

## Dept. of Computer Science

Widespread use of computers coupled with fast computer communication technology brought rapidly growing social demand for information processing technology and for its applications. Department of Computer Science provides good quality of education in both computer hardware and software as a means of information processing system. Department of Computer Science offers core courses that teach fundamental knowledge of computer science. On top of these courses, our department teaches system softwares such as database system, operating system, compilers, and computer network, and also put emphasis on practical training. There are list of courses offered to keep up with real world challenges and dynamically-evolving research trends: Computer Graphics, Multimedia System, Embedded System, Mobile Computing, Wireless Network, and E-Commerce. We also invite professionals from industry, research lab and other universities to our weekly colloquium on variety of research subject, and our colloquium is renowned for its quality contents. The students appreciate it as a good opportunity to balance theory and practice.

The faculty is highly devoted to educating and to advising students to write their thesis in high quality, and as a result, the masters and Ph.D.s trained in our department are internationally competent and recognized.

In these times when the use of computers is universal and the communication technology enhances rapidly, the society demands highly qualified IT personnel's to lead the society. Our mission is to educate students and to provide well - equipped computer professionals to the society in order to meet such need. For that purpose, department of Computer Science trains the students to have a deep understanding of fundamental knowledge in computer science. Based on such knowledge, the students are also trained to have design, development and analysis techniques in broad applications such as computer graphics, parallel and distributed computing, artificial intelligence, image processing, multimedia and computer networks.

Students majoring in computer science acquire fundamental knowledge in computer software and hardware in core courses.

Among those core courses are image processing, artificial intelligence, natural language processing, computer architecture, embedded system, operating systems, computer vision, pattern recognition, wireless network, parallel processing, and object-oriented system.

Ten research laboratories actively perform research and development projects funded by governmental agencies or industry. Knowledge acquired in course materials is exercised in the real-world applications, performing those research projects.

### Courses

#### Core Courses

##### · **Advanced Analysis of Algorithms (3)**

An introduction to the design of algorithms. The emphasis is on learning techniques for creating algorithms, analyzing them, and proving their correctness. Topics include models of computation, asymptotic notation for analysis of algorithms, sorting and searching algorithms, design techniques such as divide-and-conquer and dynamic programming, graph algorithms including spanning tree, shortest paths. Additional topics chosen from pattern matching, NP-hard, and NP-complete.

##### · **Advanced Operating Systems (3)**

Introduction to the design and analysis of operating systems. Topics include processes, mutual exclusion, synchronization, semaphores, monitors, deadlock prevention and detection, memory management, virtual memory, processor scheduling, disk management, file systems, security, protection, distributed systems. Students will present and discuss with hot issued topics.

##### · **Advanced Database Systems (3)**

Introduction to advanced database systems from a perspective of implementation. Topics include query processing, transaction management, concurrency control techniques, database recovery, database security and authorization, and how these concepts are implemented in real systems.

##### · **Advanced Artificial Intelligence (3)**

An introduction to basic concepts in artificial intelligence from a computer science perspective. We learn how to find innovative solutions to difficult, independently motivated problems, such as search, logic, knowledge representation, rule-based programming, and reasoning with programming applications.

##### · **Advanced Computer Architecture (3)**

Advanced topics in the architecture and organization of computer systems. Topics include how information is represented in memory, machine-language instructions and how they can be implemented at the digital logic level and microcode level, assembly language programming, input/output operations, and performance issues.

##### · **Advanced Computer Network (3)**

In this course, special hot issues in the recent research and development of computer network area are studied extensively. The course contents consist of lectures, paper presentation, demo, and term project.

· **Advanced Digital Image Processing (3)**

The course will provide mathematical foundations and practical techniques for manipulation of digital images: image acquisition, preprocessing, image transforms, image enhancement, image restoration, image coding, edge detection and segmentation, feature extraction, and image analysis.

· **Advanced Distributed Processing Systems (3)**

An introduction to the principles underlying state-of-the-art distributed computing technology. Topics include distributed system models, networking and internet-working, inter process communication, distributed objects and remote invocation, operating system support, security, distributed file systems, name services, time and global states, coordination and agreement, transactions and concurrency control, distributed transactions, replication, distributed multimedia systems, distributed shared memory, CORBA case study and MACH case study issues.

