For entrants in AY 2024

Appended Form 1

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.

This program develops specialists who have hybrid capabilities regarding data science and informatics and, are capable of solving individual problems in each academic field. In other words, this program aims to develop specialists who have profound knowledge and understanding for each specialized area, in addition to the basic knowledge and skills in data science and informatics.

The data/network environment in contemporary society has been rapidly developed over the last 20 years. 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 data science education, therefore, it is required to develop not only expertise in statistics and mathematics, which has been provided in conventional education, but also the ability to collect, process, and analyze various data using advanced information processing technologies and algorithms in order to contribute to the creation of new knowledge and decision making.

However, it is difficult to develop specialists who can work in both fields of data science and informatics by providing only superficial knowledge and skills in those fields, since the two fields have become highly specialized and fragmented. This program aims to develop specialists who can exercise profound understanding and ability in areas of data analysis and system development based on hybrid capabilities in both academic fields.

In this program, up to the second year, all students take the subjects of information mathematics that constitute the basics of information science, as well as core subjects such as probability, statistics, computer science, and applied mathematics. The core subjects are required for both courses, and all subjects are designated as required, or elective required subjects. In the second academic year, students

take common basic subjects in information science to establish a foundation for study after choosing their course, and to obtain the knowledge required for choosing a course and/or career after graduation.

In the third year, they choose either the data science or the informatics course according to their own interest and aptitude. This program provides such a complex curriculum for the early stages of education in the undergraduate school in order to develop people who have a broad perspective that covers multiple fields, as well as a high level of capabilities as specialists in their own field.

(Data science course)

The data science course is organized in a way that attaches importance to data analysis based on statistics, and consists of academic fields related to the development of specialists, such as data analysts and information service analysts, who are engaged in processing and analysis of huge amounts of information such as big data and high-dimensional data. In this course, students learn the system of knowledge and skills for solving high-dimensional, data-based problems by fully exercising their knowledge of statistics and skills in information processing. Through this process, this course educates students to be able to solve problems by quantitative and logical thinking based on data, to use diverse points of view and advanced information processing capabilities, and to understand the theoretical system of statistics and data analysis in order to precisely and efficiently analyze various information.

(Informatics course)

The informatics course aims to educate students to study basic and systematic knowledge and skills related to data analysis, and to systematically learn computer software and architecture, operating systems, computer networking, and information processing technologies in various media to enable them to become system engineers who support the basis of the information-intensive society of today. In addition, this course educates students to study subjects related to the structure and development of information processing systems, parallel distributed processing and machine learning, intelligent calculation such as data mining, data analysis, and model construction using network systems, in order to develop information service engineers who can provide the most appropriate system solutions based on many forms of information technology.

In the fourth year, as a preparation for graduation thesis, students attend seminars provided in both the data science course and the informatics course 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. In preparing their graduation thesis, students use the specialized knowledge, skills, and abilities that they have acquired in the Informatics and Data Science Program to pursue an advanced research topic. 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. Specifically, students individually define a research topic related to data science or informatics. Also, students are engaged in research,

skills, and abilities that they have acquired in the Informatics and 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 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.

○ 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 Informatics and Data Science Program. The dean of School of Informatics and Data Science takes on the responsibility for implementation of the program. It is mainly the Informatics and Data Science Program committee 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 courses, laboratories 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 structure of the program, are published on the web site of School of Informatics and Data Science and/or another medium with the reason.

Sheet 1

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

				1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2	Peace Science Courses	2	Compulsory elective																
2	Introduction to University Education	2	Required																
2	Introductory Seminar for First-Year Students	2	Required																
0		1																	
4																			

Basic Specialized Subjects for Imformatics and Data Science

Required subject
Compulsory elective subject
Free elective subject

Subject Type	Class Subjects	Credits	Type of course registration			Class Hours/Week															Note
						1st year				2nd year				3rd year				4th year			
			Computer Science	Data Science	Intelligence Science	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	2						4													
	Programming I	2				2															
	Programming	2							2												
	Programming	2								2											
	Programming	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	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		△												[illegible]					
	Software Management	2		△											[illegible]						
	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 Informatics and Data Science Program
The Relationship between Evaluation Items and Evaluation Criteria

