[Title]			[Instructor]		
Large-scale Discrete Structure Processing			Koji Iwanuma / Hidetomo Nabeshima		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK501	2	Computer Science and Engineering	2nd Semester	Fri.／I	Japanese

[Outline and purpose]

As the Internet explosively has spread, we have experienced a flood of information. Consequently, there is a growing demand for advanced computing techniques which effectively handle large-scale data as much as possible. The purpose of this course is to give students an understanding of large-scale discrete data structures and some core algorithms for efficiently compute them. The first half of this course introduces the basics of transaction data mining and some advanced topics for online approximation mining algorithms for data streams. In the second half of the course, modern algorithms on propositional logic which handle large-scale discrete data and their applications are introduced.

[Objectives]

- To understand basic natures of huge transactional data and fundamental mining computation principles.
- To learn some state of the art technologies for online approximation computation of huge date stream mining.
- To learn modern algorithms on propositional logic for discrete data and their applications.

[Requirements]

A grounding of linear algebra, analytics, discrete mathematics, Boolean algebra, algorithms and data structure, information theory, and database

[Evaluation]

Students are evaluated primarily based on homework.

[Textbooks]

None

[References]

- J. Han and M. Kamber, Data Mining – Concepts and Technique – Second Edition, Morgan Kaufmann Pub.(ISBN:1558609016)
- P. Tan, M. Steinbach and V. Kumar, Introduction to Data Mining, Adison-Wesley (ISBN:0321464494)
- Armin Biere et.al., Handbook of Satisfiability, IOS-Press (ISBN:1586039296)

[Schedule]

1. Data mining: basic natures of huge transactional data, mining frameworks and principles (1).
2. Data mining: basic natures of huge transactional data, mining frameworks and principles (2).
3. Data mining: fundamental association rule mining.
4. Data mining: advanced association rule mining.
5. Data mining: measures for evaluating the interestingness of association rules
6. Data mining: basic algorithms for mining a single data stream.
7. Data mining: advanced online approximation algorithms for mining multi-dimensional data streams.
8. Discrete algorithms: introduction of modern algorithms for discrete data.
9. Discrete algorithms: integer programming and constraint satisfaction problem.
10. Discrete algorithms: fundamental of Boolean propositional satisfiability.
11. Discrete algorithms: principles of modern SAT solvers.
12. Discrete algorithms: SAT encoding and SAT based constraint satisfaction solvers.
13. Discrete algorithms: introduction of BDD/ZDD.
14. Discrete algorithms: applications of BDD/ZDD.
15. Summary.

[Title]			[Instructor]		
Advanced Software Engineering			Masakazu Takahashi / Yoshimichi Watanabe		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK502	2	Computer Science and Engineering	1st Semester	Mon. / II	Japanese

[Outline and purpose]

We aim to learn methods that are applied to develop software with high quality and functionality. Students will be able to acquire advanced requirements analysis and software design methods (structured method and object oriented method for real-time system) that are required to develop through lectures and exercises. Furthermore, we will discuss development planning, verification planning and quality management related to the development of such software.

[Objectives]

- To be able to create development and verification plans for real-time software.
- To be able to analyze and design for real-time software.
- To be able to manage quality and safety for real-time software.

[Requirements]

Students are required to have knowledge of software engineering and programming.

[Evaluation]

- Homework 80%
- Exercise 20%

[Textbooks]

Handouts and related research paper will be distributed.

[References]

- Derek J. Hatley and Imtiaz A. Pirbhai, Strategies for real-time system specification, Dorset House Publishing, 1988.
- Bruce Douglass, Real-time UML, 2nd edition, developing efficient objects for embedded systems, Addison Wesley Longman Inc., 2001.

[Schedule]

(01) Planning for software development and verification
(02) Structured Analysis for real time systems 1 (sequential systems and combination systems)
(03) Structured Analysis for real time systems 2 (control flow diagrams)
(04) Structured Analysis for real time systems 3 (activation tables and decision tables)
(05) Structured Analysis for real time systems 4 (case studies)
(06) Exercise 1 (planning)
(07) Exercise 2 (analyzing requirements)
(08) Exercise 3 (designing architectures)
(09) Object oriented development for real time systems 1 (requirements modeling)
(10) Object oriented development for real time systems 2 (analysis modeling)
(11) Object oriented development for real time systems 3 (static analysis)
(12) Object oriented development for real time systems 4 (dynamic analysis)
(13) Object oriented development for real time systems 5 (class specification design and design quality)
(14) Lecture by an external lecturer (project management)
(15) Lecture by an external lecturer (tools for project management)

[Title]			[Instructor]		
Parallel Computing			Hidetoshi Ando/ Tomohiro Suzuki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK503	2	Computer Science and Engineering	2nd Semester	Tue.／I	Japanese

[Outline and purpose]

Parallel computing technologies bring out high performance computation power of modern multi-core CPUs and GPUs. The practical knowledge of parallel computing using such devices and its cluster system contributes to the large-scale scientific computing, big data analysis and machine learning. This course provides such skills and knowledge.

[Objectives]

At the end of this course, the students should be able to: understand the basic knowledge of program optimizations for recent CPUs, understand the characteristic problems of parallel computing and its solutions, and understand the typical pattern of parallel computing and its efficient implementations on the GPU.

