Descriptions of Courses

WST500 Introduction to Web Science and Technology
Web is a platform for online communication, trust, identity, and collective intelligence and also is a medium for social and political opinions, decision-making processes, and online reputation formulation. Web science and technology is an interdiscplinary program that combines law, social sciences, natural sciences and engineering and covers the role and functions of the web. This course offers an introduction to Web Science and Technology.

WST501 Fundamentals of Searching Web-scale Datasets
In this course, we will study index structures and algorithms that are commonly applied in practice to support queries on large datasets. The course will be divided into three parts, which focus on data streams, multi-dimensional objects, and web-specific applications, respectively. Topics to be covered include sampling, hashing, sketch structures (e.g., count-min sketch, bloom filter, etc.), R-trees, nearest neighbor search, instance optimality, and so on. We will also discuss a series of foundamental techniques for analyzing the performance of algorithms.

WST510 Web Architecture
This course is on basic concept of web architecture and building a web service. It deals with web architecture design principles and its performance and security issues.

WST520 Software Engineering for the Web World
As the role of and functionality provided by the World Wide Web have evolved, the role of software engineering in creating Web-based systems, and the ability of software engineers to harness Web-based resources to perform engineering tasks, have also evolved. This has implications for the practice of software engineering by professional software engineers, and in this course we will study these implications. A further consequence of this evolution, however, is the rapid growth of web-based platforms supporting end-user programming. This in turn motivates concerns about "end-user software engineering", and in this course we will study this phenomenon as well.

WST550 Ontology Engineering
The objective of this course is to provide students with basic understanding of ontology engineering. This course consists of concepts and examples of ontology, construction of ontology, and how ontology used in philosophy, linguistic, artificial intelligence, and computer science.

WST560 Mobile Web Application
This course deals with difference between the existing and mobile web environment and major issues due to the difference. Furthermore, applications of mobile web and their utilization are covered in this course.

WST590 Research Methods for Information Behaviors on the Web
Web is considered as a rich repository for humans to gather, store, and process information. In order to develop efficient and effective web technologies and/or serivces for information behaviors, it is so necessary to understand what people need and what they desire for their lives. In turn, appropriate understanding of web users regarding what information they want to see on the web and how much they are satisfied with the present web technologies and/or services is the stepping stone to improve the existing web conditions and to compete for the pre-occupancy of the edges of future web technologies and/or services. To achieve such purposes, this course, from the behavioral perspectives, will inform class participants that how we can examine what web users want and hope, and that how we can evaluate the effectiveness of the potential technologies and services.

WST591 Web Audience Research
The rise of the web transforms our media landscape. Conventional media continuously lose their own audience who increasingly moves to the newer flatform, such as the web and/or mobile flatforms. Especially, in the era of Web 2.0, the audience's active participation in the production, remix, distribution, and exhibition of media content is getting more attention. This course convey knowledge in audience research in conventional media, examines the limitation of old audience research, and suggests novel ways how to measure the size of audience and how to

evaluate the benefits or concerns - cognitive, social, as well as industrial - observed in the era of new media. With convergence of conventional media and new media, media competes and/or co-exists with the exploded cultural contents produced by both professionals and amateurs. Media consumption and people's reactions in non-conventional media should be developed, which serves the main challenging topic in the course.

WST620 Research on Web Software Dependability

In this course we will investigate recent research on techniques for assessing and improving the dependability of various classes of Web software. We will begin by studying basic techniques for analyzing such software and for verifying its dependability; these include testing, static analysis, and dynamic analysis techniques. Of particular interest are Web applications built by non-professional (end-user) programmers, such as mashups and Web macros, and we will consider current research aimed at helping these users build more dependable programs. We will also spend time studying empirical methodologies for assessing techniques, including, in particular, empirical studies of programmers. There will be no exams in the course; instead, students will be asked to complete a course project which may involve research on new techniques, implementation of techniques, or empirical study of issues related to dependability. Prerequisite course-WST520

WST621 External Memory Data Structures

The external memory (EM) model was introduced by Alok Aggarwal and Jeffrey S. Vitter in 1988, observing that I/O time is often the performance bottleneck in algorithms on massive datasets that do not fit in memory. This fact has become increasingly evident as the data volume continues to outgrow a computer’s memory capacity, rendering the EM model the predominant computation model in studying I/O-efficient algorithms. In this model, a computer has an internal memory of M words and a disk of unbounded size. An I/O operation transfers a block of B consecutive words between the memory and disk. Space complexity is measured in number of disk blocks occupied, whereas time complexity is in number of I/Os performed. CPU calculation is free.

In this course, we will discuss EM structures with good tradeoff between (worst-case) space and query time. A well-known example is the B-tree, which indexes a set of N real numbers in O(N/B) space, and supports retrieval of any number in O(logBN) I/Os. We will cover other structures settling problems such as stabbing-query on 1-d intervals, 2-d orthogonal range reporting, and 2-d orthogonal range count/max, all of which are rudimentary in a large number of applications. We will study numerous fundamental techniques for developing I/O-efficient structures, such as persistency, boot-strapping, fractional cascading, compression, weight-balancing, logarithmic method, etc.

WST622 Multimedia Contents Protection

In this course, the technology related with the multimedia content protection is studied. Particularly, it covers the multimedia protection issues for the personal private information security on the web.

WST630 High Performance Computing

This course will focus on high-end architectures and computing including recent supercomputers, and architectures used in modern datacenters. High-performance will be focus but with the increasing importance of energy, we will also investigate energy-efficient computing as well. We will also discuss recent trend in computing, which included heterogeneous computing and accelerator architecture.

