

2023

# Syllabi

Artificial Intelligence and Science  
(Graduate Courses)

Rikkyo University



Course Title	Machine Learning		
Instructor	Taki Masato		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5110	Language	Japanese

#### Course Objectives

The purpose of this course is to help students understand machine algorithms correctly so they can appropriately apply machine learning. Students will also learn the essential elements required to improve the algorithm on their own.

#### Course Contents

Initially, students will learn how various machine learning algorithms are designed mathematically. They will subsequently intensify their understanding by actually coding algorithms using Python. At the same time, they will imbibe efficient machine learning practices by using libraries. Practical learning, such as data preprocessing and tweaks, will also be introduced.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR101](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR101)

Course Title	Deep Learning		
Instructor	Taki Masato		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5110	Language	Japanese

#### Course Objectives

By imbibing varied concepts for the implementation of deep learning, students will be able to utilize deep learning to accomplish discrete tasks. They will also acquire the fundamental knowledge required to follow the rapid progress of deep learning.

#### Course Contents

Students will learn the details of neural networks and will become aware of the techniques utilized for deep learning. Furthermore, they will be provided concrete examples and computer experiments by Keras library to apprehend the architectural design of accomplishing various tasks. The purpose of this course is to ensure students acquire the knowledge needed for deep learning to achieve more involved tasks.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR106](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR106)

Course Title	Ethics in Advanced Technology		
Instructor	Murakami Yuko		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5310	Language	Japanese

#### Course Objectives

This course outlines philosophical theories to approach ethical aspects of advanced science and technology such as artificial intelligence. Case studies follow.

#### Course Contents

This course will begin with five sessions of lectures. Discussion sessions will follow: students will read assignments in group and prepare a presentation to others.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR111](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR111)

Course Title	Seminar on Machine Learning		
Instructor	Masada Tomonari/Kato Tsunehiko		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5610	Language	Japanese

#### Course Objectives

The purpose of this course is as follows:

- (1) to develop the fundamental skills required to perform data analysis
- (2) to foster advanced skills in implementing machine learning methods taught in classroom sessions of the Machine Learning course
- (3) to evolve practical abilities to utilize machine learning via various methods relevant to data analysis.

#### Course Contents

This course includes introductory, primary, and supplementary topics. Introductory awareness involves hands-on exercises conducted to support entry level students. Primary subject matter concerns the implementation and evaluation of the methods explained in the lectures delivered in the "Machine Learning" course. Supplementary material refers to hands-on practices relevant to the utilization of machine learning. The first few lectures will be devoted to introductory awareness. Subsequent lectures will alternately attend to primary and supplementary topics.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR116](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR116)

Course Title	Project-based Learning 1		
Instructor	Uchiyama Yasunobu/Iwasaki Hiroyoshi/Ishikawa Shin-nosuke/Ohba Hirotsugu		
Semester	Spring Others	Credit	3 Credits
Course Number	AIR6720	Language	Japanese

#### Course Objectives

This class (project-based learning 1) promotes a social implementation project that utilizes artificial intelligence and data science.

Together with the project-based learning 2 in the fall semester, students will learn how to develop project concepts, utilize related technologies, and promote intra-team communication.

#### Course Contents

This class (project team training 1) is combined with project team training 2.

Playing a set role in the project team, students will drive a variety of processes for research/technology development and practical application, and will also consider various issues related to practical use such as data privacy.

The following projects are tentatively listed as this year's projects:

- 1) AI application and big data analysis in professional baseball (Sports Tech)
- 2) AI application in the field of long-term care (Health Tech)
- 3) Virtual Classroom (Metaverse)

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR201](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR201)

Course Title	Project-based Learning 2		
Instructor	Uchiyama Yasunobu/Iwasaki Hiroyoshi/Ohba Hirotsugu		
Semester	Fall Others	Credit	3 Credits
Course Number	AIR6720	Language	Japanese

#### Course Objectives

This class (project-based learning 2) promotes a social implementation project that utilizes artificial intelligence and data science.

Combined with the project-based learning 1 in the spring semester, students will learn how to develop project concepts, utilize related technologies, and promote intra-team communication.

#### Course Contents

Playing a set role in the project team, students will drive a variety of processes for research/technology development and practical application, and will also consider various issues related to practical use such as data privacy.

The following projects are tentatively listed as this year's projects:

- 1) AI application and big data analysis in professional baseball (Sports Tech)
- 2) AI application in the field of long-term care (Health Tech)
- 3) Virtual Classroom (Metaverse)

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR211](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR211)



Course Title	Research for Master's Thesis 3		
Instructor	Uchiyama Yasunobu/Murakami Yuko/Ohnishi Takaaki/Masada Tomonari/Miyake Youichiro/Taki Masato/Ohba Hirotsugu/Kato Tsunehiko/Ishikawa Shin-nosuke		
Semester	Spring Others	Credit	3 Credits
Course Number	AIR6720	Language	Japanese

#### Course Objectives

The purpose of this course is to lay the foundation for research and development. Students are expected to set their research theme in consultation with their supervisor and experience the process from research planning to reporting results. Students are expected to learn how to proceed with research activities and to experience the frontiers of advanced research.

#### Course Contents

Each instructor provides research guidance to the second-year master's students. Students are expected to acquire advanced technical knowledge and advanced information gathering skills and also to acquire comprehensive research execution skills such as problem solving skills and presentation skills through research activities.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR221](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR221)

Course Title	Supervisory Seminar for Master's Thesis		
Instructor	Uchiyama Yasunobu/Murakami Yuko/Ohnishi Takaaki/Masada Tomonari/Miyake Youichiro/Taki Masato/Ohba Hirotsugu/Kato Tsunehiko/Ishikawa Shin-nosuke		
Semester	Fall Others	Credit	3 Credits
Course Number	AIR6720	Language	Japanese

#### Course Objectives

The purpose of this course is to lay the foundation for research and development. Students are expected to set their research theme in consultation with their supervisor and experience the process from research planning to reporting results. Students are expected to learn how to proceed with research activities and to experience the frontiers of advanced research.

#### Course Contents

Each instructor provides research guidance to the second-year master's students. Students are expected to acquire advanced technical knowledge and advanced information gathering skills and also to acquire comprehensive research execution skills such as problem solving skills and presentation skills through research activities.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR231](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR231)

Course Title	Introduction to Data Science		
Instructor	Uchiyama Yasunobu		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5200	Language	Japanese

#### Course Objectives

The purpose of this course is to cultivate a perspective that gives a bird's-eye view of the entire data science field. As the accumulated social digital data and scientific data increase exponentially, advanced data science technologies are becoming important in various fields. In this course, students are expected to learn practical examples of data science and the mathematical, statistical, and computational techniques behind them as a bridge to specialized learning and research.

#### Course Contents

This course consists of introductory lectures on data science for beginners in data science. It introduces examples of how data science technology is used in natural sciences, social sciences, and business, and explains the basic ideas and knowledge of mathematical, statistical, and computational technologies used there.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR401](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR401)

Course Title	Introduction to Artificial Intelligence		
Instructor	Miyake Youichiro		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5100	Language	Japanese

#### Course Objectives

You can see a whole image of AI, and find the best field to research.

#### Course Contents

A large foundations of AI are introduced as different topics for each lecture. Each lecture is independent, Fundamental theory of AI should be reconstructed by each audience.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR406](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR406)

Course Title	Statistical Modeling 1		
Instructor	Masada Tomonari		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5400	Language	Japanese

#### Course Objectives

The aim of this course is to learn elementary topics in statistical data modeling, including probabilistic inferences, Bayesian modeling, and related topics.

#### Course Contents

The main themes of this course are:

1. Fundamentals of probabilistic modeling (Basics of probability distributions and their properties)
2. Probabilistic inference: MLE/MAP/Bayesian inference
3. Supervised learning of mixture models
4. Unsupervised learning of mixture models

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR411](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR411)

Course Title	Complex Networks		
Instructor	Ohnishi Takaaki/Ito Mariko		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5500	Language	Japanese

#### Course Objectives

After completing this course, students should be able to:

- explain the concepts and terminology associated with complex network science
- understand and apply general complex network science methods for data analysis
- choose the appropriate data analysis method given particular phenomena and data
- understand the limitations of data analysis stemming from assumptions embedded in the method, the finite resolution of the data, the sampling bias of the data, and so on.

#### Course Contents

This course will provide students with the foundations of data science, based especially on complex network science techniques. Students will learn the concepts, techniques, and tools they need to analyze various types of real data.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR416](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR416)

Course Title	Introduction to Informatics		
Instructor	Ohnishi Takaaki/Andrade Daniel		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5200	Language	Japanese

#### Course Objectives

After the completion of this course, students will be able to:

- explain terminology and concepts related to information science
- understand the fundamental principles of digital computing
- more effectively use information and communication technology (ICT) as tools for their own research

#### Course Contents

This comprehensive introductory course in information science is meant primarily for graduate students who have not majored in science and engineering. Students will learn the fundamental concepts and principles of information science to help them conduct their research in an effective manner. Students will gain practical skills in the use of computers. This course will also prepare students for other courses such as data science and machine learning.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR421](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR421)

Course Title	Introduction to Mathematical Science		
Instructor	Ishikawa Shin-nosuke		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5400	Language	Japanese

#### Course Objectives

This course deals with the mathematical aspect of machine learning through the review how we describe problems mathematically and through the instruction of mathematical techniques used in machine learning algorithms.

#### Course Contents

For better understanding of the machine learning class, this lecture introduces basic ideas of mathematics such as vector, matrix, derivation, probability and statistics. Outline and solutions of optimization problems, to which many problems are boiled down, are also introduced. If you are not from department of science or engineering in an undergraduate course, or you do not have an experience on numerical calculation using computer program, this course is recommended.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR426](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR426)



Course Title	Introduction to Social Informatics		
Instructor	Ohnishi Takaaki		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5200	Language	Japanese

#### Course Objectives

After completing this course, students should be able to:

- explain the concepts and terminology associated with socio-econophysics
- understand and apply general socio-econophysics methods for data analysis
- choose the appropriate data analysis method given particular phenomena and data
- understand the limitations of data analysis stemming from assumptions embedded in the method, the finite resolution of the data, the sampling bias of the data, and so on.

#### Course Contents

This course will provide students with the foundations of data science, based especially on socio-econophysics techniques. Students will learn the concepts, techniques, and tools needed to analyze various types of real data pertaining to socio-economic phenomena.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR431](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR431)

Course Title	Introduction to Computer Science		
Instructor	Murata Yuya		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5500	Language	Japanese

#### Course Objectives

The purpose of this course is to learn the theory of computer science and to understand the systems and services used in research and business.

#### Course Contents

This lecture explains the basics of computer science and deepens the understanding of both hardware and software of computers.

In addition, the application of the learned knowledge to reality will be introduced using IoT systems as an example.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR441](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR441)

Course Title	Artificial Intelligence and Philosophy		
Instructor	Murakami Yuko		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5100	Language	Japanese

#### Course Objectives

Artificial intelligence and philosophy are historically connected. The course will overview philosophy of artificial intelligence from historical points and discuss future development of the research area.

#### Course Contents

To discuss a draft of a book by the lecturer, background knowledge will be explained. Students will work on problems in mathematical logic in class, as it is required to understand the history of artificial intelligence.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR446](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR446)

Course Title	Special Seminar on Artificial Intelligence Business A		
Instructor	Yoshikawa Atsushi		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5200	Language	Japanese

#### Course Objectives

Diverse issues emerge from the utilization of AI in business, with discrete approaches possible for the resolution of each difficulty. Thus, examples will be used to teach students the means of appropriate selection by taking advantage of varied constraints.

#### Course Contents

New services and new tools are being developed using AI. Some services succeed and others fail. Experienced instructors will discuss these successes and failures with students and will demonstrate the key to the achievement of positive results. In the process, students will learn how to make choices. Some of these lessons may be changed because external instructors proficient in practical work may be busy. Classes may be online due to instructor availability or infection status. On-line lessons and recorded lessons are available for all sessions.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR451](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR451)

Course Title	Special Seminar on Artificial Intelligence Business B		
Instructor	Nakajima Hiroto		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5200	Language	Japanese

#### Course Objectives

Through lectures by external lecturers, and discussions between participants and lecturers, participants will gain insight into the state-of-the-art of DX in Japan. The aim is to learn how cutting-edge technology creates value in business from the stories of engineers who support DX in the corporate world, and to gain insight into the social implementation of technology.