Academic Achievements		Evaluation Items	Evaluation Criteria		
			Excellent	Very Good	Good
Knowledge & understanding	(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.	Fully understands various problems related to human beings, societies, and individuals and their variety, and has a sufficient level of knowledge required for solving these problems.	Understands various problems related to human beings, societies, and individuals and their variety at a standard level, and has a standard level of knowledge required for solving these problems.	Understands various problems related to human beings, societies, and individuals and their variety at a minimum level, and has a minimum level of knowledge required for solving these problems.
	(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.	Fully understands the theoretical system of statistics and data analysis, and has sufficient knowledge for precisely and efficiently analyzing big data.	Understands the theoretical system of statistics and data analysis at a standard level, and has a standard level of knowledge for precisely and efficiently analyzing big data.	Understands the theoretical system of statistics and data analysis at a minimum level, and has a minimum level of knowledge for precisely and efficiently analyzing big data.
	(3)	I1. Knowledge and ability required for collecting and processing high-dimensional data using information processing technologies based on scientific logic, while understanding the theoretical system that forms the basis of informatics.	Has sufficient knowledge required for collecting and processing high-dimensional data using information processing technologies, while fully understanding the theoretical system of informatics.	Has a standard level of knowledge required for collecting and processing high-dimensional data using information processing technologies, while having a standard level of understanding on the theoretical system of informatics.	Has a minimum level of knowledge required for collecting and processing high-dimensional data using information processing technologies, while having a minimum level of understanding on the theoretical system of informatics.
Ability & 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.	Has fully acquired skills and is capable of exercising them regarding the development of an information infrastructure,information processing techniques, and technology for producing new added value through data analysis.	Has acquired skills and is capable of exercising them at a standard level regarding the development of an information infrastructure,information processing techniques, and technology for producing new added value through data analysis.	Has acquired skills and is capable of exercising them at a minimum level regarding the development of an information infrastructure,information processing techniques, and technology for producing new added value through data analysis.
	(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.	Has acquired a sufficient level of ability to identify and solve new problems their own by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information processing and analysis, and is capable of exercising this ability.	Has acquired a standard level of 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, and is capable of exercising this ability.	Has acquired a minimum level of 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, and is capable of exercising this ability.
	(3)	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.	Has acquired a sufficient level of ability to develop strategies and plans for an organization based on statistical evidence by using knowledge and skills related to data science, and is capable of exercising this ability.	Has acquired a standard level of ability to develop strategies and plans for an organization based on statistical evidence by using knowledge and skills related to data science, and is capable of exercising this ability.	Has acquired a minimum level of ability to develop strategies and plans for an organization based on statistical evidence by using knowledge and skills related to data science, and is capable of exercising this ability.
	(4)	I3. Knowledge related to hardware and software, and the programming skills required for efficiently processing data.	Has acquired knowledge regarding hardware and software, and the programming skills required for efficiently processing data at a sufficient leve,l and is capable of exercising these skills.	Has acquired knowledge regarding hardware and software, and the programming skills required for efficiently processing data at a standard level, and is capable of exercising these skills.	Has acquired knowledge regarding hardware and software, and the programming skills required for efficiently processing data at a minimum level, and is capable of exercising these skills.

Comprehensive capability	(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.	Has acquired skills for communication in English, and the presentation and documentation skills required for research activities at a sufficient level, and is capable of exercising these skills.	Has acquired skills for communication in English, and the presentation and documentation skills required for research activities at a standard level, and is capable of exercising these skills.	Has acquired skills for communication in English, and the presentation and documentation skills required for research activities at a minimum level, and is capable of exercising these skills.
	(2)	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.	Has acquired the ability to solve problems by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information analysis at a sufficient level, and is capable of exercising these skills.	Has acquired the ability to solve problems by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information analysis at a standard level, and is capable of exercising these skills.	Has acquired the ability to solve problems by quantitative and logical thinking based on data, diverse perspectives, and advanced skills for information analysis at a minimum level, and is capable of exercising these skills.
	(3)	I2. Ability to provide the most appropriate system solution to a cross-sectional problem in the diversified and complicated information society based on the many forms of cutting edge information technology.	Has a sufficient level of ability to provide the most appropriate system solution to a cross-sectional problem in the information society based on the many forms of cutting edge information technology, and is able to exercise this ability.	Has a standard level of ability to provide the most appropriate system solution to a cross-sectional problem in the information society based on the many forms of cutting edge information technology, and is able to exercise this ability.	Has a minimum level of ability to provide the most appropriate system solution to a cross-sectional problem in the information society based on the many forms of cutting edge information technology, and is able to exercise this ability.
	(4)	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.	Has acquired a sufficient level of ability for creative and logical thinking required for analyzing practical issues and challenges to provide a rational solution that matches social needs, as well as the capabilities for realizing the solution, and is capable of exercising this ability.	Has acquired a standard level of ability for creative and logical thinking required for analyzing practical issues and challenges to provide a rational solution that matches social needs, as well as the capabilities for realizing the solution, and is capable of exercising this ability.	Has acquired a minimum level of ability for creative and logical thinking required for analyzing practical issues and challenges to provide a rational solution that matches social needs, as well as the capabilities for realizing the solution, and is capable of exercising this ability.

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 the specialized education. Students take such subjects as foreign language subjects and disciplinary 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 and statistical data analysis.

