

Science Report WebSite

The ROIS publishes an online magazine, SCIENCE REPORT, to inform the audience overseas about Japan's latest academic research activities and achievements. SCIENCE REPORT focuses on a specific research topic for six months at a time with monthly feature articles introducing different aspects of the field. The magazine is intended to provide insights into some of the major ongoing research projects and how the country uses the Team Japan approach to bring together all the expertise and resources it has to offer to advance studies in certain areas. The site offers links to the news releases and publications of various universities and other academic institutions from across Japan.



<https://sr.rois.ac.jp/en/>

Akaike Guest House

The ISM opened Akaike Guest House in June 2010 in the suburban city of Tachikawa in Tokyo to offer researchers visiting from out of the region/country a place to stay that has easy access to their research sites. The facility was named after the late Dr. Hirotugu Akaike, a renowned statistician, to pay tribute to his wide-reaching and influential achievements in the field of Statistical Science. We hope Dr. Akaike is watching us over as we strive to advance science and try to carry on his legacy.



https://www.ism.ac.jp/guest_house/index.html

Activities for Gender Equality

The ROIS has the Office for Gender Equality set up at each of its research centers to promote a fair and equal work environment where both men and women researchers can thrive and access the support they need. As part of the initiative, the ROIS also publishes on its website a directory of female researchers who can be found through the ROIS researchmap search engine.

Online Public Access

ROIS has been working to provide online public access to various events such as open houses and online courses. In addition to streaming videos and images of lectures, we are hosting a wide range of poster presentations in virtual spaces.

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4 The Institute of Statistical Mathematics

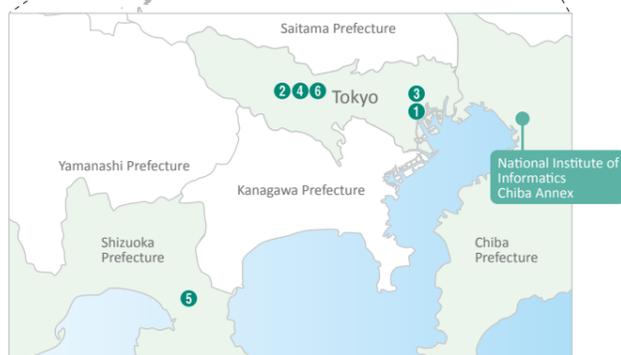
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6 Joint Support-Center for Data Science Research(ROIS-DS)

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Inter-University
Research Institute Corporation

Research Organization of Information and Systems

2020 / 2021

National Institute of Polar Research
National Institute of Informatics
The Institute of Statistical Mathematics
National Institute of Genetics
Joint Support-Center for Data Science Research



Pioneering Research Frontiers in the Data Age to Solve Modern Society Problems

President's Message

Today, we find ourselves in the midst of a transformational era. Rapid and revolutionary advancements in communications technology, the emergence of various kinds of big data, and dramatic improvements in computational performance have transformed society and dramatically altered the research environment. In such a society, science must be "data-driven." It would not be an exaggeration to say that the advancement of data science—which could be called "the fourth science"—is the key to solving many of the complex issues facing society today and that this field will be the driving force behind scientific and technological innovation for many years to come.

The Research Organization of Information and Systems (ROIS) comprises four distinguished institutes—the National Institute of Polar Research (NIPR), the National Institute of Informatics (NII), the Institute of Statistical Mathematics (ISM), and the National Institute of Genetics (NIG)—plus the Joint Support-Center for Data Science Research (ROIS-DS) established in 2016. ROIS's mission is to pioneer new areas of research from the perspectives of information and systems, with an aim toward solving contemporary problems through the advancement of data science.

As an inter-university research institute corporation, ROIS's primary mission is to contribute to the advancement of research by universities and other institutes by promoting resource sharing and joint research that is responsive to the needs of the research community. Furthermore, ROIS has partnered with industry to promote open science that involves participation by ordinary citizens and, as a parent institute of the Graduate University for Advanced Studies (SOKENDAI), provides critical support for the development of human resources.

Modern society is faced with various challenges, including threats to the Earth, the natural environment, and human civilization. The COVID-19 pandemic that began in 2019 and has since spread to every corner of the globe is but one example of such a threat. ROIS strives to find proactive solutions to these and other issues facing society. We humbly ask for your continued support and cooperation in these efforts.