· **Advanced Embedded Systems (3)**

Introduction to advanced imbedded system. Topics include embedded kernels and various device drivers.

· **Modern Network Analysis (3)**

This course covers the architecture and principles of the modern network (Infrastructure networking, mobile communication, mobile network, social network, etc). It also covers the network structures of wireless lan, ad-hoc network, mesh network, and cellular networks. Furthermore many recent technologies such as medium access protocol, network resource management, mobility and location management, and routing protocols. The students will implement modern network simulation programs by using open source programming, then learn the performance comparison, evaluation, and analysis algorithms.

· **Research Ethics & Master Thesis (3)**

This course will provide the graduate students with the writing skill for the master's thesis as well as the research ethics. It will cover the identification of the research problem, problem solving approaches and results, literature survey, and thesis formats. This course will also provide opportunity to become involved in graduate research, under guidance of a supervisor, on a problem of mutual interest to student and supervisor. Regarding the research ethics, the course emphasizes on plagiarism so that the students can follow the research standards.

· **Research Ethics & Ph.D. Thesis (3)**

The purpose of this course is to enable the student to demonstrate the ability to

conduct research and write a scholarly dissertation reporting, evaluating, interpreting, and synthesizing results, and to orally defend a completed dissertation before faculty and peers. The purpose of the dissertation is to produce new knowledge, new materials, or new methods in the student's field of specialization. Furthermore, the student will learn the research ethics. Especially, the course emphasizes on plagiarism so that the students can follow the research standards.

□ **Computer Science Major Courses**

· **Advanced Software Engineering (3)**

An introduction to the techniques for building large, reliable, maintainable, and understandable software systems. Topics include programming paradigms for real systems, systems programming tools, structured design, software testing, and documentation.

· **Machine Learning (3)**

Topics in machine learning, including artificial neural networks, genetic algorithms, support vector machines, Bayesian network, Markov chain are taught in this course.

· **Advanced Design of Compilers (3)**

Advanced topics in compilation techniques for high level languages. Topics include lexical analysis, grammars, parsing, symbol-table management, type-checking, run-time storage organization, code generation, and optimization. The course involves a substantial project, to develop a compiler for a significant subset of a high-level programming language.

· **Human Computer Interface (3)**

This course provides an overview and introduction to the field of human-computer interaction. It introduces tools, techniques, and sources of information about HCI and provides a systematic approach to design. The course increases awareness of good and bad design through observation of existing technology, and teaches the basic skills of task analysis, and analytic and empirical evaluation methods.

· **Advanced Pattern Recognition (3)**

This course represents an advanced course in pattern recognition. The following topics are covered: statistical pattern recognition (classifiers, optimal classification schemes, feature extraction, learning, applications); syntactic pattern recognition (grammars, grammar inference, applications), neural networks for recognition: non-standard and combined pattern recognition approaches.

· **Advanced Parallel Processing Systems (3)**

Introduction to primitive parallel computing models and programming skills. This

course includes small projects those make use of parallel programming libraries, such as MPI, PVM, Linda, Open MP and BSP.

· **Advanced Object Oriented Systems (3)**

An introduction to the principles underlying state-of-the-art object oriented technology. Topics include object-oriented programming language, object-oriented analysis and design, unified process and design patterns issues.

· **Advanced Real Time Systems (3)**

Introduction to basic concept of real time system and applications. Topics include real time kernel, scheduler, and programming model.

· **Advanced Mobile Computing (3)**

The advanced electronic and communication technology invited wireless communication in any handheld component nowadays. Thus, the computing service can be offered at anywhere and anytime, which is named as mobile computing. In this course, we study basic foundation and its application.

· **Advanced Computer Graphics (3)**

This course provides an introduction of advanced topics in computer graphics. We cover the theoretical background and applications of a selected topic among advanced modeling, real-time rendering and animation, non-photorealistic rendering, and imaging.

· **Advanced Web Information Processing (3)**

This course looks at the methods used to search for and discover information in the Web and Web information systems. Methods that are covered include techniques for searching, browsing and filtering information, classification, clustering, filtering, web mining, the use of classification systems and thesaurus, and Web search systems.

· **Advanced Wireless Internet (3)**

Wireless Internet is one of the key research and development area in computer network. There are several platforms working on wireless phone, based on which we develop wireless application software realizing new concepts in pervasive computing. The course consists of lecture and programming practice.

· **Advanced Information Security (3)**

An introduction to the principles underlying advanced information security technology. Topics include classical encryption techniques, modern encryption techniques, conventional encryption algorithms, confidentiality using conventional encryption, public-key cryptography, message authentication and hash functions,

hash and MAC algorithms, digital signatures and authentication protocols, network security and system security issues.

· **Advanced Media (3)**

An introduction to new digital media and related technologies through their life cycle from creation, delivery and consumption. Topics include audio and video encoding algorithms, metadata description, intellectual properties management and, conditional access system.

· **Advanced Numerical Analysis (3)**

Advanced topics in scientific computation. Topics include differentiation, integration, solution of differential equations, equation solving, minimization/ maximization, linear algebra, interpolation.

· **Artificial Intelligence in Education (3)**

This course addresses the use of artificial intelligence and cognitive psychology to build computer-based intelligent tutoring systems. Students will learn empirical and theoretical methods for creating cognitive models of human problem solving. Such models have been used to create educational software that has been demonstrated to dramatically enhance student learning in domains like mathematics and computer programming. This course will have three components: a literature review of some of the fundamental papers in the field: lectures on the needed cognitive psychology and human-computer interaction (HCI) background; and a significant project component in which students will be practicing the use of methods used to design tutors.

· **Advanced Computer Vision (3)**

The course will cover a number of topics ranging from low level to high level vision, with a focus on both the mathematical formulation of vision tasks, and the development and implementation of algorithms to solve them. Lecture topics will include biological vision and early vision, projective geometry and camera modeling, shape from shading and texture, stereo vision, motion analysis and optical flow, object representation and recognition, high level vision and vision applications.

· **Advanced Formal Languages and Automata Theory (3)**

An introduction to the theory of computation. Topics include finite automata, regular languages and regular grammars, properties of regular languages, context-free languages, simplification of context-free grammars, pushdown automata, properties of context-free languages, turning machines. a hierarchy of formal languages and automata and limits of algorithmic computation.

· **Advanced Topics in Computer Science (3)**

This course is designed to deal with state-of-the-art topics in computer science outside the regular course offerings. For a given semester the course content will be announced prior to registration for that semester.

· **Selected Topics in Computer Science (3)**

This course is designed to study the topics of computer science not covered in regular course offerings, or directed experience in computer science by means of lecture, discussion, seminar, and research. Recent offerings include advanced databases, computer networks, Java programming, and unix system programming. It is good for the first year graduate students who wish to find research topics in various area.

· **Independent Study (3)**

To get a deep study, it is frequently necessary for a student to meet his adviser regularly so as to get the timely and proper guide in the personal meeting. This course exists to meet this kind of needs. It is like a personal tutoring course in the research and development.

· **Case Study in Computer System (3)**

In this course, students survey and study the recent technical trend of computer system architecture ranging from mobile phones and mobile PCs to large computer systems. Selected technical papers are read and presented during the course and each student writes a survey paper for a selected topic on novel computer system architecture.

· **Software Project Management (3)**

In this course, students are trained to follow systematic project management processes in software development. Example software development projects are selected and the whole development processes for the projects are reviewed and revised by course participants.

· **Cyber Infrastructure (3)**

This course is designed to treat the current topics in various issues on Cyber Infrastructure those are including applied Grid computing, e-Science, cluster computing, reliable server management, etc. This course includes seminars and small projects those make use of Globus Toolkit, COG, etc. The contents of seminars will be given in the first lecture.

· **Advanced Computer Network Application (3)**

In this course, special hot issues in the recent research and development of

computer network application, e.g., Web 2.0, sensor network, wireless network, etc., are studied extensively. The course contents consist of lectures, paper presentation, demo, and term project.

· **Intelligent Robot (3)**

This course covers intelligent robot research topics related to building and programming mobile and articulated robots to perform simple tasks. It also covers major paradigms of robot programming and architectures for building perception, control, and learning systems for intelligent robots. These topics will be pursued through independent reading, class discussion, and project implementations. Papers covered will be drawn from robotics, computer vision, animation, machine learning, and neuroscience. Special emphasis will be given to developing autonomous control from human performance.

· **Data Mining (3)**

An introduction to the design of data mining programs. The emphasis is on learning techniques for searching for hidden relationships and patterns in the data, which has been accumulating in many forms, including database systems, spreadsheets, text files, and recently web pages. Topics include machine learning and classification, knowledge representation, decision tree, clustering, visualization, and customer modeling and targeted marketing.

· **Design and Analysis of Algorithms (3)**

An introduction to the design and analysis of algorithms. This course covers a number of ideas and techniques useful for designing and analyzing algorithms. Basic paradigms, e.g., divide and conquer strategies, greedy algorithms, dynamic programming, back-tracking, graph algorithms will be focused. A practical side of algorithm design is also explored with interesting examples of the designing techniques. This course also covers a number of current research topics in this field: problems in communication networks, on-line algorithms, computational geometry, computational biology.

· **Advanced Big Data (3)**

With the advancement in the hardware, distributed computing platforms, and data mining algorithms, BigData analytics provide insights about large-scale dataset that was easily ignored. In the Advanced Big Data course, distributed computing platforms to store and analyze large-scale dataset are covered. By using a real-world open dataset, students are expected to conduct project and have a chance to share the outcome publicly.

· **Advanced Open Source Software (3)**

Open source software has become the most important way of innovating in all

industries. In this course, students learn the technical and cultural implications of open source technologies, licensing, and governance. The course covers applications of open source software, community-based development practices, theory of legal issues in open source licensing, case studies in real industry, and examples of governance building.

· **Advanced Information Computing (3)**

This course will cover traditional material as well as recent advances in information retrieval (IR), the study of the indexing, processing, and querying of textual data. The focus will be on Korean language processing techniques and the newer techniques that try to move beyond keyword search and bring some intelligence to the task of processing and retrieving textual information, including hypertext documents available on the world-wide-web.

· **Smart Internet of Things (3)**

Through this lesson, we will be able to apply IoT / IoS, that is, the distributed environment elements of human, things, and services, to the object space network that forms intelligent relationships such as sensing, networking, and information processing cooperatively without human intervention.

· **Future Internet (3)**

As all the activities of the modern people are connected to the network, the learning of the network infrastructure, the internet architecture and the internet service are carried out in order to overcome the structural limitations of the existing Internet technology and build a more efficient internet environment.

· **Practices in Advanced Big Data (3)**

Students will learn the advanced theory and practices in big data. Students will have industry expert-level skills to program real-world big data software based on open platforms. This course includes a development project and in-depth discussions.

· **Practices in Advanced Machine Learning (3)**

Students will learn the advanced theory and practices in machine learning. Students will have industry expert-level skills to program machine learning software based on open platforms. This course includes a development project and in-depth discussions.

· **Practices in Advanced Mobile Computing (3)**

Students will learn the advanced theory and practices in mobile computing. Students will have industry expert-level skills for mobile programming based on open platforms. This course includes a development project and in-depth

discussions.

· **Cloud Architect by AWS Academy (3)**

This course covers the fundamentals of building IT infrastructure on cloud. It covers how to optimize the use of the cloud services by understanding AWS services and how they fit into cloud-based solutions with few hands-on exercises.

· **Selected Topics in Security (3)**

Topics include advanced theory and practice for information security. Special topics on big data and security are covered.

· **Artificial Intelligence and Security (3)**

Topics include theory and practice for information security and artificial intelligence. Special topics on artificial intelligence for security and security for artificial intelligence are covered.

· **Advanced Vehicle Intelligence (3)**

Students are expected to learn the core aspects of intelligent vehicles including: 1) localization and mapping, 2) object recognition and tracking, 3) path planning and following. They implement all or part of the learned techniques in software, which is validated on a simulator driven by data sets obtained from real vehicles running on actual streets.

· **Intelligent Mobility Service (3)**

Emerging services such as car sharing, personal vehicles, unmanned delivery, and adaptive traffic control offer new opportunities for mobility technologies based on artificial intelligence. Students are requested to formulate techniques targeted towards resolving real-world problems, and provide solutions to them exploiting data obtained from practical systems.

· **Autonomous Driving System (3)**

Students are expected to learn techniques involved in perception, planning, and control for autonomous vehicles. They also execute their own projects that run on either a simulator or a self-driven model car.

· **Introduction to Quantum Computing (3)**

Fundamental concepts in quantum computing are taught in terms of Dirac notation. Quantum operations such as Quantum Fourier Transform, Quantum Phase Estimation are introduced. Quantum circuits which implements quantum algorithms such as Shor's factoring algorithm, Grover's search algorithm will be built and simulated in python + IBM qiskit library.

## □ Artificial Intelligence Major Courses

### · Advanced System Performance Analysis (3)

The course focuses on measuring and optimizing system performance, covering various performance analysis tools and techniques in diverse computing environments.

### · Projects in Artificial Intelligence 3 (3)

The course emphasizes the practical application and utilization of AI technology in real-world settings. It aims to improve the students' practical experience and deepen their understanding of AI through self-driven project planning, implementation, evaluation, and collaboration.

### · Projects in Artificial Intelligence 2 (3)

The goal is to understand the practical applications of AI technology across various fields through hands-on exercises and applications based on a comprehensive understanding of AI. Experimentation is used to gain insights into how AI technology can be applied in diverse domains using various datasets.

### · Projects in Artificial Intelligence 1 (3)

Based on a technical understanding of AI technology, the objective is to plan projects using diverse datasets, enhance collaborative skills through utilization, and gain practical experience. The goal is to develop an understanding of the societal applicability of AI.

### · Advanced Topics in Artificial Intelligence (3)

Conducting research on highlighted challenges that emerge as major targets in the field of AI.

### · 3D Vision (3)

Based on the latest technology and theories in the field of 3D Vision, the course deepens understanding through advanced algorithms and applications. It aims to enhance practical skills, specifically improving the ability to solve real-time 3D vision problems, fostering expertise for contributions to next-generation vision systems.

### · Advanced Robotics (3)

Focusing on advanced robotics, students learn robot system design, control algorithms, and sensor applications. The course enhances their ability to address challenges in the industry. By gaining understanding and practical experience in cutting-edge robotic technology, it aims to strengthen the capability to develop creative and innovative robotic solutions.

### · Artificial Intelligence Platform (3)

Providing platform technology essential for developing AI applications, the course enhances practical skills and problem-solving abilities through diverse AI platform applications. It aims to cultivate students' capability to effectively develop and merge AI systems.

### · Artificial Intelligence Ethics (3)

A course addressing the ethical aspects of AI from a technical perspective. It explores the ethical considerations of AI, including morality safety, transparency, and fairness, while learning about ethical development and utilization of AI. The course aims to foster students into ethically responsible AI technology experts, capable of leading sustainable AI innovations considering societal impact.

### · Advanced Recommendation System (3)

Focusing on in-depth recommendation system theory and exercise, the course covers various recommendation algorithms and data modeling techniques. It aims to enhance practical skills for applications in real industrial and service sectors, cultivating professionals with expertise needed to design and implement effective and innovative recommendation systems.

### · Reinforcement Learning (3)

Covering various reinforcement learning algorithms and applications based on agents interacting with the environment, the course teaches algorithms to solve complex decision-making problems. Students learn specialized knowledge for applying reinforcement learning in real systems and improving performance, fostering the ability to develop innovative reinforcement learning solutions.

### · Probabilistic Graphical Models and Machine Learning (3)

A course integrating graph models and machine learning, it covers probabilistic graph theory and machine learning techniques to model patterns and relationships in complex systems. Students learn theories related to data analysis, prediction, and the fusion of probabilistic graph theory with machine learning.

### · Machine Learning with Graphs (3)

A course teaches techniques for analyzing and modeling network and complex interaction structures in graph-based data. It cultivates the ability to develop effective learning models for real-world problems.

### · Advanced Topics in Natural Language Processing (3)

Focusing on advanced natural language processing theory and applications, the course emphasizes learning the latest technologies in language modeling, machine translation, etc. Students learn the ability to address problems using real natural language data.

· **Deep Learning II (3)**

The goal is to enhance understanding of deep neural network through in-depth research and practical exercises based on real-world data, building on a foundation of knowledge about neural networks and deep learning.

· **Deep Learning I (3)**

Building on an understanding of neural networks and deep learning, the course focuses on learning various deep learning algorithms and studying methods for extracting and representing the meaningful information from complex data.

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