Programming skill (C or C++)

[Evaluation]

Homework (Parallel Computing: 50%, GPU Computing: 50%)

[Textbooks]

[References]

1. 片桐孝洋，スパコンプログラミング入門，東京大学出版会，ISBN:978-4-13-062453-4
2. 寒川光ほか，HPC プログラミング，オーム社，ISBN:978-4-274-20746-4

[Schedule]

1. Introduction to parallel and high-performance computing (Suzuki)
2. Fundamentals of high-performance computing (Suzuki)
3. Parallel programing with OpenMP (Data parallel) (Suzuki)
4. Parallel programing with OpenMP (Task parallel) (Suzuki)
5. Parallel programing with MPI (Interprocess communication) (Suzuki)
6. Parallel programing with MPI (Asynchronous communication) (Suzuki)
7. Parallel matrix-vector multiplication (Suzuki)
8. Parallel matrix-matrix multiplication (Suzuki)
9. Introduction to GPU computing (Ando)
10. Fundamentals of GPU programming (Ando)
11. Basic parallel patterns (Map, Stencil) (Ando)
12. Basic parallel patterns (Reduction, Recurrence) (Ando)
13. Advanced parallel patterns (SCAN) (Ando)
14. Advanced parallel patterns (Ballot) (Ando)
15. Advanced topics on GPU computing (Ando)

[Title]			[Instructor]		
Machine Learning			Motonobu Hattori		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK505	2	Computer Science and Engineering	1st Semester	Tue.／II	Japanese

[Outline and purpose]

Based on various information obtained from the outside world, we humans classify a target and find the regularity behind the event. Machine learning is a technology that aims to give these capabilities to a computer, and it is applied in a wide range of fields such as pattern recognition, information retrieval, medical diagnosis, data mining, and so on. This course aims at understanding a fundamental theory and technique of machine learning and being able to apply the technique of machine learning to specific problems.

[Objectives]

1. To understand classification, the basic procedure, and notes of machine learning methods
2. To understand common points and difference of various machine learning methods
3. To apply appropriate machine learning method to specific problems
4. To understand basic English literature on machine learning

[Requirements]

A grounding of linear algebra, calculus, discrete mathematics, probability and statistics, and programming

[Evaluation]

Exams: 80%
Small tests: 20%

[Textbooks]

[References]

Trevor Hastie et. al, The Elements of Statistical Learning, Data Mining, Inference, and Prediction, Second Edition, Springer New York, 2009.
Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer New York, 2006.

[Schedule]

1. Introduction
2. Linear Regression
3. Linear Discriminant Function
4. Linear Discriminant Analysis
5. Decision Trees
6. Naïve Bayes
7. Multilayer Neural Networks
8. Midterm Review and Exam
9. Support Vector Machine
10. Ensemble Learning
11. Deep Learning1: Loss functions, learning methods and their improvement
12. Deep Learning2: Examples of deep neural networks and techniques for improving accuracy
13. Clustering
14. Karhunen-Loève Expansion
15. Course Review and Final Exam

[Title]			[Instructor]		
User-Centered Design Methodology			Kentaro Go / Masaki Omata / Yuichiro Kinoshita		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK508	2	Computer Science and Engineering	1st Semester	Thu.／I	Japanese

[Outline and purpose]

This graduate course is an introduction to User-Centered Design (UCD) methodology, a discipline concerned with the research, design, implementation, and evaluation of interactive products, systems, and services for human use based on users' requirements and context of use. The first part surveys the history of UCD and provides the overview of the discipline focusing on the viewpoint of design process and product. It specifically considers service concepts in HCD. The second part introduces Kansei engineering, a set of methodologies that translate users' impression or feelings into concrete product parameters and support future product design. The third part of the course focuses on user interface design based on the physiological properties of human senses.

[Objectives]

Upon completion of this course, the students are expected to be able to:

1. Explain the history and overview of UCD, specifically from the viewpoint of process, product, and services.
2. Explain the design procedure in Kansei engineering and utilise subjective evaluation data to design products and services.
3. Describe the physiological properties of human senses and explain the importance of user interface design on the basis of the properties.

[Requirements]

Undergraduate-level HCI and/or User interface design course(s)
Basic statistics and linear algebra

[Evaluation]

The following is the grading scheme. The assignments include short repots and/or quizzes.

First part assignment(s): 35%
Second part assignment(s): 35%
Third part assignment(s): 30%

[Textbooks]

N/A

[References]

- Yvonne Rogers, Helen Sharp, and Jenny Preece, Interaction Design: Beyond Human-Computer Interaction (3rd Edition), Wiley, 2011, ISBN-10: 0470665769.
- 長沢 伸也, 神田 太樹 (編), 数理的感性工学の基礎―感性商品開発へのアプローチ, 海文堂出版, 2010, ISBN-10: 4303723940.
- 舘 暲, 佐藤 誠, 廣瀬 通孝 (監修), 日本バーチャルリアリティ学会 (編集), バーチャルリアリティ学, コロナ社, 2010, ISBN-10: 4904490053.
- William Albert, Thomas Tullis, Measuring the User Experience, Second Edition, Morgan Kaufmann, 2013 ISBN-10: 0124157815.

