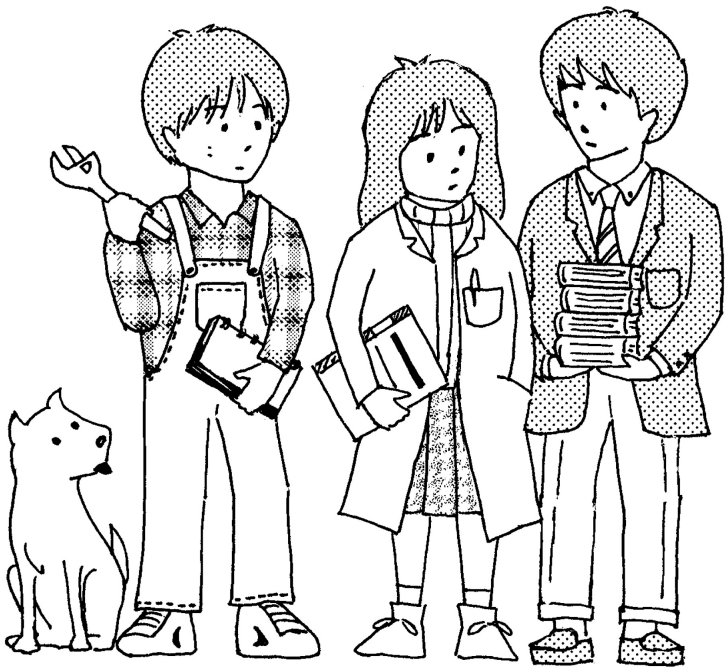
SYLLABUS *2011*

[E] Informatics and Mathematical Science



Kyoto University, Faculty of Engineering

[E] Informatics and Mathematical Science

Informatics and Mathematical Science

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91130

Introduction to Computer Science

計算機科学概論

【Code】91130 【Course Year】1st year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Applications(Yamamoto)		
Algorithms(Iwama)		
Systems(Takagi)		

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91140

Introduction to Applied Mathematics and Physics

数理工学概論

【Code】91140 【Course Year】1st year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】Basic ideas in applied mathematics and physics are introduced via topics on communications and reasoning, operation researches, and quantum information science.

【Grading】Evaluated by writing homework.

【Course Goals】Understanding basic ideas in applied mathematics and physics.

【Course Topics】

Theme	Class number of times	Description
	4	
	4	
Quantum Information	4	While the macroscopic world is governed by laws of classical physics, the microscopic world is governed by laws of quantum physics. Recently, a new technology for computation and communication based on quantum physics becomes probable and realistic. We will provide an introductory course on quantum theory and a basic idea of quantum cryptography.
reserved	3	

【Textbook】None

【Textbook(supplemental)】None

【Prerequisite(s)】None

【Web Sites】

【Additional Information】

91150

Introduction to Algorithms and Data Structures

アルゴリズムとデータ構造入門

【Code】91150 【Course Year】 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】 【Language】 【Instructor】Hiroshi G. Okuno
【Course Description】Learn the basic skills of structures and interpretation of computer programs.
【Grading】Examination 70%
Assingments 30%
【Course Goals】To learn the skills of Scheme programming and its philosophy with respect to programming languages.
【Course Topics】

Theme	Class number of times	Description
Introduction	2	Goals of the class History of Computers How to use JAKLD, a Java-based Scheme
Building Abstractions with Procedures	4	1.1 The Elements of Programming 1.2 Procedures and the Processes They Generate 1.3 Formulating Abstractions with Higher-Order Procedures
Building Abstractions with Data	5	2.1 Introduction to Data Abstraction 2.2 Hierarchical Data and the Closure Property 2.3 Symbolic Data 2.4 Multiple Representations for Abstract Data 2.5 Systems with Generic Operations
Sorting and Searching	3	Sorting -- Internal sorting and external sorting Insertion sort, Bubble sort, Quick sort, Heap sort, Merge sort Binary search, Hashing

【Textbook】"Structure and Interpretation of Computer Programs" (MIT Press)
Online Fulltext (provided by MIT Press).
【Textbook(supplemental)】"Programming Pearls" (ACM Press)
Japanese Translation（Piason Education)
【Prerequisite(s)】Elementary Computer Techniques(23015)
【Web Sites】Lecture HP
Prof. Okuno's Lectures
For further study, I recommend the book written by Gerald Jay Sussman et al. "Structure and Interpretation of Classical Mechanics"
【Additional Information】Scheme implemented in Java, JAKLD is used for practice. JAKLD is available at the Media Center. It also runs on Android.
An assignment will be given at the end of class every week. The deadline of submission is noon next Tuesday. The report should be composed by LaTeX and submitted as a PDF file.
The contents is subject to change.
Another assignment is to compose a painter by using Picture Language. The pictures created by students of the past classes are available at the Gallery.
Lecture Page .

90690

Linear Programming

線形計画

【Code】90690 【Course Year】1st year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】M. Fukushima

【Course Description】Lectures on modeling and algorithms of mathematical programming, with main focus on linear programming, which is the most fundamental subject in system optimization.

【Grading】Based on the score of the term examination.

【Course Goals】To learn the basic ideas of formulating optimization models, and to understand theoretical properties and solution methods of linear programming.

【Course Topics】

Theme	Class number of times	Description
Mathematical Programming Models	4	Representative mathematical programming models such as linear programming models, network programming models, noninear programming models, and combinatorial programming models, with simple illustrative examples.
Linear Programming and Basic Solutions	2	Formulation of linear programs in the standard form, and basic concepts of basic solutions, basic feasible solutions, and optimal basic solutions.
Simplex Method	3	Basic ideas and concrete procedures of the simplex method that is a classical method for linear programming. Topics include two-stage linear programming, variables with upper bounds, and network simplex methods.
Duality and Sensitivity Analysis	3	Duality as an important theory in linear programming, and sensitivity analysis as a useful technique in decision making.
Interior Point Methods	2	Polynomial-time algorithms in linear programming, ellipsoid method and interior point method.

【Textbook】Fukushima, M.: Introduction to Mathematical Programming: New Edition (in Japanese), Asakura Shoten.

