

## Fall 2024 Special Topics Course Descriptions

**CSCI 4800 Cloud Computing:** This course studies fundamental designs and key technologies in Cloud Computing by reading technical articles, and conducting a semester group project. Topics include cloud computing design and architectures, service models, virtualization, advanced computer networks, programming, often software, and security. Note: Operating System, Computer Networks, and programming experience are recommended for success in this course.

Prereq: CSCI 3761 & 3453 with a C- or higher

**CSCI 4800 GenAI:** An in-depth examination of generative deep learning, focusing on the design and development of models that can generate new content. Topics include: Generative modeling, Deep learning, Variational autoencoders, Generative adversarial networks, Autoregressive models, Normalizing flow models, Energy-based models, Diffusion models, Transformers, Music generation, World models, Multimodal models, Ethics and challenges in generative AI.

Prereqs: CSCI 3412 with a C- or higher

**CSCI 4800 Natural Language Processing & LLMs:** Natural language processing (NLP) is one of the most important technologies of the information age. Applications of NLP are everywhere because people communicate almost everything in language: web search, advertising, emails, customer service, language translation, virtual agents, medical reports, politics, etc. In the last decade, deep learning approaches have obtained very high performance across many different NLP tasks, using single end-to-end neural models that do not require traditional, task-specific feature engineering. In this course, students will gain a thorough introduction to cutting-edge machine learning, deep learning and Generative AI models for NLP. Through lectures, hands-on assignments and a term project, students will learn the necessary skills to design, implement, and understand their own computational models for NLP tasks.

Prereqs: CSCI 3412 and MATH 2411 with a C- or higher

**CSCI 4800/5800 Explainable AI:** As artificial intelligence/machine learning (AI/ML) models are increasingly being employed to aid critical decision making in high-stakes domains such as government, healthcare, finance, and law, it becomes important to ensure that relevant stakeholders can understand the behavior of these models and the decisions they recommend. Such an understanding helps determine if, when, and how much to rely on the outputs generated by these models. This special topic course familiarizes students with recent advances in the emerging field of eXplainable Artificial Intelligence (XAI). In this course, we will review seminal research papers in the field, understand the concept of explainability from the perspective of different end users, discuss in different classes of interpretable models and post hoc explanations (e.g., rule-based and prototype-based models, feature attributions, counterfactual explanations, mechanistic interpretability).

Undergrad Prereqs: CSCI 3412 with a C- or higher

Graduate Foundational Pre-Req: CSCI 2312, 2421, 2511, & 3412

**CSCI 5800 AI with Reinforcement Learning:** We now live in an era of Artificial Intelligence (AI) where we rely on responses as well as actions by numerous autonomous systems that are

crisscrossed in our daily lives. These systems are powered by AI that learn to provide us with reasonable answers for us with respect to our respective perspectives. Reinforcement learning is one of the most advanced and powerful way of developing such systems and are very much in line with the learning paradigms used to make us knowledgeable since our childhood, which is to learn from our mistakes. In this course, students are going to get a solid foundation in the field of reinforcement learning, learn the core challenges, and ideas to bring in newer approaches to make the systems robust, and more humanoid, and better to some degree. Through a combination of lectures, programming assignments students are expected to receive a hands-on-experience in exploring this field effectively. In addition, through the final project in this course, students will advance their understanding of reinforcement learning paradigm and are going to be able to design, develop and demonstrate by the end of the semester smart competitive players in video games, autonomous chatbots, autonomous vehicle control systems, early detection of malicious activities in the communication networks in the field of cybersecurity, and so on.  
Foundational Pre-Req: CSCI 2312, 2421, 2511, & 3412

**CSCI 5800 Natural Language Processing & GenAI:** Natural language processing (NLP) is one of the most important technologies of the information age. Applications of NLP are everywhere because people communicate almost everything in language: web search, advertising, emails, customer service, language translation, virtual agents, medical reports, politics, etc. In the last decade, deep learning approaches have obtained very high performance across many different NLP tasks, using single end-to-end neural models that do not require traditional, task-specific feature engineering. In this course, students will gain a thorough introduction to cutting-edge machine learning, deep learning and Generative AI models for NLP. Through lectures, hands-on assignments and a term project, students will learn the necessary skills to design, implement, and understand their own computational models for NLP tasks.  
Foundational Pre-Req: CSCI 2312, 2421, 2511, & 3412