[Schedule]

First part
1. Overview of User-Centered Design (UCD) methodology (Kentaro Go)
2. UCD process (Kentaro Go)
3. Understanding and specifying the context of use and requirements (Kentaro Go)
4. Producing and evaluating design solutions (Kentaro Go)
5. Service design (Kentaro Go)
Second part:
6. Kansei engineering / subjective evaluation methods (Yuichiro Kinoshita)
7. Analysis of subjective evaluation data I (factor analysis) (Yuichiro Kinoshita)
8. Analysis of subjective evaluation data II (visualisation of subjective evaluation data) (Yuichiro Kinoshita)
9. Analysis of subjective evaluation data III (quantification theory) (Yuichiro Kinoshita)
10. Product design based on subjective evaluation data (Yuichiro Kinoshita)
Third part
11. Human senses and user interfaces I (physiological properties of human senses) (Masaki Omata)
12. Human senses and user interfaces II (input and output interfaces) (Masaki Omata)
13. Virtual reality and mixed reality (Masaki Omata)
14. User interface for smartphones (Masaki Omata)
15. Usability testing (Masaki Omata)

[Title]			[Instructor]		
Computer Vision			Xiaoyang Mao / Masahiro Toyoura		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK509	2	Computer Science and Engineering	2nd Semester	Thu.／III	Japanese

[Outline and purpose]

This course offers opportunity to learn both analysis and synthesis of visual information, namely, computer vision and 2D/3D computer graphics.
(First half: Masahiro Toyoura)
In the first half, the fundamental theories on computer vision, especially on 3D shape reconstruction, will be discussed. The latest topics of computer vision will be introduced, and unsolved problems will be overviewed. After learning about camera calibration, depth estimation by multiple cameras will be practically implemented. Human-centered image processing will be discussed through the topics on eye tracking, human vision, immersive video representation, and others.
(Latter half: Xiaoyang Mao)
The second half deals with visual information synthesis. Advanced filtering techniques for 2D images, image segmentation, stitching, texture analysis and transfer, and others will be discussed.

[Objectives]

1. The student understands fundamental algorithms, and implements depth image reconstruction from video captured by multiple cameras.
2. The student understands human vision, and implements eye tracking by eye captured video and synthesizes/presents attractive video considering human vision.
3. The student is able to acquire newly available image analysis and synthesis methods on his/her own, benefit from and implement the methods.

[Requirements]

One must have the knowledge of linear algebra and calculus, skills in programming (e.g., by using C++, MATLAB and python), as well as understanding of important algorithms and data structures. One should also know basics of image processing techniques (e.g., image filtering) and computer graphics.

[Evaluation]

Students are evaluated by quizzes and reports that involves programming.

[Textbooks]

None.

[References]

To be announced.

[Schedule]

1. Introduction on computer vision, guidance of the course
2. Internal camera calibration
3. External camera calibration
4. Depth estimation with stereo vision (1) – rectification and feature point matching
5. Depth estimation with stereo vision (2) – global optimization
6. Eye tracking
7. Human vision
8. Camera models and immersive video presentation
9. Fractals and natural images
10. Texture synthesis
11. Texture and image editing, advanced image filtering
12. Gradient-domain image filtering
13. Poisson editing and its applications
14. Paper survey presentation (1)
15. Paper survey presentation (2)

[Title]			[Instructor]		
Digital Speech Processing			Kenji Ozawa		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK510	2	Computer Science and Engineering	2nd Semester	Thu.／Ⅳ	Japanese

[Outline and purpose]

Speech is an important way for human-to-human communication as well as human-machine-interface. This course covers major topics in Speech Processing. The first part of the course addresses the basis of digital signal processing techniques required for speech processing. The second part of the course addresses the issues of speech recognition and synthesis as well as physiological and psychological bases of speech and hearing.

[Objectives]

1. To understand the basis of digital signal processing techniques required for understanding speech processing.
2. To understand the physiological bases of speech generation and hearing, and the psychological characteristics of speech and sound perception.
3. To understand the basis of speech recognition, audio perceptual coding, and data compression.

[Requirements]

Integral and differential calculus, Introductory statistics, Introductory digital signal processing

[Evaluation]

Test: 40%
Report: 40%
Mini-examination (quiz): 20%

[Textbooks]

[References]

[Schedule]

1. Overview of speech and acoustical information technology.
2. (Acoustics) Fourier series and spectrum
3. (Acoustics) Complex Fourier series and complex spectrum
4. Discrete Fourie transform
5. Impulse response, convolution and FIR filter
6. z transform and IIR filter
7. Basics of speech recognition and synthesis
8. Midterm evaluation: Summary of the first part
9. (Acoustical physiology) Anatomical and physiological bases of hearing. (Speech processing 1) Bases of speech synthesis and high-efficiency speech coding
10. (Speech processing 2) Feature extraction of speech, Audio perceptual coding
11. (Speech processing 3) Bases of speech recognition, Statistical pattern recognition
12. (Speech processing 4) Finite-state automaton, Basic acoustical model for speech recognition
13. (Speech processing 5) Advanced acoustical model for speech recognition, Language model
14. (Speech processing 6) Advanced language model, Search algorithm
15. (Speech processing 7) Overview of speech analysis/synthesis

[Title]			[Instructor]		
Natural Language and Image Media Processing			Ryutarou Ohbuchi / Fumiyo Fukumoto		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK511	2	Computer Science and Engineering	1st Semester	Wed.／Ⅲ	Japanese/English

[Outline and purpose]

This course covers fundamental topics in Natural Language Processing (NLP) and Image media processing. This course is split into the first and the second half, and taught by two instructors.