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

60682

Electric Circuits and Differential Equations

電気回路と微分方程式

【Code】60682 【Course Year】1st year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

230114

Exercises in Information Processing Basics

基礎情報処理演習

【Code】230114 【Course Year】1st year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】 【Instructor】Takuya FUNATOMI

【Course Description】Exercises for using UNIX workstation as a tool.

【Grading】Evaluation based on attendance record and reports.

【Course Goals】To acquire computer literacy in UNIX environment.

【Course Topics】

Theme	Class number of times	Description
Basics of UNIX system	2	Learn basic usage of UNIX system, including X Window, file system, commands, etc.
Shell & text editor (Emacs)	3	Learn basic usage of shell and Emacs, and write texts using them.
Security, Email, the Web	1	Learn basics of information security, how to set up and use Email clients and how to retrieve various information and data by web search engines.
LaTeX	2	Learn how to write documents by LaTeX.
Figure & graph drawing, file format conversion	3	Learn how to draw figures and graph charts by gnuplot and tgif, how to convert file formats and include them in LaTeX documents.
Programming; string processing & arithmetic calculus	1	Learn how to write programs for string processing and arithmetic calculus in AWK.
Advanced exercise	3	Advanced exercises for more understanding.

【Textbook】Exercises in Information Processing Basics (sold by Kyoto Univ. Coop)(MUST)

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】http://www.lab2.kuis.kyoto-u.ac.jp/~tamak/kiso/

【Additional Information】Exercise schedule depends on the academic calender and learning level. As the background knowledge of Introduction to Algorithms and Data Structures (91150) and Hardware and Software Laboratory Project 1 (90210), taking this course is strongly recommended. Prepare the textbook and ECS-ID (issued by The Institute for Information Management and Communication (IIMC) of Kyoto University) in advance. Take the e-Learning on information security.

230115

Exercises in Information Processing Basics

基礎情報処理演習

【Code】230115 【Course Year】1st year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】 【Instructor】TAMAKI

【Course Description】Exercises for using unix workstation as a tool.

【Grading】Evaluation based on attendance record and reports.

【Course Goals】To acquire computer literacy in unix environment.

【Course Topics】

Theme	Class number of times	Description
Basics of UNIX system	2	Learn basic usage of UNIX system, including X Window, file system, commands, etc.
Shell & text editor (Emacs)	3	Learn basic usage of shell and Emacs, and write texts using them.
Security, Email, the Web	1	Learn basics of information security, how to set up and use Email clients and how to retrieve various information and data by web search engines.
LaTeX	2	Learn how to write documents by LaTeX.
Figure & graph drawing, file format conversion	3	Learn how to draw figures and graph charts by gnuplot and tgif, how to convert file formats and include them in LaTeX documents.
Programming; string processing & arithmetic calculus	1	Learn how to write programs for string processing and arithmetic calculus in AWK.
Advanced exercise	3	Advanced exercises for more understanding.

【Textbook】Exercises in Information Processing Basics (sold by Kyoto Univ. Coop)(MUST)

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】http://www.lab2.kuis.kyoto-u.ac.jp/~tamak/kiso/

【Additional Information】Exercise schedule depends on the academic calender and learning level. As the background knowledge of Introduction to Algorithms and Data Structures (91150) and Hardware and Software Laboratory Project 1 (90210), taking this course is strongly recommended. Prepare the textbook and ECS-ID (issued by The Institute for Information Management and Communication (IIMC) of Kyoto University) in advance. Take the e-Learning on information security.

20500

Applied Mathematics A1

工業数学 A1

【Code】20500 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】The theory of analytic functions of one complex variable

【Grading】Evaluation depends mainly on marks of examination, but marks of exercises are taken into account when needed.

【Course Goals】To understand properties of analytic functions with a skill for evaluation of integrals appearing in applied mathematics and physics

【Course Topics】

Theme	Class number of times	Description
The plane of one complex variable and elementary functions	3	After describing the point-set topology of the plane of one complex variable, elementary functions are introduced with their properties.
Complex integrals and Cauchy's theorem	4	Cauchy's theorem and Cauchy's integral formula are shown along with outstanding properties of analytic functions. An example is given of Cauchy's theorem.
Power series	3	Sequences, series, and series of functions are discussed with the notion of convergence and divergence.
Taylor's expansio0n and Laurent's expansion	3	The Taylor series of analytic functions and the Laurent series of analytic functions on an annulus are discussed together with some examples.
Singularity and residues	2	The calculus of residues is dealt with. Examples are given of integral evaluations.

【Textbook】

【Textbook(supplemental)】Advanced engineering mathematics (Japanese translation), E. Kreyszig

【Prerequisite(s)】Calculus, Linear algebra

【Web Sites】

【Additional Information】

90680

Dynamics of Particles and Vibration

質点系と振動の力学

【Code】90680 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90890

Applied Mathematics and Physics Laboratory

数理工学実験

【Code】90890 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	6	
	6	
	6	
	6	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90900

Exercise on Applied Mathematics and Physics

基礎数理演習

【Code】90900 【Course Year】 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	4	
	5	
	4	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90910

Exercise on Programming

プログラミング演習

【Code】90910 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Seminar 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	13	
	2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90210

Hardware and Software Laboratory Project 1

計算機科学実験及演習 1

【Code】90210 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】1

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	2	
	7	
	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90220

Hardware and Software Laboratory Project 2

計算機科学実験及演習 2

【Code】90220 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	6	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90070

Introduction to Systems Analysis

システム解析入門

【Code】90070 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Yoshito Ohta

【Course Description】This lecture covers dynamical system modeling for engineering systems and studies analysis techniques.

【Grading】The grade is determined by the final examination.

【Course Goals】On completion of the course, students will learn the rudiments of dynamical systems and approximated linear system. They will be able to understand analysis techniques for such systems.

【Course Topics】

Theme	Class number of times	Description
Introduction to system analysis	2	Examples of dynamical systems.
Linear dynamical systems	3	First and second order systems such as electric circuits consisting of a capacitor and an inductor and mechanical systems consisting of a spring and a dumper.
State equation	2	Linearized systems at an operating point. Linear dynamical systems and their responses.
Laplace transform	1	Laplace transform and linear differential equations.
Transfer function	2	Transfer functions of first and second order systems.
Block diagram and feedback systems	2	Feedback connection of linear systems.
Discrete-time systems	2-3	Discrete-time systems described by difference equations.

