



Creating Society, Connecting to the Future.



**School of Information and Data Sciences,
Nagasaki University**

The Mission of the School of Information and Data Sciences

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Director, Office for Establishment of an Information-related School



What is the difference between information and data? For example, how many points can Japan score against Brazil when they play each other in the soccer World Cup? You can get a vast amount of data from the Internet, including not only the results of previous matches between the two countries and FIFA rankings but also the results of recent matches with other countries and the condition of key players. You can thus predict scores by extracting information useful for predictions from this big data.

In general, raw observations of phenomena can be called data. Data selected and condensed to meet a specific purpose is called information. Rational decision-making based on the information and data (evidence) is an essential skill for individuals and companies in this modern age of big data. The School of Information and Data Sciences offers students a series of know-how, from information extraction to decision-making, based on mathematical models such as AI, machine learning, mathematics, and statistics. Furthermore, we return the results to society as “products” by using information technology. This foundational training is not focused on a specific field. It teaches students versatile methods that can be applied to all academic fields and companies that handle information and data.

Japan is seeking build “a human-centered society” as the next stage of an advanced information society. The School of Information and Data Sciences will contribute to building society with students who wish to study information and data as a scientific discipline, students who seek to actively involve themselves in hot topics in a wide range of fields, and students who wish to improve themselves.



Features of the School of Information and Data Sciences

Curriculum that can be tailored to each student's envisioned future

- After learning the foundations during their first year, students choose either the Data Science Program or Information Science Program.
- Regardless of the program they select, students can choose courses they are interested in and learn a wide variety of fields.

Utilization of big data in healthcare and tourism

- Students will carry out statistical machine learning-based data analysis to support healthcare by using data accumulated in the medical and healthcare fields, where Nagasaki University is a leader.
- Many tourists visit Nagasaki. Students will conduct statistics-based big data analysis, which extracts features from tourists' behavioral data. Students will thus help expand municipalities and industries.

"Real-World Solutions Project"

– engaging students in solving challenges faced by society and companies

- Students will tackle practical problems while in school by working with municipalities and local companies to develop problem-solving and communication skills.
- Each student will have opportunities to gain problem-solving experience, such as vitalization of local companies, eliminating community problems, etc.

Nurturing Human Resources



The School of Information and Data Sciences fosters human resources who contribute to society as core human resources in a variety of fields.

The nucleus of the School of Information and Data Sciences is Nagasaki University's Computer and Information Science Program in the School of Engineering. The School of Information and Data Sciences adds data science education and research functions. We welcome diverse students who are interested in not only the subjects of information science and data science themselves but also in a variety of academic disciplines to which they can be applied. In this exciting environment, we train human resources such as "information scientists" skilled in using AI for IT business and "data scientists" skilled in big data analysis, medical information analysis, and other types of data analysis.

Composition of Curriculum

1st Year

Students gain foundation of advanced, specialized knowledge.

Common courses

Foundational mathematics / Computer science / Communication / Programming (C,Python)

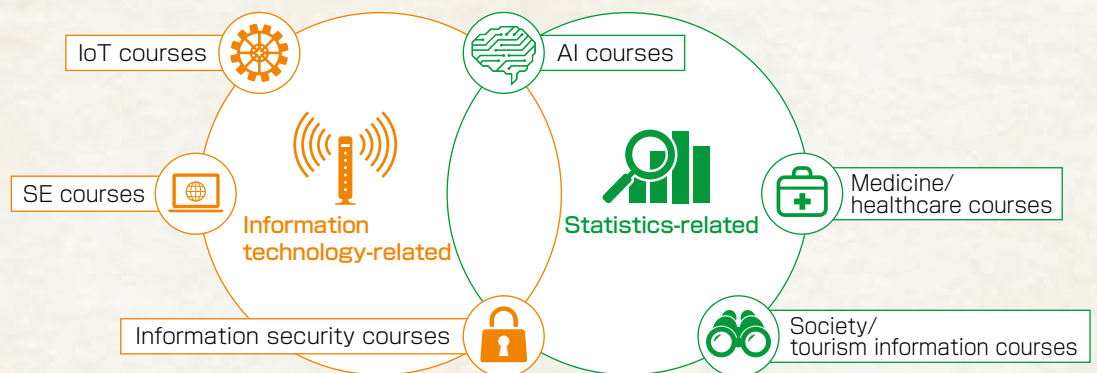
Students select desired courses from 2nd Year

Information Science Program



Data Science Program

Specialized Tracks



Students acquire and deepen specialized knowledge with elective courses

Graduation research

Career Options after Graduation

Graduates of the School of Information and Data Sciences will be active in a wide range of fields and contribute to creating the society of the future.