The first half of the course addresses the issue of NL analysis and its applications. We begin with a discussion of what is NLP and introduce some computational models for language analysis. The latter half of the first part introduces recent trend on NLP, i.e., solutions on several NLP tasks based on deep learning techniques.

The second part of this source focuses on analysis and processing, namely, recognition, of scenes and objects in 2D image, 3D data, and other visual media. We first review basic concepts of image processing, followed by traditional approaches to image recognition by using interest points and local image feature aggregation. We then discuss approaches using deep learning, especially convolutional neural network (CNN), for scene recognition, object recognition and object detection.

[Objectives]

1. To understand the basics of NL analysis
2. To understand some deep learning techniques for NLP
3. To understand basic techniques for image analysis and object recognition.
4. To be able to implement basic object recognition algorithms that employs (1) local image feature aggregation and (2) convolutional neural network.

[Requirements]

Integral and differential calculus, Introductory statistics, Linear algebra. Knowledge on machine learning, such as clustering, support vector machine, and neural network will be helpful.
It is highly recommended to take GTK505 “Machine Learning” class at the same time.
Programing skills in Python and/or C++ will be required for some assignments. It is beneficial if you are familiar with TensorFlow and Keras deep learning frameworks. Familiarity with other deep learning frameworks, e.g., PyTorch, would also help.

[Evaluation]

* First Half:
Report 50%, Mini-examination (quiz) 50%

* Second Half:
Assignments involving programming in Python, Keras, and Tensorflow 50%.

[Textbooks]

* First half:
None, but the reference 3 below is highly recommended.

* Second half:
None, but the reference 3 below is highly recommended.

[References]

1. S. Nagao, “Natural Language Processing”, Iwanami, ISBN:9784000103558
2. Y. Saitoh, “Deep Learning from Scratch”, O’REILLY, ISBN-9784873117584
3. Aurélien Géron, “Hands-on machine-learning with Scikit-Learn, Keras & Tensorflow”, 2nd Edition, ISBN:978-1-492-03264-9
4. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O’Reilly, ISBN:978-1449316549

[Schedule]

Lectures 1 to 7: taught by Fumiyo Fukumoto
Lectures 8 to 15: taught by Ryutarou Ohbuchi.

1. (Morphological Analysis) Viterbi, HMM
2. (Syntactic Analysis) Tree Structure, Context Free Grammer, CKY
3. (Syntactic Analysis) Chart Parser, Decision Tree
4. (Deep Learning for NLP) Simple Word Vector Representations
5. (Deep Learning for NLP) Sentence Analysis
6. (Deep Learning for NLP) Sentiment Analysis
7. (Deep Learning for NLP) Sentence Classification
8. Introduction to image recognition
9. Local features, interest point detectors
10. Local feature descriptor, coding and pooling,
11. Geometric verification, machine learning,
12. Classifiers, gradient descent method
13. Deep neural network, image recognition using CNN
14. Regularization, loss landscape, various CNN architectures
15. Unsupervised representation learning, practical aspects of CNN training

[Title]			[Instructor]		
Phenomenology of Environment			Shuji Morita		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK512	2	Computer Science and Engineering	2nd Semester	Thu.／Ⅲ	English

[Outline and purpose]

We will study, with the help of phenomenology and cultural history, how people recognize and live various aspects of their social and cultural environments. We will discuss in teams questions raised by the teacher or by ourselves and then give an account of discussions to other teams.

[Objectives]

The purpose of this course is to enable you to discuss questions in English.
You will learn basic notions of some approaches including phenomenology and cultural history.
We hope to give students an opportunity to both reflect on their own cultures and gain an understanding of other cultures.

[Requirements]

Brush up your skills of expression through activities in English while opening your eyes to another culture.
Students are expected to participate fully in different class activities such as discussion, writing, presentation.

[Evaluation]

Participation in class activities: 60%
Output (Research, Presentation): 40%

[Textbooks]

[References]

There will be weekly handouts.

[Schedule]

01) Introduction : brainstorming exercise (self presentation)
02) Semantics of rainbow : brainstorming exercise (seat)
03) Structural analysis : brainstorming exercise (food)
04) Structural analysis : food
05) Structural analysis : brainstorming exercise (clothing)
06) Structural analysis : clothing
07) Group presentation & Recapitulation
08) Cultural history : brainstorming exercise (landscape)
09) Cultural history : invention of landscape (Europe, Japan, China)
10) Comparative analysis of stories : brainstorming exercise (folktales)
11) Comparative analysis of stories : folktales
12) Analysis of stories : rewriting stories
13) Analysis of stories : films
14) Analysis of stories : Life and death on the screen
15) Group presentation & Recapitulation

[Title]			[Instructor]		
Advanced Topics in Computer Science and Engineering I			( )		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK601	1	Computer Science and Engineering	Intensive	／	Japanese／English

[Outline and purpose]

In this lecture, we invite technologists and researchers of universities, private companies and public institutions that are active at the cutting edge in related fields of computer science and engineering to lecturers and learn about the latest trend of research technology development. Through participation in this lecture and exchange of opinions directly with instructors, students will deepen their understanding of the significance and value of the thesis theme.