【Textbook】PDF Handouts are given.

【Textbook(supplemental)】Osauka and Adachi, An approach to systems and control, Korona (in Japanese)

【Prerequisite(s)】Linear Algebra (A and B) and Calculus (A and B)

【Web Sites】

【Additional Information】

90700

Logical Systems

論理システム

【Code】90700 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】

【Instructor】Nobuo Yamashita, Liang Zhao

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	6	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91050

Introduction to Dynamical Systems

システムと微分方程式

【Code】91050 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】Hitoshi YOSHIKAWA

【Course Description】This lecture is a basic course of theory of dynamical system.

【Grading】Homeworks and an examination are scored.

【Course Goals】This lecture has three purposes: (1) to master the methods solving differential equations. (2) to practice qualitative analysis. (3) to get able to formulate and to analyze mathematical models.

【Course Topics】

Theme	Class number of times	Description
What is MODEL?	2	A model is an abstractization of an aspect of the actual world. A model is a system of symbols equipped with inference rules. A good model is simple, distinct, having correspondence between symbols and actual phenomena, analyzable and predictable.
Purpose for building models	1	Why we formulate models in terms of differential equations?
Exponential function	2	Definition and properties of exponential function.
Basic method for solving differential equations	2	Linear differential equations.
Qualitative analysis	3	Phase flow, phase diagram, stability, Lyapunov function, linearized approximation, limit cycle.
Number and quanitity	2	Dimensional analysis, tensor algebra.
Applications	3	Equations of motion, models of rocket, planet, ecology.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】These lectures are given in Japanese.

【Web Sites】

【Additional Information】

90710

Analytical Dynamics

解析力学

【Code】90710 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	6	
	5-6	
	5	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90970

Logic Circuits

論理回路

【Code】90970 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Naofumi Takagi

【Course Description】We learn logic algebra which is a basis of computer science and logic circuit which is a basis of digital systems such as computers. First, we learn logic algebra and logic function, and then minimization of logic functions and design methods of logic circuits. We also learn sequential machine which is a mathematical model of sequential circuit and its minimization, and design methods of sequential circuits.

【Grading】Grading is done through exercises and a term-end examination on the course goals.

【Course Goals】1. Understanding basic concepts in logic algebra and logic function, and being able to explain them.
2. Understanding the minimization methods of logic functions, and being able to use them.
3. Understanding basic concepts in combinational circuits and sequential circuits, and being able to explain them.
4. Understanding the minimization methods of sequential machines and state assignment, and being able to use them.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	What is a logic circuit?
Logic algebra and logic function	4-5	Logic algebra, logic expression, logic function and its representation and its characteristics, etc.
Combinational circuits and their design methods	4-5	Design methods of combinational circuits, especially minimization methods of logic functions.
Sequential machines and sequential circuits	4-5	Sequential circuits and their design methods, especially minimization methods of sequential machines and state assignment.

【Textbook】Logic circuits, by Naofumi Takagi, Shokodo

【Textbook(supplemental)】

【Prerequisite(s)】Basic knowledge on sets and relations.

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/lc.html

【Additional Information】Office hour: Wednesday, 16:30-17:30
Office: Rm. 314, Engineering Building #10
Email:takagi@i.kyoto-u.ac.jp

91040

Languages and Automata

言語・オートマトン

【Code】91040 【Course Year】 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】We start with regular expressions and finite automata, then go to context-free grammars and pushdown automata. We learn why studying automata theory is important in computer science especially design and analysis of algorithms.

【Grading】Two reports and a final exam.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Finite automata	5	Description of finite automata, minimization and regular expressions.
Context-free grammars	4	Push-down automata, context-free grammars and their equivalency.
Turing machines and related issues	4	Turing machine, its definition and basic properties.
Hierarchy of languages	1	

【Textbook】Iwama, Automata, languages and theory of computation, Corona-sha, 2003.

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90160

Computer Architecture 1

計算機アーキテクチャ 1

【Code】90160 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Naofumi Takagi

【Course Description】We learn basic organization of computers, representation of numbers and arithmetic in computers, and arithmetic circuits. We also learn how to design simple computers.

【Grading】Grading is done through exercises and a term-end examination on the course goals.

【Course Goals】1. Understanding basic organization of a computer, and being able to explain it.
2. Understanding number representation and arithmetic in computers, and being able to explain them.
3. Understanding methods of evaluating processors, and being able to explain them.
4. Understanding design methods of simple processors, and being able to use them.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	What is computer architecture?
Basic organization of a computer	4-5	Basic organization of a computer, machine codes, addressing modes, etc.
number representation and arithmetic	4-5	Number representaion and arithmetic in computers, arithmetic circuits, etc.
Design of simple processors	4-5	Methods of evaluating processors, design methods of simple computers, etc.

【Textbook】Computer Organization and Design - The Hardware/Software Interface - 3rd ed., by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP
No. 1: ISBN 978-4-8222-8266-0, No. 2: ISBN 978-4-8222-8267-7

【Textbook(supplemental)】

【Prerequisite(s)】Logic circuits

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/ca1.html

【Additional Information】Office hour: Tuesday, 16:30-17:30
Office: Rm. 314, Engineering Building #10
Email:takagi@i.kyoto-u.ac.jp

90170

Programming Languages

プログラミング言語

【Code】90170 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	7	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91020

Compilers

コンパイラ

【Code】91020 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90230

Information Theory

情報理論

【Code】90230 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	4	
	3	
	3	
	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91090

Computer Networks

コンピュータネットワーク

【Code】91090 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	4	
	4	
	2	
	1	
	2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90300

Graph Theory

グラフ理論

【Code】90300 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
What are graphs?	2	
Shortest path problems	2 ～ 3	
Coloring problems	1 ～ 2	
Maximum flow problems	2	
Np-complete problems	2 ～ 3	
The maximum matching problems	1	
Connectivity of graphs	1 ～ 2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90301

Graph Theory

グラフ理論

【Code】90301 【Course Year】2nd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	1	
	1	
	2	
	2	
	1	
	2	
	1 〜 2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90250

Numerical Analysis

数値解析

【Code】90250 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

20600

Applied Mathematics A2

工業数学 A2

【Code】20600 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】Applied Mathematics A1 is prerequisite to this course. Systems of linear differential equations with constant coefficients are dealt with on the basis of functions of one complex variables along with applications. The Cauchy theorem for the existence and uniqueness of ordinary differential equations is proved with applications.

【Grading】mainly evaluated by examination score, but reports of exercises will be taken into account in a case.

【Course Goals】Since ordinary differential equations with constant coefficients are basic in a variety of fields in engineering, understanding both the theory and practical methods for solutions is an important goal of this course.

【Course Topics】

Theme	Class number of times	Description
Ordinary linear differential eqution woith	2	On the basis of complex functions of one variable, ordinary linear differential equations with constant coefficients are discussed in association with the method of Laplace transformation.
Calculus of matrices with a complex parameter	3	Calculus for matrices with a complex parameter is given in the scope of applications to differential equations. The exponential functions of matrices are treated in this calculus.
Linear equation with constant coefficients	2	Solutions to systems of linear differential equations with constant coefficients are given on the basis of calculus of matrices with a complex parameter.
Existence and uniqueness of a solution	3 ～ 4	The Cauchy theorem for the existence and uniqueness of a solution to a differential equation is proved. This theorem is shown to be effective in the application to the Jacobi elliptic functions.
Solutions to linear equations	2	The space of solutions to a homogeneous linear equation is shown to form a vector space. And fundamental matrices and Wronskian are described.
Dependence on paremeters	2	The parameter depencence of solutions are discussed; solutions depend on parameters in continuous or differentiable manner.

【Textbook】

【Textbook(supplemental)】H. Ito; Ordinary differential equations and analytic mechanics (Japanese), N. Shimakura; Ordinary differential equations (Japanese)

【Prerequisite(s)】Calculus A, B, Advanced calculus A, Linear algebra, Applied Mathematics A1

【Web Sites】

【Additional Information】

20700

Applied Mathematics A3

工業数学 A3

【Code】20700 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Tsujimoto

【Course Description】The theory of Fourier analysis

【Grading】Evaluation depends mainly on marks of examination, but marks of exercises are taken into account when needed.

【Course Goals】To understand fundamental theory of Fourier and Laplace analysis with a skill for evaluation of specific examples and applications in applied mathematics and physics.

【Course Topics】

Theme	Class number of times	Description
Fourier series	4～5	Introduction of the Fourier series for periodic functions. Best approximation property and the convergence of this series are shown. Discrete Fourier transform is also discussed.
Applications of Fourier series	3～4	Application of Fourier series to differential equations
Fourier transform	3～4	Introduction of the Fourier transform for L^2 functions. Invertibility of this transform and the convolution theorem are shown.
Applications of Fourier transform related	1～2	Application of Fourier series to differential equations. The relationship with Fourier transform and Laplace transform.

【Textbook】S. Nakamura: Fourier analysis, Asakura shoten

【Textbook(supplemental)】S. Oishi: Fourier analysis, Iwanami shoten

【Prerequisite(s)】Calculus, Linear algebra

【Web Sites】

【Additional Information】

90720

Linear Control Theory

線形制御理論

【Code】90720 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	2	
	3	
	2	
	2	
	2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90280

Probability and Statistics

確率と統計

【Code】90280 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3-4	
	4	
	3	
	4	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90960

Stochastic Discrete Event Systems

確率離散事象論

【Code】90960 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Yutaka Takahashi

【Course Description】This course covers fundamental modeling and analysis methodologies to mathematically treat queueing phenomena arising in our daily life. Queues are observed when congestion occurs in those systems such as service facilities (banks, supermarkets, etc.), transportation systems, as well as communication networks/the Internet. Foundamentals of queueing theory and traffic theory are the main part of this course.

【Grading】Grading is based on the scores of the term examination and homeworks.

【Course Goals】Mastering the fundamentals of performance modeling and analysis and acquiring how to apply them for various types of systems.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	Queueing model is introduced and its usefulness to mathematically describe the stochastic behaviors of discrete event systems is demonstrated. Applications of queueing theory are also shown. As a whole, the overview of the lecture is given.
Preliminaries	1～2	Probability distributions such as Poisson, exponential, Erlang, hyper distributions and some others and related stochastic characteristics are presented. Poisson process is also described in detail.
Discrete-time Markov chain	2～3	Discrete-time Markov chain is covered. Topics include state transition probability, steady state probability, recurrence time and others.
Continuous-time Markov chain	2～3	Continuous-time Markov chain is taught. In particular, birth-and-death process is described in depth. Steady-state equation and state transition diagram are explained and the condition for the existance of steady-state is clarified. Steady-state probability distribution is also derived.
Birth-and-death type queueing models	2	Some basic queueing models such as M/M/1, M/M/c, M/M/ ∞ , M/M/1/K, M/M/c/c etc. are analyzed to derive probability distributions of waiting time and queue length.
More general queueing models	4	More general queueing models such as M/G/1, M/G/1/K, and GI/M/1 are treated.

【Textbook】Handouts are provided.

【Textbook(supplemental)】One of recommended textbooks is L. Kleinrock, Queueing Systems vol.I, John Wiley and Sons.

【Prerequisite(s)】Some background on related topics such as Probability, Stochastic Process will be helpful to learn the course but it is not prerequisite. The course is managed to for students to attend without the background.

【Web Sites】

【Additional Information】

90310

Applied Algebra

応用代数学

【Code】90310 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Tsujimoto

【Course Description】An introduction with application to basic algebra in informatics.

【Grading】Evaluation depends mainly on marks of examination, but marks of exercises are taken into account when needed.

【Course Goals】To understand basic ideas and some applications of algebras (mainly group theory).

【Course Topics】

Theme	Class number of times	Description
Introduction to group theory	2	Definition and examples of group: symmetric group, permutation group, cyclic group, general linear group and so on.
Structure of groups	4	subgroup, coset, normal subgroup, quotient group, the isomorphism theorems.
Symmetric group and enumeration problem	3	Action of the symmetric group on a finite set. Enumeration problem.
Group representation	3	Groups in terms of linear transformations of vector space.

【Textbook】

【Textbook(supplemental)】T. Hiramatsu: Joho no suri oyo daisugaku (Shokabo)

【Prerequisite(s)】Linear algebra

【Web Sites】

【Additional Information】

91160

Artificial Intelligence

人工知能

【Code】91160 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】This lecture introduces basic technologies of artificial intelligence. Topics will be selected from search, knowledge representation, and learning.

【Grading】By reports and a final examination.

【Course Goals】Learning the concept of artificial intelligence and the basic models and algorithms of search, knowledge representation, and learning.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	Introducing the history of artificial intelligence researches.
Search	3-4	Introducing breadth-first search, depth-first search, heuristic search, AND/OR-graph search, adversarial search, constraint satisfaction, etc. It comes with exercise. Applications of search techniques such as computer chess, Sudoku, are also introduced.
Knowledge representation	4-5	Introducing semantic network, production system, Bayesian network, predicate logic, etc. It comes with exercise. Applications of knowledge representation techniques such as semantic web are also introduced.
Learning	5-6	Introducing decision tree learning, perceptron, SVM, genetic algorithm, reinforcement learning, etc. It comes with exercise. Applications of machine learning techniques such as data mining are also introduced.

【Textbook】Materials will be distributed.

【Textbook(supplemental)】S. Russell and P. Norvig, Artificial Intelligence A Modern Approach, Prentice Hall, 1998.
M. Ginsberg, Essentials of Artificial Intelligence, Morgan Kaufmann, 1993.
P.H. Winston, Artificial Intelligence, Addison-Wesley, 1992.

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91170

Human Interface

ヒューマンインタフェース

【Code】91170 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	3	
	4	
	4	
	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90920

Exercise on Numerical Analysis

数値計算演習

【Code】90920 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90740

Seminar on Applied Mathematics and Physics

数理工学セミナー

【Code】90740 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】Having seminars on various themes related to applied mathematics and physics.

【Grading】Attendances are requested. Presentation and discussions are evaluated.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Seminars		Eight themes are provided.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】In early July, all the themes of seminars are announced. Students are asked to give application forms. It is assumed that students are looking at the announce board of the department office carefully.

90930

System Analysis Laboratory

システム工学実験

【Code】90930 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	14	
	14	
	14	
	14	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90840

Hardware and Software Laboratory Project 3

計算機科学実験及演習 3

【Code】90840 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】4

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90390

Hardware and Software Laboratory Project 4

計算機科学実験及演習４

【Code】90390 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】3

【Restriction】 【Lecture Form(s)】Seminar 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90940

Statistical Physics

物理統計学

【Code】90940 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	2	
	2	
	2	
	2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90830

Mechanics of Continuous Media

連続体力学

【Code】90830 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Funakoshi Mitsuaki

【Course Description】The lecture on fundamental theory of fluid dynamics and elasticity is given as an introduction to the theory of mechanical behavior of continuous media.

【Grading】Evaluation is based on the score of examination.

【Course Goals】Understanding the basic concepts in fluid dynamics and elasticity.

【Course Topics】

Theme	Class number of times	Description
concept of continuous media	1	
stress	2	
momentum equation	1	
basic equations of fluids	2-3	
dynamics of viscous fluid	3-4	
dynamics of inviscid fluids	1-2	
compressible fluids and sound waves	1	
basic equations in elasticity	2-3	

【Textbook】No

【Textbook(supplemental)】Introduced in the lecture

【Prerequisite(s)】analysis, linear algebra, fundamentals of dynamics

【Web Sites】

【Additional Information】

90580

Modern Control Theory

現代制御論

【Code】90580 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	3	
	1	
	2	
	3	
	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90790

Optimization

最適化

【Code】90790 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】

【Instructor】M. Fukushima, H. Nagamichi, N. Yamashita, L. Zhao

【Course Description】Mathematical programming or optimization is a methodology for modeling a real-world problem as a mathematical problem with an objective function and constraints, and solving it by some suitable procedure (algorithm). This course consists of lectures on basic theory and methods in nonlinear optimization and combinatorial optimization.

【Grading】Based on the score of the term examination.

【Course Goals】To understand basic theory and algorithms in continuous optimization and combinatorial optimization.

【Course Topics】

Theme	Class number of times	Description
Fundamentals of nonlinear optimization	2	Basic notions in continuous optimization such as global and local minima, convex sets and functions, gradients and Hessian matrices of multivariate functions.
Method of unconstrained optimization	2	Basic unconstrained optimization methods such as steepest descent method, Newton's method, quasi-Newton methods, conjugate gradient method.
Optimality conditions and duality	2	Optimality conditions for constrained optimization problems, called Karush-Kuhn-Tucker conditions, as well as the second-order optimality conditions and Lagrangian duality theory.
Methods of constrained optimization	1	Basic methods of constrained optimization such as penalty methods and sequential quadratic programing methods.
Combinatorial optimization	1	Typical combinatorial optimization problems such as traveling salesman problem and knapsack problem, and their computational complexity.
Branch-and-bound method and dynamic programming	2	Basic exact solution strategies for combinatorial optimization such as branch-and-bound method and dynamic programming.
Approximation algorithms	3	Approximation algorithms for hard combinatorial optimization problems, and their theoretical performance guarantees.

【Textbook】

【Textbook(supplemental)】M. Fukushima, Introduction to Mathematical Programming: New Edition (in Japanese), Asakura Shoten; M. Yagiura and T. Ibaraki, Combinatorial Optimization - Metaheuristic Algorithms (in Japanese), Asakura Shoten.

【Prerequisite(s)】Linear Programming (90690) recommended.

【Web Sites】

【Additional Information】

90950

Mathematical Physics in Nonequilibrium Systems

非平衡系の数理

【Code】90950 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
What is nonequilibrium system?	2	
Probabilistic aspects in nonequilibrium systems	3	
Dynamical descriptions of nonequilibrium systems	3	
Chaos and fractal	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90590

Theory of Information Systems

情報システム理論

【Code】90590 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Takahashi, Kasahara

【Course Description】For optimal design of computer/communication networks, modeling techniques and methods of performance evaluation based on queueing theory and Monte Carlo simulation are covered in the lecture.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Computer/communication network system	1	Overview of circuit switching networks and packet transport network is given, and the significance of optimal design of network systems is discussed.
Introduction to performance evaluation	1	The objective of performance evaluation of computer/communication networks, performance measures, and the methods of performance evaluation are introduced.
Performance evaluation based on queueing theory	5～6	Queueing theory including priority queueing, queueing network, and approximation methods are explained. The significance of quantitative analysis is discussed with the performance comparison of basic queueing systems.
Monte Carlo simulation	3	Monte Carlo simulation basics are introduced. Topics includes methods of pseudo random number generation, confidence interval, and steady-state simulation.
Performance evaluation of network systems	3～4	Performance analysis of automatic repeat request (ARQ) protocols is explained.
Traffic modeling	1	Some current topics on traffic modeling are presented.

【Textbook】Printed materials are given in the lecture.

【Textbook(supplemental)】D. Bertsekas and R. Gallager, Data Networks 2nd Ed., Prentice-Hall, 1992.
L. Kleinrock, Queueing Systems Vol.2, John Wiley and Sons, 1976.

【Prerequisite(s)】Stochastic discrete event systems, and basics of queueing theory.

【Web Sites】

【Additional Information】

90490

Computer Architecture 2

計算機アーキテクチャ 2

【Code】90490 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Naofumi Takagi

【Course Description】We learn pipeline processing and storage hierarchy in computers. We also learn secondary storage devices and peripheral devices.

【Grading】Grading is done through exercises and a term-end examination on the course goals.

【Course Goals】1. Understanding pipepline processing in computers and being able to explain it.
2. Understanding storage hierarchy in computers, and being able to explain it.
3. Understanding basics of secondary storage devices and peripheral devices, and being able to explain them.

【Course Topics】

Theme	Class number of times	Description
Pipeline processing	5-6	Basic concepts of pipeline processing, pipelining of data paths, data hazards, branch hazards, more sophisticated pipeline processing, etc.
Storage hierarchy	6-7	Basic concepts of storage hierarchy, caches, virtual store, etc.
Secondary storage devices and peripheral devices	2	Secondary storage devices such as hard discs, bus and interface between CPU/memory and peripherals, etc.

【Textbook】Computer Organization and Design - The Hardware/Software Interface - 3rd ed., by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP No. 2: ISBN 978-4-8222-8267-7

【Textbook(supplemental)】Computer Organization and Design - The Hardware/Software Interface - 3rd ed., by David A. Patterson and John L. Hennessy, Translated in Japanese by M. Narita, Nikkei BP No. 2: ISBN 978-4 -8222-8267-7

【Prerequisite(s)】Computer Architecture 1

【Web Sites】http://www.lab3.kuis.kyoto-u.ac.jp/~ntakagi/ca2.html

【Additional Information】Office hour: Wednesday, 16:30-17:30
Office: Rm. 314, Engineering Building #10
Email:takagi@i.kyoto-u.ac.jp

91030

Operating System

オペレーティングシステム

【Code】91030 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91220

Pattern Recognition

パターン認識と機械学習

【Code】91220 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】This course provides foundations of Pattern Recognition and Machine Learning and includes exercises with some Machine Learning systems. Their applications to Artificial Intelligence, Intelligent Media Processing, and Processing large scale data are also provided.

【Grading】The grading is based on the examination following the course, and some home-works provided in the course.

【Course Goals】The course aims at making students acquire foundations of Pattern Recognition and Machine Learning and understand data driven computing. The exercises are for students to ensure the contents and to making use of them.

【Course Topics】

Theme	Class number of times	Description
Pattern Recognition (Kawahara)		What is Pattern Recognition?: feature vector and feature space, prototype and nearest neighborhood Discriminant Function: linear discriminant function, piece-wise linear discriminant function, quadratic discriminant function, over-fitting Feature Extraction: feature normalization, KL expansion, principal component analysis, discriminant analysis Parametric Training: Bayes decision, loss function, maximum likelihood estimation, normal distribution
Discriminant Learning (Ogata)		What is Discriminant Learning?: Perceptron, Neural Network, Support Vector Machine, Learning by Evaluating Errors: Back Propagation, Widrow-Hoff learning rule, Exercise: exercises with WEKA
Machine Learning (Yamamoto)		What is Machine Learning? : Defining Machine Learning, Knowledge representation, Search space for learning Learning Association Rules : Content-based faltering, Breath-first search Algorithms, a Divide-and-conquer algorithm, Maximal frequent item sets Clustering: Hierarchical clustering, the k-Means method, distances of data Validation and Evaluation: Cross validation, ROC, False positive and false negative, Precision and recall Statistics and Machine Learning: AIC, MDL, Statistical clustering, the EM Algorithm, the K-2 Algorithm for learning Bayesian-networks

【Textbook】Indicated in the Japanese page

【Textbook(supplemental)】Richard O. Duda, Peter E. Hart, and David G. Stork: Pattern Classification, Wiley N.J.Nilsson, Morgan Kaufmann: Learning Machines

【Prerequisite(s)】Artificial Intelligence, Mathematical Analysis, Linear Algebra, Probability and Statistics, Information Theory

【Web Sites】

【Additional Information】The contents above will be changed according to some reasons, e.g. the total number of classes in the term.

90980

Databases

データベース

【Code】90980 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	4	
	3	
	2-3	
	1-2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91100

Introduction to Integrated System Engineering

集積システム入門

【Code】91100 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】 【Language】 【Instructor】H. Ochi and K. Takagi

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2 〜 3	
	3 〜 4	
	2	
	4	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90540

Reading and Writing Scientific English

技術英語

【Code】90540 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】This lecture provides knowledge for reading and writing technical articles(e.g., theses, manuals and letters), in English using articles on information science and technology as materials.

【Grading】Your grade is determined by your performance of class attendance and the score of final examination.

【Course Goals】You will acquire basic knowledge and skill for reading and writing technical articles in English.

