared repository service)

For institutions that find it difficult to independently build and operate their own repositories, NII provides a shared repository system environment in the form of a cloud service based on our institutional repository software WEKO (http://weko.at.nii.ac.jp/).

Usage (as of the end of March 2016

Number of institutions using the service 362



Crossover Searches of Academic Information Accumulated in Institutional Repositories in Japan

JAIRO (Institutional Repositories Portal)

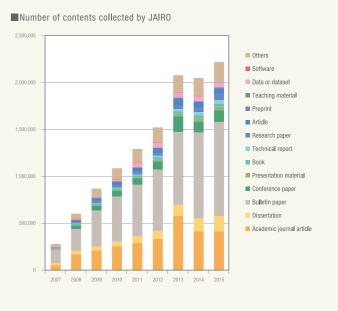
This portal enables crossover searches of education/research results of university and research institution (journal articles, dissertations, research bulletins, research papers, teaching materials, etc.) accumulated in institutional repositories in Japan. Users are able to access full texts available in each institutional repository, as well as linking to CiNii.

Collection status

(as of the end of March 2016)

Number of institutional repositories Number of contents 2.23 million





Education and Training Programs

http://www.nij.ac.in/hrd/

NII provides the following range of education and training programs to develop human resources at universities supporting Japan's academic information infrastructure.

- Advanced training (for staff responsible for cataloging and staff responsible for institutional repositories)
- Comprehensive training (comprehensive themes involving academic information infrastructure for developing core human resources)

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Database of Grants-in-Aid for Scientific Research

KAKEN 科学研究的 発成事態データベース

KAKEN (Database of Grants-in-Aid for Scientific Research)

This database allows users to browse adopted projects and research results (reports, summaries, etc.) funded by Grants-in-Aid for Scientific Research from the Ministry of Education, Culture, Sports, Science and Technology and the Japan Society for the Promotion of Science. It provides access to the latest research information in Japan in a wide variety of fields. The system developed by KAKEN is also used in the JST Project Database (https://projectdb.jst.go.jp), which contains research projects funded by the Japan Science and Technology Agency (JST).

Collection status (as of the end of March 2016)

No. of adopted projects

790,000

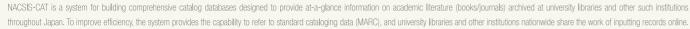


Catalog Information Service

http://www.nii.ac.jp/CAT-ILL/

The Catalog Information Service consists of the Cataloging System (NACSIS-CAT) and the Interlibrary Loan System (NACSIS-ILL).

Cataloging System (NACSIS-CAT)







Interlibrary Loan System (NACSIS-ILL)

NACSIS-ILL makes use of the comprehensive catalog databases constructed using NACSIS-CAT to support the exchange of books and journal articles between libraries and so facilitate the provision of academic literature to researchers at universities and other institutions. As well as supporting interlibrary loan services with university libraries overseas by linking to systems such as OCLC in the US and KERIS in South Korea, NACSIS-ILL promotes the efficiency of library work through an offsetting service for ILL document copying and other charges.

Electronic Resources Data Sharing Service

ERDB-JP (Electronic Resources Database-JAPAN)

https://erdb-jp.nii.ac.jp

ERDB-JP is a database created and operated collaboratively by universities and NII containing management data for electronic resources, such as e-journals and e-books, published in Japan.

The database is operated by NII and the "Electronic Resources Data Sharing Task Force," made up of staff responsible for managing e-resources at each university. The accumulated data are available for anyone to search, browse, and export, free of charge. By submitting an application, universities can become "partners", which allows them to modify or delete data in addition to registering new data.

Institutions can use exported data to create lists of titles of e-resources belonging not only to their own institution but to other institutions as well, and can import these data into library systems and use them in OPAC.

Participation

(as of the end of March 2016)

Partner A (Institution that can modify data, including data issued by other institutions)	"Partner B (Institution that can modify data that it has issued)
30 institutions	7 institutions

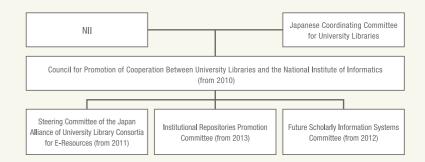


Collaboration with University Libraries

httn://www.nii.ac.in/content/cnc/

Council for Promotion of Cooperation Between University Libraries and the National Institute of Informatics

NII entered into an agreement with the Japanese Coordinating Committee for University Libraries in order to promote projects in cooperation with university libraries. Based on this agreement, NII established the Council for Promotion of Cooperation Between University Libraries and the National Institute of Informatics. This Council and the three committees established beneath it (Steering Committee of the Japan Alliance of University Library Consortia for E-Resources; Future Scholarly Information Systems Committee; Institutional Repositories Promotion Committee) promote collaborative projects concerning electronic materials and institutional repositories.



Japan Alliance of University Library Consortia for E-Resources

http://www.nii.ac.in/content/justice

JUSTICE : Japan Alliance of University Library Consortia for E-Resources

Aiming to implement a range of activities to provide stable and continuous access to academic information, including e-journals, JUSTICE is one of the world's largest consortia with over 500 participating national, public, and private university libraries. To support the activities of JUSTICE, NII has established the Library Liaison Office, which functions as the JUSTICE secretariat and is staffed from university libraries.



