2025-2026 Syllabus

Future University Hakodate
Graduate School of
Systems Information Science

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List of Courses -Dividend Year, Credits and Instruction Language of Class-

Program		Category		Subject Names	Dividend Years	Semester	Credits		Instruction Language	
							Compulsory	Elective	Oral	Handout
Program	Master's Program	Specialized Subjects	Common subjects for graduate school	Academic Literacy in Context 1	1	Spring	(2)		J	J
				Academic Literacy in Context 2	1	Fall	(2)		E	E
				Introduction to Basics of Systems Information Science	1,2	Spring/Fall		*	-	-
				Experimental Design and Data Analysis	1,2	Spring		2	JE	JE
				Internship 1	1,2	Spring/Fall		2	-	-
				Internship 2	1,2	Spring/Fall		1,2	-	-
				Overseas Course Program	1,2	Spring/Fall		1,2	-	-
			Media Architecture Field	Advanced ICT Design	1,2	Spring		2	J	J
				Advanced Topics of Information Network 1	1,2	Fall		2	J	J
				Advanced Topics of Information Network 2	1,2	Spring		2	J	E
				Advanced Topics in Data Science	1,2	Spring		2	JE	JE
				Advanced Topics in Information Environmentology	1,2	Spring		2	J	J
				Advanced Topics in Media Information Studies	1,2	Fall		2	J	J
				Advanced Topics in Field Information Studies	1,2	Spring		2	J	J
				Introduction to the Science of the Artificial	1,2	Fall		2	JE	JE
			Advanced ICT Field	Advanced ICT Design	1,2	Spring		2	J	J
				Advanced Topics of Embedded Systems	1,2	Fall		2	J	J
				Advanced Open Technologies	1,2	Fall		2	J	J
				Advanced Topics in IT Architecture	1,2	Fall		2	J	J
				Advanced Topics in Service Management	1,2	Fall		2	J	J
			Media Design Field	Introduction to Information Design	1,2	Fall		2	J	J
				Introduction to Cognitive System	1,2	Spring		2	JE	JE
				Introduction to Interactive Systems	1,2	Spring		2	JE	JE
				Field Research Methods for Design Work	1,2	Spring		2	J	J
				Special Topics of Information Design 1	1,2	Fall		2	J	J
				Special Topics of Information Design 2	1,2	3Q		2	JE	JE
				Special Topics of Cognitive System 1	1,2	Spring		2	J	J
				Special Topics of Cognitive System 2	1,2	Fall		2	J	J
				Special Topics of Interactive Systems 1	1,2	Fall		2	JE	JE
				Special Topics of Interactive Systems 2	1,2	Fall		2	JE	JE
			Complex Information Science Field	Advanced Topics in Information Mathematics	1,2	Spring		2	J	J
				Advanced Topics in Nonlinear Mathematics	1,2	Spring		2	JE	JE
				Advanced Topics in System Mathematics	1,2	Spring		2	J	J
				Advanced Topics in Data Science	1,2	Spring		2	JE	JE
				Advanced Topics in Mathematical Analysis	1,2	Fall		2	J	J
				Advanced Topics in Applied Complex Systems	1,2	Fall		2	J	J
				Advanced Topics in Complex Systems	1,2	Spring		2	JE	JE
			Intellectual Information Science Field	An Introduction to Intelligent Information Science	1,2	Spring		2	J	JE
				History and Future of Intelligent Systems	1,2	Fall		2	JE	E
				An Introduction to Intelligent Systems Programming	1,2	Spring		2	J	JE
				Advanced Topics in Adaptive System	1,2	Fall		2	J	JE
				Advanced Topics in Autonomous System 1	1,2	Spring		2	JE	JE
				Advanced Topics in Autonomous System 2	1,2	Fall		2	JE	JE
				Advanced Topics in Intelligent Media	1,2	Fall		2	J	JE
		Research Guidance Subjects		Project Study 1	1	Spring/Fall	2		-	-
				Project Study 2	1	Spring/Fall	2		-	-
				Project Study 3	2	Spring/Fall	2		-	-
				System Information Science Research	1,2	All	4		-	-
	Doctoral Program	Specialized Subjects		Internship 2	1,2,3	Spring/Fall		1,2	-	-
				Overseas Course Program	1,2,3	Spring/Fall		1,2	-	-
		Research Guidance Subjects		Special Seminar	1-3	All			-	-
				Research on Systems Information Science	1-3	All			-	-

Notes

- Completion requirements: For master course students, acquire 30+ credits (20+ credits for specialized subjects and 10+ credits for research guidance subjects) and pass thesis examination.

- Mandatory subjects: Students must acquire 2+ credits of parenthesized subjects, "Academic Literacy in Context I" and "Academic Literacy in Context II."

-Surroage project: Students may be allowed to complete the program, after their research outcome is reviewed and considered it appropriate to the purpose of their master's study.

- Instruction language: J: Japanese only, E: English only, and JE: For details, see the instruction language section of the syllabus.

- The number of credits for "Introduction to Basics of System Information Science" marked * conforms to the number of credits of the courses to take.

Academic Literacy in Context I

Grade	2025
Semester	Spring
Credits	2
Instructor	TOMINAGA Atsuko

1. Course Outline

Graduate students must write theses and research papers. In this course,
students will learn the academic literacy necessary to write these papers (how to collect related literatures and how to manage them,
reading skills,
and writing skills). Moreover,
students also learn research ethics that must be kept as researchers.
Each lesson consists of lectures,
personal work,
group work,
and peer review.

2. Keywords

Literature review, Reading, Writing, Research Ethics

3. Course Objectives

1. To read articles (about ten pages) of own research field and write the summary.
2. To write own research report.
3. To check each other's reports.
4. To understand Research ethic and act while being conscious of it.

4. Course Schedule

Week 1: Orientation (course summary, how to study, and assessment). How to search and manage the documents related own study.
Week 2-4: Reading (speed reading and intensive reading). How to write summary. Research ethic.
Week 5-6: References and citations. Plagiarism prevention.
Week 7-15: Writing skill.

5. Prior/Post Assignment

Prior: Prepare for the peer review.
Post: Individual work.

6. Assessment

Report (60%)（Course Objectives1, 2）
Individual work (30%)（Course Objectives3）
Quiz (10%)（Course Objectives4）

7. Textbooks

8. Language of Instruction

Japanese

9. Requirements for registration

10. Note

Academic Literacy in Context II

Grade	2025
Semester	Fall
Credits	2
Instructor	RIVERS Damian

1. Course Outline

Effective communication is crucial for graduate students, especially when presenting research and writing academic papers. This course is designed for students in the field of Systems Information Science and focuses on literacy development in three key areas: academic discussion, research presentations, and academic writing. Firstly, students will develop the ability to express and discuss research-related information clearly and appropriately in English. Secondly, students will learn to deliver well-structured academic presentations and respond effectively to audience questions. Thirdly, students will learn to draft coherent research reports while integrating peer feedback and instructor guidance. The course also emphasizes the importance of research ethics and social responsibility in academic work. Conducted primarily through the HOPE platform, the course includes weekly seminar meetings where students share progress, engage in discussions, and refine their skills through interactive learning and hands-on practice. By the end of the course, students will be better equipped to communicate their research effectively in a variety of academic formats and contexts.

2. Keywords

* Academic communication
* Academic writing
* Discussion and engagement
* Research ethics
* Research publications

3. Course Objectives

* Goal 1 (Academic Discussion) : Clearly express research-related ideas, respond to peers' contributions, and participate in discussions using appropriate academic English.
* Goal 2 (Research Presentation) : Deliver an academic presentation with a logical structure and clear visual aids, effectively responding to questions.
* Goal 3 (Academic Writing) : Integrate literature, construct logical arguments, and produce a coherent research report using appropriate academic language, incorporating feedback.

4. Course Schedule

Week 1-5: Academic Presentation
* Presentation structure and clarity / logical organization of content
* Communicating with academic language / audience engagement and questions
* Visual aid design for academic presentations / referencing sources

Week 6-10: Academic Research Report
* Report structure and coherence / introduction to IEEE standards
* Literature review and integration / logical argumentation in academic writing
* Academic tone and in-text citation skills / incorporating peer feedback and correction

Week 11-13: Revisions and Refinement
* Discussing strengths and weaknesses / revising text for improvement

Week 14-15: Final Presentation and Report Submission

5. Prior/Post Assignment

* Complete required preparation tasks via HOPE
* Apply acquired information toward satisfying course objectives

6. Assessment

* Goal 1 (30%) : Graded on participation, engagement with peers, and appropriate use of academic English.
* Goal 2 (30%) : Graded on structure and content, clarity of delivery, visual support, and responsiveness to questions.
* Goal 3 (40%) : Graded on organization, coherence, use of academic conventions, and responsiveness to feedback.

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7. Textbooks

* Distributed via HOPE

8. Language of Instruction

* English

9. Requirements for registration

10. Note

* English is the language of communication used on this course.
* This is an asynchronous online course with weekly face-to-face progress meetings.

Introduction to Basics of Systems Information Science

Grade	2025
Semester	Spring, Fall
Credits	Conforming to the number of credits of the courses to take.
Instructor	Superviser Head of Graduate School

1. Course Outline

Depends on undergraduate courses to take. This course is supplementary lessons to acquire expert knowledges.

2. Keywords

Systems Information Science

3. Course Objectives

- Understand the basic knowledge regarding to the research theme.
- Condunt the research theme voluntarily.

4. Course Schedule

Depends on undergraduate courses to take.

5. Prior/Post Assignment

Depends on undergraduate courses to take.

6. Assessment

Grades are evaluated by each faculty member in charge of the course.

7. Textbooks

Depends on undergraduate courses to take.

8. Language of Instruction

Depends on undergraduate courses to take.

9. Requirements for registration

The course should be selected from specialized subjects of the Dept. of Media Architecture and the Dept. of Complex and Intelligent Systems except Virtural English Program, Enteprise Intership, System Information Science Practice, and Graduation Study.
Select the cource carefully according to your supervisor's instructions.

10. Note

Experimental Design and Data Analysis

Grade	2025
Semester	Spring
Credits	2
Instructor	MIYAMOTO Edson Tadashi

1. Course Outline

This is a hands-on class. Students will design an experiment as part of a course project. They will consider possible alternative scenarios, anticipating problems and finding ways around them, so that they can more clearly link later outcomes to their earlier decisions and choices. At each step, students will be required to evaluate each other's proposals. Students will also be required to analyze data made available during lectures.

2. Keywords

experimental design, data analysis

3. Course Objectives

Students taking this course learn about experimental design and data analysis:
- by taking into consideration the entire process of a research project,
- by planning each step considering the drawbacks and tradeoffs of their decisions before collecting and analyzing data.

4. Course Schedule

Classes 1-2. Introduction to experimental design
- bottom-up or top-down: qualitative versus quantitative designs
- causality: experiments versus quasi-experiments
- independent variables, dependent variables, confounding factors

Classes 3-4. Data visualization on R
- trends, outliers, trimming

Classes 5-6. Basic modeling on R
- modeling, model-based trimming

Classes 7-12. Linear mixed-effects models on R
- random factors, model selection

Class 13. How to report results
- citing previous research: dues where dues are due

Classes 14-15. Final presentation and overall considerations
- final report
- replications and where to go from here
- tradeoffs in the decisions made during experimental design

5. Prior/Post Assignment

Read materials and answer quizzes made available online weekly.
Review materials from previous weeks and look for further readings.

6. Assessment

Grades will be based on weekly activities such as quizzes (小テスト). Quizzes will be conducted weekly, are open-book and to be answered individually, not in groups.
All students must participate in a group project and hand in regular reports. Students will evaluate each other's reports through quizzes. The topic of the project is of students' choice.
There are no makeup tests or extra activities for those with low grades. Your final grade will be based on the weekly activities only.

7. Textbooks

Readings will be assigned weekly, including portions of the following books.
- Baayen, R. H. (2008). Analyzing Linguistic Data - A Practical Introduction to Statistics using R. (801.01 Ba, https://lib-auth.fun.ac.jp/webopac/BB00249818)
- Kirk, R. E. (2013). Experimental Design: Procedures for the Behavioral Sciences. (140.7 Ki, https://lib-auth.fun.ac.jp/webopac/BB00236911)

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8. Language of Instruction

English and Japanese

9. Requirements for registration

None

10. Note

- All readings and quizzes will be made available in English.
- Install the latest version of R on your computer (https://www.r-project.org).

Internship 1

Grade	2025
Semester	Spring, Fall
Credits	2
Instructor	Superviser Head of Graduate School

1. Course Outline

Students participate in the research/working program provided by outside organizations including companies and research institutes for a certain period, submit the report about the result to the graduate school education affairs committee. They earn 2 credits when the committee admit the result is equivalent to a course for 1 semester.

2. Keywords

Training, Internship for research, Outside organization

3. Course Objectives

Internships aim that students learn various viewpoints and knowledge including relationship with the society through the research/working training outside of school including companies and research institutes to develop their researches wider and deeper through the experience. (evaluated based on plan and results)

4. Course Schedule

1. (Selection and application for participating program)
Students select participating program consistent with the abovementioned contents and obtain permission of their advisors. They need to submit “internship plan” to the graduate school education affairs committee through the advisors in advance of the program.
2. (Participation in program)
Students conduct research/working activities following by the direction of the companies providing the internship program.
3. (Submission of report)
Students submit following documents to the graduate school education affairs committee through the administration bureau after the program:
(1) “Internship report” written by students (with specified format.
(2) “Internship evaluation” issued by the organization provided the program (with arbitrary format)

5. Prior/Post Assignment

Prior: Students should consult their supervisors and understand the contents and precautions of this course. Further, understand the significance of this subject and prepare internship plan.
Post: Students review the internship achievements and various other things they have learned, and prepare internship reports.

6. Assessment

Grades are determined by the graduate school education affairs committee that evaluates the contents of the submitted documents.

7. Textbooks

None

8. Language of Instruction

Depends on the plan.

9. Requirements for registration

• The research/working program is not only the one recommended by the advisors and graduate school committee meeting, but also the one students select by themselves. In either case permission of the advisors are required beforehand to participate in the program.
• The internship program must be the research/training activities consistent with the purpose of the course. The programs aiming at job and social experiences are excluded.

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• The period of the program shall be more than 2 weeks including weekends and holidays in principle. There is no restriction on the timing of participation, but it is encouraged to avoid the term of classes. If the internship period and term of classes are overlapped, students need to consult with their advisors before starting the program.

10. Note

If you have any questions or concerns,
please consult with the secretariat,
your academic advisor,
and the Dean of the Graduate School.

Internship 2

Grade	2025
Semester	Spring, Fall
Credits	1 or 2
Instructor	Superviser Head of Graduate School

1. Course Outline

This course aims to learn the theory and practice of advanced information technology and multicultural collaborative design, and cultivate the ability to discover and solve problems and design new social systems.
For the purpose, students will stay at the laboratory of overseas universities, research institutes, or enterprises for a few weeks to half a year or more, and be engaged in the academic activities with faculty members, researchers, and/or students there.
Students will have experiences of different cultures, enhance technological and communication skills, and develop the international mind as a future global talent.
A student decides the institute to stay and an overseas supervisor (or person in charge) beforehand, submit “overseas internship plan.”
If the overseas internship plan is approved by the FUN supervisor and graduate school curriculum committee, a student will conduct the internship.
Styles of activities for overseas internships include collaborative research, workshops, short-term intensive schools and the like.
During the stay, a student will report progress to the FUN supervisor.
After the end of internship, students write “overseas internship report”including the results of collaborative research, the outcome of workshop to participate in, the contents of the classes students took, etc. and present the report at a debriefing session.

2. Keywords

Advanced information technology, multicultural collaborative design, international mind

3. Course Objectives

The course objectives are as follows:
- Can carry out interdisciplinary research with a broad perspective (evaluated based on plan and results)
- Can become conscious to meta-learning and achieve self-regulated learning (evaluated by progress report)
- Can acquire an open and positive attitude towards different fields and different cultures (evaluated based on the contents of the report and the performance at the debriefing session)

4. Course Schedule

1: Briefing session
2-14: Internship activity at an overseas institute
15: Debriefing session

5. Prior/Post Assignment

Prior Assignment: Students participate in the in-campus briefing session, are interviewed with a FUN supervisor, and learn the purpose of the subject to comprehend the significance of the subject. Students make overseas internship plans.
Post Assignment: Students reflect the achievements gained through internship and various other things they learned, and write overseas internship reports. Students make presentations at a debriefing session.

6. Assessment

Based on the content of the overseas internship plan (40%),
the progress report during stay (20%),
the content of the outcome or the evaluation by overseas supervisor (30%),
and the report after the internship and a debriefing meeting (10%),
the graduate school curriculum committee makes a dicision.

7. Textbooks

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8. Language of Instruction

Depends on the plan.

9. Requirements for registration

Regarding the eligibility for the class,
comprehensive judge is made by language proficiency,
student's record,
and ability to carry out research. Regarding language proficiency,
the results of TOEIC or TOEFL iBT will be taken into account. The ability to carry out research is assessed by examining the overseas internship plan submitted. Regarding the number of credits,
it is decided according to the course content.

10. Note

Watch the schedule guide of the briefing session in the university.
Students are encouraged to take “Academic Literacy in Context 2”.
For questions and consultation,
please contact a FUN supervisor at any time

Overseas Course Program

Grade	2025
Semester	Spring, Fall
Credits	1 or 2
Instructor	Superviser Head of Graduate School

1. Course Outline

If students take a course related to their own research theme while studying abroad, the credits earned at the study abroad destination can be counted as credits for this course.
For details, please refer to the web bulletin board.

2. Keywords

3. Course Objectives

Depends on the course to take.

4. Course Schedule

Depends on the course to take.

5. Prior/Post Assignment

Prior : make a plan at study abroad destination
Post : submit transcripts and syllabus at study abroad destination

6. Assessment

The graduate school education affairs committee examines the contents of the credits acquired at an overseas university and translates them into the unit of this subject.

7. Textbooks

8. Language of Instruction

Depends on the plan.

9. Requirements for registration

Before starting to study abroad, students have to contact the office (the education affairs section). If a student would study abroad at a sister university, a student has to check “Regulations on studying abroad of FUN students and acceptance of international students to FUN.

10. Note

Advanced ICT Design

Grade	2025
Semester	Spring
Credits	2
Instructor	ITO Kei

1. Course Outline

This lecture deals in trends in leading technology and practical engineering by the collaboration of subject teacher and several professionals inside/outside of FUN.
In addition, basic knowledge learning by e-learning materials.

2. Keywords

Project Management, Requirements Analysis, System Design, System Architecture, System Modeling, System Management, Accessibility, Agile Development

3. Course Objectives

- Understanding some parts of practical engineering and their problems.
- Understanding practical problems engineers experienced.

4. Course Schedule

Because this lecture is handled by the cooperation with professionals outside of FUN, the detail course schedule is shown at the beginning of the lecture.
Target topics of the lecture are shown below.
- project management
- requirements acquisition, requirements analysis
- design, development of several systems
- system modeling
- system management and maintenance

5. Prior/Post Assignment

Pre: reading pre-materials and e-learning
Post: reflection of lecture contents and answering post-lecture questionnaire

6. Assessment

Quizzes for every lecture and some reports (80%),
e-learning (20%)

7. Textbooks

Deliver required materials for each lecture

8. Language of Instruction

Japanese

9. Requirements for registration

10. Note

Advanced Topics of Information Network 1

Grade	2025
Semester	Fall
Credits	2
Instructor	INAMURA Hiroshi ISHIDA Shigemi

1. Course Outline

To learn the basic technologies and design principles for computer networks, in particular the optical networks. The network protection issues will also be covered in the lecture.

2. Keywords

Computer Network, Network design, Mobile Network

3. Course Objectives

Students are expected to acquire the following:
1. Ability to understand and discuss fundamental technologies for constructing computer networks, particularly for various advanced topics in such as the next-generation Internet technologies.
2. Ability to read the research papers and discuss on the advanced topics in computer networks.

4. Course Schedule

Lecture 1-3 Overview of computer network systems
Lecture 4-6 Overview of next-gen Internet systems
Lecture 7-9 Overview of next-gen wireless communication systems
Lecture 10-12 Design of network architecture and protocols
Lecture 13-15 Technologies in business on Web/Network services

5. Prior/Post Assignment

Readning course material in prior to the classes. Finishing assignments required.

6. Assessment

The course will be evaluated comprehensively based on presentations summarizing research in the field of networks and participation in discussions (~80%), submitted reports (~20%). (Evaluation targets 1 and 2).

7. Textbooks

The materials are specified in the course.

8. Language of Instruction

In Japanese.

9. Requirements for registration

None

10. Note

Advanced Topics of Information Network 2

Grade	2025
Semester	Spring
Credits	2
Instructor	SHIRASE Masaaki

1. Course Outline

Cryptography and information security technologies are essential for keeping communications secure over networks. In this course, students will learn about the fundamentals of cryptography, the concept of cryptographic security, the relationship between quantum computing and cryptography, and new security technologies.

2. Keywords

Information security, Cryptosystem

3. Course Objectives

1. Learn cryptographic technology.
2. Learn information security technology.

4. Course Schedule

1. Symmetric key Cryptography
2. Public key Cryptography
3. Hybrid Methods and Digital Signatures
4. Cryptographic Implementation and Security
5. Cryptography and Quantum Computing
6. Network Security
7. Web Security
8. IoT Security
9. Automotive Security
10. AI Security
11-15. Student Presentations

5. Prior/Post Assignment

Prior: Read the distributed materials.
Post: Complete the assignments given in the lecture.

6. Assessment

Assignments (50%) (Goal 1 to be evaluated)
Presentation (50%) (Achievement objectives 1,2 to be evaluated)

7. Textbooks

Deliver required materials for each lecture

8. Language of Instruction

Handouts in English, and Oral Explanation in Japanese

9. Requirements for registration

None

10. Note

None

Advanced Topics in Data Science

Grade	2025
Semester	Spring
Credits	2
Instructor	SATO Naoyuki NIIMI Ayahiko

1. Course Outline

This course consists of two parts.
In part A: Statistical Machine Learning methods have been developing drastically in recent years and are utilized to extract information from massive data. In this course of lectures,
we show the introduction as well as applications of such methods.
In Part B: The overview of the theory, modeling and design of database systems, to learn about the processing of large-scale data.

2. Keywords

Database, Data model, Massive data processing, Machine learning, Pattern recognition

3. Course Objectives

1. This course introduces data store, data analysis, and data processing for understanding of basic theory of information science.
2. The aim of the course is to learn the massive data processing technology.

4. Course Schedule

Part A:
1 Optimization problem
2 Parameter estimation
3 Clustering method
4 Classification method (Naive Bayes classifier)
5 Classification method (Support vector machine)
6 Model selection

Part B:
1. Data model
2. Relational data model
3. SQL
4. Database design
5. Transaction processing
6. Database and programming
7. Massive data processing

5. Prior/Post Assignment

Prior: Work on assignments given in the class.
Post: Solve the quizzes.

6. Assessment

The final score is decided by final examination and/or reports. The ratio will be informed in the class (Goal 1, 2 to be evaluated).
Grades are separated Part A and Part B, and final grade is sum of them.

7. Textbooks

There are many topics in this lecture, the textbooks will be specified at the first lecture. There will be selected references each week if necessary.

- Reference book (Part A): Pattern Recognition and Machine Learning (Christopher M. Bishop) Springer, 2010
- Reference book (Part B): AnIntroduction to Database Systems:Eighth Edition (C. J. Date) Addison-Wesley, 2003

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8. Language of Instruction

Lecture materials in English and Japanese, and Oral Explanation is in Japanese (or some part is in Japanese and English).

9. Requirements for registration

This course is necessary the knowledge of the undergraduate level probability theory, statistics, operations research and database engineering.

10. Note

Advanced Topics in Information Environmentology

Grade	2025
Semester	Spring
Credits	2
Instructor	TSUKADA Koji SHIRAISHI Yoh

1. Course Outline

Recently,
computers and information technology became “ubiquitous” in the daily environment,
such as smart phones and IoT (internet of things). This course focuses on such new information environment,
and introduces fundamental technology and application through recent research projects.

2. Keywords

Ubiquitous Computing, Human Computer Interaction, Locating Technology, Activity Recognition

3. Course Objectives

1. Understanding fundamental technology and application of information environment through various research and projects.
2. Understanding advanced technology of information environment through latest international conferences.

4. Course Schedule

The possible topics in this course are as follows:

- Ubiquitous Computing
- Human Computer Interaction
- Tangible Interface
- Augmented Reality
- Wearable Interface
- Personal Fabrication
- Advanced Sensing Technology
- Locating Technology
- Navigation
- Network and Database
- Intelligent Transport Systems
- Collective Intelligence and Open Data
- Smart City and Mobility

5. Prior/Post Assignment

Prior: Prepare the contents designated in each class.
Post: Do assignment given in class or HOPE.

6. Assessment

Presentation, Report, Attendance attitude. The details will be informed in the class.

7. Textbooks

None. Some books and papers might be introduced for references in the lecture.

8. Language of Instruction

Japanese only. Presentation and report are allowed both in Japanese and English.

9. Requirements for registration

10. Note

Advanced Topics in Media Information Studies

Grade	2025
Semester	Fall
Credits	2
Instructor	SATO Ikuma

1. Course Outline

With the development of multimedia information technology, unstructured data such as images and sounds have been handled on a daily basis, and the amount of distribution has been increasing. In this lecture, image data will be taken as an example, and the data processing, statistical processing, and classification and recognition techniques required to handle such unstructured data will be learned. In addition to explanations of the theory, the students will also conduct programming exercises to utilize them. Furthermore, the exercises and assignments are developed by instructor who have practical, professional experience as embedded systems engineers.

2. Keywords

Multimedia Information Processing, Image Processing, Computer Vision, Feature Extraction, Pattern Recognition, Deep Learning.

3. Course Objectives

In this course, students will learn the fundamental principles and practical applications of multimedia information processing techniques, with a focus on image-based methods, for designing intelligent and interactive information systems. The specific learning objectives are as follows:

1. Develop the ability to process image data according to its intended application.
2. Understand the concept of feature extraction from unstructured data.
3. Comprehend the principles of image recognition and gain an understanding of image recognition methods utilizing machine learning and deep learning.
4. Acquire the skills to develop software that implements basic image recognition algorithms as well as machine learning- and deep learning-based image recognition techniques.

4. Course Schedule

1. The difference of image processing and computer vision
2-3. Image formation and its mathematical models
4-5. Region-based image processing and image filtering
6. Geometric transformations
7. Binary image processing
8. Pattern detection using image features
9-10. Pattern recognition
11-12. Image Recognition using Machine Learning
13. Deep Learning
14-15. Programing practice

5. Prior/Post Assignment

Prior: Review the previous lecture and prepare for the next lecture.
Post: Review the lecture and deepen understanding. Perform the tasks presented.

6. Assessment

The evaluation will be based on the minor assignment (report) (50 points) and the final assignment (program + report) (50 points) (objectives 1-4).

7. Textbooks

Textbook: Digital Image Processing, Okutomi, CG Arts Society

Reference: Computer Vision: Algorithms and Applications, Szeliski, Springer

8. Language of Instruction

Japanese

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9. Requirements for registration

Undergraduate level knowledge of image engineering and C language is desirable.

10. Note

Next year,

Prof. Prof. K. Terasawa will teach this course.

The main theme will be image processing with emphasis on feature extraction and pattern recognition.

Advanced Topics in Field Information Studies

Grade	2025
Semester	Spring
Credits	2
Instructor	ISHIGURE Yasuo WADA Masaaki

1. Course Outline

In this lecture, we will look into field informatics using global issues such as SDGs and carbon neutrality, as well as ICT applications in individual fields such as smart primary industries for DX and medical and health ICT for well-being.

2. Keywords

Filed informatics, Big data, SDGs, Society 5.0

3. Course Objectives

1. Understand what field informatics is, and examples of problem-solving practices and social implementation in the real world.
2. Learn the concept and process for solving problems in systems informatics.

4. Course Schedule

01. Orientation
05-08. Topics of global issues and primary industries
09-15. Lectures by outside experts in various fields

5. Prior/Post Assignment

Referring to related materials such as websites introduced in class for a better understanding.

6. Assessment

Evaluation will be based on reports and presentations.

7. Textbooks

8. Language of Instruction

Japanese Only

9. Requirements for registration

10. Note

Introduction to the Sciences of the Artificial

Grade	2025
Semester	Fall
Credits	2
Instructor	NAKAKOJI Kumiyo

1. Course Outline

This course aims to construct the knowledge and skills that are essential in the studies of design as the sciences of the artificial. Students will learn models and principles related to information artifacts, as well as the fundamentals of the cognitive and social science behind them through simple experimentation and reflections. The course focuses on essential topics including representation, communication, interactive perception characteristics, and collective creativity & social capital.

2. Keywords

design, cognitive science, representations, communication, creativity, interaction

3. Course Objectives

1. Students will develop the basic understanding of the nature of design and the cognitive and social characteristics of human beings.
2. Students will learn the methods applied, processes managed, and phenomena observed while engaging in design.
3. Students will acquire the vocabulary to express the above and communicate with others about them.

4. Course Schedule

1. Sciences of the artificial basics: Following the introduction of the overall course structure, the class briefly addresses the nature of design as the sciences of the artifact, and how it would be grounded in the cognitive and social aspects of human beings.
2-5. Representation and cognition: The four classes address how representations and their interactivity influence and affect human cognitive and thought processes.
6-9. Communication and shared understanding: The four classes describe language as design material, and how mutual and shared understanding is developed through communication.
10-12. Collective creativity and social capital: The three classes explain the notion of social capital, which serves as a foundation in understanding how people do or do not collaborate, and the issues and challenges in balancing incentives in synchronous and asynchronous collaborative work situations.
13-14. Interactive perception and illusion: The two classes address how controlling the temporal aspects of visual interaction affects the human perception and demonstrate haptic illusions through touch-based user interface programming.
15. Reflection and engagement: Students will be asked to reflect on the overall course.

5. Prior/Post Assignment

Prior assignment: Students are encouraged to reflect on what has been taught and discussed after each class.
Post assignment: Some of the classes ask students to compose 1-2 page essays or give them reading assignment.

6. Assessment

- participation in class discussions: 15 points (course objectives: 1, 2 and 3)
- theme essays/compositions assigned during lectures: 40 points (course objectives: 1, 2 and 3)
- term paper in the end of the course: 45 points (course objectives: 1, 2 and 3)

7. Textbooks

(not mandatory but recommended)
H. Simon, The Sciences of the Artificial
T. Winograd and F. Flores, Understanding Computers and Cognition
D.A. Schoen, the Reflective Practitioner
D.A. Norman, Psychology of Everyday Things

8. Language of Instruction

Lecture material and oral explanations will be presented both in Japanese and in English.

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9. Requirements for registration

Active participation in class discussions is encouraged.

10. Note

Advanced Topics of Embedded Systems

Grade	2025
Semester	Fall
Credits	2
Instructor	NAGASAKI Takeshi

1. Course Outline

This course has two components like the following to understand what kind of techniques are necessary to develop embedded systems and obtain these techniques.

(1) Enterprises developers give lectures about the business world, for example, techniques for embedded systems or recent trends.

(2) Lectures about basic techniques for embedded system by me. To be more specific, you will make an robot by Lego Mindstorms EV3 to develop an understanding about “task segmentation system on real-time control method, “ “communication between tasks, “ and “task scheduling” for practical training.

2. Keywords

Embedded system, Realtime system, Software Modeling

3. Course Objectives

You aim to obtain advanced techniques for embedded systems and related matters.

4. Course Schedule

(1) Lectures by embedded developers 9 lessons

A) Practicing modeling development 2 lessons

B) Product lifecycle 1 lesson

C) Introducing examples of each area; 6 lessons

- Automobile related example
- Industrial Equipment example
- Consumer equipment example

(2) Practicing embedded systems by Lego Mindstorms EV3 6 lessons

A) Introducing real-time OS, which we will use in the course, and its sample programs. 2 lesson

B) Practicing real-time processing and its programming / Development control program. 4 lessons

Notes: Times of each lesson may be change at the developer’s convenience.

5. Prior/Post Assignment

Prior: Read lecture materials.

Post: Work on assignments given in the class.

6. Assessment

The result will be evaluated by the report.

7. Textbooks

I will give instructions in the course, accordingly.

8. Language of Instruction

Japanese

9. Requirements for registration

10. Note

Advanced Open Technologies

Grade	2025
Semester	Fall
Credits	2
Instructor	OKUNO Taku

1. Course Outline

Present enterprise information systems are constituted by heterogeneous system that consists of many computers, which are closely coupled within an organization and are loosely coupled through the Internet, i.e., the open systems. Information engineers working in the critical uppermost phase of system development processes need to grasp the business strategy and to realize it by utilizing the information systems together with various stakeholders.

This lecture introduces constituent technologies of open systems, and real-world examples of enterprise businesses that utilize information technologies and systems. Enterprise engineers practically teach their own specialties week by week.

2. Keywords

Open System, Enterprise Information System, Business Process, Financial Information System, Business Model, Linked Open Data, AI, Big Data, Data Analysis, I

3. Course Objectives

1. Students will understand constituent technologies of open systems, and real-world examples of enterprise businesses that utilize information systems.

4. Course Schedule

The following is a list of lectures by company lecturers in 2024, with specific course content varying from year to year.

- The reality of data analysis and what it brings to business
- Regional revitalization of new business planning case studies (lecture + practice)
- Enterprise information systems and business processes
- Trends in spoken dialogue interface technology
- What do AI engineers do?
- Connecting learning to work
- International interoperability and open technologies - date-time and characters
- Trends in Smartphone Development Environments, Monaca and Monaca Education Development Activities
- Overview of banking system and financial solution
- How to create connected data
- Ophthalmic imaging and machine learning - an example of medical engineering collaboration

5. Prior/Post Assignment

Prior: Do pre-learning tasks assigned by lecturers.

Post: Do feedback to lecturers (questions and comments on the lecture).

6. Assessment

Assignments (paper) (100%) (Goal 1 to be evaluated)

7. Textbooks

Reference books will be introduced as needed.

8. Language of Instruction

Japanese

9. Requirements for registration

10. Note

Advanced Topics in IT Architecture

Grade	2025
Semester	Fall
Credits	2
Instructor	MATSUBARA Katsuya

1. Course Outline

The course's work is to read public documents and the source code of an actual system and develop small application programs to understand the excellent and notable architecture design corresponding to system requirements.

The teaching materials are created by an instructor who has experience as a developer of system software, such as Android, for products.

2. Keywords

Android, Software Architecture, System Design, Android

3. Course Objectives

1. Can understand the architecture design of large-scale software
2. Can design functionalities and API of a software system under consideration of performance, availability, extensibility, and operation cost.
3. Can implement systems and applications according to design philosophy.

4. Course Schedule

This course will be divided into nine chapters as follows:

1. Background, the latest development of the target system
2. SDK and tools
3. System architecture
4. Application model
5. Framework for application collaboration
6. Inter-process communication
7. Bootstrap
8. Framework for graphics and media processing
9. Access control and security

5. Prior/Post Assignment

Prior: Review the content of the previous lecture.

Post: Work on homework (program or report) given in the class.

6. Assessment

Grades are comprehensively assessed based on assignment (program/oral presentation/report) (achievement objectives 1, 2, and 3 to be assessed) and attitude to class participation. The ratio will be informed in class.

7. Textbooks

Reference Book: Karim Yaghmour, “Embedded Android”, O'Reilly

Reference Book: Tae Yeon Kim, Hyung Joo Song, Ji Hoon Park,Bak Lee, Ki Young Lim, “Inside Android”, Personal Media (in Japanese)

8. Language of Instruction

Japanese

9. Requirements for registration

Students are expected to have basic knowledge and experience in programming with Java, C/C++, or other languages.

10. Note

Advanced Topics in Service Management

Grade	2025
Semester	Fall
Credits	2
Instructor	ISHIO Takashi

1. Course Outline

Traditional service research has focused on service as a business in industries such as service industry, manufacturing, and information industry. On the other hand, any value-creating businesses are recognized as new services. In this course, students will learn the concept of the new services, their applications, and creation, operation, and management of services through lectures and exercises.

2. Keywords

Services, Service Science, Service management, Starting a business, Entrepreneur

3. Course Objectives

1. Students will be able to analyze existing services using theoretical frameworks.
2. Students will gain familiarity with applications and business models based on services.
3. Students will develop the ability to extract and interpret key information from terms of service agreements.

4. Course Schedule

This course includes the following topics:
- What is services
- New perceptions of service
- Service-oriented project management
- Decision support and service value
- Service of to promote corporate sustainability
- Service value creation model
- Service transformation of information business by approach
- Collaboration as seen from the service point of view
- And information ideas creation method of service
- Service-oriented information element stems business of organization theory

The schedule may be adjusted according to the level of understanding of students.

5. Prior/Post Assignment

Previous learning: Prepare for the next lesson.
Follow-up learning: Submit a report assignment.

6. Assessment

Goal 1: Students will write a report analyzing existing services using theoretical frameworks and present their findings in class (50%).
Goal 2: Students will submit reports summarizing insights from guest lectures by industry professionals (25%).
Goal 3: Students will complete in-class exercises focused on reading terms of service agreements (25%).

7. Textbooks

Textbook:
小坂満隆編「サービス志向への変革−顧客価値創造を追求する情報ビジネスの新展開−」（社会評論社）
Other reference books are instructed as appropriate at the time of lecture.

8. Language of Instruction

Japanese

9. Requirements for registration

Nothing in particular.

10. Note

Nothing in particular

Introduction to Information Design

Grade	2025
Semester	3Q
Credits	2
Instructor	YASUI Shigeya

1. Course Outline

In this course,
students will practice information design by creating and giving a presentation of an expression that conveys the “subjective sense of the expressionist” to others.

2. Keywords

nformation design, embodiment, perception design

3. Course Objectives

Students will be able to practice trial and error involving embodiment in the real world.
Students will be able to communicate to others about the new framework they have created.

4. Course Schedule

01 orientation
02-10 prototyping
11-13 creating and shareing each portfolio
14,
15 presentaion an reflection

5. Prior/Post Assignment

Pre-learning:collecting materials.
Post-learning: brush up materials created in advance based on class content.

6. Assessment

Assessment will be based on the prototypes produced and their presentations.

7. Textbooks

assignment books are selected together with the students in the first lesson.

8. Language of Instruction

Japanese

9. Requirements for registration

Students may be required to pay for prototyping supplies.
(If the items are inexpensive and generally available,
they may be purchased in class.)

10. Note

This class is to be held in the first half of the latter term.

Introduction to Cognitive System

Grade	2025
Semester	Spring
Credits	2
Instructor	MIMA Noyuri

1. Course Outline

Cognitive science is an interdisciplinary field that includes engineering, linguistics, psychology, and other fields. In particular, understanding trends in research on knowledge and learning, such as situated cognition and the theory of legitimate peripheral participation, is very useful for studying artificial intelligence and user interfaces, as well as for designing systems. In this course, we will focus on the uniqueness of research content and methods, while being aware of the points of contact between cognitive science and computer science. The instructors, who have experience in research, development, and practice based on information science, education, and cognitive psychology, will draw on this experience to discuss specific topics related to learning environment design, artificial intelligence research, and user interface research, with a focus on knowledge and learning. At the same time, they will also discuss the specific application of research results, while cultivating the attitude to participate in graduate school lectures (seminars), such as how to read and understand technical books, how to give presentations, and how to participate.

2. Keywords

knowledge, learning, learning environment design, artificial intelligence, user interface, situated cognition

3. Course Objectives

Understand the fundamental knowledge and new direction on cognitive science research contents and research methods.
Developing skills of reading, understanding, presenting and discussing on specialized books in a postgraduate lecture (seminar).

4. Course Schedule

1-4week
Noyuri Mima “Designing Future Learning: Space, Activity, and Community” (University of Tokyo Press).
Both books are written in Japanese.
5-9week
Jean Lave and Etienne Wenger “Situated Learning: Legitimate Peripheral Participation” (Cambridge University Press).
10-14 week
Lucy Suchman “Plans and Situated Actions: The Problem of Human-machine Communication” (Cambridge University Press).
15 wrap up

5. Prior/Post Assignment

As preliminary learning, you are required to read the relevant documents every time and summarize the contents to PowerPoint. Also, you need to think about the parts related to your research and reference parts in the textbook and summarize it in PowerPoint.
In the post learning, you need to reflect the understanding in the class in the PowerPoint which is summarized in advance.

6. Assessment

Evaluate by participation in discussion in class (70%), and term paper (report) (30%).

7. Textbooks

Noyuri Mima “Designing Future Learning: Space, Activity, and Community” (University of Tokyo Press).
Both books are written in Japanese.
Jean Lave and Etienne Wenger “Situated Learning: Legitimate Peripheral Participation” (Cambridge University Press).
Lucy Suchman “Plans and Situated Actions: The Problem of Human-machine Communication” (Cambridge University Press).

Go to the next page

8. Language of Instruction

The lecture is basically done in Japanese, but for students who need English, I prepare English texts and oral explanations with Japanese and English.

9. Requirements for registration

As for the specific contents and methods of the class and the skills to be acquired through the class, there are messages left by the seniors in the online class feedback, and I hope you will read them before participating.

10. Note

Nothing in particular

Introduction to Interactive Systems

Grade	2025
Semester	Spring
Credits	2
Instructor	SUMI Kaoru

1. Course Outline

In this class, students will learn about the technologies of interactive systems, their interactions, and their impact on humans through reading, discussion, and work production.
Interactive systems is a general term for systems in which computers and humans exchange information with each other. In this class, students will discover the rules of interactive design in the process of learning about the technologies of interactive systems, the interaction between a human and a computer, and their impact on humans, and summarize those rules in a guidebook. Finally, we will have our own exhibition.

2. Keywords

Non-verbal communication, Affective computing, Human computer interaction, Psychology

3. Course Objectives

(1) Understand the technologies, interactions, and human impact of interactive systems.
(2) Apply this knowledge to build system designs.
(3) Summarize the learned design rules into a guidebook.
(4) Present the results in an exhibition and deepen understanding through discussion.

4. Course Schedule

Students will present and explain the contents of the designated textbook in a round-reading format, and deepen their knowledge by discussing questions and impressions about it.
In addition, a weekly report will be submitted that describes what was found in the class and any remaining questions, and the professor will explain them. The knowledge gained through commentary and discussion is summarized as a form, and the found design rule collection is completed as a design guidebook for undergraduate students.

Schedules:

1	Orientation
2-7	Reading Book1
8-12	Reading Book2
13	Making a Guide Book
14	Exhibition rehearsal
15	Setting up an exhibition

5. Prior/Post Assignment

Read the chapter of the book before class.
Complete any reports or assignments you may have.

6. Assessment

- Exercises and reports (30%) → Evaluates objectives (1)(2)
- Class discussions (20%) → Evaluates objectives (1)(2)
- Final work (30%) → Evaluates objective (3)
- Exhibition presentation (20%) → Evaluates objective (4)

7. Textbooks

1) The Power of Language: How the Codes We Use to Think, Speak, and Live Transform Our Minds, Viorica Marian(Author) Penguin Random House

2) The Simulation Hypothesis: An MIT Computer Scientist Shows Why AI, Quantum Physics, and Eastern Mystics All Agree We Are in a Video Game, Rizwan Virk(Author) Bayview Books (2019)

8. Language of Instruction

Japanese / English

Go to the next page

9. Requirements for registration

The class will be conducted on the premise that you are preparing, so be sure to read the textbook as a preparation.

10. Note

Basically, this class is conducted in Japanese.
If international students attend, the class will be conducted in English and the materials will be changed to English if necessary.

Field Research Methods for Design Work

Grade	2025
Semester	Spring
Credits	2
Instructor	NAMBU Misako SAKAIDA Rui

1. Course Outline

Learn the methods of field research, which is the foundation of design work, including the knowledge of anthropology and sociology.

Plan and implement field research based on their own interests, and design a media to communicate the results.

This course is designed by two faculty members with practical experience in field research and qualitative analysis.

2. Keywords

Field Research, Participant Observation, Interview, Ethnography, Interaction Analysis

3. Course Objectives

1. Acquire basic knowledge of field research (history, techniques, analysis, ethics, etc.)
2. Practice a research appropriately based on their own interests
3. Publish the results in some form of media
4. Engage in this series of activities with a proactive attitude

4. Course Schedule

1-5. Overview of field research methods: history, background, disciplines, theory, methods, description, data, tools, ethics, etc.

6-10. Practice of field research: planning, implementation, reporting, analysis, etc.

7-15. Production based on research results: paper, report, booklet, poster, website, exhibition, etc.

5. Prior/Post Assignment

Prepare for and reflect on class, and produce own work based on the instructions and discussions in class.

6. Assessment

1. Active involvement and motivated attitude in the class (attainment targets 1, 3 and 4)
2. Progress reports on research, analysis, production, etc. (attainment targets 2, 3, 4)
3. Quality of the final designed media (attainment targets 3,4)

7. Textbooks

TBA

8. Language of Instruction

Japanese

9. Requirements for registration

This course may have a limit on the number of students. Details will be explained in the first lesson.

10. Note

Required to conduct field research and produce work outside of class hours.

Special Topics of Information Design 1

Grade	2025
Semester	4Q
Credits	2
Instructor	OSADA Junichi

1. Course Outline

In this class, students will learn vision design techniques to depict the ideal future, using uncertain and complex local social issues as a subject. As the scope of design expands today, designers are also being asked to depict a sustainable future society. In this class, students will combine “scenario planning,” a method from the marketing field, with UI/UX design techniques to depict the lifestyle of their hometown, Hakodate, 30 years from now.

2. Keywords

UIUXdesign, scenario planning

3. Course Objectives

1. Experience interviewing local stakeholders and extracting latent needs
2. Acquire the skills to classify and structure the various opinions heard based on PEST
3. Acquire scenario planning techniques and concretely depict possible futures using Hakodate as an example
4. Embody a symbolic consumer in a possible future as a persona
5. Express the life of the persona in the future as a story
6. Make a presentation about the depicted future life and present it to a third party

4. Course Schedule

1. Orientation
2-6. Observation and Prototyping
7. Midterm-presentation
8-13. Observation and Prototyping
14.Pre-presentaition
15. Final presentation

5. Prior/Post Assignment

Pre: reading papers and books
Post-lecture: Writing Reports

6. Assessment

Grades will be determined based on “Class Objectives 1-6,” with 30% based on participation in exercises and 70% based on the exercise assignment (work).
Students will be tasked with creating an assignment (work), which will be graded comprehensively with 20% for concept design, 30% for production and implementation, and 20% for presentation.
Total marks are out of 100, with a score of 60 or above being the pass mark.

7. Textbooks

8. Language of Instruction

Lecture: Japanese
Lecture materials: Japanese

9. Requirements for registration

Messages to students: Let's communicate closely and make lively discussions.

10. Note

In addition to preparatory work,
students may be required to do some production work outside the class.

Special Topics of Information Design 2

Grade	2025
Semester	2Q
Credits	2
Instructor	KANG Namgyu

1. Course Outline

This course investigates the domain of Kansei (Emotional) design with a particular emphasis on human Kansei (emotion). The objective is not only to propose practical design solutions that resonate with users but also to formulate more logically grounded designs through the development of a comprehensive report that documents and analyzes the entire design process. As part of this year's academic activities, the course aims to present its findings at the Annual Conference of the Japan Society of Kansei Engineering, scheduled for the fall.

2. Keywords

Research on design practice, information design, design research methods

3. Course Objectives

- To Understand the outline and characteristics of the design research methods adopted in your own research, and be able to explain their validity.
- To explain your own research by positioning it within design research.
- To plan your own information design research.(To be able to feedback for own design practice.)

4. Course Schedule

1) Orientation
2-3) Presentation of own research outline and research plan.
4-7) own research on references, precedent cases, and research cases related to your own research.
8-13) Writing reports and make these slides or posters.
14-15) Presentation using slides or posters.

5. Prior/Post Assignment

6. Assessment

Classroom attitude (40 %)
Quality of assignment (40%)
Quality of assignment presentation (20%)

7. Textbooks

Donald A. Norman "Emotional Design: Why We Love (or Hate) Everyday Things"

8. Language of Instruction

Japanese • English

9. Requirements for registration

10. Note

This course will be held during the second quarter.(6/11-)

Special Topics of Cognitive System 1

Grade	2025
Semester	Spring
Credits	2
Instructor	HANADA Mitsuhiko

1. Course Outline

Knowledge of human cognitive information processing is necessary for good design. Basic knowledge of visual information processing is also useful for computer graphics and image processing. Lectures will be given by those who have studied human cognition and visual information processing based on their experience. In the first half of the lecture, perceptual information processing, such as color perception, will be explained. It will also show how knowledge about perceptual information processing can be applied to computer science. The second half of the course covers psychological research methods and statistical analysis of psychological data. Students will learn data analysis, such as multivariate analysis, by analyzing actual psychological data using statistical software.

2. Keywords

cognitive system, color perception, psychological research methods, statistical analysis

3. Course Objectives

Participants in this course learn human cognitive information processing. They also learn psychology research methods such as experimental design to study human information processing.They learn statistical analysis of data from experiments and surveys.

4. Course Schedule

1. Introduction
3-4. Color representation system
5-6. Color vision
7. Visual information processing
8. Color management
9. Experimental design
10-12. Principal component analysis and factor analysis
13-14. Other statistical methods
15. Summary

5. Prior/Post Assignment

Prior: Do assigned tasks to prepare next class
Post: Review course contents and work on assignments.

6. Assessment

Final grades are assessed by performance of assignments.

7. Textbooks

None

8. Language of Instruction

Japanese

9. Requirements for registration

None

10. Note

None

Special Topics of Cognitive System 2

Grade	2025
Semester	3Q
Credits	2
Instructor	ITO Kiyohide

1. Course Outline

This course will focus on Fcological sychology, especially sound perception, through books, papers, and experiments.

In the lecture, students will read books and papers related to auditory and visual affordance perception, and conduct simple experiments.

Students will practice sound recording.

2. Keywords

Ecological psychology, Acoustics, Physiological psychology, Music perception

3. Course Objectives

To acquire basic knowledge of pysical influence of event sound and music perception and action through reading in a circle and exercises.

4. Course Schedule

reading of papers

5. Prior/Post Assignment

Prior Assignment: Summarize the assigned books/articles in a resume

Post Assignment: Find and read papers that interest you. Relate your research to the content of lectures and exercises.

6. Assessment

1. participation in discussions
2. assignments

7. Textbooks

This will be explained the first meeting.

8. Language of Instruction

Japanese

9. Requirements for registration

Students interested in auditory media such as hearing and recording are welcome.

Please note that the content of the lecture may be subject to change depending on the infection status of COVID-19.

10. Note

Special Topics of Interactive Systems 1

Grade	2025
Semester	4Q
Credits	2
Instructor	WATANABE Hiroki

1. Course Outline

Interactive systems are characterized by the fact that the system responds accordingly to human actions and situations. Therefore, in the field of interaction, many students are encouraged to present demonstrations that allow them to actually experience the system.
In this course, students will design and implement interactive systems related to their own research goals.

2. Keywords

Interaction, Interactive System

3. Course Objectives

1. to understand the current trend of interactive systems in their field by investigating existing researches and technologies.
2. to create interactive systems related to their research topics.
3. to present their research effectively using the systems they have created.

4. Course Schedule

The following schedule will be used, but may be changed depending on the progress of the course and the number of students.

1: Orientation
2–3: Survey of current status of interactive systems
4: Introduction to the current status of interactive systems (interim presentation)
5 –7: Survey of elemental technologies required to create interactive systems
8: Presentation of the system to be created
9-10: Creation of interactive systems 1
11: Interim progress report
12-14: Creation of interactive systems 2
15: Introduction of interactive systems (final presentation)

5. Prior/Post Assignment

Before: To prepare the contents instructed in each time.
After: To do homework instructed in each time.

6. Assessment

Mid-term presentation (30%) (Goal 1 to be evaluated)
Final presentation (70%) (Goal 2 and 3 to be evaluated)

7. Textbooks

8. Language of Instruction

Japanese,
English

9. Requirements for registration

You must attend the first time to know the important information in this class.

10. Note

To learn cutting-edge research topic,
it is possible to have flexible events for the benefit of students.

Special Topics of Interactive Systems 2

Grade	2025
Semester	4Q
Credits	2
Instructor	TAKEGAWA Yoshinari

1. Course Outline

Creating an attractive demo movie is one important research activity. In this lecture, each student will create a demo movie of their own research achievements, utilizing every kind of interactive technology, such as the widely applicable JavaScript, digital machine tools, electronic kits,
video-editing software (Premiere etc.), 3D modelling software (MAYA etc.),
3D CAD software (Inventor etc.) and digital signage software.
Regarding the content of each lecture, students will first independently assign roles and conduct investigation, and the class will be continued in the form of conducting lectures to share information between all participants.

2. Keywords

HCI, Information design, Prototyping, Communication

3. Course Objectives

The learning of interactive technology and expression methods to explain each student's research theme and achievements effectively; creation of a research demo movie.

4. Course Schedule

Lecture 1: Explanation of lecture policy/outline
Lectures 2 and 3: Analyisis of research demo movies
Lectures 4 and 5: Conception of research demo movie
Lecture 6: Evaluation of research demo movie (mid-term presentations)
Lectures 7-9: Investigation of underlying technology necessary for research demo movie
Lecture 10: Report of investigation results (mid-term presentations)
Lectures 11-14: Creation of research demo movie
Lecture 15: Final presentation of created research demo movie

5. Prior/Post Assignment

Prior: Work on the assignments given in the class
Post: Revise the assignments given in the class

6. Assessment

Grades are based on "Course Objectives," such as degree of completion of created research achievement demo movie, and students' peer evaluation.

7. Textbooks

There is no specified textbook. Reference materials will be specified during lectures.

8. Language of Instruction

Japanese,
English

9. Requirements for registration

There is no specified.

10. Note

A quarter system has been introduced for this class,
which will be conducted twice a week starting in the second half of the second semester.

Advanced Topics in Information Mathematics

Grade	2025
Semester	Spring
Credits	2
Instructor	YOSHINAGA Natsuhiko

1. Course Outline

Nature is always fluctuating. Its statistical information, such as probability distribution, gives us useful insight into the system in addition to its deterministic change. In this lecture, we study two issues: one is sampling, and the second is stochastic process. Sampling is a way to realise a state from a certain statistical distribution. We focus on the Monte Carlo method and its extension. We also study how the statistical distribution changes using stochastic differential equations in stochastic processes. In contrast with point estimation, the statistical point of view plays a significant role in modern machine learning techniques, such as generative models and diffusion model. We study the relation between statistical mechanics and machine learning.

2. Keywords

Statistical Inference, Monte Carlo Sampling, Stochastic Process

3. Course Objectives

To understand the basics of sampling using Monte Carlo and to apply it to actual problems (achievement objective 1). To understand the basics of a stochastic process (achievement objective 2).

4. Course Schedule

1. Optimisation and statistical inference
2-3. Statistical physics and sampling
4-8. Markov-chain Monte Carlo method and sampling
9-10. Cost function and optimisation based on gradient methods
11-15. Stochastic process, stochastic differential equation and Langevin equation, Master equation, Fokker-Planck equation

5. Prior/Post Assignment

(prior) Review the topics in the prevous class. (30min)
(post) Review python codes demonstrated in the class (1hour)

6. Assessment

Rating several reports (achievement objectives 1,2 to be assessed)
Attendance of at least 2/3 of all class sessions is mandatory for credit

7. Textbooks

No textbook designated.

8. Language of Instruction

Japanese

9. Requirements for registration

The class attendee is supposed to be the elementary level of ordinary differential equations, non-linear dynamics, and probability.

10. Note

Advanced Topics in Nonlinear Mathematics

Grade	2025
Semester	Spring
Credits	2
Instructor	KATORI Yuichi

1. Course Outline

In this course, we will study the different aspects of the world around us, including nature, engineering, social science, and other systems. We will focus specifically on the “motion” aspect, which can be viewed as a dynamical system described by a differential equation. Many of these systems are nonlinear, which means they have rich dynamic properties. We will learn methods for analyzing nonlinear systems and information processing using nonlinear dynamics. We will also discuss mathematical models of neurons and neural networks as examples of systems with complex dynamic structures.

2. Keywords

Non-linear dynamics, mathematical modelling, neurodynamics

3. Course Objectives

1. Master the fundamentals of nonlinear dynamics.
2. Analyze fixed points and their stability, limit cycles, and bifurcation phenomena on two or three-dimensional continuous-time dynamical systems.
3. Understand the connection between nonlinear dynamics and information processing.

4. Course Schedule

1. physical systems and differential equations
2. characteristic structure of dynamical systems, phase diagram
3. equilibrium point and its stability
4. limit cycle
5. bifurcation of dynamical systems
6. saddle node bifurcation
7. hop bifurcation
8. global bifurcation of periodic orbits.

9-11. neuronal dynamics

12-14. dynamics of neural networks

15. summary

5. Prior/Post Assignment

Prior: Preparation for the class using the handouts.

Post: Report assignment to be given in class.

6. Assessment

Evaluation will be based on the quiz and the reports (objectives 1,2,3 to be assessed).

7. Textbooks

- Steven H. Strogatz. Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistry, and Engineering. Westview Press.
- Yuri A. Kuznetsov. Elements of Applied Bifurcation Theory. Springer.
- Eugene M. Izhikevich. Dynamical Systems in Neuroscience. The MIT Press.

8. Language of Instruction

Lecture materials are written in both English and Japanese.

Japanese and English will be used as necessary.

9. Requirements for registration

10. Note

Advanced Topics in System Mathematics

Grade	2025
Semester	Spring
Credits	2
Instructor	YAMADA Yasufumi

1. Course Outline

When we want to know the properties of the current observations, i.e., the system, the essential information about them is a set of data. In this lecture, we will discuss the state-space representation, a method for modeling a system using these pairs of data, or states.
The lecture will also explain the methods of extracting information from data, predicting, and controlling the system by modeling the system using the state-space representation.

2. Keywords

Data analysis, Time series analysis, State space representation, Dynamic systems
Linear and nonlinear systems, Modeling, Filter, Estimation, Prediction, Control

3. Course Objectives

Students will acquire a basic knowledge of estimation, prediction, and control of linear systems and their application to nonlinear systems using nonlinear non-Gaussian state-space models.

4. Course Schedule

1. introduction
2. state space representation
3. linear Gaussian state space model
4. the AR model
5. state estimation
6. fixed interval smoothing
7. Statistical Modeling and Markov Representation
8. the Kalman filter
9. linear Gaussian state space applications 1
10. generalization of the Kalman filter
11. nonlinear non-Gaussian state space models
12. mixed Gaussian sum approximation
13. distribution approximation
14. application example 2
15. model extension (Gaussian and nonlinear state-space models)

5. Prior/Post Assignment

Prior Assignment: Review the contents of the previous lectures.
Post Assignment: Students are expected to organize the contents of the oral explanation in their notebooks.

6. Assessment

Some reports

7. Textbooks

8. Language of Instruction

Lecture materials and Oral Explanation in Japanese.

9. Requirements for registration

It is desirable to have taken “Neurocomputing”.

10. Note

Advanced Topics in Mathematical Analysis

Grade	2025
Semester	Fall
Credits	2
Instructor	SHIMAUCHI Hirokazu

1. Course Outline

This year, I will give a lecture on statistical learning theory. Beginning with the necessary mathematical foundations -such as Lebesgue integration, probability theory, statistics, and functional analysis- I will introduce concepts including the Vapnik-Chervonenkis (VC) dimension and Rademacher complexity, and then discuss the statistical properties of several machine learning algorithms.

2. Keywords

Vapnik–Chervonenkis, Rademacher, Vapnik–Chervonenkis Dimension, Rademacher Complexity

3. Course Objectives

1. Understand the basic mathematical concepts covered in the lectures (such as Lebesgue integration, probability and statistics, and functional analysis).
2. Understand the fundamentals of statistical learning theory (such as the Vapnik–Chervonenkis dimension and Rademacher complexity).
3. Understand the statistical properties of the machine learning algorithms discussed in the lectures.

4. Course Schedule

1-5: Fundamental Mathematics (Basics of Lebesgue integration, Probability and Statistics, Functional Analysis, etc.)
6-10: Fundamentals of Statistical Learning Theory (Vapnik–Chervonenkis dimension, Rademacher complexity, etc.)
11-15: Statistical Properties of Selected Machine Learning Algorithms

5. Prior/Post Assignment

(Prior) Review the material from previous lectures before class and organize it in your own way.
(Post) Work on the assignments given during the lecture.

6. Assessment

Grades will be based entirely (100%) on the assignments given during the lectures.

7. Textbooks

[1] 金森敬文, 統計的学習理論 (機械学習プロフェッショナルシリーズ), 講談社サイエンティフィック, 2015.
[2] Mehryar Mohri, Foundations of machine learning, MIT press, Second Edition, 2018.
[3] 新井 仁之, ルベーグ積分講義［改訂版］, 日本評論社, 2023.
[4] 杉山将, 機械学習のための確率と統計, 講談社, 2015.
[5] 渕之内治男, 改訂 関数解析入門 (サイエンスライブラリ理工系の数学), サイエンス社, 1995.

8. Language of Instruction

Japanese

9. Requirements for registration

10. Note

Review the linear algebra, analysis, and probability/statistics you learned as an undergraduate.

Advanced Topics in Applied Complex Systems

Grade	2025
Semester	Fall
Credits	2
Instructor	KAWAGOE Toshiji

1. Course Outline

Designing a desirable voting rule that aggregates individual preferences is main topic of Social Choice Theory. But there exists no desirable voting rule except for dictatorship. This negatve result is a famous Arrow's impossibility theorem. If an individual can successfully manipulate the voting outcome, such a voting rule is not strategy-proof. But, in general environment, there exists no strategy-proof voting rule except for dictatorship. This is called Gibbard-Satterthwaite theorem. Those topics are taught in first part of this lecure. In the second part of the lecture, topics in Market Design are introduced. Main focus is on auction theory and matching theory.

2. Keywords

Game theory, social choice theory, voting, market design, auction, matching

3. Course Objectives

1. Understanding the basics of Social Choice Theory and Market Design.

4. Course Schedule

1. What is Social Choice Theory?
2. Apportionment problem
3. Paradox of voting
4. Arrow's impossibility theorem
5. Strategy-proofness
6. Gibbard-Satterthwaite theorem
7. Liberal paradox
8. King Solomon's dilemma
9. Basics of auction theory
10. Revenue equivalence theorem
11. Auctions with multiple goods
12. Stable marriage problem
13. College admission problem
14. School choice problem
15. Matching with contracts

5. Prior/Post Assignment

Prior: Read a part of textbooks and articles assigned
Post: Summarize the important points addressed in the class in your notebook.

6. Assessment

For the course objective 1, evaluation is made by the end-term report.

7. Textbooks

Haeringer, G. (2018) Market Design: Auctions and Matching, The MIT Press

Roth, A. E. and M. A. O. Sotomayor (1990) Two-Sided Matching: A Study in Game-Theoretic Modeling and Analysis, Cambridge University Press

Krishna, V. (2009) Auction Theory, Second Edition, Academic Press.

Feldman, A. E. and R. Serrano (2005) Welfare Economics and Social Choice Theory, Springer Verlag.

8. Language of Instruction

Japanese

Go to the next page

9. Requirements for registration

None

10. Note

None

Advanced Topics in Complex Systems

Grade	2025
Semester	1Q
Credits	2
Instructor	KATO Yuzuru

1. Course Outline

Complex systems, which exhibit emergent behavior due to interactions among a large number of subsystems, can be analyzed from the perspective of systems science. In this course, students will learn several mathematical frameworks for analyzing and controlling complex systems, incorporating concepts from physics, systems theory, and control theory. The course introduces the analysis and control of physical systems, with a particular focus on synchronization analysis based on reduction theory and fundamental concepts from modern control theory. Additionally, the fundamental mathematical framework of quantum systems, which describes micro- and nanoscale systems, will be covered. The course consists of three main parts: 1. Synchronization analysis, 2. Modern control theory, 3. Mathematics of quantum systems. Each topic will be introduced comprehensively, progressing from basic to advanced concepts. The course will be taught by a faculty member with industry experience in a private company.

2. Keywords

complex systems, systems and control, nonlinear oscillations and synchronization, control theory, quantum mechanics

3. Course Objectives

The student will be expected to
1. understand the concept of the reduction theory through synchronization analysis
2. understand the fundamental concepts of modern control theory
3. understand the fundamental concepts of quantum systems

4. Course Schedule

1. Synchronization analysis
- Introduction
- Nonlinear oscillations, phase reduction theory
- Synchronization of an oscillator with periodic forcing and of two coupled oscillators
- Kuramoto model, synchronization of globally coupled oscillators
- Synchronization of noisy oscillators
- Other advanced topics

2. Modern control theory
- Introduction
- Systems modeling, stability analysis
- Controllability and observability
- Regulators and observers
- Optimal control and Kalman filter
- Other advanced topics

3. Mathematics of quantum systems
- Introduction
- Pure states, mixed states, density matrix
- Bloch sphere, uncertainty principle
- Quantum dynamics, quantum measurement
- Composed systems, quantum entanglement
- Other advanced topics

5. Prior/Post Assignment

Research for related topics

6. Assessment

Students will be evaluated only by the final report, which is evaluated based on “Course Objectives 1, 2, 3”. There will be no final exam.

Go to the next page

7. Textbooks

Nothing

8. Language of Instruction

Japanese. English explanation will be included if necessary.

9. Requirements for registration

Nothing

10. Note

Nothing

An Introduction to Intelligent Information Science

Grade	2025
Semester	Spring
Credits	2
Instructor	TERAI Asuka MURAI Hajime

1. Course Outline

This lecture presents the fundamental concepts of the recent artificial intelligence research. You can learn how the recent AI ideas such as partiality of information, embodiment, real-time algorithms so on become more important than physical symbol system hypothesis. And we study how the important concepts are implemented in the real world systems by some examples.
In this lecture, the instructors are researchers in artificial intelligence field, and the instructors explain about actual utilization and application in research and development based on their experiences.

2. Keywords

Artificial intelligence, behavior-based intelligence, frame problem, symbol grounding problem

3. Course Objectives

The object is to study the philosophy of artificial intelligence,
and to become possible to understand and explain papers about artificial intelligence.

4. Course Schedule

The lecture is designed to learn basic concepts underlying intelligence information science.
Aiming to touch on latest researches,
presentation and discussions will be held after reading papers. The contents of the lecture are the following:

1 Introduction for AI
2 History of AI researches
3 Knowledge representation
4 Brain and AI
5 Natural language
6 Intelligence based on embodiment
7 Creativity
8 Development of future artificial intelligence
9-15 Presentation and discussions about research paper

5. Prior/Post Assignment

Before: To search related research papers and to understand these papers
After: To do an assignment on the websites

6. Assessment

The exercises (presentation and report) 80% and the learning attitude 20%.

7. Textbooks

References are introduced in the lecture.

8. Language of Instruction

Japanese, handouts are both English and Japanese

9. Requirements for registration

None.

10. Note

None.

History and Future of Intelligent Systems

Grade	2025
Semester	Fall
Credits	2
Instructor	Ian FRANK

1. Course Outline

The history of intelligent systems is long and fascinating. A steam-powered “pigeon” is said to have been created around 400 to 350 BCE by Archytas (who was maybe one model for Plato's philosopher king), and the word “automaton” is from the ancient Greek “acting of one’s own will.” In the present, we seem to be living through a time of significant change, which makes it even more important to appreciate the field from a broad perspective. The future of artificial intelligence is the subject of much discussion, with some predicting a “singularity” and others considering the idea of a “tipping point”.

This class, delivered as a dynamic mixture of face-to-face workshops and online participation, offers students the opportunity to delve into the history of intelligent systems, to learn about the latest advancements and technologies, and to engage in discussions about the future of the field. Students will also be challenged to explore the ethical and societal implications of artificial intelligence and to consider what it means to be human in the age of AI. Whether you are already familiar with the field or just starting to build your knowledge, this class offers a unique and engaging perspective on the history and future of intelligent systems.

The speed of technological progress means that tracking “news” is a major part of this course, including issues such as morals and ethics. Each year, we try to find and work on the questions and subjects in which the students have an interest, so students are encouraged to express their opinions.

2. Keywords

Algorithms, Historical Perspectives, AI in Society, Advancements in Technology, Constraints
Intelligence Augmentation, Big Data, Quantum Computing, Ethics of AI, Free will, Stories
Perspective, Prediction

3. Course Objectives

Students will be expected to:
- gain a perspective on historical development of ideas
- deepen knowledge of notable figures in the past and present
- improve the granularity of their understanding of the current speed of technological progress
- acquire insights on possible futures for intelligent systems
- introspect on human intelligence, and its relationship with the technologies around us
- consider ethical and moral issues
- participate in a forward-thinking class project

4. Course Schedule

The first ten weeks of the class alternate between “online” and then face-to-face “workshop” style.
Students should bring their “open mind” to the workshops, and be prepared to actively participate. The final weeks
in December and January are online classes and project work.
It is important to attend this class from Week#1. Students joining late are required to email the instructor to explain their situation.
Class Policy: Through learning, students are encouraged to build a deeper understanding of the world, to look for relationships and patterns of connection, and to strive to find their own “voice” that may help them succeed in their personal and professional lives.
The following are outlined in more detail on the class pages:
- We try our best
- We challenge the new world
- We trust each other
- We are a team
- We learn from mistakes
- We declare our sources

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AI Policy: This class assume that students will use AI tools. Some assignments may require it. Understanding and skilful use of things like ChatGPT is important, and the class will provide instruction and pointers. For example, “prompt engineering” is the practice of refining your prompts in order to get good outcomes. You will need to experiment.
Be careful when using LLMs:
- Don't trust any output. AI tools work best in conjunction with your own understanding. RLHF and other language agents can “hallucinate”, so assume numbers, facts, or programs are wrong unless you either know the answer or can check. You are responsible for any errors or omissions.
- Declare. For assignments where you use AI, you must describe what you did, and the prompts you used. Sharing ideas, results, and experiences helps us to learn as a community. Failure to declare is a violation of academic honesty policies.

5. Prior/Post Assignment

Teams are formed for watching weekly videos and working on Popups, and experience shows that students can benefit from starting the class with some idea of the peers they want to work with.
Other than this, prepare by reading and watching videos about research in intelligent systems, and becoming attuned to future trends.
Follow-up by reading and watching videos about research in intelligent systems, and becoming attuned to future trends.

6. Assessment

Overall course goals are addressed through regular homework, including critical reviews of selected videos and the submission of at least one news article per month. A final project, likely focused on creating Japanese subtitles for an existing video, further reinforces key themes. These assignments collectively account for approximately 65% of the grade, with specific breakdowns available on the course web pages.

The remaining portion of the grade is based on active participation, including engagement with weekly Popups and Feedback Forms and recording SRs (self-reflections) on videos.

Beyond these formal requirements, this course sometimes visits as a topic of study the history of how education has used numbers to represent learning. As part of the broader goal of introspecting on human intelligence, students are encouraged to think critically about grading itself as a technology. Instead of a graded exam, this course emphasises deeper engagement, inviting students to consider a fundamental question in both education and AI: Can thinking skills truly be measured by a test?

7. Textbooks

There are no particular course textbooks. There may be reading assignments modified to meet the interests of the students.

8. Language of Instruction

In principle, Japanese is used for spoken class content, but if significant numbers of overseas students enrol there may be classes in English that use technology such as live captions to provide Japanese subtitles. Class web pages and other materials usually based on English. Student comments in live chat are expected to be in English (can be DeepL), but other written student feedback can be in English or Japanese.

9. Requirements for registration

Check the class pages for details of the process that limits the participating student numbers to 25. In general, places will be offered first to Master's students, with 4th year students accepted if there is capacity remaining.

10. Note

This course will have significant video content, both original and “curated”. Students watch videos and share their reviews within the class. Communication is promoted with “Popup” comments that encourage students to share their ideas on each week's themes.

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The 2025 version of this class will build on the experience of the last four years of educational experimentation, with a schedule that looks to combine the best aspects of both face-to-face classes and online classes. The delivery for the “online” portion will be based on using OBS to create a dynamic and interactive “streaming” experience. The face-to-face portion of the course will continue the “workshop” style that was highly evaluated in the course in previous years. Note that space pressures for delivering impactful workshops require that this course is limited to 25 participants each year. All students should check the class pages on hope for details of the selection process.

Students are always encouraged to join the instructor in finding yet more ways to participate together creatively. All class participants, including the instructor, will be challenged to think for themselves, and to use and develop their own critical faculties (itself a meta-theme on intelligence).

Richard Saul Wurman calls teaching a “binary choice”: teach about what you already know or teach about what you would like to learn. I prefer, as him, the latter. So, this class will try to have the lecturer run his “mind parallel to the mind of a student, rather than acting as a director of traffic”.

For this Master's class, there is a final “exam” that happens after graduation, according to the class policy: “Through learning, students are encouraged to build a deeper understanding of the world, to look for relationships and patterns of connection, and to strive to find their own 'voice' that may help them succeed in their personal and professional lives.”

An Introduction to Intelligent Systems Programming

Grade	2025
Semester	Spring
Credits	2
Instructor	KATO Koji

1. Course Outline

In the research, it is important to verifying the methods as well as theoretical learning.
Therefore, in this lecture, students program several kinds of basic machine learning methods and verify the differences of those methods.

2. Keywords

Programming, Machine learning, Presentation

3. Course Objectives

This lecture introduces the programming methods using machine learning.

4. Course Schedule

This course make use of following methods.

1. Support vector machine
2. IoT devices or Deep Learning

Finally an applied problem using these methods.

5. Prior/Post Assignment

Pre-learning is not necessary. However you must read related papers and consider how to realize the learning contents.

6. Assessment

Attendances and Reports.

7. Textbooks

8. Language of Instruction

Basically use Japanese language. Some documents may use English.

9. Requirements for registration

Programming language is not specified. However it is necessary to have at least a basic knowledge of C language and Java language.

10. Note

Advanced Topics in Adaptive Systems

Grade	2025
Semester	Fall
Credits	2
Instructor	MIKAMI Sadayoshi

1. Course Outline

To make a robot or an autonomous software/hardware agent, it is essential to have a functionality that responds properly to its environment.
This lecture introduces some basic methods of optimization from two different viewpoints. One is a class of Bio-Inspired Computing methods, which solves optimisation and adaptation by the interaction of massive elements through underlying simple dynamics (part I).
The other is a class of feedback control methods (modern control systems), which calculates feasible control values by using a model of control target (part II).

2. Keywords

Ant Colony Optimisation, Bio Inspired Computation, Particle swarm optimization,
Modern control systems, State feedback, Observer

3. Course Objectives

This lecture aims at understanding the basics of adaptive systes. By this lecture, students will be able to choose appropriate adaptive methods to a given problem. The methods includes Bio-Inspired Computing and state feedback methods.

4. Course Schedule

1: A short guidance

Part-I
2: System dynamics and differential equations
3: Environmental adaptation system of microorganisms
4: Synchronization, entrainment and movement of swarm
5: BOID, Particle Swarm Optimization (PSO)
6: Amoeboid algorithm for network optimization
7: Ant Colony Optimization (AOC)

Part-II
8: Overview of the control systems
9: Modelling dynamical systems
10: (Workshop) Maglev system assemble
11: Basics of state feedback
12-13: State feedback with observer
14-15: Various state space models and their stabilities

5. Prior/Post Assignment

Prior: Read the handout of the next lecture posted on the HOPE.
Posterior: Read the handout of the lecture to develop an understanding.

6. Assessment

Final report (Part-I, 50%, Part-II, 50%).

7. Textbooks

(Part-I, reference) Biologically Inspired Optimization Methods, Mattias Wahde, WIT Press, 2009.
(Part-II, reference) Modern Control Systems, Richard Dorf and Robert Bishop, ISBN-13 : 978-0134407623 (about 800 pages)

8. Language of Instruction

Lecture materials in English and Japanese and Oral Explanation in Japanese

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9. Requirements for registration

Bring your PC that is accessible to HOPE system. Students may be required to install Scilab/Xcos control simulation software in their PCs.

10. Note

Advanced Topics in Autonomous System 1

Grade	2025
Semester	Spring
Credits	2
Instructor	YAMAUCHI Sho

1. Course Outline

This lecture covers various theories of agent and multiagent systems. Agent is an intelligent and autonomous entity, and multiagent systems consists of multiple agents. These theories include practical reasoning, interaction among agents, design methodology, and applications.

2. Keywords

Agent, multiagent, practical reasoning, communication, reactive agent, collaboration.

3. Course Objectives

Several well known agent and multiagent theories and systems are introduced.
Also, we discuss design of agent systems and application of agent systems.

4. Course Schedule

1. Introduction
2. Intelligent agents
3. Agent oriented programming
4. Multi-agent system
5-6. Practical agent programming
7-8. Multi-agent interaction
9-10. Reaching agreements
11-12. Communication
13. Experiment and evaluation with agent simulation
14-15. Presentation

5. Prior/Post Assignment

Prior: The main points of each lecture will be published in advance on the website of the lecture, so each student will prepare for the lecture using the website.