【Course Topics】

Theme	Class number of times	Description
English reading and writing	15	Reading and writing articles on information science and technology in English

【Textbook】We will deliver supplemental materials in classes.

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】You are expected to attend class regularly.

91110

Information Systems

情報システム

【Code】91110 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90551

Theory of Algorithms

アルゴリズム論

【Code】90551 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】We introduce a computation model suitable for discussing both time and space complexities of algorithms and problems, then study basic ideas and issues of computational complecity theory.

【Grading】Two reports and a final exam.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
review of language and automata theory	1	
Turing machines	4	Basic properites of Turing machites including their computation power and several equivalent machines.
Decidability and Undecidability	4	The notion of decidability of problems and examples of undecidable problems.
Introduction of complexity theory	6	Decidable but intractable problems and NP-completeness.

【Textbook】Iwama, Introduction to theory of algorithms, Shoko-do, 2001.

【Textbook(supplemental)】

【Prerequisite(s)】91040

【Web Sites】

【Additional Information】

90660

Image Processing

画像処理論

【Code】90660 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】

【Instructor】Michihiko MINOH, Masayuki MUKUNOKI

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1 〜 2	
	4	
	4	
	4	
	1 〜 2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90990

Software Engineering

ソフトウェア工学

【Code】90990 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91120

Multimedia

マルチメディア

【Code】91120 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】

【Instructor】Michihiko MINOH, Tatsuya KAWAHARA, Masayuki MUKUNOKI

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	1	
	1	
	3 〜 4	
	2 〜 3	
	3	
	1 〜 2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90860

Computation and Logic

計算と論理

【Code】90860 【Course Year】 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91190

Systems Bioinformatics

生命情報学

【Code】91190 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】This course overviews mathematical models and computational methods in systems biology. In particular, this course explains how such methods as graph theory, machine learning, optimization, and nonlinear differential equations are applied to analyses of biological networks, neural networks and evolution of biological sequences. This course is given in Japanese.

【Grading】See Japanese page for details.

【Course Goals】See Japanese page for details.

【Course Topics】

Theme	Class number of times	Description
Overview of systems bioinformatics	1	
Network biology	1	
Analysis of metabolic networks	1	
Analysis of protein-protein interaction	1	
Analysis of gene expression data	1	
Population genetics and genetic algorithms	4 ～ 5	
Mathematical models and analyses of neural networks	2	
Phylogenetic trees	2 ～ 3	
Concluding remarks	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】None

【Web Sites】

【Additional Information】

91200

Mathematics of Information and Communication

情報と通信の数理

【Code】91200 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】Describes basics of "Shannon theory," which provides a solid mathematical framework for quantitatively understanding and dealing with "information" (reduction of uncertainty) and "communication" (relationship between uncertainties). Advanced topics such as rate-distortion theory and network information theory will be reviewed as well.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction / Basic concepts	3	An overview of the whole course is followed by introduction of basic information measures such as entropy, relative entropy, and mutual information. Asymptotic equipartition property and entropy rate of Markov chains are also described.
Data compression	3	The problem of data compression can be reduced to that of how to provide to random variables a description whose length is short on average. Average description length of given random variables, as well as its relation with entropy, is discussed.
Channel capacity	3	One of the most profound results of Shannon theory is channel coding theorem, which states that it is possible to transmit information over a noisy channel with a vanishing amount of errors. Channel capacity, which is a measure of information transmission ability of a given channel, is introduced, and theoretical limit of communication is argued.
Information theory for continuous-valued random variables	2	In view of wireless communication and measurements, a theory that can deal with continuous-valued random variables. Differential entropies for such random variables are introduced, on the basis of which information transmission capability of a Gaussian channel is discussed as the most basic example.
Advanced topics	2	Some advanced topics such as rate-distortion theory, Kolmogorov complexity, and network information theory will be discussed.

【Textbook】T. M. Cover and J. A. Thomas, Elements of Information Theory, 2nd ed., Wiley-Interscience, 2006.

【Textbook(supplemental)】

【Prerequisite(s)】Assumes basic knowledge of probability theory. Knowledge of statistics and Markov chains should be helpful.

【Web Sites】

【Additional Information】

90810

Signals and Systems

信号とシステム

【Code】90810 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	2	
	2	
	2	
	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91180

Analysis in Mathematical Sciences

数理解析

【Code】91180 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91060

Dynamics of Nonlinear Systems

非線形系の力学

【Code】91060 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】

【Instructor】Funakoshi Mitsuaki, Tsutsu Hiroki

【Course Description】In the former half, various nonlinear behaviors of nonlinear oscillators such as bifurcations, hysteresis and chaos, and the methods for their analysis are explained. In the latter half, analytical methods with Fokker-Planck equations for concrete examples of stochastic process are explained. And phase ordering process in a ferromagnetic system, which is described by Ising model, and nucleation process in binary alloy system, which is described by the so-called Kawasaki dynamics, are explained. Through these examples, coarse-grained descriptions for stochastically fluctuating systems or systems with large degrees of freedom are demonstrated.

【Grading】Evaluated according to the scores of report examinations and quizzes in class.

【Course Goals】Understanding of various basic methods for the analysis of nonlinear phenomena of nonlinear dynamical systems.

【Course Topics】

Theme	Class number of times	Description
Behavior of nonlinear oscillators and the methods for their analysis	3-4	
Behavior of forced nonlinear oscillators and the methods for their analysis	3-4	
Analysis of stochastic models with few degrees of freedom using their Fokker-Planck equations	4-5	
Phase transition phenomena and their phase ordering processes	2-3	

【Textbook】None

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

90870

English for Mathematical Science

数理科学英語

【Code】90870 【Course Year】2nd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】Ohta, Fujioka, Zhou

【Course Description】This course aims to learn reading and writing of English for mathematical science.

【Grading】Quizzes and assignments.

【Course Goals】Students will learn the rudiments of reading and writing of English for mathematical science. They will learn how to make a presentation in English.