Electronic Archives

http://reo.nii.ac.jp/

NII carries out the following activities to store and provide electronic academic information on a permanent basis.

NII-REO (NII Electronic Resource Archives)

Back issues of international electronic journals (approx. 3.9 million records) and an electronic collection of humanities and social science material (approx. 310,000 items) are stored on NII servers and provided to universities in Japan. Electronic resources archived in NII-REO are maintained in collaboration with JUSTICE.

Archived contents

(as of the end of March 2016)

OJA e-journal archive	Archived Years	No. of items
Springer Online Journal Archive	1832-1999	Titles: Approx. 1,100 No. of records: Approx. 2.2 million
Springer Lecture Note in Computer Science	1973-1999	Titles: 1,501
Oxford Journal Archive Collection	1849-2003	Titles: 202 No. of records: Approx. 910,000
Kluwer Online	1997-2005	Titles: Approx. 800 No. of records: Approx. 350,000
IEEE Computer Society Digital Library ⊠CSDL⊠	1988-2011	Titles: 30 No. of records: Approx. 350,000

International Scholarly Communication Initiative

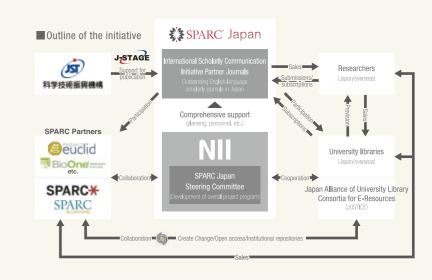
http://www.nii.ac.jp/sparc/

SPARC Japan

SPARC Japan was launched in FY2003 based on cooperation with academic societies and university libraries, and in collaboration with SPARC (USA) and SPARC Europe. The aim is to promote further dissemination of the results of Japanese research, as well as to promote the digitization and international distribution of academic journals published by Japanese academic societies and to contribute to improvements in the international infrastructure for the distribution of academic information.

The SPARC Japan Seminars provide an opportunity for interaction between stakeholders in academic information, and the latest topics in information distribution are discussed.

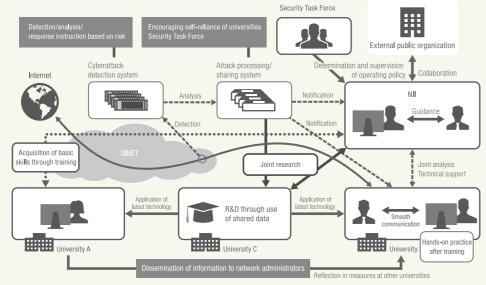
The basic plan of action in the fifth term (FY2016–2018) is to "implement open access under a framework of international collaboration, to promote the distribution of academic information, and to strengthen the ability to disseminate information." As well as promoting collaboration with university libraries and researchers, the project aims to understand the issues around open access and to study the measures that universities should adopt.



Operations

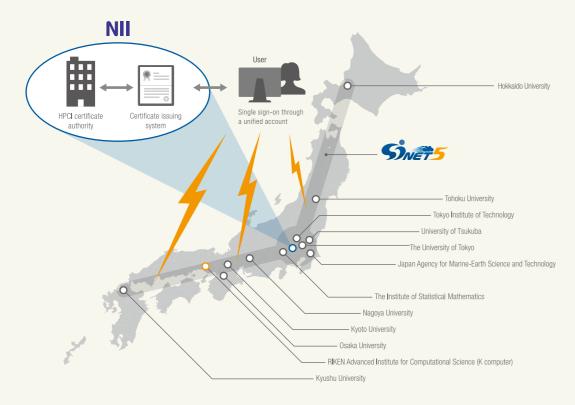
Construction of Cybersecurity Infrastructure Based on Inter-University Collaboration

NII established the Cybersecurity Research and Development Center in FY2016 and supports the construction of systems that allow national university corporations to respond quickly to cyberattacks. By training hybrid cybersecurity personnel and applying research results regarding attack detection and defense capability based on inter-university cooperation, NII is working to improve the quality of cybersecurity infrastructure at national university corporations and is also preparing for the provision of environments promoting cybersecurity research and secure and reliable educational/research environments in all academic research fields.



Operation of HPCI Authentication Infrastructure and Network Infrastructure

High Performance Computing Infrastructure (HPCI) implements a computing environment that meets the needs of various users, including the industrial sector, by linking the K computer in Kobe and other supercomputers installed at universities and research institutes in Japan. HPCI has a single sign-on authentication mechanism that allows users to gain access to any computing resources by using a common login account to improve usability. NII is constructing and operating the authentication system, including the certificate authority and a certificate issuing system, which are the core of this single sign-on authentication mechanism, in collaboration with the K computer and universities. A high-security mechanism based on electronic certificates is adopted to ensure security and reliability when using HPCI. These features allow users to use HPCI in a reliable, secure, and convenient way (single sign-on) after acquiring an HPCI account just once. Linking remote supercomputers and sharing large-scale experimental data and computation results require high-speed network infrastructure, and SINET5 fulfils this role.



Education

Graduate Education

The National Institute of Informatics makes use of its unique, comprehensive informatics research structure and its practical environments in which academic information services and research and development are combined to provide graduate education. Aiming to develop researchers equipped with a broad outlook, a high level of expertise, leadership abilities, and real problem-solving abilities, the National Institute of Informatics provides education to graduate students in three ways: (1) participation in The Graduate University for Advanced Studies (SOKENDAI), (2) cooperation with other graduate schools, and (3) special collaboration with research students.

http://www.nii.ac.jp/graduate/

Education

The Graduate University for Advanced Studies (SOKENDAI), Department of Informatics

Establishment of graduate school

The National Institute of Informatics joined the Graduate University for Advanced Studies (SOKENDAI) and opened the Department of Informatics (three-year doctoral program) in April 2002, seeing its first students graduate in March 2005. A five-year doctoral program was launched in FY2006. The first graduate university in Japan, SOKENDAI was founded with the aim of promoting original, international research that goes beyond the boundaries of conventional academic disciplines, and opening up advanced scientific fields that create new streams of science.

Content and structure

The Department of Informatics aims to develop young IT researchers and engineers who will play key roles on an international level in the 21st century. Students are able to acquire a Ph.D. (Informatics) (or depending on the content, a Ph.D. (Science)). Education and research guidance is provided in the following six fields: (1) foundations of informatics, (2) information infrastructure science, (3) software science, (4) multimedia information science, (5) intelligent systems science, and (6) information environment science. The Department offers more than 70 subjects, including major subjects and common foundational subjects.

Characteristics

The Department of Informatics welcomes students from overseas and is a place of lively cross-cultural communication between students. There are also many mature students; in fact, they account for around 30% of all the department's students.



idance session for new students (April 2016)



Lesson



Degree medal ceremony (March 201

Greetings from Chair of Department

Zhenjiang Hu, Chair, Department of Informatics (Professor, Information Systems Architecture Science Research Division)

The Department of Informatics consists of six fields: Foundations of Informatics, Information Infrastructure Science, Software Science, Multimedia Information Science, Intelligent Systems Science, and Information Environment Science. These are new disciplines that are based on the traditional fields of computer science and information engineering, while covering a wide range of the social sciences, humanities, and life sciences. Our department carries out various phases of research and education: basic, applied, and practical. As well as training researchers, we aim to develop highly skilled professionals and leaders in the field of informatics. Instruction is tailored to individual student's ambitions, interests, and academic research plans through a system of personal guidance and a Ph.D. mentorship program by top-class researchers at the National Institute of Informatics. We employ a sub-advisor system whereby students can obtain advice from staff in different research fields, or with different areas of specialization within the same field of research, who can provide a variety of perspectives. In the five-year doctoral program, graduates can tackle specific topics thoroughly; while in the three-year doctoral program, master's graduates can concentrate on a topic that they were researching before entering the department. As well as being SOKENDAI students, students of the Department of Informatics are members of the National Institute of Informatics, and as such are able to study in an international collaborative environment, participate in various research projects, and gain experience as international researchers through exchange programs with overseas partner universities and research institutions. Roughly half of our Japanese student population are company employees who wish to systematically reorganize the job that they have been doing and learn about the latest technology. The fact that we have a high percentage of foreign students is also an important feature of our department. Many of the lectures ar



Message from a Current Student

Xing Wang

2015: Graduated from a master's course at the University of Science and Technology of China
2015: Enrolled in the three-year doctoral program, Department of Informatics, The Graduate University for Advanced Studies
Main supervisor: Associate Professor Junichi Yamagishi

Before coming to Japan, I gained a master's degree involving research on spoken language processing in China.

At the Department of Informatics, I am researching voice synthesis that makes computers speak like humans. Some of you might know about the voice synthesizer used by Professor Stephen Hawking and might use voice synthesis technology in your car navigation system, smartphone applications, and so on.

Recently, voice synthesis technology has become a bridge for human—machine communication and person-to-person communication. The end goal is to build machines and artificial intelligence with the same level of language ability as you or I. Humans' interest in intelligent machines is evidenced by the fact that intelligent machines have long appeared in science fiction. This interest is increasing, with AlphaGo recently beating a human player at the game of Go. However, building a machine that talks naturally like a human being is a difficult goal that remains unattained. The quality of synthetic speech has improved considerably, but it still sounds mechanical and does not fully express the rhythms or emotions that are essential in human conversation.

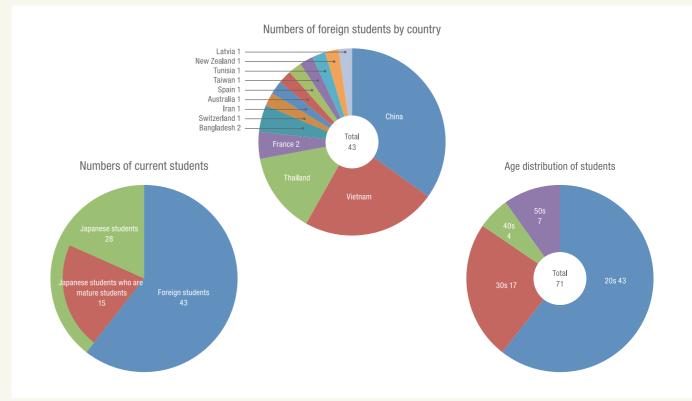
Even the most advanced voice synthesizers cannot represent the natural speech and linguistic diversity of human beings. I find research into this missing area of voice synthesis to be challenging and fascinating. I was delighted when I learned about how humans produce natural speech, and when I found out that it is feasible for computers to synthesize the same natural speech. I don't know all the answers, but that feeling of delight is the reason why I am doing research at the Department of Informatics, and I am sure I will continue researching throughout my career.



No. of students in Department of Informatics (as of April 2016) *Numbers inside brackets indicate foreign students

Five-year program	Three-year program	Total
30 (22)	41 (21)	71 (43)

Student data (as of April 2016)



Education

Curriculum

The Department of Informatics provides research instruction and guidance by top-class researchers within the advanced environment and international atmosphere of the National Institute of Informatics.

A broad range of academic fields are offered: from fundamental disciplines such as mathematics, to the basics of computer architecture and networks, and extending to software and media engineering, artificial intelligence, infosocionomics, and informatics for research. Ever since the Department was first established, classes and research guidance have been given in small groups, meaning that the system of education is flexible to suit the individual students. Advanced research instruction and guidance are given on a daily basis to develop people capable of working at the forefront of informatics. The academic year consists of two semesters: the first semester runs from April to September and the second semester runs from October to March.

In order to complete the course, students are required to acquire a certain number of credits, to carry out research under appropriate guidance, and to pass the doctoral dissertation review on their research results. The minimum number of credits required is 10 for the three-year doctoral program and 40 for the five-year doctoral program. The duration of the program is flexible and may be shortened for students with excellent research results. Also, if a student enrolled in the five-year doctoral program has to withdraw before graduation, they may be awarded a master's degree as long as certain requirements are met.

1. Major Subjects	
Foundations of Informatic	Logic in Computer Science (Makoto Tatsuta); Theory of Numerical Methods (Ken Hayami); Bioinformatics (pending); Algorithms (Takeaki Uno); Mathematical Linguistics (Makoto Kanazawa)
	Discrete Mathematics (Ken'ichi Kawarabayashi); Mathematical Logic (pending); Quantum Information Systems (Kae Nemoto)/Quantum Computation (Keiji Matsumoto); Modern Cryptography (pendin
	Computational Neuroscience (Ryota Kobayashi); Sublinear Algorithms (Yuichi Yoshida); Optimization Theory (Masako Kishida); Graph Algorithms (Yoichi Iwata)
Information Infrastructure Science	Computer System Design (Tomohiro Yoneda, Masahiro Goshima); Information and Communication Systems (Shunji Abe, Yusheng Ji, Kensuke Fukuda, Megumi Kaneko)
Software Science	Mathematical Structures in Programming (Zhenjiang Hu); Distributed Systems (Ichiro Satoh); Data Engineering (Atsuhiro Takasu); Software Engineering (Shin Nakajima)
	Signal Processors (Hiromichi Hashizume); Probabilistic Models in Informatics (Asanobu Kitamoto); Constraint Programming (pending); Service-Oriented Computing (Fuyuki Ishikawa)
	XML Databases (Hiroyuki Kato); Database Programming Languages (pending); Software Development Processes (Kenji Tei)
	Fundamentals of Web Application Development (Kazunori Sakamoto); Programming Languages and Theory (Kanae Tsushima)
Multimedia Information Science	Digital Media Infrastructure (Akiko Aizawa, Isao Echizen, Norio Katayama, Ryoichi Ando, Kenshi Takayama); Fundamentals of Media Processing (Shinichi Satoh, Kazuya Kodama, Hiroshi Mo, Duy-Din L
	Applications of Multimedia Processing (Akihiro Sugimoto, Imari Sato, Hironobu Gotoda, Gene Cheung, Yin Qiang Zheng)
	Interactive Media (Noriko Arai, Kenro Aihara, Nobutaka Ono, Junichi Yamagishi, Yi Yu)
Intelligent Systems Science	Logical Foundations for Artificial Intelligence (Katsumi Inoue); Reasoning Science (Ken Satoh); Knowledge Sharing Systems (Hideaki Takeda); Human-Agent Interaction (Seiji Yamada)
	Cluster Analysis (Michael E Houle); Machine Learning (Ryutaro Ichise); Intelligent Robotics (Tetsunari Inamura); Natural Language Processing (pending); Psycholinguistics (pending)
	Intelligent User Interfaces (Helmut Prendinger); Intelligent Web Systems (Ikki Ohmukai); Communication Environments (Mayumi Bono)
	Syntactic-Semantic Parsing (Yusuke Miyao); Econophysics (Takayuki Mizuno)
Information Environment Science	Digital Publications (Keizo Oyama); Information Retrieval (Noriko Kando); Terminology (pending); Governance among Humans, Technology and Social Systems in the ICT Society (pending)
	Scholarly Information Databases (pending); Academic Information Environments (pending); ICT-Enabled Business (Hitoshi Okada); Introduction to Statistical Methods in Bibliometrics (SUN Yuan); Methodology of Scientometrics (Masaki Nishiza
	Information Economics (pending); Record Management (pending); Information Society (pending)
Department's Common Subjects	Research in Informatics for PhD Thesis IA, IB—VA, VB; Seminar on Basic Knowledge in Informatics IA, IB—IIA, IIB
(all faculty)	Research in Informatics for Master Thesis IA, IB—IIA, IIB

Introduction to Mathematical Logic (Makoto Tatsuta); Introduction to Algorithms (Takeaki Uno, Takuya Akiba); Quantum Information and Computing (Kae Nemoto, Keiji Matsumoto); High-Performance Computing (Kento Aida, Michihiro Koibuchi, Atsuko Takefusa) Information Sharing System Architecture (Shigeo Urushidani, Noboru Sonehara, Hiroki Takakura, Takashi Kurimoto); Introduction to Software Science I (All professors in Software Science); Introduction to Software Science II (All professors in Software Science). Introduction to Multimedia Information Science (All professors in Multimedia Information Science); Introduction to Intelligent Systems Science I (Katsumi Inoue, Seiji Yamada, Tetsunari Inamura, Ryutaro Ichise, Yusuke Miyao, Michael E Houle) Introduction to Intelligent Systems Science || (Ken Satoh, Hideaki Takeda, Helmut Prendinger, Ikki Ohmukai, Takavuki Mizuno, Mayumi Bono); Introduction to Information Environment Science | (All professors in Information Environment Science) Introduction to Information Environment Science II (All professors in Information Environment Science); Academic Communication (pending); Intellectual Property Rights (pending); Research, Development and International Collaboration in a Changing World (Henri Angelino) Presentation in English I (Ken Hayami, Michael E Houle, Gene Cheung, Caryn Jones) Presentation in English II (Ken Hayami, Michael E Houle, Gene Cheung, Caryn Jones) Introduction to Information Security Infrastructure (Noboru Sonehara, Isao Echizen, Hiroki Takakura, Hitoshi Okadai; Applied Linear Algebra (Ken Hayami, Nobutaka Ono, Hironobu Gotoda, Shinichi Satoh); Introduction to Big Data Science (Professors related to big data)

Career paths of students after completion of doctoral program (Over the past 3 years). *Numbers inside brackets indicate foreign students

Year of completion	University/research institution	Company	Undetermined	Total
FY2015	9 (6)	5 (3)	0 (0)	14 (9)
FY2014	5 (3)	4 (3)	2 (2)	11 (8)
FY2013	7 (5)	0 (0)	2 (2)	9 (7)

Cooperation with Graduate Schools

NII actively cooperates with graduate education at the University of Tokyo, Tokyo Institute of Technology, Waseda University, Japan Advanced Institute of Science and Technology (JAIST), Kyushu Institute of Technology, the University of Electro-Communications, and Tokyo University of Science. NII conducts lessons in partnership with these institutions and accepts graduate students for research guidance.

Cooperation with Graduate Schools

University	Graduate School	Notes
The University of Tokyo	Graduate School of Information Science and Technology	Since FY2001
Tolaya Institute of Technology	Graduate School of Information Science and Engineering	Since FY2002
Tokyo Institute of Technology	Interdisciplinary Graduate School of Science and Engineering	Since FY2003
	Graduate School of Fundamental Science and Engineering	
Waseda University	Graduate School of Creative Science and Engineering	Since FY2005
	Graduate School of Advanced Science and Engineering	
Japan Advanced Institute of Science and Technology (JAIST)	Graduate School of Advanced Science and Technology	Since FY2008
Kuushu lastituts of Tashaslasu	Graduate School of Computer Science and Systems Engineering	Since FY2010
Kyushu Institute of Technology	Faculty of Computer Science and Systems Engineering	SHICE FIZUTO
University of Electro-Communications	Graduate School of Information Systems	Since FY2012
Tokyo University of Science	Graduate School of Science	Since FY2015

Special Collaboration with Research Students

As an inter-university research institute, NII accepts graduate students from other universities in Japan and overseas as research students in special collaborative projects. These students benefit from research guidance using NII's academic information databases and communications infrastructure, and instruction by NII staff appropriate to their research subject.

Universities to which research students for special collaboration belong

Kyushu University	Keio University
Chiba University	University of Tsukuba
The University of Tokyo	Japan Advanced Institute of Science and Technology (JAIST)
Tokyo University of Science	University of Namur
École Normale Supérieure (ENS)	Karlsruhe Institute of Technology
University of Buenos Aires	Instituto Superior Técnico
Graduate School of University of Science and Technology of China	Shanghai Jiao Tong University
Hong Kong University of Science and Technology	ETH Zurich
Federal University of Rio Grande do Sul	Pierre and Marie Curie University (UPMC)

Number of students accepted through both systems of collaboration with graduate schools and research students (FY2015)

	,	· · ·
Master's program	Doctoral program	Total
64	36	100

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Organization

Executives

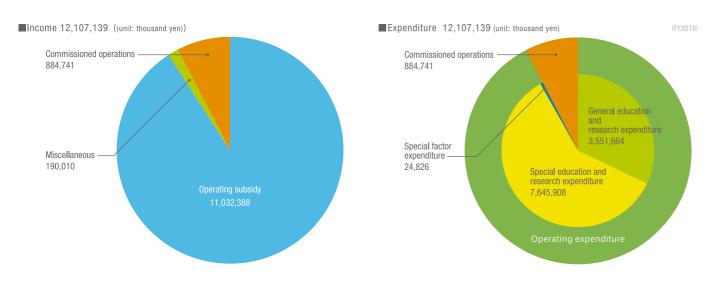
Director General Masaru Kitsur	egawa				
Deputy Director General Shinichi Honio	den Deputy Directo	Deputy Director General Jun Adachi			
Advisor to the Director General Akiko Aiza	Advisor to the	Advisor to the Director General Ichiro Satoh			
Academic Infrastructure Promotion			Acader	mic Infrastructure Division	
Director Shigeo Urushida	ani Deputy Directo	or Kiyohiko Sakai	Direc	ctor Koji Kame	ei
Scholarly and Academic Information Division		Cooperation Office	Advano	ced ICT Center	
Director Seiji Hosokawa	Head	Sawako Kojin	Direc	ctor Shunji Ab	е
General Affairs Department	Planning Divisio	ın			
Director Hiromi Iwata	Director	Toyomi Takekawa	Head	of Office for Social Collaboration W	'ataru Hashimoto
General Affairs Division	Budget and Acc	Budget and Accounts Division		rary	
Director Yukio Yanagihas	shi Director	Toshiaki Sato	Head	ı İkki Ohmu	ukai

Staff Numbers

(as of April 2016)

									100 011 p111 E011
Category	Director	Deputy Director	Professor	Associate Professor	Lecturer	Assistant Professor	Subtotal	Administrative staff	Total
Full-time employees	1	2	30	36		14	83	57	140
Adjunct professors, etc.			11	10	1	15	37		37
Special term/fixed-term/short-term staff									183

Budget



Administrative Council

Discusses important matters concerning the management and operation of NII in response to inquiries from the Director General. These matters include the selection of candidates for the post of Director General, as well as academic personnel, joint research plans, and matters concerning NII in the mid-term targets and plans of the Research Organization of Information and Systems (ROIS).

Advisory Board

Consists of Japanese and overseas experts who are external to NII and have extensive, advanced knowledge of academic information. The Board responds to inquiries from the Director General regarding issues involving informatics research, the development and establishment of infrastructure for distributing academic information, and so on.

Professors Emeriti

National Center for Science Information Systems (NACSIS)

Name	Award date
Kimio Ohno	06/25/1992
Atsunobu Ichikawa	06/25/1992
Hitoshi Inoue	06/23/1999

National Institute of Informatics (NII)

Name	Award date
Takamitsu Sawa	04/01/2002
Eisuke Naito	07/02/2002
Mitsutoshi Hatori	11/19/2004
Kinji Ono	11/19/2004
Takeo Yamamoto	04/01/2005
Yasuharu Suematsu	04/01/2005
Haruki Ueno	04/01/2007
Katsumi Maruyama	04/01/2010

Name	Award date
Masamitsu Negishi	04/01/2010
Kenichi Miura	04/01/2011
Masao Sakauchi	04/01/2013
Shoichiro Asano	04/01/2013
Teruo Koyama	04/01/2015
Akira Miyazawa	04/01/2015
Shigeki Yamada	04/01/2015
Yoshihisa Yamamoto	04/01/2015

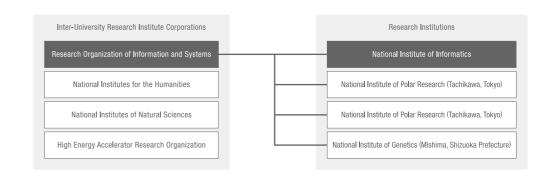
(as of April 1 2016).

Inter-University Research Institutes

The National Institute of Informatics is one of four organizations that constitute the Inter-University Research Institute Corporation, Research Organization of Information and Systems (ROIS). Inter-university research institutes are unique Japanese research institutions that promote joint research beyond the boundaries of individual universities. Covering a range of fields and available for all universities to use, they provide free of charge to researchers nationwide the kind of large, cutting-edge equipment, tremendous volumes of academic data, high-value data, and analytical procedures that individual universities would have difficulty installing and maintaining.

There are currently four Inter-University Research Institute Corporations including ROIS, and a total of 19 institutes have been established, of which NII is one.

The objective of ROIS is integrative research that goes beyond the boundaries of traditional disciplines by applying the perspective of information and systems to complex issues such as life, earth, the natural environment, and human society that greatly impact our lives in the 21st century.



Dissemination of Research Results

Delivering NII's Research and Operations to the Wider Society

NII holds public lectures and publishes information with the aim of sharing its latest research findings on informatics widely throughout society and deepening understanding of its operations and services. NII also delivers timely information via digital media such as the NII website, NII email newsletter, and social media (Twitter, Facebook).

NII Open House

NII holds an annual Open House to present its various research projects and results to a broad audience including the general public, researchers, and Ph.D. candidates. The event is designed to stimulate young people's interest in science and technology, with activities such as workshops for elementary and junior high school students.



Nelcome address and presentation about NII activities by Director General Kitsuregawa





"NII Research 100" by 10 researchers

Programming lesson for child

Public Lectures

The National Institute of Informatics holds free public lectures from time to time.

The Forefront of Informatics, the National Institute of Informatics Public Lectures

In these free lectures, NII researchers explain about various subjects at the forefront of informatics-related fields to the general public. There are six lectures per year held at the National Center of Sciences (Hitotsubashi, Chiyoda Ward, Tokyo). Images, materials, and Q&As from past lectures are available on the NII website.



Ontology was the topic of the fourth public lecture in the 2015 series, "The Forefront of Informatics" (November 2015)

Karuizawa Saturday Salon

Several lecture meetings a year about informatics and various other fields are held at the International Seminar House for Advanced Studies (Karuizawa, Nagano Prefecture) for people living in the surrounding area and others. The contents of past lectures have been published in Karuizawa Doyo-Konwakai Koenshu: Chi to Bi no Harmony (Collection of Lectures from the Karuizawa Saturday Salon: Harmony of Intelligence and Beauty) (Volumes 1–6), and are available on the NII website.



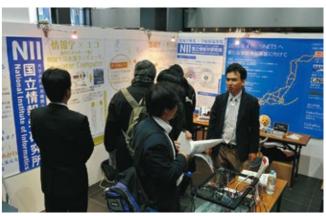
The first Karuizawa Saturday Salon of FY2015 discussed problems of modern civilization (July 2015)

Exhibitions

NII participates in various exhibitions to deepen understanding about its research findings, operations, and services.



Explaining NII's library services in an easy-to-understand way at an exhibition that attracts people involved in libraries nationwide (November 2015)



Presenting NII's research activities and operation details at an event with twenty-one of Japan's leading research institutions (November 2015)

Publications

●『NII Series』

A new commercially available publication (Maruzen Library) that introduces and explains the contents of NII's research to the general public in an easy-to-understand way using familiar topics.

Public information magazines

- NII Today (Japanese/English)
- Catalogue of National Institute of Informatics (Japanese/English)
 Outline of National Institute of Informatics (Japanese/English)
- Annual Report of National Institute of Informatics
- NII SEEDs
- Getting to Know NII with Info Dog "Bit-kun"



Latest edition of NII Series published in March 2016, Camera? Camera? Camera?! Future Cameras That Make Calculations





NII Today is published four times a year. From FY2016, the number of pages has been increased to provide more information

Digital Media

NII website http://www.nii.ac.jp/
 Visit the NII website for details about events and publications.

NII Video Channel http://www.nii.ac.jp/event/videos/
 Watch videos of NII lectures and research presentations.

Email newsletter http://www.nii.ac.jp/mail/

Twitter https://twitter.com/jouhouken/

@jouhouken (NII's official account)

@NII_Bit (Bit-kun's official account)

Facebook https://www.facebook.com/jouhouken

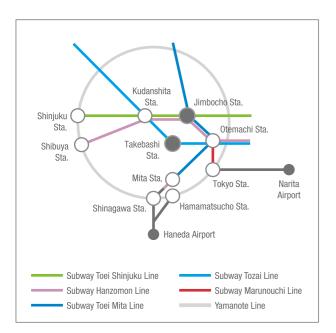
National Center of Sciences (Chiyoda Ward, Tokyo)

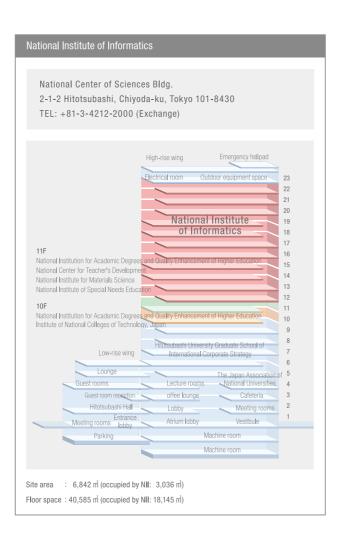
http://www.nii.ac.jp/

The National Center of Sciences was established as a center for research in fields such as informatics, academic exchange, dissemination of scientific information, and social collaboration, with the aim of improving and strengthening Japan's academic research infrastructure. Construction was completed in December 1999. The high-rise wing consists primarily of three organizations: NII, Hitotsubashi University Graduate School of International Corporate Strategy, and part of the National Institution for Academic Degrees and Quality Enhancement of Higher Education. The Center aims to provide an advanced base for intellectual creativity through comprehensive application of the academic functions of each institute. Conference facilities such as Hitotsubashi Hall are located in the low-rise wing, and these accommodate activities such as international conferences, lectures, and academic meetings organized by national university corporations and



National Center of Sciences



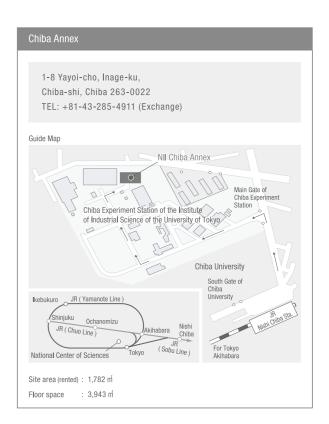




Chiba Annex (Inage-ku, Chiba City)

Chiba Annex is a building that houses the computer systems and networking equipment used to operate academic information systems and provide academic information services. It was built in November 1994 and is located in the Chiba Experiment Station of the Institute of Industrial Science of the University of Tokyo.