Sincerely, **Ryoichi Fujii**

President of Research Organization of Information and Systems



Joint Support-Center for Data Science Research (ROIS-DS)



The Joint Support-Center for Data Science Research (DS-Center) is an institution that was founded in April 2016 to promote activities of "data science (or Data-drive type research)", those currently being conducted at academics as well as industries. The center contributes to the development and growth of those activities through maximizing the abilities and the activities of data science in the Research Organization of Information and Systems.

Our "data sharing initiative" focuses on a variety of research fields, including life science, polar environments, social science, and humanities. Our "data analysis support movement" provides cutting-edge support for data analysis or data mining that focuses on specialized field such as genome science, and develops and supports cross-disciplinary high-level mathematical methods. DS facility invites publicly-offered joint research every year.

DS Centers and Project

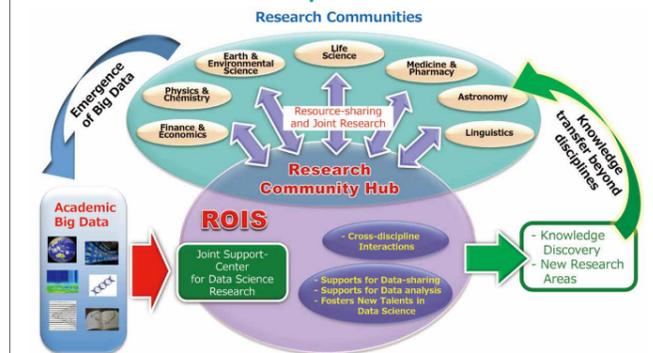
Data Sharing Support Groups

- Database Center for Life Science: Promoting developments of open science and database integrations in life science fields.
- Polar Environment Data Science Center: Promoting various research collaboration with a synthetic database and analysis-support-tools for long-term variation of polar environment in global earth system.
- Center for Social Data Structuring: Building a platform for managing social data, including social survey data, public opinion data, official micro data and social big data, for providing empirical data that solve various social issues.
- Center for Open Data in the Humanities: Sharing data for and from humanities to develop novel approaches for data science-driven humanities, or digital humanities, on an integrated platform that goes beyond organizational and disciplinary barriers.

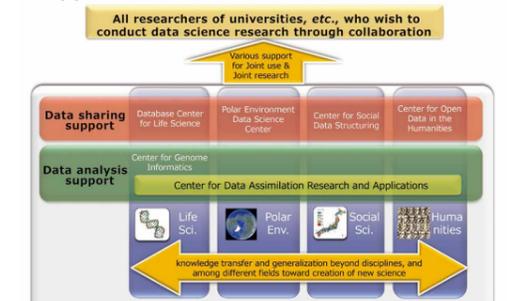
Data Analysis Support Groups

- Center for Genome Informatics: Supporting computational analysis of genomic/proteomic data (e.g. next-generation sequencing data) based on the state-of-the-art bioinformatics artifices.
- Center for Data Assimilation Research and Applications: Supporting simulation and modeling studies based on statistical methodologies such as data assimilation and statistical emulation, aiming at solving practical problems in science and industry.

ROIS as a Hub for Japan's Academic Societies

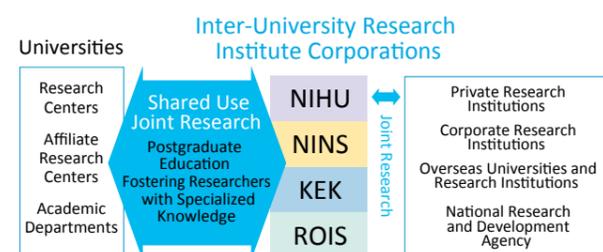


Joint Support-Center for Data Science Research (ROIS-DS)



About Inter-University Research Institutes

An inter-university research institute helps promote research collaborations and resource sharing among universities across Japan. It provides universities with access to cutting-edge equipment, voluminous academic data and hard-to-find research materials that would be difficult for them to obtain and maintain individually. It also offers them support for analysis of such data.



Research Hub for Academic Institutions

The four research institutes that make up the Research Organization of Information and Systems have researchers-in-residence from various national and private universities in Japan. A total of 2,355 researchers from 440 institutions participated in the residency programs during 2019.