[Objectives]

Students will understand the significance and value of their master thesis theme. Specific goals will be indicated in each lecture.

[Requirements]

From the contact person, it is shown along with lecture announcement.

[Evaluation]

From the contact person, it is shown along with lecture announcement.

[Textbooks]

N/A

[References]

N/A

[Schedule]

Please note that the lecture date and time will be posted on CNS.

[Title]			[Instructor]		
Advanced Topics in Computer Science and Engineering Ⅱ			Issei Fujishiro		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK602	1	Computer Science and Engineering	2nd Semester	Mon.／Ⅱ	Japanese／English

[Outline and purpose]

With the advent of HPC, WSN, and GII, digital data to be simulated, measured, and retrieved has been getting larger and more complex. The main target of this course is a computing methodology, called computer visualization, which provides insights gained through visual analysis of salient structures and behaviors embedded in such a data. After fundamental principles are surveyed, we place particular focus on representative techniques to visualize scalar fields in 2D, 3D, 3D+time, and multi-dimensions along the dedicated taxonomies. Up-to-date R&D topics are chosen to discuss the potentials of scalar data visualization, including advanced volume data mining based on differential topology and dimensional reduction schemes.

[Objectives]

To be familiar with dedicated paradigm and taxonomies;
To acquire proficiency in fundamental principles and representative techniques;
To be able to visualize practical datasets with standard tools such as Paraview; and
To acquire familiarity with recent R&D topics of computer visualization.

[Requirements]

Prerequisite includes basic knowledge about database, computer graphics, image processing, and numerical analysis.

[Evaluation]

Short quizzes: 50% (Level of understanding the content of each c lass) , Report: 50% (Literature survey or visualizing practical datasets)

[Textbooks]

Handouts will be distributed.

[References]

1. NIH/NSF Visualization Research Challenge Report January 2006.
2. NVAC: Illuminating the Path: The Research and Development Agenda for Visual Analytics, 2005.
3. T. Munzner: Visualization Analysis and Design, AK Peters/CRC Press, 2014.
4. M. Nakajima and I. Fujishiro (eds.): Computer Visualization (in Japanese), Kyoritsu-Syuppan, 2000.

[Schedule]

Please note that the lecture date and time will be posted on CNS.
1: Orientation
2: Introduction to scientific visualization
3: Visualization paradigm and taxonomy
4: Marching Squares algorithm and its disambiguation
5: Indirect/direct volume visualization
6: Topologically accentuated volume rendering
7: Advanced volume visualization based on differential topology
8: Multidimensional data visualization

[Title]			[Instructor]		
Seminar in Computer Science and Engineering IA			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK603	1	Computer Science and Engineering	1st Semester		Japanese／English

[Outline and purpose]

This exercise is conducted in small group and seminar format by cooperation of laboratory unit or a few laboratories. It is carried out in parallel with Research Work in Computer Science and Engineering IA. Students will select the themes to be studied, voluntarily and positively learn papers and other materials on the relevant fields, summarize the results in presentation materials, present at the seminar, and discuss. Students will also participate in planning related to other students' research topics, learn how to approach a wide range of fields and subjects, and learn how to communicate among researchers and work together. Although the content and target of this seminar are overlapped with the “research work” conducted at the same time, “research work” conducts intensive research work on his / her research subject mainly under the guidance of the academic supervisor. On the other hand, “seminar” shares the result in the laboratory, discusses it, and gives feedback to the research.

[Objectives]

The goal is to define the direction of new research to organize what students have learned in the undergraduate courses and to identify necessary topics in carrying out the research.

[Requirements]

General knowledge of computer science and engineering field

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Selection of research agenda #1
2. Selection of research agenda #2
3. Method of collecting data
4. Survey on previous research #1
5. Survey on previous research #2
6. Survey on previous research #3
7. Acquisition of related knowledge #1
8. Acquisition of related knowledge #2
9. Acquisition of related knowledge #3
10. Reading papers written in foreign language and acquisition of related knowledge #1
11. Reading papers written in foreign language and acquisition of related knowledge #2
12. Reading papers written in foreign language and acquisition of related knowledge #3
13. Reading papers written in foreign language and acquisition of related knowledge #4
14. Reading papers written in foreign language and acquisition of related knowledge #5
15. Reading papers written in foreign language and acquisition of related knowledge #6

[Title]			[Instructor]		
Seminar in Computer Science and Engineering IB			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK604	1	Computer Science and Engineering	2nd Semester		Japanese／English

[Outline and purpose]

This exercise is conducted in small group and seminar format by cooperation of laboratory unit or a few laboratories. It is carried out in parallel with Research Work in Computer Science and Engineering IB. Students make concrete and feasible plans for the themes selected in Seminar in Computer Science and Engineering IA, actually conduct preliminary research and surveys, and present the results at a presentation session including members of other laboratories. Although the content and target of this seminar are overlapped with the “research work” conducted at the same time, “research work” conducts intensive research work on his / her research subject mainly under the guidance of the academic supervisor. On the other hand, “seminar” shares the result in the laboratory, discusses it, and gives feedback to the research.

[Objectives]

The goal is to conduct preliminary research and surveys on the selected themes, and to make presentation the results.