International Seminar House for Advanced Studies (Karuizawa, Nagano Prefecture) http://www.nii.ac.jp/access/karuizawa/

Inose Lodge

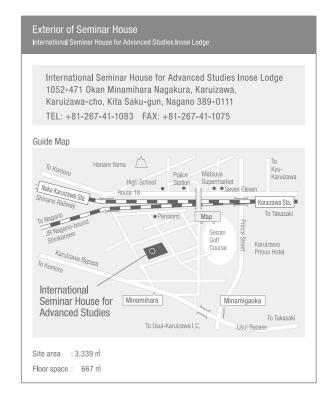
The International Seminar House for Advanced Studies (Inose Lodge) was built on land donated by Dr. Hiroshi Inose, the first director general of NII. His idea was to create an ideal place for interdisciplinary and international discussions.

Uses

- 1) Domestic and international academic conferences, seminars, etc.
- 2) Public lectures, social gatherings, etc.
- 3) Research and training of NII researchers and staff.



Exterior of Seminar House



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History

Time	Event
1973 October	Ministry of Education, Science, Sports and Culture proposes an "Improved Circulation System for Academic Information" in the Third Report (Basic Policies for the Promotion of Scholarship) of the Science Council.
1976 May	Research Center for Library and Information Science (RCLIS) is established at the University of Tokyo.
1978 November	"A New Plan for Academic Information Systems" is presented to the Science Council by the Minister of Education, Science, and Culture. The Science Council issues a response in January 1980.
1983 April	The Center for Bibliographic Information is established at the University of Tokyo, with the reorganization of the Research Center for Information and Library Science.
1984 December	The NACSIS-CAT catalog information service is launched.
1986 April	The National Center for Science Information Systems (NACSIS) is established, with the reorganization of the Center for Bibliographic Information, University of Tokyo.
1987 April	The Science Information NETwork (SINET) is launched.
April	The NACSIS-IR information search service is launched.
1988 April	Email service is launched.
1989 January	International connection between SINET and US (National Science Foundation: NSF)
1990 January	International connection between SINET and the UK (British Library: BL)
1992 April	The Inter-Library Loan (ILL) System is launched.
April	The Internet backbone (SINET) is launched.
1993 November	Start of mutual access to databases through gateways with the Japan Information Center of Science and Technology (JICST)
1994 April	Start of ILL service with the British Library Document Supply Centre (BLDSC)
November	Chiba Annex (Inage-ku, Chiba City) is built.
1995 October	International connection between SINET and Thailand
1996 April	Start of ILL service with the National Diet Library
1997 March	International Seminar House for Advanced Studies, Inose Lodge (Karuizawa, Nagano Prefecture) is established.
April	Electronic Library Service is launched.
December	An Advisory Panel on a Core Institution for Scientific Research in the Information Field is established by the Ministry of Education, Science, and Culture.
1998 January	A proposal entitled "Promoting Computer Science Research" is published by the Science Council of Japan, calling for the establishment of a core institution for inter-university research in informatics.
March	Advisory Panel on a Core Institution for Scientific Research in the Information Field issues its report.
April	Coordination Office is established for the Core Institution for Scientific Research in the Information Field; committee is formed in May.
1999 March	Coordinating Committee of the Core Institution for Scientific Research in the Information Field issues its report.
April	Preparatory Office is established for the Core Institution for Scientific Research in the Information Field; committee is formed in May.
July	Preparatory Committee of the Core Institution for Scientific Research in the Information Field issues its interim report.
2000 February	Operations move to the National Center of Sciences (Hitotsubashi, Chiyoda-ku, Tokyo).
March	Preparatory Committee of the Core Institution for Scientific Research in the Information Field issues its final report.
April	National Institute of Informatics (NIII) is established, with the reorganization of NACSIS and assumption of its functions.
2002 January	SuperSINET is launched.
April	Ph.D. Program in Informatics is established in the Department of Informatics, Graduate University for Advanced Studies.
April	GeNii (NII Academic Contents Portal) is released.
April	Japan–U.S. document delivery service is launched.
June	Intersystem linkage of catalogs with RLG in the U.S. is launched.
September	Research Planning and Promotion Strategy Office is founded.
October	International Course is established within Ph.D. Program in Informatics.
October	Start of joint construction of meta-databases
2003 January	Global Liaison Office is formed.
April	Initiation of Project to Improve Infrastructure for International Circulation of Scholarly Information
2004 April	NII begins a new chapter as a member of the new Inter-University Research Institute Corporation/Research Organization of Information and Systems.
2005 April	Official service of CiNii (the NII Scholarly and Academic Information Navigator) is launched.
2007 June	Science Information NETwork3 (SINET3) is launched.
2009 April	NII Scholarly and Academic Information Navigator (CiNii) and the KAKEN database of Grants-in-Aid for Scientific Research are revamped. Japanese Institutional Repositories Online (JAIRO) is officially launched.
2010 February	First NII Shonan Meeting takes place.
2011 April	Science Information NETwork4 (SINET4) is launched.
April	Library Liaison Office is established.
November	CiNii Books is launched.
2012 April	Japanese Institutional Repositories Online Cloud (JAIRO-Cloud) is launched.
2015 October	CiNii Dissertations is launched.
2016 April	Science Information NETwork5 (SINET5) is launched.