#### Course Contents

Students will learn tips for using AI in the Japanese business environment from external lecturers who are active in the field of business. This will help students develop the basic skills to utilize AI in their business in the future.

With this in mind, we have invited engineers and other outside lecturers to introduce their specific approaches in their companies. In particular, the topics will range from technology development, which is a fine-grained topic, to actual business application, which is a more granular topic.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR456](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR456)

Course Title	Special Seminar on Natural Language Processing		
Instructor	Masada Tomonari		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR5200	Language	Japanese

#### Course Objectives

The aim of this course is to learn various topics in natural language processing through lectures and assignments.

#### Course Contents

1. Basic approaches in bag-of-words modeling, including TF-IDF and document classification
2. Elementary applications of natural language processing, including document similarity estimation and sentiment analysis
3. Elementary methods in deep-learning-based natural language processing, including word embeddings, RNN, and transformers

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR461](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR461)

Course Title	Social Implementation of AI Technology		
Instructor	Uchiyama Yasunobu/Urakawa Shinichi		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR6300	Language	Japanese

#### Course Objectives

In this class, we aim to be able to talk about the following items regarding "AI social implementation" that will bring the research and development of artificial intelligence (AI) to fruition in society.

- Understanding AI social principles and guidelines is a major premise of AI research and development.
- Japan that was late in Phase 1 can be recovered in Phase 2 (must be)
- A decisive difference between a normal information system and an AI system
- The social impact of AI will begin in earnest
- AI is an important part that is indispensable for DX

#### Course Contents

After lectures on AI social principles and guidelines, the environment surrounding AI social implementation (information systems and AI, characteristics of AI projects, AI human resources, latest trends in DX and AI, distribution of data / learned models) In order to learn actual examples of social implementation of AI technology, we will introduce examples from various companies that are making advanced efforts by inviting guest speakers. Then, based on lectures and case studies, group work and discussions will be held on various issues of social implementation.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR466](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR466)

Course Title	Special Lecture on Recognition Technology		
Instructor	Kitazawa Masaki		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR6100	Language	Japanese

#### Course Objectives

This course aims to learn recognition technology for various types of data.

#### Course Contents

This course will focus on the following data and tasks:

- \* Image : classification / segmentation / object detection / pose estimation / action recognition / anomaly detection,
- \* Sound : speech recognition,
- \* Time-series : anomaly detection,
- \* Multimodal : multitask.

Each task included modeling technology and noted points when building a recognition system.

Modeling technology is explained by using major papers and latest papers.

Noted points when building a recognition system are explained based on examples, cases, and discussion.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR471](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR471)



Course Title	Special Lecture on Neuroscience		
Instructor	Taki Masato/Toyozumi Taro/Nishimoto Shinji/Amemori Kenichi/Chikazoe Junichi/Watanabe Masataka/Matsui Teppei		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR6400	Language	Japanese

#### Course Objectives

Artificial intelligence, machine learning and neuroscience have evolved under close influence. This lecture will give you an overview of the basics of neuroscience in order to understand artificial intelligence, as well as a broad overview of recent developments in neuroscience itself.

#### Course Contents

Following the explosive development of deep learning in recent years, the actual similarity between artificial deep neural network and biological neural circuits has received a great deal of attention among neuroscientists. Various observational means for that purpose have been developed, and it has become possible to observe human mental activity non-invasively. The topics covered in this lecture are as follows: Relationship between biological neural circuits and deep learning, analysis by human psychological activity and machine learning for functional MRI data, quantitative understanding of brain functions that control vision and cognition, primate mental mechanism and artificial intelligence, brain mathematics. Front-line researchers give lectures in omnibus format on a wide range of topics.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR476](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR476)

Course Title	Statistical Modeling 2		
Instructor	Masada Tomonari		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR6400	Language	Japanese

#### Course Objectives

The aim of this course is to learn advanced statistical modeling topics, including variational inferences, MCMC, and related topics.

#### Course Contents

This course explains the methods for posterior inference in Bayesian modeling.

Topics to be covered in the first half of this course include the elementary expositions of MCMC, the implementation of MCMC in Python, and practical coding for posterior inference via MCMC.

Topics to be covered in the second half of this course include the fundamentals of variational inference, its application in natural language processing (ex. LDA), and the variational auto-encoder.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR481](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR481)

Course Title	Special Lecture on Quantum Information		
Instructor	Uchiyama Yasunobu/Khangulyan Dmitriy/Ozeki Masayuki/Utsunomiya Shoko/Haribara Yoshitaka		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR6403	Language	Others

#### Course Objectives

In this class, we will learn about quantum computers, which are considered to be important technologies for thinking about the future of artificial intelligence and data science. Starting from the basics of quantum mechanics, we will learn the basics of quantum computing, introduce quantum annealing as an advanced topic, and experience the execution of quantum computing in a hands-on format. The goal is to understand the difference from the classical computer from the basics and to gain knowledge on the latest topics.

#### Course Contents

In the first half of the class, we will explain the introduction to quantum mechanics without assuming undergraduate knowledge of physics. This part will be a lecture in English. In the latter half of the class, we will give a lecture on the basics of quantum computers, running quantum computers in a hands-on format, quantum annealing, and key issues in the industrialization of quantum computers.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR486](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR486)

Course Title	Special Lecture on Fintech		
Instructor	Maeda Junichiro		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR6300	Language	Japanese

#### Course Objectives

The objective of this course is to recapture the relationship between traditional financial theory and Fintech. The students will be able to think for themselves how the finance system will change in the future through learning how Fintech's technology is currently changing finance compared to the past.

#### Course Contents

The guest speaker who are active in the front lines of Fintech's industry to give lectures. Students will be asked to make a brief presentation after having discussions in several groups based on the content. Please see Course Schedule for the planned speakers.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR491](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR491)

Course Title	Python Programming		
Instructor	Todo Kense		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5600	Language	Japanese

#### Course Objectives

The purpose of this course is to instruct students on the description system of Python, a programming language used in artificial intelligence and machine learning.

#### Course Contents

This course is divided into the following four parts:

- ① Introduction to Python
- ② Numpy, Pandas, and matplotlib
- ③ Object-orientation, regular expression, and Practical techniques
- ④ Project

The students' skills in Python will be measured through tests administered in the first session.

The scope of the test is "Introduction to Python".

You should submit a confirmation report as each section ends.

After this lecture, students will be required to submit an assignment report.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR496](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR496)

Course Title	Python Programming		
Instructor	Todo Kense		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR5600	Language	Japanese

#### Course Objectives

The purpose of this course is to instruct students on the description system of Python, a programming language used in artificial intelligence and machine learning.

#### Course Contents

This course is divided into the following four parts:

- ① Introduction to Python
- ② Numpy, Pandas, and matplotlib
- ③ Object-orientation, regular expression, and Practical techniques
- ④ Project

The students' skills in Python will be measured through tests administered in the first session.

The scope of the test is "Introduction to Python".

You should submit a confirmation report as each section ends.

After this lecture, students will be required to submit an assignment report.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR501](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR501)

Course Title	Special Seminar on Artificial Intelligence		
Instructor	Murakami Takao/Aritake Toshimitsu		
Semester	Spring Others	Credit	2 Credits
Course Number	AIR6600	Language	Japanese

#### Course Objectives

The goals of this course are to

- be able to understand and explain the technologies and theories of AI.
- be able to understand and explain matrix/tensor factorization and its applications.
- be able to understand and explain sparse modeling.

#### Course Contents

This course deals with case studies on matrix/tensor factorization and sparse modeling at lecture sessions. It also enhances the development of students' skill in matrix/tensor factorization and sparse modeling at hands on sessions.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR511](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR511)

Course Title	Seminar on Deep Learning 1		
Instructor	Ishikawa Shin-nosuke/Mitei		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR6600	Language	Japanese

#### Course Objectives

This practical session will correspond to the course on "Deep Learning" with the aim of making students acquire a sense of the ways in which deep learning actually works and the specific situations in which it can be used.

#### Course Contents

Using the frameworks of TensorFlow and Keras, students will apply the content taught in the course on the topic of "Deep Learning" on specific cases.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR516](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR516)



Course Title	Seminar on Deep Learning 2		
Instructor	Taki Masato		
Semester	Fall Semester	Credit	2 Credits
Course Number	AIR6600	Language	Japanese

#### Course Objectives

Understand more advanced topics of deep learning based on the basic knowledge of machine learning and deep learning. This course also gives a broad overview of the development of deep learning techniques to solve more specific tasks.