[Requirements]

General basic knowledge in the field of computer science and engineering
Results of Seminar in Computer Science and Engineering IA and Research Work in Computer Science and Engineering Research IA

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Preparation for preliminary research #1
2. Preparation for preliminary research #2
3. Preparation for preliminary research #3
4. Preliminary research #1
5. Preliminary research #2
6. Preliminary research #3
7. Preliminary research #4
8. Preliminary research #5
9. Preliminary research #6
10. Preliminary research #7
11. Preparation for mid-term presentation of master's thesis
12. Preparation for mid-term presentation of master's thesis
13. Preparation for mid-term presentation of master's thesis
14. Mid-term presentation of master's thesis
15. Mid-term presentation of master's thesis

The timing of the mid-term presentation of the master's thesis will be specified later. (In the above syllabus, it is assigned to 11 to 15, but it may be conducted at other times, for example, in the middle of the semester.)

[Title]			[Instructor]		
Seminar in Computer Science and Engineering IIA			All academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK605	1	Computer Science and Engineering	1st Semester"		English／Japanese"

[Outline and purpose]

This exercise is conducted in small group and seminar format by cooperation of laboratory unit or a few laboratories. It is carried out in parallel with Research Work in Computer Science and Engineering IIA. Based on the results of the preliminary research conducted in Seminar in Computer Science and Engineering IA and IB, the research theme will be reviewed and the policy will be revised if necessary. After clarifying the direction of master's thesis research, students will demonstrate their originality and work on research, and present the results at a presentation session including members of other laboratories. Although the content and target of this seminar are overlapped with the “research work” conducted at the same time, “research work” conducts intensive research work on his / her research subject mainly under the guidance of the academic supervisor. On the other hand, “seminar” shares the result in the laboratory, discusses it, and gives feedback to the research.

[Objectives]

The goals are to organize research results and reexamine research themes, to determine the theme of the master's thesis, and to conduct preliminary research.

[Requirements]

Results of Seminar in Computer Science and Engineering I and Research Work in Computer Science and Engineering Research I

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Examination of result of preliminary research and planning of the present research #1
2. Examination of result of preliminary research and planning of the present research #2
3. Conducting research and investigation #1
4. Conducting research and investigation #2
5. Conducting research and investigation #3
6. Conducting research and investigation #4
7. Conducting research and investigation #5
8. Conducting research and investigation #6
9. Conducting research and investigation #7
10. Conducting research and investigation #8
11. Conducting research and investigation #9
12. Conducting research and investigation #10
13. Conducting research and investigation #11
14. Preparation for oral presentation
15. Oral presentation

[Title]			[Instructor]		
Seminar in Computer Science and Engineering IIB			All academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK606	1	Computer Science and Engineering	2nd Semester"		"English／Japanese"

[Outline and purpose]

This exercise is conducted in small group and seminar format by cooperation of laboratory unit or a few laboratories. It is carried out in parallel with Research Work in Computer Science and Engineering IIB. Students will examine the results obtained in Seminar in Computer Science and Engineering Exercise IIA and conduct research necessary to overcome the remaining problems. Write and present a master's thesis as a culmination of research. Although the content and target of this seminar are overlapped with the “research work” conducted at the same time, “research work” conducts intensive research work on his / her research subject mainly under the guidance of the academic supervisor. On the other hand, “seminar” shares the result in the laboratory, discusses it, and gives feedback to the research.

[Objectives]

The objectives are to write a master's thesis and to make a presentation of it.

[Requirements]

Results of Seminar in Computer Science and Engineering IIA and Research Work in Computer Science and Engineering IIA.

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Conducting research and survey #1
2. Conducting research and survey #2
3. Conducting research and survey #3
4. Conducting research and survey #4
5. Making the outline of his or her thesis #1
6. Making the outline of his or her thesis #2
7. Writing his or her thesis #1
8. Writing his or her thesis #2
9. Writing his or her thesis #3
10. Writing his or her thesis #4
11. Writing his or her thesis #5
12. Preparation for an oral presentation #1
13. Preparation for an oral presentation #2
14. Preparation for an oral presentation #3
15. Oral presentation

[Title]			[Instructor]		
Research Work in Computer Science and Engineering IA			All academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK607	2	Computer Science and Engineering	1st Semester		

[Outline and purpose]

This course is conducted in the laboratory under the guidance of each academic advisor, and will be conducted in parallel with Seminar in Computer Science and Engineering Exercise IA. Each student selects his or her own research theme, voluntarily and actively studies papers and other materials in related fields, summarizes the results, and presents them at seminars with deep discussion. Students select the theme to be studied, voluntarily and actively study treatises and other materials in related fields, summarize the results in presentation materials, present them at seminars, and hold discussions. Although the contents and goals of this research overlap with the "seminars" that are conducted at the same time, the “seminars” are conducted in the form of seminar in collaboration with each laboratory or a small number of laboratories, and presentation discussions are the main focus. On the other hand, research involves intensive research work on one's own research theme, mainly under the guidance of an academic advisor.

[Objectives]

The goals are to organize what each student has learned in the faculty, to set the direction of new research to be pursued in the future, and to identify the matters necessary for carrying out that research.

