# Description of Courses

## ▣ Master and Doctoral Program

### DS501 Statistical Inference for Data Science 3:0:3

This course lays statistical foundation for data scientists. Probability model, random variables and their probability distribution, joint distribution, and conditional distribution are introduced along with data generation from a given distribution via computer exercise. Statistical inference with likelihood principle and Bayesian approach will be covered.

### DS503 Machine Learning for Data Science 3:0:3

This is an introductory course on machine learning, which belongs a broader family of machine learning methods concerned with the development and application of modern neural networks. We will cover a range of topics from basic neural networks, convolutional and recurrent network structures, deep unsupervised learning, attention-based models, and applications to computer vision, language understanding, and other areas. The course will be focused on understanding deep learning methodology, rather than implementing them using modern libraries.

### DS504 Programming for Data Science 3:0:3

This course introduces the technologies and programming techniques for datascience. This course covers from the programming language basic, which is effective in datascience, common libraries for analytics, and utility tools and techniques on software for datascience.

### DS523 Pervasive Computing for Data Science 3:0:3

There has been an increasing trend towards integrating sensing, storing, and computing in the real world. This course takes an interdisciplinary look at this pervasive computing from the datascience perspective. A huge set of data is being collected, stored, and analyzed via sensors, SNSs, metaverse, etc. Students are expected to understand how to integrate the datascience into the sensing, collecting, and analyzing such data in an impactful way.

### DS535 Recommender System and Graph Machine Learning 3:0:3

This course is a project-based course focused on recommender systems and machine learning on graphs. The first half of the course covers fundamental techniques in recommender systems ranging from content-based approaches, and traditional collaborative filtering, to recent advanced techniques including matrix factorization and deep learning based collaborative filtering methods. In the second half of the course, we discuss about major topics in machine learning on graphs including random walk-based methods and recent graph neural network-based approaches for node-level and graph-level tasks. Furthermore, we talk about various applications of graph neural networks.

### DS545 Business Intelligence 3:0:3

Business intelligence plays a central role in transforming a large amount of data into information and business insight for effective decision making. The ability to understand, filter, digest, and analyze information is essential to success for data scientists and knowledge workers. Therefore, the overall goal of this course is to help students develop those abilities by covering the fundamental concepts and techniques of business intelligence.

### DS551 Human-Computer Interaction: Theory and Design 3:0:3

This course provides an overview of theories and design practices in the HCI field. Students will learn not only the basic concepts of HCI but also recent research practices and key findings on human behavior. Students will engage in a semester-long research project, and participating in the project will help them improve their research skills.

**DS621 Social Computing Systems Design and Analysis** **3:0:3**

Social computing describes any type of computing applications in which software serves as an intermediary or a focus for a social relation (e.g., social networking, knowledge sharing, computer supported collaborative work, and collaborative learning). In this class, we study social computing systems design (e.g., service design methods, encouraging user motivation/commitment, dealing with newcomers, starting new communities, designing persuasive services) and review existing social computing research areas (e.g., crowdsourcing, social Q&A, and social recommendation).

**DS622 Knowledge Structure and Modeling** **3:1:3**

Knowledge structure is an interrelated collection of facts or knowledge about a particular topic. It is composed of concepts linked to other concepts by labeled relationships. The course involves modeling of knowledge structure using XML, RDF, and ontology using the semantic Web as a knowledge source.

**DS623 Content Networking** **3:0:3**

In this course, we review content networking technologies designed for efficient content dissemination and management in the networked environment. The course is composed of five parts. In the first part we review Internet architecture and mobile wireless networking technologies (e.g., 3G/4G/LTE, Wi-Fi, Bluetooth, etc.). In the second part we learn content transport methods (e.g., HTTP, TCP/IP), content caching, and multimedia streaming. In the third part we investigate content delivery networks and recent future Internet efforts to make the Internet content-networking-friendly. In the fourth part we focus on mobile content networking, namely personal content networking, location-aware services, and user experiences. Finally, we study Web 2.0 and beyond, including social networking (e.g., Facebook, Flickr) and emerging (mobile) Web 3.0 services based on agents and semantic web.

**DS631 Data Mining for Social Networks** **3:0:3**

Social networks typically contain a tremendous amount of content and linkage data which can be leveraged for analysis. This abundant data provides unprecedented opportunities for knowledge discovery in the context of social networks. This course teaches key concepts and algorithms for analyzing online social networks from the data mining point of view. The course will cover many interesting topics including community discovery, evolution analysis, link prediction, and influence analysis. The instructor will introduce the representative papers (two for each week) published in the data mining field. In addition, the students will get to play with real data crawled from social networking sites.

**DS641 Human Decision Making and Support** **3:0:3**

Decision-making is central to the survival and advancement of human race and to the functioning and success of knowledge workers. Understanding how people make decisions has also immense implications for the effective design and successful implementation of computerized tools and systems. The primary focus of this course is on understanding how people make decisions and how decision-making could be improved. Various types, strategies, limitations, and models of human decision-making are considered. Human problem-solving strategies and heuristics in choice, estimation, and diagnosis problems are analyzed. Also discussed are various intelligent approaches and systems to support the human strategies by providing timely and well-designed information.

**DS642 Knowledge Engineering and Intelligent Decision Making** **3:0:3**

Knowledge engineering plays a key role in integrating knowledge into computer systems for intelligent decision making. This course covers the fundamental concepts, methods, and tools related to knowledge engineering and examines the new applications of knowledge engineering including Semantic Web and Linked Open Data.

**DS651 Introduction to Learning Science** **3:0:3**

The field of Learning Science has as one of its foundational goals to work towards understanding the pedagogical and technological features that make education effective. The purpose of this class is to expose students to the foundational theoretical, technological, and methodological issues underlying previous work in learning science. In addition, the class introduces students to the wide range of current learning environments for formal and informal interaction and learning on-line, and explores current research in improving the quality of experiences these environments have to offer

**DS652 Cognitive Engineering** **3:0:3**

The human cognitive process, capability, and performance characteristics are introduced. Topics include how Human-System integration should be designed and human errors can be prevented and reduced. Some hands-on case studies are conducted to be acquainted with the realistic system-engineering practice of cognitive system design.

**DS801 Special Topics in Data Science I** **3:0:3**

This course is offered to meet the ad hoc demand of students in special areas of Data Science which is not covered by regular courses.