【Course Topics】

Theme	Class number of times	Description
Reading	4-5	
Writing	4-5	
Presentation	4-5	

【Textbook】K.R.Matthews, Elementary Linear Algebra. http://www.numbertheory.org/book/

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91210

Business Mathematics

ビジネス数理

【Code】91210 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】Y. Kai

【Course Description】It is important to learn the mechanism of the business and the process of the value creation in understanding the contemporary society. I introduce various theories of the business strategy including the finance, accounting and risk management. Moreover, how the technique and the idea of mathematical engineering are used in the phase of various decision makings of the business.

【Grading】Written examination (70%), and attendance and the class participation (30%)

【Course Goals】The target of the class is to obtain enough knowledge about an outline, a vital point of the business strategy and the effectiveness of mathematical methods.

【Course Topics】

Theme	Class number of times	Description
Evaluation of corporate value and business strategy	4	
Finance and accounting	2	
Business strategy	6	Bayes theorem (strategic change by acquisition of information by marketing); Optimization technique (decision of business portfolio and sales price); Decision tree and real option (research management); Game Theory (environmental solution)
Business risk management	2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

91080

Information and Business

情報と職業

【Code】91080 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

21050

Engineering Ethics

工学倫理

【Code】21050 【Course Year】4th year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	1	
	1	
	2	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

21080

Introduction to Engineering

工学序論

【Code】21080 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】1

【Restriction】No Restriction 【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

22020

Exercise in English of Science and Technology

科学技術英語演習

【Code】22020 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】1 【Restriction】

【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

22110

Engineering and Ecology
工学とエコロジー

【Code】22110 【Course Year】【Term】1st term 【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

22210

Engineering and Economy

工学と経済

【Code】22210 【Course Year】【Term】2nd term 【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

24010

Global Leadership Seminar I

ＧＬセミナーＩ

【Code】24010 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】1 【Restriction】

【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

25010

Global Leadership Seminar II

ＧＬセミナーII

【Code】25010 【Course Year】4th year 【Term】【Class day & Period】【Location】【Credits】1 【Restriction】

【Lecture Form(s)】 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

53000

Introduction to Elecronics

エレクトロニクス入門

【Code】53000 【Course Year】 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	5	
	2	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

50182

Quantum Physics 1

量子物理学 1

【Code】50182 【Course Year】3rd year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】examination

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction	2	
Basics of quantum mechanics	3	
Particle motion in one dimension	4	
Particle motion in three dimensions (1)	2	
Particle motion in three dimensions (2)	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

50192

Quantum Physics 2

量子物理学 2

【Code】50192 【Course Year】3rd year 【Term】2nd term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】examination

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Theoretical framework of quantum mechanics	3	
Approximation methods (stationary states)	3	
Approximation methods (transition problems)	3	
Electron and spin	3	
Spin and quantum statistics	2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】Quantum Physics 1

【Web Sites】

【Additional Information】

60101

Electronic Circuits

電子回路（電気）

【Code】60101 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】Following the lecture of fundamentals of active device circuits in the course "Electric and Electronic Circuits", modeling of active devises, fundamentals of transistor circuits, various amplifier circuits, negative feedback in circuits, operational amplifiers, and oscillators are lectured. Nonlinear circuits, power supplies, and noise would be included in the course, when the lecture time remains.

【Grading】Examination and reports. More details are opened in the URL of this lecture.

【Course Goals】The goal of this course is to acquire the fundamentals of electronic circuits. Starting with understanding of a fundamental concept of electronic circuits i.e., modeling of active devices, the lecture based on the fundamental concept proceeds step by step to understand electric circuits. In this style, the lecturer wants to give the students an ability to understand the principles of more complicated circuits by application of deep understanding the fundamentals. The main targets to be understood are the circuits with bipolar transistors and operational amplifiers, as well as the fundamental concepts.

【Course Topics】

Theme	Class number of times	Description
Modeling of active devices	3	The essential concepts in the electronic circuit are lectured in order to treat active devices in the electric circuit theory. The concepts are the controlled source and the linearization. The decoupling between the bias and the signal, another important concept, is lectured.
Fundamentals of transistor circuits	3	The characteristics of the basic bipolar-transistor circuits of three different common references are lectured based on the operation principle of the bipolar transistor. The biasing circuits are lectured with somewhat practical circuits.
Various amplifier circuits	3	Several power amplifier circuits are lectured as we focus on their power efficiencies. DC amplifier circuits are lectured as we bear in mind that they are applied in operational amplifiers.
Operational amplifiers	2	The concept and advantages of the negative feedback circuit are lectured, and an important concept in the operational amplifier, the virtual short, is explained. The linear operational circuits such as integrator and differential circuits, and nonlinear operational circuits such as logarithmic and exponential amplifiers are introduced.
Oscilators	2	The principle of the oscillator circuit is lectured as a concept of the positive feedback. Various oscillator circuits are introduced with their characteristics.
Others	1~2	If we have a more lecture time, nonlinear circuits of multiplier and modulation/demodulation circuits, power supplies for electronic circuits, and the noise in electronic circuits will be lectured.

【Textbook】M. Kitano, Fundamentals of Electronic Circuits (Reimei Publishing, Kyoto, 2008)

【Textbook(supplemental)】In addition to Japanese books, Tietze and Schenk: Electronic Circuits (Splinger); Hayes and Horowitz: Student Manual for the Art of Electronics (Cambridge)

【Prerequisite(s)】"Electric and Electronic Circuit (60030)" and "Fundamentals of Circuit Theory (60630)". (The lecturer recommends moderate understanding of fundamentals of electric circuit as the minimum prerequisites in order to achieve this course.)

【Web Sites】Link to the homepage of this course is here; (https://www.t.kyoto-u.ac.jp/lecturenotes/fe/d/60100/outline) Sorry for Japanese version only.

【Additional Information】The topics will be selected owing to limit of lecture time. The students should prepare "Bar Cover (http://www.kuee.kyoto-u.ac.jp/barcover/)" by themselves, used as a title page of each report. The homepage of this course is located in the "page of lecture materials" in the homepage of the faculty of engineering (https://www.t.kyoto-u.ac.jp/lecturenotes).

60321

Modulation Theory in Electrical Communication

通信基礎論（電気）

【Code】60321 【Course Year】4th year 【Term】1st term 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】 【Instructor】

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3-4	
	5-6	
	4-5	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【Web Sites】

【Additional Information】

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