[Requirements]

General basic knowledge in the field of computer science and engineering

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Selection of research subject #1
2. Selection of research subject #2
3. Method of collecting materials
4. Survey on previous researches #1
5. Survey on previous researches #2
6. Survey on previous researches #3
7. Acquisition of related knowledge #1
8. Acquisition of related knowledge #2
9. Acquisition of related knowledge #3
10. Reading papers in foreign languages and acquisition of related knowledge #1
11. Reading papers in foreign languages and acquisition of related knowledge #2
12. Reading papers in foreign languages and acquisition of related knowledge #3
13. Reading papers in foreign languages and acquisition of related knowledge #4
14. Reading papers in foreign languages and acquisition of related knowledge #5
15. Reading papers in foreign languages and acquisition of related knowledge #6

[Title]			[Instructor]		
Research Work in Computer Science and Engineering IB			All academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK608	2	Computer Science and Engineering	2nd Semester		

[Outline and purpose]

This course is conducted in the laboratory under the guidance of each academic advisor, and will be conducted in parallel with Seminar in Computer Science and Engineering Exercise IB. Students make concrete and feasible plans for the themes selected in Research Work in Computer Science and Engineering IA, actually conduct preliminary research and surveys, and present the results at a presentation session including members of other laboratories. Although the contents and goals of this research overlap with the "seminars" that are conducted at the same time, the “seminars” are conducted in the form of seminar in collaboration with each laboratory or a small number of laboratories, and presentation discussions are the main focus. On the other hand, research involves intensive research work on one's own research theme, mainly under the guidance of an academic advisor.

[Objectives]

The goal is to conduct preliminary research and surveys on the selected themes, and to make presentation the results.

[Requirements]

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Preparation for preliminary research #1
2. Preparation for preliminary research #2
3. Preparation for preliminary research #3
4. Preliminary research #1
5. Preliminary research #2
6. Preliminary research #3
7. Preliminary research #4
8. Preliminary research #5
9. Preliminary research #6
10. Preliminary research #7
11. Preparation for mid-term presentation of master's thesis
12. Preparation for mid-term presentation of master's thesis
13. Preparation for mid-term presentation of master's thesis
14. Mid-term presentation of master's thesis
15. Mid-term presentation of master's thesis

The timing of the mid-term presentation of the master's thesis will be specified later. (In the above syllabus, it is assigned to 11 to 15, but it may be conducted at other times, for example, in the middle of the semester.)

[Title]			[Instructor]		
Research Work in Computer Science and Engineering IIA			All academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK609	2	Computer Science and Engineering	1st Semester"		English／Japanese

[Outline and purpose]

This course is conducted in small group and seminar format by cooperation of laboratory unit or a few laboratories. It is carried out in parallel with Seminar in Computer Science and Engineering IIA. Based on the results of the preliminary research conducted in Research Work in Computer Science and Engineering IA and IB, the research theme will be reviewed and the policy will be revised if necessary. After clarifying the direction of master's thesis research, students will demonstrate their originality and work on research, and present the results at a presentation session including members of other laboratories. Although the content and target of this seminar are overlapped with the “seminar” conducted at the same time, “research work” conducts intensive research work on his / her research subject mainly under the guidance of the academic supervisor. On the other hand, “seminar” shares the result in the laboratory, discusses it, and gives feedback to the research.

[Objectives]

The goals are to organize research results and reexamine research themes, to determine the theme of the master's thesis, and to conduct preliminary research.

[Requirements]

Results of Seminar in Computer Science and Engineering I and Research Work in Computer Science and Engineering Research I

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Examination of result of preliminary research and planning of the present research #1
2. Examination of result of preliminary research and planning of the present research #2
3. Conducting research and investigation #1
4. Conducting research and investigation #2
5. Conducting research and investigation #3
6. Conducting research and investigation #4
7. Conducting research and investigation #5
8. Conducting research and investigation #6
9. Conducting research and investigation #7
10. Conducting research and investigation #8
11. Conducting research and investigation #9
12. Conducting research and investigation #10
13. Conducting research and investigation #11
14. Preparation for oral presentation
15. Oral presentation

[Title]			[Instructor]		
Research Work in Computer Science and Engineering IIB			All academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK610	2	Computer Science and Engineering	2nd Semester"		English／Japanese

[Outline and purpose]

This course is conducted in small group and seminar format by cooperation of laboratory unit or a few laboratories. It is carried out in parallel with Seminar in Computer Science and Engineering IIB. Students will examine the results obtained in Research Work in Computer Science and Engineering Exercise IIA and conduct research necessary to overcome the remaining problems. Write and present a master's thesis as a culmination of research. Although the content and target of this research work are overlapped with the “seminar” conducted at the same time, “research work” conducts intensive research work on his / her research subject mainly under the guidance of the academic supervisor. On the other hand, “seminar” shares the result in the laboratory, discusses it, and gives feedback to the research.

[Objectives]

The objectives are to write a master's thesis and to make a presentation of it.

[Requirements]

Results of Seminar in Computer Science and Engineering IIA and Research Work in Computer Science and Engineering IIA.

[Evaluation]

Based on subjective learning and the participation situation of research discussions at seminars, the achievement objectives are evaluated comprehensively.

[Textbooks]

Each academic supervisor will assign reading materials related to the research theme.