Wide range of next steps



Development of intelligent robots

Technologies for building partners of the future



Development of systems

Create new systems for supporting society



Management, municipalities

Create new business with big data



Tourism

Create new flow of people by analyzing tourism data



Healthcare

Save lives with data

Explore specialized domains and advance further



Enter the Graduate School of Information and Data Sciences (planned)

“Real-World Solutions Project”



The School of Information and Data Sciences has established a course called “Real-World Solutions Project.” For four years from their first year to their fourth year, students work in collaboration with municipalities and local companies to discover and address challenges facing actual society. The project also seeks to foster universally needed skills such as creativity, communication ability, and critical thinking as participants explore approaches to solutions. Through the project, the School of Information and Data Sciences seeks to develop human resources who can actively work in an information society. Furthermore, students can deepen their studies in school by applying the specialized skills and techniques they learned in classes and practicums to practical problems in actual society in a feedback cycle.



Post-Graduation Options



Graduates of the School of Information and Data Sciences can advance to the Graduate School of Information and Data Sciences (establishment planned) or expect to find employment in the following industries:

Information Science Program

System engineering (SE)-related

Companies creating new services with robots and IoT
Companies related to promotion of information industry
Information security industry, information system development industry



Software Development

IoT-related

Robot Process Automation (RPA) application industry, aerospace industry, civil engineering/construction industry, marine industry



AI robot development



Development of embedded devices

Data Science Program

Society and tourism information-related

Data-based tourism policy-making, regional revitalization policy-making, Shinkansen tourism policy-making



Tourism policy by data

Medical and healthcare information-related

Diagnostic outsourcing, new drug creation ventures, remote diagnostic services, health tourism industry



Pathological diagnosis by AI



Drug discovery by genome analysis

Beginning with foundational knowledge in information science, students will gain problem-solving skills and communication skills through practical courses.

IoT coursework model

■IoT-related

- Software engineering
- Embedded systems
- Control engineering

■Information technology-related

- Programming exercises
- Information engineering experiments
- Pattern recognition

■Information security-related

- Information mathematics
- Cryptographic theory
- Network security

Skills to be acquired

Students will acquire knowledge of the IoT field and data analysis abilities. With these knowledge and skills, students can be expected to contribute to the development of robots and AI-equipped devices.

SE coursework model

■SE-related

- Software engineering
- Database
- Computer architecture

■Information technology-related

- Programming exercises
- Information engineering experiments
- Pattern recognition

■Information security-related

- Information mathematics
- Cryptographic theory
- Network security

Skills to be acquired

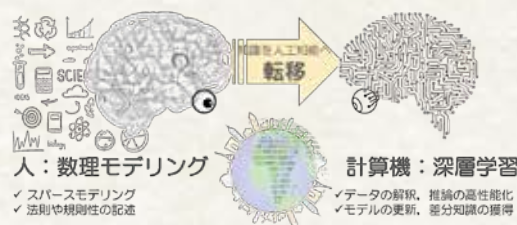
Students will acquire data analysis skills and information security skills. With these abilities, students can be expected to become active as system engineers equipped with high expertise demanded by society today.



Research Themes (Information Science Program)

Scientific Knowledge and Data-Integrated Research

Because we have scientific knowledge cultivated to this day, should AI just learn data? We are engaged in research that integrates existing scientific methods, which explain the composition of data with mathematical models expressing human knowledge, and the new methods of data science, as represented by deep learning. For example, a doctor must be able to explain the results of a data analysis that support the diagnosis. In such a case, data science grounded in human knowledge will be beneficial.



Next-Generation Computing

Underpinning the dramatic development of information technology in modern society is the sharp rise in the performance of computers themselves. However, going forward the conventional approach of simply extending computers' performance as in the past will be difficult. We are conducting research on realizing “soft” computers in which logical flexibility is introduced into their hardware structure. At the same time, we are also actually creating these computers.