Number of Institutions and Joint Researchers Enrolled in Joint Research Projects, FY2019

	Breakdown of organizations to which joint researchers belong									
	Number of institutions	Total	National Universities	Inter-University Research Institutes	Public Universities	Private Universities	Public Institutions	Private Institutions	Foreign Organizations	Others
Headquarter	9	15	2	0	1	3	6	0	3	0
NIPR	139	692	297	5	28	63	207	72	15	5
NII	123	380	249	17	5	58	12	27	12	0
ISM	228	671	321	9	54	166	85	29	7	0
NIG	112	458	252	14	27	89	27	6	43	0
ROIS-DS	77	139	64	10	7	22	18	6	12	0
Total	440*	2,355	1,185	55	122	401	355	140	92	5

*Duplicates are excluded.

Postgraduate Education

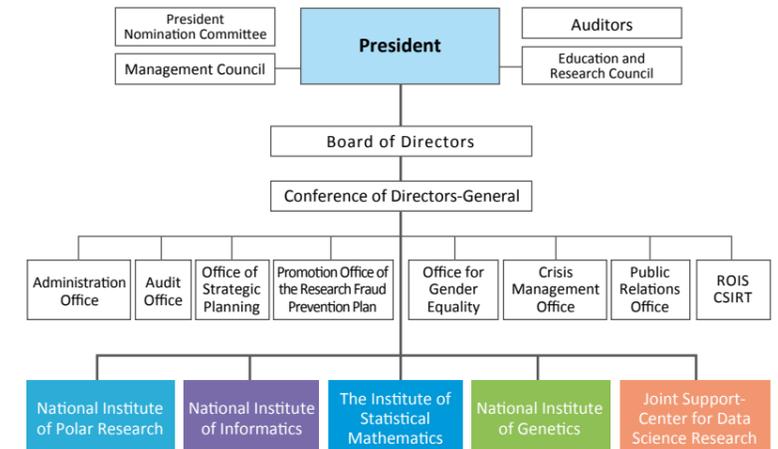
The research institutes provide critical support for The Graduate University for Advanced Studies (SOKENDAI) by bringing together cutting-edge research and education to develop human resource of the next generation.

Students at SOKENDAI, The Graduate University for Advanced Studies

Schools	Departments	Parent Institutes	Number	Number of academic degrees granted
School of Multidisciplinary Sciences	Polar Science	NIPR	18(0)	0
	Informatics	NII	92(53)	14
	Statistical Science	ISM	35(3)	5
School of Life Science	Genetics	NIG	32(14)	3
Total			177(70)	22

※ The number of students as of May 1, 2019.

※ The number in brackets is the number of international students.



Four Research Institutes in Pursuit of Scientific Principles and Cutting-edge Research



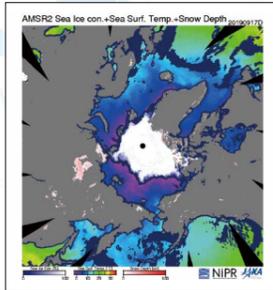
National Institute of Polar Research



Polar regions around the South and North Poles are sensitive to global environmental changes, including global warming, with results that will affect the future of human beings. Focusing on how the global environment forms and how it will change in the future, based on field observations, analysis of materials and samples, parsing of data, and modeling, the institute promotes advanced, integrated, and multi-discipline earth systems science, including geoscience and the environmental, biological, space and planetary sciences. Furthermore, the institute, having observation bases in the Arctic and Antarctic, plays a core role in the Japanese Antarctic Research Expedition (JARE) and Arctic Challenge for Sustainability (ArCS II).

Latest Accomplishments:

- The extent to which the Arctic sea ice has thinned was determined by an integrated analysis of sea ice area data obtained from the Advanced Microwave Scanning Radiometer 2 (AMSR2) installed on the water cycle observation satellite "Shizuku" as well as sea ice volume and thickness data obtained from numerical prediction models.
- Simultaneous measurements from large-scale atmospheric radars installed in the Arctic and Antarctic as well as the geospace satellite "Arase" have revealed that high-energy electrons from space entering the upper atmosphere at the North and South Poles penetrate deeper into the mesosphere than previously thought, where they can potentially deplete ozone in the stratosphere.