WST640 Web Search Technology

This course covers issues related to retrieval and extraction of information from a variety of information types on the Web. Topics to be covered are: Web crawling, text analysis and indexing, link analysis and social search, Web user query log analysis, distributed processing of large amount of data, automatic classification, and retrieval models. As the Web evolves, new contemporary topics will be also covered.

WST650 Linguistic Web Science

This course will examine the linguistic make-up of the Web, and ask: what should a language-oriented Web Science look like? The Web has evolved into the largest corpus of language use in existence, and continues to grow on a daily basis. We will look at how computational linguists use the Web as a corpus, to extract common-sense or definitional knowledge from its texts, and to test linguistic hypotheses on a large scale. Because the Web captures the bleeding-edge of language change, we will look at how the essential creativity of language

can be analyzed and modeled using Web content. More specifically, we will look at two different ways of using Web content: static databases of Web n-grams, and dynamic Web queries. A case-study will look at language use on the Web in a particular domain, such as online newspapers.

WST665 Web-scale Image and Video Retrieval
In this class we will discuss various techniques related to image/video retrieval. Especially, we will go over image/video features (e.g., SIFTs and GISTs), their indexing data structures, and runtime query algorithms. We will also study scalable techniques that can handle web-scale image/video databases.

WST670 Online Social Networks
Online social networks are the new leading technology in the IT industry after Microsoft, Google, and Apple. While existing online social networks offered a single feature of social networking, Facebook and Twitter are changing the definition of OSNs by presenting themselves as a platform for new services. The emergence of OSNs as a service platform poses new challenges in interdisciplinary research with cognitive science, sociology, poltical science, and communications. In this course we cover the basic features of online social networks, analytical basis for interdisciplinary research, and social network data analysis.

WST891 Special Topics in Web Science and Technology
This course is offered to meet the ad hoc demand of students in special areas of Web Science and Technology which is not covered by regular courses.

CS500 Design and Analysis of Algorithms
This course introduces basic techniques for the design and analysis of computer algorithms, such as divide-and-conquer, the greedy method, and dynamic programming. Students learn to reason algorithmically about problems arising in computer applications, and experience the practical aspects of implementing an abstract algorithm.

CS510 Computer Architecture
This goal of this course is to provide the student with an understanding of (*i*) the architectural aspect of the performance issues, and (*ii*) investigation of the full spectrum of design alternatives and their trade-offs.

CS520 Theory of Programming Languages
This course reviews design principles and implementation techniques of various programming languages. This course also introduces a wide spectrum of programming paradigms such as functional programming, logic programming, and object-oriented programming.

CS522 Theory of Formal Languages and Automata
This course is intended to understand the current theories of deterministic parsing of context-free grammars. Two basic parsing schemes, LR(k) and LL(k) parsing, are considered and the practical SLR(1) and LALR(1) techniques are discussed. The syntactic error recovery in LR-based parsing is also discussed.

CS530 Operating System
The main focus of this course is to understand the concurrency features of modern operating systems. Concurrent programming is dealt with in detail to simulate various parts of an OS. Other topics that are required to understand the process-oriented OS structure are also discussed.

CS540 Network Architecture
The goal of this course is to provide students with an understanding on the following topics. (1) the concept of layered architectures, (2) the design and implementation of communication protocols, (3) the multimedia communication protocol, and (4) the design of high-speed protocols. The course also covers many aspects of protocol engineering: design, implementation and test of communication protocols.

CS548 Advanced Information Security
The main objective of this course is to provide students with comprehensive knowledge of information security. The course helps students to build profound understanding of information security by teaching the fundamentals of

information security, which include, but are not limited to: cipher, access control, protocol, and software engineering. The primary fous of the course is on the general concept of information security.

CS550 Software Engineering
This course covers fundamental concepts required in developing reliable softwares in a cost-effective manner.

CS560 Database System
This course addresses current technologies of various aspects of database systems. The main objective of this course is to study the design and implementation issues of high performance and high functionality database systems. Through this course, the students will have concrete concepts on database systems and will have in-depth knowledge on most issues of advanced database researches.

CS562 Database Design
The goal of this course is to establish a consistent framework for database design. Practical database design methodology, major principles, tools and analysis techniques for various phases of database design process are studied.

CS570 Artificial Intelligence and Machine Learning
The goal of this course is to give both a comprehensive introduction to core concepts of AI and hands-on experience in symbolic language programming. This course not only provides a thorough discussion of AI's foundational technologies including predicate calculus, search, and AI languages, but introduces processing, pattern recognition, computer vision, and neural networks.

CS574 Natural Language Processing I
As a typical application of symbolic AI machine translation (M.T) addresses the major issues involving computational linguistics, rules base, and more fundamentally knowledge representation and inference. In this regard, the goal of the course is to provide students with first-hand experience with a real AI problem. The topics include application of M.T., basic problems in M.T., and classical approaches to the problems.

CS580 Computer Graphics
This course presents the principles of three-dimensional graphics, including geometric, modeling and realistic image synthesis. It also covers techniques for representing, manipulating, and rendering three-dimensional objects.

CS600 Graph Theory
This course is intended as a first course in graph theory. It covers the basic theory and applications of trees, networks, Euler graphs, Hamiltonian graphs, matchings, colorings, planar graphs, and network flow.

CS664 Advanced Database System
The goal of this course is to study the formal foundation of database systems. The course covers advanced topics such as deductive databases, relational database theory, fixed point theory, stratified negation, closed-world assumption, safety, multivalved dependency, generalized dependency and crash recovery.

WST960 M.S Thesis

WST966 Seminar(M.S)

WST980 Ph.D Thesis

WST986 Seminar(Ph.D)