For entrants in AY 2024

Appended Form 1

Specifications for the Major Program

Name of School(Program)〔School of Informatics and Data Science(Informatics and Data Science）〕

Program name (Japanese)	データ科学プログラム
（English）	Data Science Program

1. Degree to be obtained:

Bachelor of Science in Informatics and Data Science

2. Overview

Because the complexity of economics, society, and the environment is increasing due to rapid globalization, people with the ability to identify problems and find solutions on their own have become indispensable for various organizations. In addition, it is urgently required to develop people capable of efficiently processing and analyzing huge amounts of information and data, so-called "big data", and of developing strategies and plans for their organizations based on evidence. The educational program in the School of Information Science consists of three programs, "Computer Science Program," "Data Science Program," and "Intelligent Science Program," and aims to develop specialists who have profound knowledge and understanding for each specialized area, in addition to the basic knowledge and skills in the three programs.

The data/network environment in contemporary society has been rapidly developed. In particular, the amount of data is swelling rapidly (big data), data is becoming more heterogenic and increasing in variety (qualitative/quantitative data, audio, images, movies, documents, graph structures, etc.), and the travel distance and speed of data are dramatically expanding. In today's information science education, it is required to develop various abilities, such as advanced information processing technologies based on basic knowledge of computer science and programming, technologies for collecting, processing, and analyzing various data acquired through specialized knowledge of mathematics and statistics, and advanced technologies that lead to new knowledge creation and innovation to solve problems that mankind has not been able to solve in the past, as represented by artificial intelligence.

However, it is difficult to develop specialists in information science, which is currently required in many fields, by providing only superficial knowledge and skills commonly required in "Computer Science", "Data Science", and "Intelligent Science". This program aims to develop specialists with diversity who can sufficiently exercise their profound understanding and abilities in areas of "Computer Science", "Data Science," and "Intelligent Science," based on a hybrid background across the three major academic fields.

In this program, in the first year, all students take higher mathematics such as algebra and analysis, information mathematics, probability and statistics, and programming courses as the basis of information

science. From the second year, students are assigned to one of three programs according to their interests and aptitudes. In each program, basic specialized subjects essential for professional education are required, and specialized subjects that are assigned to be taken in order to further broaden knowledge are required as elective subjects and free electives. From the third year, students choose a model course that takes into account their own future career development while belonging to each program. In the "Basic Model Course", students aim to learn a wide range of knowledge from basic to advance through taking specialized lecture subjects in information science. In "Integrated Model Course " considering that information science and technology is essential in all academic fields and domains, students are expected to acquire the ability to play an active part in a wide range of fields, not limited to the field of information science, while having an academic background in information science. In "Practical Model Course," students reconsider their university studies and learn the practical knowledge and skills required in industry and society through long-term internships at companies.

All students can learn practical skills required in each program by taking the exercises of information science. In addition, English ability is essential for global human resources, regardless of whether they are highly-skilled professionals who lead their respective fields of specialization or highly-applied professionals who contribute to regional development and industrial development. In the third year, all students take a practical English course, which provides training in technical writing and communication, and cultivates the ability to play an active part in an increasingly globalized international society. Also, from the second year, the program offers practical, business-oriented courses in collaboration with external experts, cooperating companies, and local governments, and requires all students to take them as elective subjects, aiming to develop human resources with a broad perspective and an interest in research and development trends practiced in society without focusing on specialized fields.

In the fourth year, as a preparation for graduation thesis, students attend seminars provided in each program under the guidance of the faculty members who are engaged in instruction for the thesis. In the seminar, students have the opportunity to familiarize themselves with state-of-art results in the academic field through colloquiums on research papers and textbooks in the specialized area in order to learn and acquire the study methods in each area, the methods for identifying and solving problems, capabilities for literature based research, and presentation and communication skills required for discussion of the research. Students who choose the "Basic Model Course" and the "Integrated Model Course" take a graduation thesis and work on an advanced research theme using the specialized knowledge, skills, and abilities they have acquired through this program. For preparation of the graduation thesis, therefore, they are required to have not only knowledge of the specialized area but also an ability for research planning, a positive attitude, a cooperative mindset, and the capacity for continuous effort. This program educates students to comprehensively improve these capabilities in order to enable them to acquire the ability to identify and solve new problems on their own. Students who choose “Practical Model Course” apply the specialized knowledge, skills, and abilities acquired through this program to practical problem solving by taking the long-term fieldwork courses provided in the third and fourth years, and participate in off-campus research and development projects and survey fieldwork.

3. Diploma policy (policy for awarding degrees and goal of the program)

This school educates students to become specialists with advanced capabilities in each of computer science, data science and intelligent science, as well as the basic abilities that consist of processing techniques based on the information technology, which are the basis of the information-intensive society of today, as well as advanced data analysis capabilities. In addition, this school aims to develop people who are capable of appropriately managing, processing, and analyzing information that has swelled significantly, and become complicated, due to such phenomena as the accumulation of big data, technological breakthroughs in fields related to artificial intelligence (AI), and the development of the IoT.

This school will award the degree of Bachelor of Science in Informatics and Data Science to students who have acquired the knowledge and abilities described below, and earned the required credits defined for the educational course. The diploma policy of the department of information science, faculty of information science, which is common to all program, is as follows.

- To evenly acquire the skills related to the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.
- To acquire the ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis.
- To acquire the ability for reading and logical writing in English, capabilities required for giving a good, clear oral presentation, and documentation and communication skills that contribute to active discussion.

The following are the achievement goals for awarding the specified degree in this programs.

Achievement target A. Skills related to the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.

Achievement target B. Ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis.

Achievement target C1. Knowledge and capabilities required for solving problems, while understanding that various problems of human beings, societies, and individuals can be interpreted in different ways according to social conditions, culture, etc.

Achievement target C2. Skills for communication, reading, and writing in English, capabilities required for giving a good, clear oral presentation, and documentation and communication skills that contribute to active discussion.

Achievement target D1. Knowledge and skills required for understanding the theoretical system of statistics and data analysis, and for precisely and efficiently analyzing qualitative/quantitative information in big data.