Distribution of Arctic sea ice on September 17, 2019 based on "Shizuku" satellite data



The large-scale PANSY (Program of the Antarctic Syowa MST/IS Radar) antenna array installed at the Syowa Station



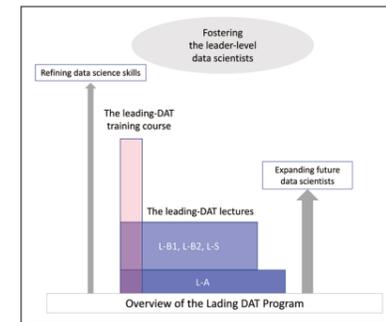
The Institute of Statistical Mathematics



"Statistical mathematics" refers to a science aimed at extracting meaningful information from data in order to gain and develop knowledge that is useful for decision-making. As the only research institute for "statistical mathematics" in Japan, ISM works on both cutting-edge and basic researches and accelerates solutions to academic, societal and industrial problems through the "NOE (Network Of Excellence) Project" in collaboration with other organizations in different sectors. At the same time, ISM conducts the "Project for Fostering and Promoting Statistical Thinking" to develop professional data scientists who lead various research activities.

Latest Accomplishments:

- Leading DAT (Data Analytics Talents) program offers an advanced intense course on data science made of lectures and data analysis tasks. Participants will be certified if they attend all the lectures and their submitted report makes the passing mark. It is possible to enroll only in a lecture separately.
- An image of the shadow of a supermassive black hole created using a data science method known as sparse modeling was released as the one of first results of collaborative research with the Event Horizon Telescope (EHT).



Overview of the Leading DAT (Data Analytics Talents) program

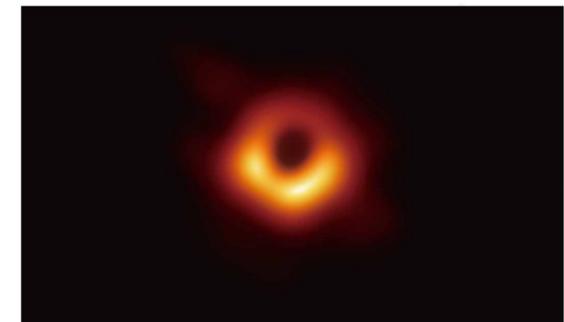


Image of a black hole shadow © Event Horizon Telescope Collaboration

NII National Institute of Informatics

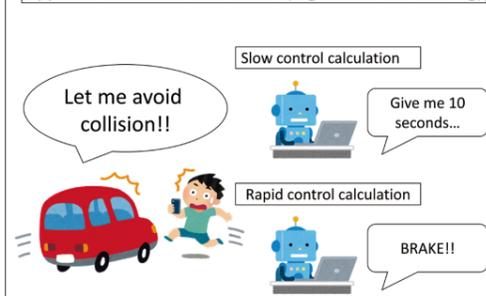


NII promotes research in all areas of informatics – from theoretical computer science to such cutting-edge topics as artificial intelligence, big data, IoT (Internet of Things) and cybersecurity – to build the way for "future value creation" in this new study field as Japan's only academic informatics research center. In addition to building and operating networks, such as the Science Information NETWORK 5 (SINET5), and offering academic online content and services, NII develops research data infrastructures for open science and information security platforms based on inter-institutional cooperation. NII also focuses on collaboration with universities, research institutions and corporations both inside Japan and overseas.

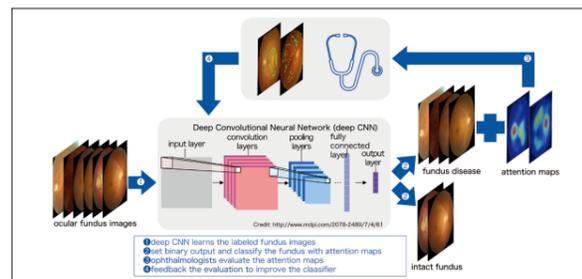
Latest Accomplishments:

- Development of a decision support system that enables correct choices to be made at high computational speeds: The methodology, which can be used in a wide range of applications such as making decisions related to quality control of industrial goods and automated driving, ensures the correctness (accuracy) of choices while rapidly calculating the results.
- New IT-based medical support: NII is developing a cloud platform based on SINET5 to handle medical imaging big data and is working on AI-based technology for analyzing medical images. Leveraging its close ties with professional medical societies, NII is realizing dramatic improvements in AI-based medical image diagnostic technologies that incorporate the knowledge and skill of medical specialists.

Application to real-time control (e.g. automated driving)



For the optimal control problem common to a wide range of decision support systems, the newly developed method ensures the generation of high-precision choices while also enabling rapid calculation.



Example of development of an AI-based medical imaging diagnostic system that incorporates the knowledge of medical specialists.