Audio Signal Processing

Audio user interfaces like speech recognition are technologies that anyone can easily use. We are conducting integrated research on speech and language with the goal of creating man-machine interfaces using speech recognition and comprehension and dialogue systems. We are also conducting research on bioacoustic signal processing to identify, for example, healthy patients and patients with pulmonary illnesses using respiratory sounds obtained by auscultation and to infer information about an infant's condition using his or her crying sounds.



Image Processing and VR/AR/MR

As information devices become more advanced and improve in performance, technologies such as VR (Virtual Reality), AR (Augmented Reality), and MR (Mixed Reality) have become commonplace. These technologies can be used easily by anyone. We are conducting research on applied technologies using VR/AR/MR to support domains like rehabilitation medicine and tourism. In addition, due to the expansion of the Internet, the illegal distribution of images and video over networks has become an issue. We are researching digital watermarking as a solution to this problem.



In this program, students are trained to become data scientists who can analyze big data and contribute to the development of society.

Medical/healthcare information coursework model

■ Statistics-related

- Descriptive and exploratory statistics
- Information statistics
- Data analysis exercises

■ Medical/healthcare-related

- Medical/healthcare informatics
- Bioinformatics
- Healthcare

■ AI-related

- Big data analysis
- Statistical machine learning
- AI

Skills to be acquired

Students will acquire healthcare data analysis skills and the ability to connect their knowledge to healthcare research and policy.

Society and tourism coursework model

■ Statistics-related

- Descriptive and exploratory statistics
- Information statistics
- Data analysis exercises

■ Society and tourism information-related

- Society and tourism informatics
- Social policy/Behavioral science
- Application of VR/AR

■ AI-related

- Big data analysis
- Statistical machine learning
- AI

Skills to be acquired

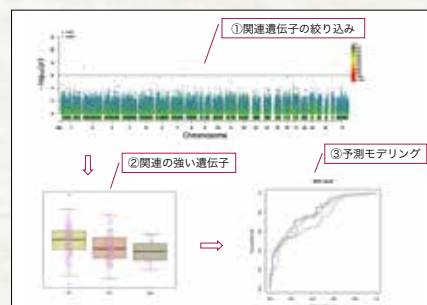
Students will acquire skills including Mathematical/Statistical data analysis techniques, composition and development of data analytic systems (programs), and methods of applying data analysis (management strategies, policy proposals, etc.).



Research Themes (Data Science Program)

Large-scale Genomic Data-based Predictive Modeling

We are developing mathematical models and algorithms for searching for genes relevant to predicting diseases from genomic data. First, strongly relevant genes are narrowed down from genomic data (1). Using the discovered genes (2), predictive modeling is performed (3). The development of algorithms makes use of extensive knowledge of mathematical statistics, biostatistics, genetics, and machine learning.



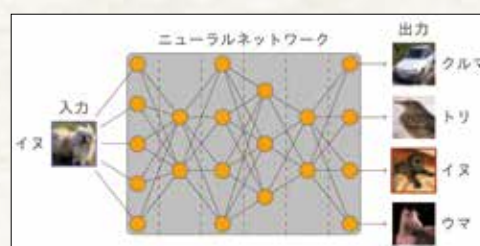
Overview of Nagasaki Prefecture Tourism Vitalization Support System

The figure below shows an information platform developed in cooperation with Nagasaki Prefecture and Nagasaki City for collecting and analyzing tourism-related big data. This system provides information for quick visualization, such as where tourists are staying and how long they stay in spots, in order to understand tourism trends. The information is based on smartphone log information and information available on the Web.



AI Mathematical Modeling

The term AI (artificial intelligence) was coined about 60 years ago. At present, its leading technology is mathematical models called neural networks (NNs). NNs model human brain functions. For example, when an image of a dog is entered as input, an NN program outputs, "This is an image of a dog." The (third) AI boom that began around 2000 may have finally subsided, but the technologies developed so far continue to be critical.



Unraveling the Mysteries of Antiquity with Information and Data Sciences

We are tackling the mystery of Egyptian pyramids, built about 4,500 years ago. We know almost nothing about these giant buildings constructed by humankind. How were the stones assembled? What were inside the pyramids? And, how were they designed? For ancient Egyptians, the design and construction of pyramids solved an unknown problem. Unraveling this mystery by humanity today will offer important clues for solving our own yet-unknown problems.