Achievement target D2. Ability to develop strategies and plans for an organization based on statistical evidence by using a wide range of knowledge and skills related to data science.

Achievement target D3. Ability to examine social needs and issues which are interlinked in a complex manner, using a top-down view to solve the problems through quantitative and logical thinking based on data, diverse perspectives, and advanced skills in information processing and analysis.

Achievement target E. Creative and logical thinking ability for analyzing practical issues and challenges in order to provide rational solutions that match social needs, as well as the capability to realize these solutions.

4. Curriculum policy (policy for arranging and implementing the curriculum)

To enable students to achieve the targets that are defined for the school, the curricula are systematically organized as three educational programs, and implemented as advanced education based on the characteristics of each field. The curriculum policy of the department of information science, faculty of information science, which is common to all programs, is as follows.

In the first academic year, students take such subjects as peace science subjects and foreign language subjects in order to develop deep humanity, flexibility, and profound intelligence to foster the basic qualifications and abilities required for working globally in an international society. In addition, they acquire the knowledge and skills that constitute the basis of the specialized education in the fundamental subjects related to such things as mathematics, data analysis, and programming.

In the second academic year, each student selects one of "the computer science program," "the data science program," and "the intelligence science program." All students acquire the knowledge and skills that form the basis of each program, while taking subjects of programming, fundamental statistics, and information engineering.

In the third academic year, each student selects a model course based on own future carrier development, while taking more specialized subjects on the chosen program. In the Basic Model Course, students aim at learning wide range of knowledge from fundamentals to applications by taking specialized subjects in department of information and data science. In the Integrated Model Course, students will acquire the ability to work in a wide range of fields, not only in the information field, with an academic background in information science. Specifically, students are allowed to take subjects offered in other school of the university as compulsory elective subjects. In the Practical Model Course, students reconsider their university studies and learn the knowledge and skills required in the industrial world through experiences of long-term fieldwork in companies. Regardless of the three model courses, all students take practical English subjects to acquire the ability to play an active role in an increasingly globalized international society.

The seminars in the fourth academic year are required subjects, in which all students learn how to conduct research, discuss, and make advanced presentations. Students who have chosen the Basic Model Course develop the ability to solve highly specialized problems on their own by setting their own themes and completing their graduation theses using the specialized knowledge, skills, and abilities acquired through each program in the school of informatics and data science. Students who have chosen the Integrated Model Course receive guidance for their graduation thesis from faculty members of the school of informatics and other faculty members in other school, and aim to cultivate diverse abilities to utilize knowledge and skills of informatics and data science in various fields. Students who have chosen the model 実践履修モデル take long-term fieldworks instead of the graduation thesis, and participate in research and development projects and field surveys in companies for eight months to acquire practical skills that can be used immediately in society after graduation.

To enable students to achieve the targets that are defined for the program, the curriculum is organized

and implemented according to the policies described below. Academic achievement is evaluated based on the grade scores for the subjects and the level of achievement against the target defined for this program.

- In the first academic year, students take peace science courses (academic target C1), basic courses in university education (target C1 and E), common subjects (foreign languages and health and sports courses; target C1 and C2), basic subjects (mathematics, statistics, and programming; target A and B); as liberal arts education subjects and a part of specialized subjects.
- In the second academic year, all students acquire the knowledge and skills that from foundation of data science, while taking programming subjects and fundamental statistics and informatics subjects (achievement target A, B, D1, D2, D3). Furthermore, students acquire the knowledge and skills for solving the social problems through practical subjects (achievement target C1).
- In the third academic year, students acquire the basic theories and applied techniques of data analysis by taking specialized subjects such as data mining, survey design, nonparametric analysis, big data, behavioral econometrics, econometrics, and bio/medical statistics as related the traditional foundation of statistics. (achievement target A, B, C2, D1, D2, D3). Furthermore, students acquire the more practical knowledge and skills for solving the social problems through practical, business-oriented subjects (achievement target C1, E).
- In the fourth academic year, students prepare their graduation thesis or engage in long-term fieldwork, using capabilities corresponding to the achievement targets A to E that they have acquired in the data science program. The thesis or fieldwork is evaluated against the achievement targets A to E based on its degree of achievement and the presentation given at the presentation assembly.

5. Start time and acceptance conditions

In this program, students are assigned to a program at the end of the first year, and at the end of the second year, students are required to choose one of the following model courses: “Basic Model Course”, “Integrated Model Course” or “Practical Model Course”.

6. Obtainable qualifications

Educational personnel certification (Information teaching and Mathematics) is awarded to the students who earn which the required credits.

7. Class subjects and their contents

＊ For class subjects, refer to the subject table in Attachment 1. (The subject table is to be attached.)

＊ * For the details of the class subjects, refer to the syllabus that is published each academic year.

8. Academic Achievement

The evaluation criteria are specified for each evaluation item for academic achievement, and the achievement level against the criteria is designated at the end of the semester.

The evaluation score for each evaluation item is converted to a numerical value (S = 4, A = 3, B = 2, and C = 1) and the evaluation standard for academic achievement, from when the student entered the university to the end of the last semester, is determined using these values while applying weightings. The evaluation standards consist of three levels, i.e. Excellent, Very Good, and Good.

Academic achievement	Evaluation standard
Excellent	3.00 - 4.00
Very Good	2.00 - 2.99
Good	1.00 - 1.99

Achievement evaluation	Numerical conversion
S (Excellent: 90 or more points)	4
A (Very good: 80 - 89 points)	3
B (Good: 70 - 79 points)	2
C (Passed: 60 - 69 points)	1

＊ Refer to the relationship between evaluation items and evaluation criteria described in Attachment 2.

＊ Refer to the relationship between evaluation items and class subjects described in Attachment 3.

＊ Refer to the curriculum map in Attachment 4.

9. Graduation thesis (graduation research) (meaning, student allocation, timing, etc.)

○ Meaning

Graduation Thesis is a comprehensive subject in which students utilize the specialized knowledge, skills, and abilities that they have acquired in the Data Science Program to pursue an advanced research topic. To take this subject, therefore, they are required to have not only knowledge of the specialized area but also an ability for research planning, a positive attitude, a cooperative mindset, and the capacity for continuous effort. This program educates students in Basic Model Course or Integrated Model Course to comprehensively improve these capabilities in order to allow them to acquire the ability to identify and solve new problems on their own. Detailed objectives are as follows:

1. To acquire the ability to develop a research plan for their research objective on their own, and to carry out their research according to that plan.
2. To develop skills for collecting materials related to the research objective, understanding the objective, and identifying problems.
3. To develop capabilities for analyzing problems related to the research objective and providing solutions that match social needs.
4. To develop skills required for research activity related to reading, writing, and searching for information in English.
5. To develop documentation skills for organizing research results and describing the meaning and efficacy of the obtained results in logical and consistent text.

6. To develop presentation skills for delivering the research results clearly and orally, and communication skills for active discussion.

On the other hand, Students in Practical Model Course take the "Long-term fieldwork I" and "Long-term fieldwork II" instead of the graduation thesis, and participate in research and development projects and field surveys in companies which are specified by the department. This course cultivates the ability to understand practical issues that are being addressed in the real world and to solve those issues. Detailed objectives are as follows:

1. To acquire the ability to understand a given research question and to carry out their research according to research plan specified in the project.
2. To develop the knowledge and skills for solving the problems by understanding the materials and methodologies related to the research problem.
3. To develop capabilities for analyzing problems related to the research objective and providing solutions that match project needs.
4. To develop skills required for research activity related to reading, writing, and searching for information in English.
5. To develop documentation skills for organizing research results and describing the meaning and efficacy of the obtained results in logical and consistent text.
6. To develop presentation skills for delivering the research results clearly and orally, and communication skills for active discussion.

○ Student allocation method and timing

Requirements for starting the research for graduation thesis are defined in the Student Handbook.

Students in their fourth or senior year, who satisfy the requirements for starting the research for their graduation thesis, are allocated to a laboratory according to their wishes. The allocation method will be explained to the students at a briefing session that will be held before the allocation process. For students to be allocated to laboratories, an assembly and/or open laboratory event is held in February or March to show the details of research topics.

10. Responsibility

(1) Responsibility for PDCA (plan, do, check, and act) cycle

This program is executed by faculty members who support the education in the School of Informatics and Data Science. The dean of School of Informatics and Data Science takes on the responsibility for implementation of the program. It is mainly the academic affairs committee of the Informatics and Data Science Program and academic affairs members elected by the program that reviews and makes decisions related to the processes of the PDCA cycle (plan, do, check, and act) in the council of the School of Informatics and Data Science (this is held, in principle, on the first Thursday of every month). In some cases, a working group may be organized according to direction by the dean of School in order to intensively work on a case. When it is required to consider and take

some action in either of the program, members which are mainly engaged in the concerned course will take responsibility. In such a case, the dean of the school designates the person in charge.

(2) Evaluation of the program

○ Perspectives for evaluation of the program

- Are class subjects arranged appropriately, while considering the aims of study and education in this program? Are the contents of classes appropriate?
- Have students, on average, achieved the level that is required of them?
- Is the system for achieving an upward spiral in the program functioning according to an appropriate cycle?

○ Evaluation method

- Each subject in the program is evaluated based on student evaluation of the classes and achievement evaluation results.
- For evaluation of the upward spiral in quality of the program, questionnaires for students are conducted in an appropriate cycle, and the opinions of ex-students and companies are collected.

○ Policy and method for feedback to students

- For individual classes, the faculty member who is in charge of the class makes comments on the evaluation of the class and the achievement evaluation results.
- Actions taken, such as changes to the lecture and program structure, are published on the web site of School of Informatics and Data Science and/or another medium stating also the reason for the changes.

Sheet 1

Table of Registration Standards for Liberal Arts Education Subjects
Informatics and Data Science

◎ Required subject (period of registration specified)
○ Compulsory elective subject (any of these subjects shall be registered)

Subject Type					Required No. of Credits	Class Subjects, etc.	No. of Credits	Type of Course Registration	Year in Which the Subject is Taken(*The lower figure means semester) (Note 1)													
									1st year				2nd year				3rd year				4th year			
									1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Liberal Arts Education Subjects		Peace Science Courses			2	Peace Science Courses	2	Compulsory elective		○														
	Basic Courses in University Education	Introduction to University Education			2	Introduction to University Education	2	Required	◎															
		Introductory Seminar for First-Year Students			2	Introductory Seminar for First-Year Students	2	Required	◎															
		Advanced Seminar			0		1																	
	Common Subjects	Area Courses			4	Courses in Arts and Humanities/Social Sc (Note 6)	2	Compulsory elective		○		○		○		○								
					4	Courses in Natural Sciences	2	Compulsory elective	○		○		○		○									
		Foreign Languages (Note 4)	English (Note 2・3)	Basic English Usage	2	Basic English UsageI	1	Required		◎														
						Basic English UsageII	1					◎													
				Communication I	2	Communication IA	1	Required		◎														
						Communication IB	1			◎														
				Communication II	2	Communication IIA	1	Required				◎												
						Communication IIB	1					◎												
			Initial Foreign Languages (Select one language from German, French, Spanish, Russian, Chinese, Korean and Arabic)		2	Basic Foreign Language I	1	Compulsory elective	○															
						Basic Foreign Language II	1			○														
		Information and Data Science Courses			4	Introduction to Information and Data Sciences	2	Required		◎														
						Ground zero programming	2				◎													
		Health and Sports Courses			2		1or 2	Compulsory elective		○		○												
		Social Cooperation Courses			0		1or 2																	
	Basic Subjects				10	Elements of Calculus (Note 45)	2	Compulsory elective	○															
						Seminar in Basic Mathematics I (Note 5)	1				○													
						Seminar in Basic Mathematics II (Note 5)	1					○												
						CalculusI	2			◎														
						CalculusII	2				◎													
						Linear AlgebraI	2		◎															
						Linear AlgebraII	2				◎													
No. of Credits Required for Graduation					38																			

Note 1: If a student failed to earn the credit in the term or semester indicated with the mark "◎" or "○" in the column of "Academic year", it is allowed to take the subject in a following term or semester. It is required to confirm the semester in which the subject is provided in the class schedule for liberal arts education subjects that is published for every academic year, because some subjects might be provided in a term or semester other than that which is shown in this document.

Note 2: The credit for "Field Research in the English-speaking World" and that for "Online English Seminar I・II・III", that are earned through a program of self-study, are not accepted as the credit for graduation. However, a credit for foreign language study abroad might be accepted as that for "Basic English Usage I", "Basic English Usage II", or "Basic English Usage III" based on advance application. For the details, refer to the description regarding English subjects in liberal arts education in the Students Handbook.

Note 3:The credits of Area course and Social Cooperation course in English, which are gained more than required, could be counted as credits of English subjects.

Note 4:Achievement in Foreign Languages skill test might be accepted as a credit. For further details, refer to "Foreign Languages" and "Credit based on Achievement in Foreign Language Skill Test" in the section for liberal arts education.

Note 5: Students by the type A examination are required to take the subject "Elements of Calculus." Students by the type B examination are required to take the subjects "Seminar in Basic Mathematics I" and "Seminar in Basic Mathematics II". (It is desirable that also about students by the type A examination take the subjects "Seminar in Basic Mathematics I" and "Seminar in Basic Mathematics II".)

Note 6： In order to acquire the license of education personnel, students need to take two credits in "Japanese Constitutional Law."

Basic Specialized Subjects for Imformatics and Data Science
The Data Science Program

◎ Required subject
○ Compulsory elective subject
△ Free elective subject

Subject Type	Class Subjects	Credits	Type of model course			Class Hours/Week																Note
			Basic	Integrated	Practical	W				2nd year				3rd year				4th year				
						1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Specialized Subjects	Discrete Mathematics I	2	◎	◎	◎		4															
	Discrete Mathematics II	2	◎	◎	◎			4														
	Programming I	2	◎	◎	◎	2																
	Programming II	2	◎	◎	◎			2														
	Programming III	2	◎	◎	◎					2												
	Programming IV	2	◎	◎	◎							3										
	Theory of Automata and Languages	2	△	△	△					4												
	Digital Circuit Design	2	△	△	△							4										
	Programming Languages	2	○	○	○								4									
	Algorithms and Data Structures	2	○	○	○							4										
	Fundamentals of Probability Theory	2	◎	◎	◎				4													
	Inferential Statistics	2	◎	◎	◎					4												
	Linear Regression Model	2	◎	◎	◎						4											
	Statistical Test	2	◎	◎	◎						4											
	Stochastic Modeling	2	○	○	○								4									
	Numerical Computation	2	○	○	○								4									
	Mathematical Programming	2	○	○	○					4												
	System Optimization	2	○	○	○							4										
	Mathematical Analysis	2	○	○	○						4											
	Multivariate Analysis	2	○	○	○							4										
	Basic and practice in Categorical data analysis	2	○	○	○								4									
	Mechanism how programs run on computer	2	△	△	△								4									
	Operating Systems	2	△	△	△							4										
	Databases	2	△	△	△								4									
	Information Theory	2	△	△	△					~~4~~	4											
	Practical English I	1	◎	◎	◎									4								
	Practical English II	1	◎	◎	◎											4						
	Informatics and Data Science Exercise I	1	◎	◎	◎									3								
	Informatics and Data Science Exercise II	1	◎	◎	◎										3							
	Informatics and Data Science Exercise III	1	◎	◎												3						
	Informatics and Data Science Exercise IV	1	◎	◎													3					
	Software Engineering I	2	○	○	○										4							
	Software Engineering II	2	△	△	△											4						
	Theory of Computing	2	△	△	△									4								
	Image Processing	2	△	△	△										4							
	Visual Computing	2	△	△	△											4						
	Introduction to Artificial Intelligence	2	○	○	○					4							~~4~~					
	Computer Network	2	△	△	△												4					
	Human Computer Interaction	2	△	△	△											4						
	Parallel and Distributed Processing	2	△	△	△											Intensive course						
	Software Management	2	△	△	△										Intensive course							
	Natural Language Processing	2	△	△	△										4							
	Information Society and Security	2	△	△	△										4							
	Digital Signal Processing	2	△	△	△									4								
	Data Mining	2	○	○	○									4								
	Survey design	2	○	○	○									4								
	Nonparametric analysis	2	○	○	○										4							
	Big Data	2	○	○	○												4					
	Behaviormetrics	2	○	○	○									4								
	Econometrics	2	○	○	○										4							
	Time Series Analysis	2	○	○	○											4						
	Biostatistics	2	○	○	○												4					
	Stochastic Processes	2	○	○	○												4					
	Financial Engineering	2	○	○	○												4					
	Speech Recognition	2	△	△	△									4								
	Text Mining	2	○	○	○												4					
	Machine Learning	2	△	△	△							4										
	Reinforcement Learning	2	△	△	△										4							
	Decision-Making	2	○	○	○										4							
	Introduction to IoT	2	△	△	△												4					
	Biological Information Processing	2	○	○	○											4						
	Bioinformatics	2	○	○	○										4							
	Sparse Estimation	2	○	○	○									4								
	Advanced Programming	2	△	△	△												4					
	Neural Networks	2	△	△	△									4								
	Bayesian Statistics	2	○	○	○									4								
	Semiotic AI	2	○	○	○										4							
	Mathematical Statistics	2	○	○	○											4						
	FinTech	2	△	△	△										4							
	Quality Management	2	△	△	△												4					
	Computer Science Seminar I	1																4				
	Computer Science Seminar II	1																	4			
	Data Science Seminar I	1	◎	◎	◎													4				
	Data Science Seminar II	1	◎	◎	◎														4			
	Intelligence Science Seminar I	1																4				
	Intelligence Science Seminar II	1																	4			
	Graduation Thesis	3	◎	◎																6		
Practical Subjects	Information Processing and Industry	2	○	○	○					4												
	Data Science and Management	2	○	○	○							4										
	Frontier of Informatics and Data Science	2	○	○	○									4								
	Research Project	2	○	○	◎										4							
	Long-term Fieldwork I	3			◎											Intensive course						
	Long-term Fieldwork II	3			◎															Intensive course		

Academic Achievement in Educational Program for Computer Science Program

The Relationship between Evaluation Items and Evaluation Criteria

Academic Achievements			Evaluation Criteria		
Evaluation Items			Excellent	Very Good	Good
Knowledge & understanding	(1)	C1. Knowledge and ability to work on problem-solving after understanding that various issues existing in human beings, society, and individuals can be interpreted in multiple ways depending on social conditions and culture.	Have sufficient knowledge to fully understand the various problems and diversity of human beings, society, and individuals and how to address them.	Have standard knowledge for understanding various problems and the diversity of human beings, society, and individuals to a standard level and how to address them.	Understand various problems and diversity of human beings, society, and individuals to the minimum extent, and have the minimum knowledge to address them.
	(2)	D1. Knowledge and ability to understand the theoretical framework underlying computer science and to collect and process high-dimensional data through full use of information processing technology based on scientific logic.	Have sufficient knowledge to understand the theoretical framework of computer science and to collect and process high-dimensional data by making full use of information processing technology.	Have a standard understanding of the theoretical framework of computer science and the standard knowledge for collecting and processing high-dimensional data by making full use of information processing technology.	Understand the theoretical framework of computer science to a minimum extent, and have the minimum knowledge to collect and process high-dimensional data by making full use of information processing technology.
Ability & skills	(1)	A. Information infrastructure development technology, information processing technology, technology that analyzes data and creates new added value.	Have sufficient knowledge to fully acquire and utilize information infrastructure development technology, information processing technology, and technology that creates new added value by analyzing data.	Have standard knowledge to learn and utilize information infrastructure development technology, information processing technology, and technology that creates new added value by analyzing data.	Have minimum knowledge to learn and utilize information infrastructure development technology, information processing technology, and technology that creates new added value by analyzing data to the minimum extent.
	(2)	B. Ability to identify new problems independently and solve them through quantitative and logical thinking based on data, multifaceted perspectives, and advanced information processing and analysis.	Have sufficient knowledge to identify new problems independently and acquire sufficient abilities to solve problems through quantitative and logical thinking based on data, multifaceted perspectives, and advanced information processing and analysis.	Have standard knowledge to identify new problems independently and acquire standard abilities to solve problems through quantitative and logical thinking based on data, multifaceted perspectives, and advanced information processing and analysis.	Have minimum knowledge to identify new problems independently and acquire a minimum ability to solve problems through quantitative and logical thinking based on data, multifaceted perspectives, and advanced information processing and analysis.
	(3)	D3. Knowledge of hardware and software and programming ability to process data efficiently.	Have to fully acquire and utilize the knowledge of hardware and software and the programming ability to process data efficiently.	Have to acquire and utilize the knowledge of hardware and software and the programming ability to process data efficiently to the standard level.	Have to acquire and utilize the knowledge of hardware and software and the programming ability to process data efficiently to the minimum level.
Comprehensive capability	(1)	C2. English conversation, reading, and writing skills are necessary for conducting research, good oral presentation skills, documentation skills for open discussion, and communication skills.	Have sufficient knowledge to fully acquire and utilize the communication, presentation, and documentation abilities related to English necessary for conducting research efficiently.	Have standard knowledge to acquire and utilize the communication, presentation, and documentation abilities related to English necessary for conducting research to the standard level.	Have minimum knowledge to acquire and utilize the communication, presentation, and documentation abilities related to English necessary for conducting research to the minimum level.
	(2)	D2. Ability to derive optimal system solutions based on abundant cutting-edge information technologies for cross-sectoral issues in a diversified and complicated information society.	Have to acquire and utilize sufficient ability to guide optimal system solutions based on cutting-edge information technology for cross-sectoral issues in the information society.	Have to acquire and utilize standard abilities to guide optimal system solutions based on cutting-edge information technology for cross-sectoral issues in the information society.	Have to acquire and utilize the minimum ability to guide the optimum system solution based on the latest information technology for cross-sectoral issues in the information society.
	(3)	E. Creative and logical thinking ability to analyze practical problems/issues and derive rational solutions that meet the demands of society, and the ability to realize these solutions.	Have to acquire and utilize creative and logical thinking ability and sufficient ability to realize this solution to analyze practical problems and derive rational solutions that meet the demands of society.	Have to acquire and utilize creative and logical thinking ability and standard ability to realize this solution to analyze practical problems and derive rational solutions that meet the demands of society.	Have to acquire and utilize creative and logical thinking ability and the minimum ability to realize this solution to analyze practical problems and derive rational solutions that meet the demands of society.

Placement of the Liberal Arts Education in the Major Program

The liberal arts education in this program aims to build the academic foundation required for specialized education. Students take such subjects as a foreign language and disciplinary subjects to develop deep humanity, flexibility, and profound intelligence to foster the essential qualifications and abilities required for working globally in international society. In addition, they acquire the knowledge and skills that constitute the basis of specialized education in fundamental subjects such as Mathematics and Statistical data analysis.

Relationships between the Evaluation Items and Class Subjects

Subject Type	Class Subjects	Credits	Grade	Evaluation items																Total weighted values of evaluation items in the subject
				Knowledge and Understanding				Abilities and Skills						Comprehensive Abilities						
				(1) C1		(2) D1		(1) A		(2) B		(3) D3		(1) C2		(2) D2		(3) E		
				Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	Weighted values of evaluation items in the subject	Weighted values of evaluation items	
Liberal Arts Education	Introduction to University Education	2	1st grade	100	1															100
Liberal Arts Education	Introductory Seminar for First-Year Students	2	1st grade	25	1			25	1	25	1							25	1	100
Liberal Arts Education	Peace Science Courses	2	1st grade	100	1															100
Liberal Arts Education	Area Courses	8	1st grade	100	1															100
Liberal Arts Education	Basic English Usage Ⅰ	1	1st grade											100	1					100
Liberal Arts Education	Basic English Usage Ⅱ	1	1st grade											100	1					100
Liberal Arts Education	Communication ⅠA	1	1st grade											100	1					100
Liberal Arts Education	Communication ⅠB	1	1st grade											100	1					100
Liberal Arts Education	Communication ⅡA	1	1st grade											100	1					100
Liberal Arts Education	Communication ⅡB	1	1st grade											100	1					100
Liberal Arts Education	Basic Foreign Languages Ⅰ	2	1st grade											100	1					100
Liberal Arts Education	Basic Foreign Languages Ⅱ	2	1st grade											100	1					100
Liberal Arts Education	Introduction to Information and Data Sciences	2	1st grade					50	1	50	1									100
Liberal Arts Education	Ground zero programming	2	1st grade					50	1	50	1									100
Liberal Arts Education	Health and Sports Course	2	1st grade	100	1															100
Liberal Arts Education	Elements of Calculus	2	1st grade					50	1	50	1									100
Liberal Arts Education	Seminar in Basic Mathematics Ⅰ	1	1st grade					50	1	50	1									100
Liberal Arts Education	Seminar in Basic Mathematics Ⅱ	1	1st grade					50	1	50	1									100
Liberal Arts Education	Calculus Ⅰ	2	1st grade					50	1	50	1									100
Liberal Arts Education	CalculusⅠⅡ	2	1st grade					50	1	50	1									100
Liberal Arts Education	Linear Algebra Ⅰ	2	1st grade					50	1	50	1									100
Liberal Arts Education	Linear Algebra Ⅱ	2	1st grade					50	1	50	1									100
Specialized Education	Discrete Mathematics Ⅰ	2	1st grade					50	1	50	1									100
Specialized Education	Discrete Mathematics Ⅱ	2	1st grade					50	1	50	1									100
Specialized Education	Programming Ⅰ	2	1st grade					50	1	50	1									100
Specialized Education	Programming Ⅱ	2	1st grade					50	1	50	1									100
Specialized Education	Programming Ⅲ	2	2nd grade					50	1	50	1									100
Specialized Education	Programming Ⅳ	2	2nd grade					50	1	50	1									100
Specialized Education	Theory of Automata and Languages	2	2nd grade					50	1	50	1									100
Specialized Education	Digital Circuit Design	2	2nd grade					50	1	50	1									100
Specialized Education	Programming Languages	2	2nd grade					50	1	50	1									100
Specialized Education	Algorithms and Data Structures	2	2nd grade					50	1	50	1									100
Specialized Education	Fundamentals of Probability Theory	2	1st grade			34	1	33	1	33	1									100
Specialized Education	Inferential Statistics	2	2nd grade			34	1	33	1	33	1									100
Specialized Education	Linear Regression Model	2	2nd grade			34	1	33	1	33	1									100
Specialized Education	Statistical Test	2	2nd grade			34	1	33	1	33	1									100
Specialized Education	Stochastic Modeling	2	2nd grade									100	1							100
Specialized Education	Numerical Computation	2	2nd grade					50	1	50	1									100
Specialized Education	Mathematical Programming	2	2nd grade													100	1			100
Specialized Education	System Optimization	2	2nd grade					50	1	50	1									100
Specialized Education	Mathematical Analysis	2	2nd grade					50	1	50										100
Specialized Education	Multivariate Analysis	2	2nd grade			100	1													100
Specialized Education	Basic and practice in Categorical data analysis	2	2nd grade													100	1			100
Specialized Education	Mechanism how programs run on computer	2	2nd grade					100	1											100
Specialized Education	Operating Systems	2	2nd grade					100	1											100
Specialized Education	Databases	2	2nd grade					100	1											100
Specialized Education	Information Theory	2	2nd grade					50	1	50	1									100
Specialized Education	Practical English Ⅰ	1	3rd grade											100	1					100
Specialized Education	Practical English Ⅱ	1	3rd grade											100	1					100

				Evaluation items																Values of in the
				Knowledge and Understanding				Abilities and Skills						Comprehensive Abilities						
				(1) C1		(2) D1		(1) A		(2) B		(3) D3		(1) C2		(2) D2		(3) E		
Specialized Education	Informatics and data science, Exercise Ⅰ	1	3rd grade			34	1	33	1	33	1									100
Specialized Education	Informatics and data science, Exercise Ⅱ	1	3rd grade			34	1	33	1	33	1									100
Specialized Education	Informatics and data science, Exercise Ⅲ	1	3rd grade			34	1	33	1	33	1									100
Specialized Education	Informatics and data science, Exercise Ⅳ	1	3rd grade			34	1	33	1	33	1									100
Specialized Education	Software Engineering Ⅰ	2	3rd grade					100	1											100
Specialized Education	Software Engineering Ⅱ	2	3rd grade					100	1											100
Specialized Education	Theory of Computing	2	3rd grade					100	1											100
Specialized Education	Image Processing	2	3rd grade					100	1											100
Specialized Education	Visual Computing	2	3rd grade					100	1											100
Specialized Education	Introduction to Artificial Intelligence	2	2nd grade			50	1	50	1											100
Specialized Education	Computer Network	2	3rd grade					100	1											100
Specialized Education	Human Computer Interaction	2	3rd grade					100	1											100
Specialized Education	Parallel and Distributed Processing	2	3rd grade					100	1											100
Specialized Education	Software Management	2	3rd grade					100	1											100
Specialized Education	Natural Language Processing	2	3rd grade					100	1											100
Specialized Education	Information Society and Security	2	3rd grade													100	1			100
Specialized Education	Digital Signal Processing	2	3rd grade					100												100
Specialized Education	Data Mining	2	3rd grade			50	1	50	1											100
Specialized Education	Survey design	2	3rd grade									100	1							100
Specialized Education	Nonparametric analysis	2	3rd grade			50	1	50	1											100
Specialized Education	Big Data	2	3rd grade					50	1							50	1			100
Specialized Education	Behaviormetrics	2	3rd grade			100	1													100
Specialized Education	Econometrics	2	3rd grade													100	1			100
Specialized Education	Time Series Analysis	2	3rd grade									100	1							100
Specialized Education	Biostatistics	2	3rd grade													100	1			100
Specialized Education	Stochastic Processes	2	3rd grade													100	1			100
Specialized Education	Financial Engineering	2	3rd grade													100	1			100
Specialized Education	Speech Recognition	2	3rd grade					50	1	50	1									100
Specialized Education	Text Mining	2	3rd grade					50	1	50	1									100
Specialized Education	Machine Learning	2	2nd grade			34	1	33	1	33	1									100
Specialized Education	Reinforcement Learning	2	3rd grade			34	1	33	1	33	1									100
Specialized Education	Decision-Making	2	3rd grade							33	1	33	1			34	1			100
Specialized Education	Introduction to IoT	2	3rd grade					100	1											100
Specialized Education	Biological Information Processing	2	3rd grade					50	1	50	1									100
Specialized Education	Bioinformatics	2	3rd grade			34	1	33	1	33	1									100
Specialized Education	Sparse Estimation	2	3rd grade			34	1	33	1	33	1									100
Specialized Education	Advanced Programming	2	3rd grade					50	1	50	1									100
Specialized Education	Neural Networks	2	3rd grade					50	1	50	1									100
Specialized Education	Bayesian Statistics	2	3rd grade			34	1	33	1	33	1									100
Specialized Education	Semiotic AI	2	3rd grade					50	1	50	1									100
Specialized Education	Mathematical Statistics	2	3rd grade			34	1	33	1	33	1									100
Specialized Education	FinTech	2	3rd grade													100	1			100
Specialized Education	Quality Management	2	3rd grade													100	1			100
Specialized Education	Computer Science Seminar Ⅰ	1	4th grade			33	1					33	1			34	1			100
Specialized Education	Computer Science Seminar Ⅱ	1	4th grade			33	1					33	1			34	1			100
Specialized Education	Graduation thesis	3	4th grade									50	1					50	1	100
Practical Subjects	Information Processing and Industry	2	2nd grade	100	1															100
Practical Subjects	Data Science and Management	2	2nd grade	100	1															100
Practical Subjects	Frontier of Informatics and Data Science	2	3rd grade	100	1															100
Practical Subjects	Research Project	2	3rd grade	100	1															100
Practical Subjects	Long-term Fieldwork Ⅰ	3	3rd grade															100	1	100
Practical Subjects	Long-term Fieldwork Ⅱ	3	4th grade															100	1	100

Curriculum Map of Data Science Program

	Academic Achievement Evaluation Itemas	1st grade Spring	1st grade Fall	2nd grade Spring	2nd grade Fall	3rd grade Spring	3rd grade Fall	4th grade Spring	4th grade Fall
Knowledge and Understandings	(1) C1. Knowledge and capabilities required for solving problems, while understanding that various problems of human beings, societies, and individuals can be interpreted in different ways according social conditions, cultures, etc.	(1T)Introduction to University Education(◎)		(1T)Information Processing and Industry(○)	(3T)Data Science and Management(○)	(1T)Frontier of Informatics and Data Science(○)			
		(1T)Introductory Seminar for First-Year Students(◎)				(2T)Research Project (○)			
		(1T)Area courses(○)							
		(1T)Health and Sports Courses(○)							
		(2T)Peace Science Courses(○)							
	(2) D1. Knowledge and skills required for understanding the theoretical system of statistics and data analysis, and for precisely and efficiently analyzing qualitative/quantitative information in big data.		(4T)Fundamentals of Probability Theory(◎)	(1T)Inferential Statistics(◎)	(3T)Multivariate Analysis(○)	(1T)Data Mining(○)	(3T)Informatics and data science, Exercise Ⅲ(◎)	(1T)Data Science Seminar I(◎)	
				(2T)Statistical Test(◎)	(3T)Machine Learning(△)	(1T)Informatics and data science, Exercise Ⅰ(◎)	(4T)Informatics and data science, Exercise Ⅳ(◎)	(2T)Data Science Seminar II(◎)	
				(2T)Linear Regression Model(◎)		(2T)Nonparametric analysis(○)	(3T)Mathematical Statistics(○)		
				(1T)Introduction to Artificial Intelligence(○)		(1T)Behaviormetrics(○)			
						(2T)Informatics and data science, Exercise Ⅱ(◎)			
						(2T)Reinforcement Learning(△)			
						(2T)Bioinformatics(○)			
						(1T)Sparse Estimation(○)			
						(1T)Bayesian Statistics(○)			
and Skills	(1) A. Skills related to the development of an information infrastructure, information processing techniques, and technology for producing new added value through data analysis.	(1T)Elements of Calculus(○)	(3T)Seminar in Basic Mathematics I(○)	ProgrammingⅢ(◎)	ProgrammingⅣ(◎)	(1T)Informatics and data science, Exercise Ⅰ(◎)	(3T)Informatics and data science, Exercise Ⅲ(◎)		
		(1T)Introductory Seminar for First-Year Students(◎)	(4T)Seminar in Basic Mathematics II(○)	(1T)Inferential Statistics(◎)	(3T)Digital Circuit Design(△)	(1T)Theory of Computing(△)	(4T)Informatics and data science, Exercise Ⅳ(◎)		
		(1T)Linear AlgebraI(◎)	(3T)CalculusII(◎)	(1T)Theory of Automata and Languages(△)	(3T)Algorithms and Data Structures(○)	(1T)Data Mining(○)	(3T)Visual Computing(△)		
		(2T)CalculusI(◎)	(3T)Linear AlgebraII(◎)	(1T)Information Theory(△)	(3T)Operating Systems(△)	(2T)Software Engineering Ⅰ(○)	(3T)Human Computer Interaction(△)		
		(2T)Introduction to Information and Data Sciences(◎)	(3T)Ground zero programming(◎)	(2T)Statistical Test(◎)	(3T)System Optimization(○)	(1T)Digital Signal Processing(△)	(3T)Parallel and Distributed Processing(△)		
		(2T)Discrete Mathematics I(◎)	(3T)Discrete Mathematics Ⅱ(◎)	(2T)Linear Regression Model(◎)	(4T)Programming Languages(○)	(2T)Informatics and data science, Exercise Ⅱ(◎)	(4T)Computer Network(△)		
		Programming I(◎)	(4T)Fundamentals of Probability Theory(◎)	(2T)Mathematical Analysis(○)	(4T)Numerical Computation(○)	(2T)Nonparametric analysis(○)	(4T)Big Data(○)		
			Programming Ⅱ(◎)	(1T)Introduction to Artificial Intelligence(○)	(4T)Mechanism how programs run on computer(△)	(2T)Image Processing(△)	(3T)Software EngineeringⅡ(△)		
					(4T)Databases(△)	(2T)Natural Language Processing(△)	(4T)Text Mining(○)		
					(3T)Machine Learning(△)	(2T)Software Management(△)	(4T)Introduction to IoT(△)		
						(1T)Speech Recognition(△)	(3T)Biological Information Processing(○)		
						(2T)Reinforcement Learning(△)	(4T)Advanced Programming(△)		
						(2T)Bioinformatics(○)	(3T)Mathematical Statistics(○)		
						(1T)Sparse Estimation(○)			
						(1T)Neural Networks(△)			
						(1T)Bayesian Statistics(○)			
						(2T)Semiotic AI(○)			
		(1T)Introductory Seminar for First-Year Students(◎)	(3T)Seminar in Mathematics Ⅰ(○)	ProgrammingⅢ(◎)	ProgrammingⅣ(◎)	(1T)Informatics and data science, Exercise Ⅰ(◎)	(3T)Informatics and data science, Exercise Ⅲ(◎)		

Academic Achievement Evaluation Itemas		1st grade		2nd grade		3rd grade		4th grade	
		Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Abilities	(2) B. Ability to identify and solve new problems on their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis.	(1T)Elements of Calculus(○)	(4T)Seminar in Mathematics Ⅱ(○)	(1T)Inferential Statistics(◎)	(3T)Digital Circuit Design(△)	(2T)Informatics and data science, Exercise Ⅱ(◎)	(4T)Informatics and data science, Exercise Ⅳ(◎)		
		(2T)Calculus Ⅰ(◎)	(3T)Calculus Ⅱ(◎)	(1T)Theory of Automata and Languages(△)		(1T)Speech Recognition(△)	(4T)Text Mining(○)		
		(1T)Linear Algebra Ⅰ(◎)	(3T)Linear Algebra Ⅱ(◎)	(1T)Information Theory(△)		(2T)Reinforcement Learning(△)	(3T)Biological Information Processing(○)		
		(2T)Introduction to Information and Data Sciences(◎)	(3T)Ground zero programming(◎)	(2T)Statistical Test(◎)		(2T)Decision-Making(○)	(4T)Advanced Programming(△)		
		(2T)Discrete MathematicsⅠ(◎)	(3T)Discrete MathematicsⅡ(◎)	(2T)Linear Regression Model(◎)		(2T)Bioinformatics(○)	(3T)Mathematical Statistics(○)		
		Programming Ⅰ(◎)	(4T)Fundamentals of Probability Theory(◎)	(2T)Mathematical Analysis(○)		(1T)Sparse Estimation(○)			
			Programming Ⅱ(◎)		(3T)Algorithms and Data Structures(○)	(1T)Neural Networks(△)			
					(3T)System Optimization(○)	(1T)Bayesian Statistics(○)			
					(4T)Programming Languages(○)	(2T)Semiotic AI(○)			
					(4T)Numerical Computation(○)				
					(3T)Machine Learning(△)				
	(3)D2. Ability to take charge of organizational strategy and planning based on statistical evidence by making full use of a wide range of knowledge and techniques in data science.				(4T)Stochastic Modeling (○)	(1T)Survey design(○)	(3T)Time Series Analysis(○)	(1T)Data Science Seminar I(◎)	
						(2T)Decision-Making(○)		(2T)Data Science Seminar II(◎)	
Comprehensive Abilities	(1) C2. Skills for communication, reading, and writing in English, capabilities required for giving a good, clear oral presentation, and documentation and communication skills that contribute to active discussion.	Basic English Usage Ⅰ(◎)	Basic English Usage Ⅱ(◎)			(1T)Practical English I(◎)	(3T)Practical English Ⅱ(◎)		Graduation Thesis(◎)
		Communication ⅠA(◎)	Communication ⅡA(◎)						
		Communication ⅠB(◎)	Communication ⅡB(◎)						
		(1T)Basic Foreign Languages Ⅰ(○)							
		(2T)Basic Foreign Languages Ⅱ(○)							
	(2)D3. Ability to overlook social needs and issues that are intertwined in a complex manner and to solve issues with quantitative and logical thinking based on data, a multifaceted perspective, and advanced information analysis ability.			(1T)Mathematical Programming(○)	(2T)Basic and practice in Categorical data analysis(○)	(2T)Econometrics(○)	(4T)Biostatistics(○)	(1T)Data Science Seminar I(◎)	
						(2T)Information Society and Security(△)	(4T)Big Data(○)	(2T)Data Science Seminar II(◎)	
						(2T)Decision-Making(○)	(4T)Stochastic Processes(○)		
						(2T)FinTech(△)	(4T)Financial Engineering(○)		
							(4T)Quality Management(△)		
	(3) E. Creative and logical thinking ability for analyzing practical issues and challenges in order to provide rational solutions that match social needs, as well as the capability to realize these solutions.	(1T)Introductory Seminar for First-Year Students(◎)					Long-term Fieldwork I(◎)		Graduation Thesis(◎)
									Long-term Fieldwork II(◎)

Academic Achievement	1st grade		2nd grade		3rd grade		4th grade	
Evaluation Itemas	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Ex)					Liberal Arts Education	Specialized Subjects	Graduation Thesis	Practical Subjects