[References]

N/A

[Schedule]

1. Conducting research and survey #1
2. Conducting research and survey #2
3. Conducting research and survey #3
4. Conducting research and survey #4
5. Making the outline of his or her thesis #1
6. Making the outline of his or her thesis #2
7. Writing his or her thesis #1
8. Writing his or her thesis #2
9. Writing his or her thesis #3
10. Writing his or her thesis #4
11. Writing his or her thesis #5
12. Preparation for an oral presentation #1
13. Preparation for an oral presentation #2
14. Preparation for an oral presentation #3
15. Oral presentation

[Title]			[Instructor]		
Advanced Topics in Computer Science and Engineering III					
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK611	1	Computer Science and Engineering	Intensive	／	Japanese

[Outline and purpose]

In this lecture, we invite technologists and researchers of universities, private companies and public institutions that are active at the cutting edge in related fields of computer science and engineering to lecturers and learn about the latest trend of research technology development. Through participation in this lecture and exchange of opinions directly with instructors, students will deepen their understanding of the significance and value of the thesis theme.

[Objectives]

Students will understand the significance and value of their master thesis theme. Specific goals will be indicated in each lecture.

[Requirements]

From the contact person, it is shown along with lecture announcement.

[Evaluation]

From the contact person, it is shown along with lecture announcement.

[Textbooks]

N/A

[References]

N/A

[Schedule]

Please note that the lecture date and time will be posted on CNS.

[Title]			[Instructor]		
Advanced Topics in Computer Science and Engineering Ⅳ					
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK612	1	Computer Science and Engineering	Intensive	／	Japanese/ English

[Outline and purpose]

In this lecture, we invite technologists and researchers of universities, private companies and public institutions that are active at the cutting edge in related fields of computer science and engineering to lecturers and learn about the latest trend of research technology development. Through participation in this lecture and exchange of opinions directly with instructors, students will deepen their understanding of the significance and value of the thesis theme.

[Objectives]

Students will understand the significance and value of their master thesis theme. Specific goals will be indicated in each lecture.

[Requirements]

From the contact person, it is shown along with lecture announcement.

[Evaluation]

From the contact person, it is shown along with lecture announcement.

[Textbooks]

N/A

[References]

N/A

[Schedule]

Please note that the lecture date and time will be posted on CNS.

[Title]			[Instructor]		
Advanced Topics in Computer Science and Engineering V			( )		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK613	2	Computer Science and Engineering	Intensive	／	Japanese

[Outline and purpose]

In this lecture, various safety analysis methods will be explained. The purpose of safety analysis is as follows; clarify what kind of failure will occur, and clarify what kind of impact will occur. In this lecture, the following safety analysis method will be explained; Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis (FTA), and System Theoretic Process Analysis (STPA).

[Objectives]

Students will understand the necessity of the safety analysis.
Students will understand the characteristics, applications, methods of FMEA, FTA, and STPA.

[Requirements]

Experience of the software development
This lecture will be conducted using ZOOM. Students will have to prepare own PC and network.
This lecture will be conducted in Japanese.

[Evaluation]

Evaluation will be conducted by the results of the reports (FMEA, FTA, and STPA).

[Textbooks]

Distribute original materials.

[References]

N/A

[Schedule]

This lecture will be held during the summer vacation. Please note the CNS notice.

1. Outline of Safety Analysis Method
2. Outline of Failure Mode and Effects Analysis (FMEA)
3. Case Study of FMEA (1)
4. Case Study of FMEA (2) + Practice of FMEA (1)
5. Practice of FMEA (2) + Presentation & Discussion
6. Outline of Fault Tree Analysis (FTA)
7. Case Study of FTA (1)
8. Case Study of FTA (2) + Practice of FTA (1)
9. Practice of FTA (2) + Presentation & Discussion
10. Outline of System-Theoretic Process Analysis (1)
11. Outline of System-Theoretic Process Analysis (2)
12. Case Study of STPA (1)
13. Case Study of STPA (2)
14. Practice of STPA (1)
15. Practice of STPA (2) + Presentation & discussion

[Title]			[Instructor]		
Advanced Topics in Computer Science and Engineering Ⅵ			Hiromitsu Nishizaki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTK614	1	Computer Science and Engineering	Intensive	／	English

[Outline and purpose]

With the evolution of information and communication technology (ICT), multimedia information (sound (voice), text, and images (video)) processing technologies are rapidly developing. Besides, in recent years, artificial intelligence (AI) technology has been widely spread among the general public, and deep learning technology for multimedia data processing and analysis has been driving the development of AI field. Therefore, this course aims to provide advanced knowledge of deep learning techniques with a focus on applications to multimedia information (sound, natural language text, and images) processing. Students will learn practically with demonstrations and exercises.

[Objectives]

1. To learn the basics of deep learning and to be able to use it to solve various problems in the field of multimedia processing.
2. To understand information processing for multimedia information, and to acquire artificial intelligence techniques for this purpose.

[Requirements]

Linear algebra, Calculus, Discrete Mathematics, Probability and Statistics, Programming, Machine Learning

[Evaluation]

Report

[Textbooks]

N/A

[References]

N/A

[Schedule]

1. Introduction of AI and deep learning
2. Machine learning with neural network
3. Introduction of deep learning programming
4. Neural network for image
5. Convolutional neural network
6. Introduction of image processing, classification and regression model
7. Tips for deep learning
8. Recurrent neural network
9. Introduction of speech processing
10. Audio signal classification
11. Introduction of text processing, and word embedding
12. Automatic sentence generation
13. Encoder-decoder model and machine translation
14. Attention mechanism
15. Summary and evaluation