Digitization in the pyramid
(Photo by Yukinori KAWAE)



Giza Pyramid Survey



Let's See How Computers Think

Associate Professor Tomoya SAKAI

Areas of Research:
High-dimensional data science and its applications



Computers are just computers, as the name suggests. The key to solving problems with information technology is, therefore, to translate them into computational problems. It looks difficult, but it's not. AI, or the computation of pattern recognition and machine learning, is actually composed mostly of repetitions of simple arithmetic operations. Let's learn not only computer skills but also the expertise to provide IT solutions by understanding their underlying mechanisms to the fullest extent.

The Allure of Data Science

Associate Professor Yuta UMEZU

Areas of Research:
Post-model-selection statistical inference



I became interested in the world of data science when I felt, "Data analysis is actually useful!" after taking a class in mathematical statistics offered by the math department. I then joined a mathematical statistics lab, and have carrying out research in this field ever since. In 2012, *Harvard Business Review* said that being a data scientist was "the sexiest job" of the 21st century. Without data scientists, modern society would not be possible. Are you interested in experiencing the world of fascinating data science?

Data-based Decision Making

Associate Professor Yu ICHIFUJI

Areas of Research:
Tourism policy, data mining, crowd sensing



In an era that requires efficient allocation and distribution of limited tourism resources, budget, and personnel, understanding the current condition accurately is critical. How can we accomplish this, and how can we achieve better results from the current condition? Data science grapples with these challenges. Won't you experience data science and transform society?

To Future Information and Data Scientists

Professor Ichiroh KANAYA

Areas of Research:
Design studies, cultural asset science/museum studies,
cultural anthropology/folklore studies



The first science, 400 years ago, was created in large part by Galileo. It began with correct observations of phenomena. Eventually, mathematical methods advanced, and unknown phenomena could be predicted by theory. In the late 20th century, computer science was born. This gave rise today to the science of "information," which flows through network—that is, digital data. In other words, information and data sciences were born. Learn these new sciences, and one day you will create a new science. We are waiting for the next Galileo.

Data Science for Health and Medicine



We are advancing efforts to make healthcare big data useful for elucidating disease mechanisms, and furthermore, for the prevention and early diagnosis before onset. Statistics has traditionally played an important role in medicine. Going forward, we will develop statistics as medical data science that incorporates advanced technologies like machine learning and AI to handle complex big data. Health and medicine contains intimate challenges directly related to life. Tackling them is extremely rewarding, with the possibility of making great contributions to progress in this field, and furthermore, to our future. Won't you take on this challenge with us?

Professor Masao UEKI

Areas of Research:
Mathematic statistics,
statistical genetics, biostatistics

Making Learning a Science



We are exploring how to essentially confront “learning” while enjoying oneself. As a tool to accomplish this, we have developed a learning system that applies technologies like VR (Virtual Reality) and AR (Augmented Reality). Furthermore, we seek to clarify the challenges and effectiveness of our developed system and provide learning that is more effective. Our methods include analyzing learners’ biological information with analysis of speech and behavior during the learning process. Won't you come and develop exciting and attractive “learning” together with us at the School of Information and Data Sciences?

Associate Professor Norio SETOZAKI

Areas of Research:
Educational technology, science education

IoT/AI Integration



IT (Information Technology) has the great potential to solve the world's problems and bring happiness to people. Making this a reality requires skills to understand people's unseen needs and realize solutions. The Intelligent Robots Laboratory is advancing the research and development of new services useful to people. We do this by integrating AI and IoT (Internet of Things), which connects all things on a network. For example, we are researching SNS-mediated robots, which can communicate with the elderly who cannot use smartphones by using SNS (social networking services); telemedicine robots, which make possible diagnosis and treatment of dementia in patients living on remote islands with few doctors; and systems for automatically removing blue-green algae from lakes and marshes by using a network of drones and unmanned boat-type robots. Through these research efforts, we can understand the unseen needs of people and develop advanced IoT and AI-related technologies to address them.

Professor Toru KOBAYASHI

Area of Research: Intelligent robots