Post: Each student is assigned a task concerning the important items to be dealt with in the lecture, so they review and confirm the contents of the lecture by tackling the task, and they also learn in an advanced way.

6. Assessment

Assessment will be done based on presentation and programming assignment.

7. Textbooks

8. Language of Instruction

Japanese and English

9. Requirements for registration

10. Note

Advanced Topics in Autonomous System 2

Grade	2025
Semester	Fall
Credits	2
Instructor	SUZUKI Sho'ji SUMI Yasuyuki

1. Course Outline

This course focuses on estimation based on interpretation of observed data, which is important in the control of autonomous systems.
As representative examples of such estimation, we will focus on position estimation and map generation for robot movement to deepen our understanding of estimation methods based on time series data.

1) Position estimation is essential for a robot to safely and efficiently move from its current position to its target position. In this lecture, basic concepts and applications of methods for position estimation based on probabilistic handling of time-series data of position and environmental observations will be lectured.

2) To deepen the understanding of the theory learned in the first half of the lecture, students will learn specific methods for estimating the robot's self-position and generating a map of its movement based on simulations using Python.

2. Keywords

robot, localization, Kalman filter, SLAM

3. Course Objectives

Goal 1. Understanding of the basic theory for localization of mobile robots
Goal 2. Understanding algorithms for self-position estimation and map generation for mobile robots through simulations

4. Course Schedule

1. Introduction
2-8. Localization of the robot
- Navigation Technology
- Localization by Sensing
- Kalman Filter

9-15. Mobile Robot Simulation in Python
- Fundamentals of probabilistic robotics
- Estimation of position for movement
- Simultaneous localization and mapping

5. Prior/Post Assignment

Prior: Prepare the contents designated in each class.
Post: Review after the class.

6. Assessment

We evaluate based on homework reports and in-class practice.
- homework report (50%) (Goal 1 to be evaluated)
- presentation and participation in discussion of assigned reading of texts (50%) (Goal 2 to be evaluated)

7. Textbooks

8. Language of Instruction

Lecture materials in English and Japanese, Oral Explanation in Japanese and English

9. Requirements for registration

10. Note

Advanced Topics in Intelligent Media

Grade	2025
Semester	Fall
Credits	2
Instructor	KANO Takeshi

1. Course Outline

We often feel 'intelligence' in various phenomena existing in the natural world and artificial entities such as robots. Where is the source of this intelligence? What is the medium that generates intelligence? In this lecture, insights into concepts such as 'understanding,' 'perspective,' 'mathematical modeling,' 'reverse control theory,' and others will be discussed. While introducing examples of systems that evoke a sense of intelligence, we will engage in a discussion about the source of intelligence. The lecture is conducted by an instructor with practical experience in the engineering application of intelligent behavior in living organisms, drawing on insights gained through his previous researches and discussions with his collaborative researchers.

2. Keywords

Intelligence, Perspective, Mathematical modeling, Reverse control theory

3. Course Objectives

1. Students will learn the perspective that “the medium that generates intelligence is the environment.”
2. Through deep reflection by students and discussions between instructors and students, students will gain a convincing understanding of the source of intelligence.

4. Course Schedule

Week 1: Introduction
Weeks 2–4: What Does It Mean to “Understand”? Perspectives and Mathematical Models
Weeks 5–8: Perspectives on Control: Forward Control Theory, Inverse Control Theory, and Yin-Yang Control
Week 9: The Source of Intelligence as Seen in Centipede Robots
Weeks 10–12: Decentralized Autonomous Control and Swarm Intelligence
Weeks 13–15: Discussions and Conclusion

5. Prior/Post Assignment

Prior: Read the textbook in accordance with the progress of the class.
Post: Organize your thoughts based on the lecture content and describe them in the assignment report.

6. Assessment

• Evaluation will be based on the submission status and content of assignments (Course Objective 1).
• Evaluation will be based on class participation (e.g., willingness to speak) and depth of insight (Course Objective 2).

7. Textbooks

Koichi Osuka,
Where Does Intelligence Come From? - Search for the 'Hidden Brain" with Centipede Robot -
Lecture materials will be distributed during the class.

8. Language of Instruction

Lecture materials will be provided in both Japanese and English (if there is a preference for English), and oral explanations will be conducted in Japanese.

9. Requirements for registration

The number of students enrolled is capped. If the number of applicants exceeds the limit, enrollment will be determined during the first class session.

10. Note

Project Study 1

Grade	2025
Semester	Spring, Fall
Credits	2
Instructor	Superviser Head of Graduate School

1. Course Outline

Students mainly work on practical research promotion process, acquire research methodology and research techniques, and study basic theory and skills required to achieve the research for the master's thesis.
In Project Study 1, it aims at acquiring basic theory and skills.
First, students set the contents to study and goal for half year, and set appropriate studying materials and topics.
Students present the studied contents from time to time in the classes, write comprehensive report in the end of the semester, and give presentation.

2. Keywords

Information Architecture, Media Design, Complex Science, Intelligence Science,
literature Survey, Case Study

3. Course Objectives

The aims of the course are that students experience practical research promotion process and acquire research methodology, research techniques, basic theory and skills.

4. Course Schedule

Study and research plan are made after consulting with advisors.

5. Prior/Post Assignment

Prior Assignment: We'll conduct literature surveys of relevant fields.
Post Assignment: We'll set up research tasks.

6. Assessment

Grades are based on performance, presentation, and report.

7. Textbooks

References are decided after consulting with advisors.

8. Language of Instruction

The language of the instruction depends on the professor.

9. Requirements for registration

Special Research students are not allowed to take this course.

10. Note

Project Study 2

Grade	2025
Semester	Spring, Fall
Credits	2
Instructor	Superviser Head of Graduate School

1. Course Outline

In Project Study 2, students develop the contents achieved in the Project Study 1, set study theme which is closer to the research theme for master's thesis, investigate related research fields, investigate research promotion process with conducting case-study.
Students write the report about the studied contents in the end of the semester, and give presentation

2. Keywords

Information Architecture, Media Design, Complex Science, Intelligence Science,
literature Survey, Case Study

3. Course Objectives

The aims of the course are that students experience practical research promotion process and acquire research methodology, research techniques, basic theory and skills.

4. Course Schedule

Study and research plan are made after consulting with advisors.

5. Prior/Post Assignment

Prior Assignment: We'll also conduct case studies as well as literature surveys on relevant fields.
Post Assignment: We'll plan the research promotion procedure.

6. Assessment

Grades are based on performance,
presentation,
and report.

7. Textbooks

References are decided after consulting with advisors.

8. Language of Instruction

The language of the instruction depends on the professor.

9. Requirements for registration

Special Research students are not allowed to take this course.

10. Note

Project Study 3

Grade	2025
Semester	Spring, Fall
Credits	2
Instructor	Superviser Head of Graduate School

1. Course Outline

In Project 3, students investigate, develop, construct the research themes continuing from Project Study 2, write the report about the research themes and give presentation about the research result.

2. Keywords

Information Architecture, Media Design, Complex Science, Intelligence Science,
literature Survey, Case Study

3. Course Objectives

The aims of the course are that students experience practical research promotion process and acquire research methodology,
research techniques,
basic theory and skills.

4. Course Schedule

Study and research plan are made after consulting with advisors.

5. Prior/Post Assignment

Prior Assignment: We'll prepare for the report and presentation on research contents.
Post Assignment: We'll consideration the results of the research.

6. Assessment

Grades are based on performance,
presentation,
and report.

7. Textbooks

References are decided after consulting with advisors.

8. Language of Instruction

The language of the instruction depends on the professor.

9. Requirements for registration

Special Research students are not allowed to take this course.

10. Note

System Information Science Research

Grade	2025
Semester	All
Credits	4
Instructor	Superviser Head of Graduate School

1. Course Outline

Students set their own research themes from the wide-ranging areas of Systems Information Science,
conduct research under the direction of advisors,
write master's thesis,
and give presentation. They acquire skills to extract problems to study,
make research process,
describe the research results with sentences,
and give presentation through the research experience.

2. Keywords

science of complex systems, information science, science of design, and cognitive science

3. Course Objectives

The course improves the capability as engineers and researchers through the research.

4. Course Schedule

Research plan are made after consulting with advisors.
Submission of research plan, participation in interim presentation session, and submission of master's thesis are required.

5. Prior/Post Assignment

6. Assessment

Grades are based on screening master's thesis or specific theme according to the school rules.

7. Textbooks

8. Language of Instruction

The language that a supervisor ordered.

9. Requirements for registration

Special Research students are not allowed to take this course.

10. Note

Special Seminar（特別ゼミナール）

Grade	D
Semester	Spring, Fall
Credits	
Instructor	Superviser Head of Graduate School

1.Course Outline

This course aims at developing specialized knowledge and research methodology to pursue the student's research in Systems Information Science.
It will be achieved by investigating related areas, learning the methodologies of related areas, observing real-world problems, and self-development by resolving these problems.

2.Keywords

Systems Information Science, Creation of New Results, Doctoral Thesis

3.Course Objectives

1.Students will be able to systematically understand the field of Systems Information Science, contribute to the development of academia and industries, and develop specialized knowledge and research methodology that contain open-minded advanced academic achievements for creating new results.
2.Students will be able to pursue new principles and new methods. They will be able to write a doctoral thesis through the research processes including research theme setting, research plan making, research evaluation, presentations in academic conferences, and paper writings.

4.Course Schedule

The first-fifteenth session: Discussion with the advisor. The number of times will vary by the instructions given by the advisor.

5.Prior/Post Assignment

Prior: Prepare reports of research progress, research survey, and experimental results. Make the necessary preparations for the meeting with the advisor.
Post: Conduct research, considerations, experiments, etc. on the content of the guidance received from the advisor, and proceed with the research for the doctoral dissertation.

6.Assessment

The goal is achieved by technical discussions with the supervisor.

7.Textbooks

Follow the instructions of the advisor.

8.Language of Instruction

The language specified by the advisor

9.Requirements for registration

None

10.Note

An interim report on doctoral research (public on campus) is conducted at the end of each semester as a result of the special seminar.

Systems Information Science Special Research(システム情報科学特別研究)

Grade	D
Semester	Spring, Fall
Credits	
Instructor	Superviser Head of Graduate School

1.Course Outline
Students will write their doctoral thesis through research process such as research theme setting, research plan, research evaluation, research presentation at academic conferences, preparation of research papers etc., with the aim of pursuing new principles and new methods under the research guidance of academic advisors. In addition, they cultivate their abilities as advanced engineers and researchers.

2.Keywords
It depends on students.

3.Course Objectives
Students will proactively conduct their research and prepare their doctoral thesis, thereby acquiring independent research capabilities under the guidance of academic advisors.

4.Course Schedule
Develop a research plan in consultation with the advisor.

5.Prior/Post Assignment
Study according to their own research plan.

6.Assessment
Grades are evaluated by interim presentation, preliminary doctoral thesis examination, and final examination.

7.Textbooks
None

8.Language of Instruction
The language specified by the advisor

9.Requirements for registration
None

10.Note
None