#### Course Contents

Deep learning, which has made great strides in the last decade or so, has been developed based on theoretical studies. Therefore, in this lecture, we will develop the ability to understand and improve models and methods based on the understanding of the theoretical mechanism of deep learning, and the basic ability to actually implement the method designed by ourselves. For that purpose, we will take up some important theoretical topics and experience numerical experiments and implementations after understanding them. We will also cover some specific task models to understand how such careful analysis is applied in actual development.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR521](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR521)

Course Title	Journal Club 1A		
Instructor	Murakami Yuko		
Semester	Spring Others	Credit	2 Credits
Course Number	AIR6600	Language	Japanese

#### Course Objectives

Participants select and read articles to present in sessions for discussion.

#### Course Contents

This course will mainly focus on discussion based on papers and articles as well as online/ offline research tools.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR701](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR701)

Course Title	Journal Club 1B		
Instructor	Taki Masato		
Semester	Spring Others	Credit	2 Credits
Course Number	AIR6600	Language	Japanese

#### Course Objectives

The purpose of this course is to help students understand the theoretical aspects of machine learning and deep learning. This course will also prepare students to learn new concepts and algorithms from scholarly literature.

#### Course Contents

Using a few chapters from "Pattern Recognition and Machine Learning" (M.Bishop.) and a few chapters from "Deep Learning" (I. Goodfellow et al.), students will learn the basics of statistical machine learning theory and will be introduced to the theoretical aspects of deep learning.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR702](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR702)

Course Title	Seminar on Data Science		
Instructor	Ohnishi Takaaki/Amamoto Yoshifumi		
Semester	Spring Semester	Credit	2 Credits
Course Number	AIR6600	Language	Japanese

#### Course Objectives

After completing this course, students should be able to:

- explain the concepts and terminology associated with data science
- understand general data science methods
- choose the appropriate data science method given particular phenomena and data
- understand the limitations of data analysis stemming from assumptions embedded in the method, the finite resolution of the data, the sampling bias of the data, and so on.
- develop an approach for the analysis of various types of real data
- recognize the importance of empirical analysis based on real data
- understand the necessity of interpreting results based on domain knowledge

#### Course Contents

This course will provide students with the foundations of data science. Students will learn the concepts, techniques, and tools they need to analyze various types of real data.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR721](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR721)

Course Title	Research for Master's Thesis 1		
Instructor	Uchiyama Yasunobu/Ohnishi Takaaki/Masada Tomonari/Murakami Yuko/Miyake Youichiro/Taki Masato/Ohba Hirotsugu/Kato Tsunehiko/Ishikawa Shin-nosuke		
Semester	Spring Others	Credit	3 Credits
Course Number	AIR6700	Language	Japanese

#### Course Objectives

The purpose of this course is to lay the foundation for research and development. Students are expected to set their research theme in consultation with their supervisor and experience the process from research planning to reporting results. Students are expected to learn how to proceed with research activities and to experience the frontiers of advanced research.

#### Course Contents

Each instructor provides research guidance to the first-year master's students. Students are expected to acquire advanced technical knowledge and advanced information gathering skills and also to acquire comprehensive research execution skills such as problem solving skills and presentation skills through research activities.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR751](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR751)

Course Title	Research for Master's Thesis 2		
Instructor	Uchiyama Yasunobu/Ohnishi Takaaki/Masada Tomonari/Murakami Yuko/Miyake Youichiro/Taki Masato/Ohba Hirotsugu/Kato Tsunehiko/Ishikawa Shin-nosuke		
Semester	Fall Others	Credit	3 Credits
Course Number	AIR6700	Language	Japanese

#### Course Objectives

The purpose of this course is to lay the foundation for research and development. Students are expected to set their research theme in consultation with their supervisor and experience the process from research planning to reporting results. Students are expected to learn how to proceed with research activities and to experience the frontiers of advanced research.

#### Course Contents

Each instructor provides research guidance to the first-year master's students. Students are expected to acquire advanced technical knowledge and advanced information gathering skills and also to acquire comprehensive research execution skills such as problem solving skills and presentation skills through research activities.

#### Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

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[https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo\\_2=VR752](https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=VR752)