□□□□□□□□

Specialized Education		1	3rd grade							33	1	33	1			34	1									100
Specialized Education		1	3rd grade							33	1	33	1			34	1									100
Specialized Education		1	3rd grade			34	1			33	1	33	1													100
Specialized Education	Informatics and data science,	1	3rd grade			34	1			33	1	33	1													100
Specialized Education	Theory of Computing	2	3rd grade					50	1	50	1															100
Specialized Education	Image Processing	2	3rd grade													100	1									100
Specialized Education	Visual Computing	2	3rd grade													100	1									100
Specialized Education	Artificial Intelligence and Machine Learning	2	3rd grade					100	1																	100
Specialized Education	Computer Network	2	3rd grade							50	1					50	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	Data Mining	2	3rd grade			50	1			50	1															100
Specialized Education		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	Biomedical Statistics	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	Data Analysis for Medical and Welfare Policies	2	3rd grade											100	1											100
Specialized Education	Society and Data Analysis	2	3rd grade																			100	1			100
Specialized Education	Total Quality Management and Data Analysis	2	3rd grade																			100	1			100
Specialized Education	Education Policy and Data Analysis	2	3rd grade											100	1											100
Specialized Education		1	4th grade			33	1							33	1							34	1			100
Specialized Education		1	4th grade			33	1							33	1							34	1			100
Specialized Education		1	4th grade					33	1							33	1							34	1	100
Specialized Education		1	4th grade					33	1							33	1							34	1	100
Specialized Education	Graduation thesis	3	4th grade											50	1									50	1	100

Curriculum Map of Informatics and 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)Introductory Seminar for First-Year Students (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 (2T)Statistical Test ◎ (2T)Linear Regression Model	(3T)Multivariate Analysis	(1T)Data Mining (2T)Nonparametric analysis (2T)Behaviormetrics	(3T)Informatics and data science, Exercise (4T)Informatics and data science, Exercise	(1T)Data Science Seminar I (2TData Science Seminar	
	(3) I1.Knowledge and ability required for collecting and processing high-dimensional data using information processing technologies based on scientific logic, while understanding the theoretical system that forms the basis of informatics.			(1T)Theory of Automata and Languages (1T)Information Theory (3T)Differential Equations (2T)Fourier Analysis	(4T)Databases	(1T)Theory of Computing (2T)Natural Language Processing	(3T)Artificial Intelligence and Machine Learning	(1T)Informatics Seminar (2T)Informatics Seminar	
Abilities 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.	Programming (1T)Elements of Calculus (1T)Introductory Seminar for First-Year Students (2T)Statistical Data Analysis (2T)Calculus (2T)Linear Algebra (2T)Discrete MathematicsI	(3T)Seminar in Mathematics (4T)Seminar in Mathematics Programming (3T)Calculus (3T)Linear Algebra (3T)Discrete MathematicsII (4T)Fundamentals of Probability Theory	Programming (1T)Theory of Automata and Languages (1T)Inferential Statistics (2T)Statistical Test ◎ (2T)Linear Regression Model	Programming (3T)Digital Circuit Design (3T)Algorithms and Data Structures (4T)Programming Languages	(1T)Informatics and data science, Exercise I (1T)Theory of Computing (1T)Data Mining (2T)Informatics and data science, Exercise (2T)Nonparametric analysis	(3T)Informatics and data science, Exercise (4T)Informatics and data science, Exercise (4T)Computer Network (4T)Big Data		
	(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.	Programming (1T)Elements of Calculus (1T)Introductory Seminar for First-Year Students (2T)Statistical Data Analysis (2T)Calculus (2T)Linear Algebra (2T)Discrete MathematicsI	(3T)Seminar in Mathematics (4T)Seminar in Mathematics Programming (3T)Calculus (3T)Linear Algebra (3T)Discrete MathematicsII (4T)Fundamentals of Probability Theory	Programming (1T)Theory of Automata and Languages (1T)Inferential Statistics (2T)Statistical Test ◎ (2T)Linear Regression Model	Programming (3T)Digital Circuit Design (3T)Algorithms and Data Structures (4T)Programming Languages	(1T)Informatics and data science, Exercise (2T)Informatics and data science, Exercise	(3T)Informatics and data science, Exercise (4T)Informatics and data science, Exercise		
	(3) D2. Ability to develop strategies and plans for an				(3T)Generalized Linear Model (4T)Stochastic Modeling	(1T)Survey design (2T)Education Policy and Data Analysis △ △	(3T)Time Series Analysis (4T)Data Analysis for Medical and Welfare Policies	(1T)Data Science Seminar (2T)Data Science Seminar	

Academic Achievement Evaluation Itemas	1st grade		2nd grade		3rd grade		4th grade	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall