COMP96XX Recommender Systems: Foundationsd and Applications

Course Outline

Recommender systems (RS) are a useful information filtering and search tool for guiding users in a personalized way to discover products/services from a large space of possible options. RS are one of the most important and popular machine learning applications. They are primarily used in commercial applications like Amazon, Netflix, Taobao and then extend to many sectors like cyber security, transportation and health informatics. As such, RS have become a vital and indispensable component in the modern internet industry.

This course aims to systematically introduce the fundamental techniques related to recommender systems, including collaborative filtering, matrix factorization and more advanced techniques like deep learning. Students will gain techniques which are essential and important for real-world applications.

Necessary Knowledge:

Pre-req: COMP9444 and basic discrete and linear algebra math skill.

Course Schedule:

Recommender Systems Foundation

Week 1: Course Overview and Introduction to Recommender Systems
Topics: Course Overview, Goals of Recommender Systems, Basic Model of Recommender Systems, Evaluation of RS, and Applications of Recommender System.

Week 2: Collaborative Filtering and Matrix Factorization
Topics: Famous Recommendation Algorithm: Collaborative Filtering Algorithm, Factorization Machine, Matrix Factorization Algorithm, and its variant like DeepFM etc. How those algorithms are used on traditional Recommender Systems.

Week 3: Content-Based Recommender Systems
Topics: Basic components of content-based RS, Pre-processing and Feature Extraction, Learning User Profiles and Filtering, Content-based versus Collaborative Filtering based RS, Using Content-based Methods on Collaborative Filtering.

Week 4: Knowledge-Based Recommender Systems
Topics: Introduction about Knowledge-Based RS, Two variants: Constraint-Based and Case-Based RS, Persistent Personalization in Knowledge-Based RS.

Week 5: Hybrid Recommender Systems
Topics: What is the hybrid RS, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Augmentation Hybrids, Feature Combination Hybrids and Meta-Layer Hybrids.

Advanced Topics and Applications

Week 6: Deep Learning in Recommender Systems – 1
Topics: Recommender system with: Multi-layer Perceptron (MLP), Auto-Encoder, Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), Restricted Boltzmann Machine (RBM), Adversarial Networks (AN) and Attention Method.

Week 7: Deep Learning in Recommender Systems – 2
Topics: Continue topics in Week 6 and Model-based Recommender Systems

Week 8: Conversational Recommender Systems and its applications
Topics: What is the Conversational Recommender Systems. Reinforcement learning based method. How to utilize user-system interaction via deep reinforcement learning.

Week 9: Guest Lecturer from Industry
Topics: Recommender System in Industry.

Week 10: Emerging Topics in Recommender Systems
Topics: Explainable Recommender Systems, Recommender systems in Social-Cyber-Physical systems, Trust-aware Recommender Systems, and Course wrap up.

Summary of Proposal:

This course will be an advanced course for (1) BSc Computer Science undergraduate students and (2) ADK for Master of IT postgraduate students at the School of Computer Science and Engineering. It will also be available as an elective in the BE Bioinformatics Engineering, BE Computer Engineering and BE Software Engineering.

This course will patch up and further develop the outcomes of current courses in Machine Learning and Data Mining (COMP9417), Deep Learning and Neural Network (COMP9444). It will briefly introduce an advanced topic in machine learning and deep learning – Recommender Systems. Recommender Systems are having a transformative impact across a wide range of applications, from online shopping websites like Amazon, eBay, cyber security, Smart cities, healthcare and bio-informatics.

This course aims to offer students a comprehensive overview of the theory and practice of recommender systems and help students better understand how real-world applications utilize machine learning theory.

Justification:

With the growing volume of online information, recommender systems have been an effective strategy to overcome information overload. The utility of recommender systems cannot be overstated, given their widespread adoption in many web applications, along with their potential impact to ameliorate many problems related to over-choice. Recommender systems play a critical role on many companies such as Facebook's Ad service, TikTok and GoogleNow. Yet, there is an acute shortage of

people, both in Australia and worldwide, with the appropriate skills to meet the current needs of the recommendation algorithm sector and the future demands placed on it by rapid change and newly emergent technologies.

While currently there are a wide range of courses on machine learning, there is a lack of courses to bridge theory and applications. This course will give an opportunity to students to gain some practical skills in solving an real-world scenario from the industry, and develop an intelligent system by integrating their prior knowledge learned from COMP3411/9414, COMP9417 and COMP9444, and also the more advanced topics presented in this course.

Assessment:

Assignment (20%), Project (20%), Final Exam (60%). Exam Hurdle: 24/60.

Reference.

[1] Zhang, S., Yao, L., Sun, A. and Tay, Y., 2019. Deep learning based recommender system: A survey and new perspectives. *ACM Computing Surveys (CSUR)*, *52*(1), pp.1-38.