National Institute of Genetics



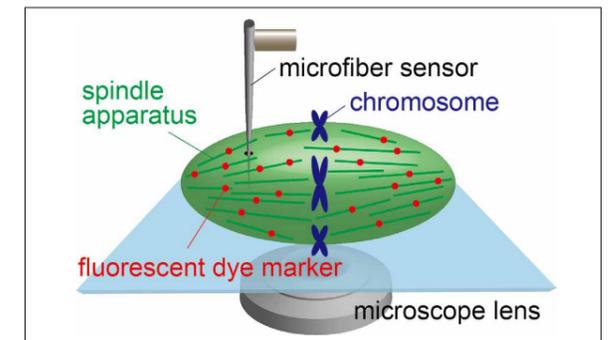
"The activity of biological organisms is based on the genetic information." Genetics is a science that reveals the mystery of life from the viewpoint of genetic information. NIG conducts state-of-the-art research on cell function, generation/differentiation, evolution/biodiversity, and genome/bio information; simultaneously, it pioneers new research in the life sciences. Furthermore, NIG, as an international hub for life science research, operates three research infrastructure projects: BioResource Project, Advanced Genomics Project, and Bioinformatics and DNA Data Bank of Japan (DDBJ) Project.

Latest Accomplishments:

- Discovery of a key gene that supports freshwater colonization by fish: It was discovered that fish having more copies of the *Fads2* gene, which is needed to synthesize the essential fatty acid DHA, have an advantage in terms of freshwater colonization.
- Design principle of chromosome segregation machinery: Using state-of-the-art force microscopy developed at NIG, we succeeded in visualizing the mechanical properties of spindles at a higher spatial resolution than ever before.



Gasterosteus nipponicus (below), which has fewer copies of *FAD2*, was not able to colonize freshwater, whereas the three-spined stickleback (*G. aculeatus*, above), which has more copies, did.



Combining a glass-fiber sensor with fluorescence imaging enabled determination of the mechanical structure of the spindle.

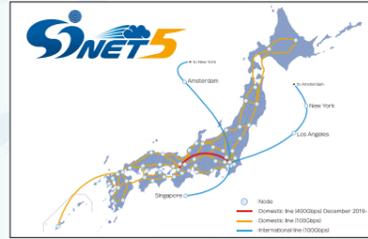
Resource Sharing and Joint Research to Meet the Needs of Universities

Resource Sharing



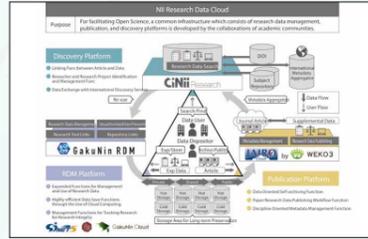
Joint Use of Polar Research Facilities

NIPR engages in a wide range of resource sharing and joint research activities, including the provision of assistance and equipment for ice-core sampling and joint research using ice cores collected at the Dome Fuji Station in Antarctica (Ice Core Research Center); conducting analyses of meteorite, rock, and mineral samples using the Sensitive High Resolution Ion Micro Probe (SHRIMP) secondary ion mass spectrometer (Polar Science Resources Center); optical calibration using the only large-scale integrating sphere in Japan (Optical Calibration System); and use of the Polar Science Computer System (Communications and Computing Science Center).



Science Information Network (SINET)

As an inter-university research institute, NII is working with academic institutions and the research community to develop and operate the Science Information Network (SINET5), the world's most advanced, high-speed network linking researchers in Japan and around the world. NII uses the ultra-high-speed, highly reliable, high-performance SINET5 network to provide cloud infrastructure and academic content services as well as to promote the practice of open science.



Research Data Infrastructure (NII RDC)

In realizing open science, a system that allows scientists to manage and easily publish their research data appropriately is essential. NII is developing the NII Research Data Cloud (NII RDC). According to each organization's policies, this research data infrastructure enables secure data management and sharing among collaborators and laboratories. NII RDC is scheduled to be fully operational in 2021.



Project for Fostering and Promoting Statistical Thinking

ISM provides various programs, for fostering the professionals that are required in the era of big data, such as "Research Collaboration Startup" that educates young scientists via OJT and the "Data Science Research Plaza" that welcomes researchers from the companies.



Supercomputer Systems and Information Resources

The Bioinformation and DDBJ center is the only repository that contains nucleic acid sequencing data in Japan, and provides genome sequences, next-generation sequencer data, and personal genome information. The center provides supercomputer optimized for bio-application such as next-generation genome sequencing analyses and human genome analyses. Every year, it is used by more than 600 users in 120 research institutions.



Bioresources and Genetic Modification

The Genetic Resource Center provides various model organisms, including zebrafish, Drosophila, and rice. The center also provides a bioresource database containing information on 6.5 million genetic strains. The division for development of genetic-engineered mouse resource assists in the production of genetically modified mice using advanced genome engineering techniques.

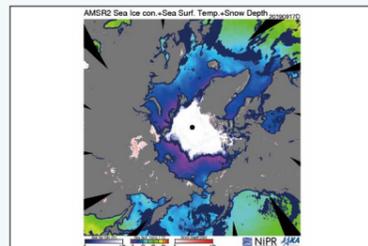


Joint Research



Joint Planning of Antarctic Observation

NIPR coordinates various joint research efforts involving many researchers from Japan and overseas. In addition to basic research and observations related to space and the upper atmosphere as well as meteorology, glaciology, geoscience, and bioscience, these collaborative efforts focus on "understanding the global atmospheric system through high-resolution observations of the Antarctic atmosphere," "understanding atmosphere-ice sheet-ocean interactions based on integrated observations at the peripheries of ice sheets and sea ice," and "reconstructing the ancient Antarctic environment to understand global system changes," which are sub-themes under NIPR's priority research and observation theme, "Investigating the Antarctic to understand changes in global systems."



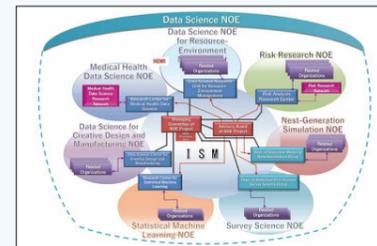
Joint Research in the Arctic

NIPR is currently conducting joint research involving the monitoring of aerosols in the Arctic atmosphere (University of Tokyo, Nagoya University, Fukuoka University) and atmospheric monitoring by cloud radar (Chiba University) at the Ny-Ålesund observation base on the Svalbard archipelago in Norway.



Strategic Joint Research on Informatics

NII engages in joint research with universities and private companies on themes selected through open solicitation and evaluation of proposals. The themes of this joint research take into consideration the latest trends in information science and vary widely from the development of innovative platform functions, applications, and services that make use of SINET5 to the development of technologies to analyze cybersecurity using NII-SOCS data and the creation of datasets and platforms for using them.



NOE (Network Of Excellence) Program

ISM promotes establishing networks based on MOUs with domestic and foreign research institutions and serving as a hub in the NOE Project in order to advance interdisciplinary research or create new research fields for solving complicated problems in modern society.



Supercomputer Systems and Information Resources

ISM provides the Supercomputer System for Statistical Science for joint use. The information resource includes various kinds of journals and books in statistical science. ISM also provides databases of academic citations for enhancing IR.



Supporting Utilization of Genomic Information

The Advanced Genomics Center offers the latest sequencing technology and genomic research tools to the research community. To date, the center has produced genome information on more than 1000 organisms and implemented human and environmental metagenomics projects.

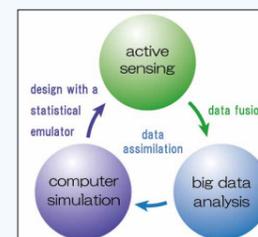


Services	Category	TOGOWS	TOGODB	DBCLS RDF Portal
Database integration	Database user	Database integration	Database user	Database integration
Database user	Database developer	Database user	Database developer	Database user
Database developer	Database administrator	Database developer	Database administrator	Database developer
Database administrator	Database manager	Database administrator	Database manager	Database administrator

Listed services in "Database integration" category

Support for Integration of Life Science Databases

The Database Center for Life Science (DBCLS) promotes adoption of Resource Description Framework (RDF) for life science databases, with the ultimate goal of creating an environment in which diverse databases distributed across the internet can be used in an integrated manner. DBCLS seeks to promote the seamless use of heterogeneous datasets by providing support for RDF conversion and, together with the JST National Bioscience Database Center, maintaining the RDF Portal as a means of providing online access to RDF datasets deposited by various institutions.



Integration of Simulation and Data Science

The Center for Data Assimilation Research and Applications offers support to scientists and industries dealing with various challenges—including the need to elucidate phenomena in dynamic and complex systems, the need to dramatically accelerate the process leading up to the release of new products and services, and the need to drastically lower costs—by combining massive amounts of data from high-performance sensors with state-of-the-art simulation technologies.

