CHAPTER 16

COMPUTER SCIENCE

Doctoral Theses

01. ADAMYA SHYAM

Leveraging Group Structures for Enhanced Representation Learning in Recommender Systems

Supervisors: Dr. Vikas Kumar and Dr. Venkateswara Rao Kagita

Th 28984

Abstract

The exponential growth of digital content across online platforms has intensified the problem of information overload, making recommender systems essential for delivering personalized content. Despite significant advances, many recommendation models remain prone to challenges arising from data sparsity, cold-start conditions, limited knowledge transfer across domains, and an inadequate ability to capture evolving user preferences over time. The focus of this thesis is on the development of novel techniques for multiple recommendation scenarios, including single-domain, cross-domain, and sequential recommendations, addressing these interconnected limitations. While conventional methods often model users in isolation, this thesis is based on the insight that group structures can provide a powerful inductive bias for recommendation modelling. The thesis develops this perspective through five contributions spanning three recommendation settings. In the single-domain setting, we introduce a unified matrix factorization framework that jointly models personalized, group, and package-level recommendations, leveraging group and package representations as structural anchors. In the cross-domain recommendation setting, we utilize group information along with overlapping entities across domains to establish effective conduits for knowledge transfer between across domains. In our first proposal under this setting, user and item embeddings are used to form latent groups, while overlapping entities across domains act as anchors for group-level knowledge transfer. In a second contribution, the reliance on overlap users for group feature modeling is alleviated by learning latent group features independently within each domain, which are then used to guide a neural mapping function for cross-domain preference transfer. We extend this perspective to sequential recommendation by integrating temporal user behavior with dynamic group affinities to capture the co-evolution of personal and collective preferences. Finally, we extend group modeling to importance-driven interaction groups, capturing preference-defining interactions through a multi-expert reasoning module. Extensive experiments on multiple benchmark datasets demonstrate consistent improvements, particularly under sparse, cold-start, and dynamic conditions.

Contents

1.Introduction 2. Related Work 3. Unified Single-domain Representation Learning Framework 4. Group-aided Representation Learning for Cross-domain Recommendations 5. Group-aware Mapping for Cross-domain

Recommendations 6. Group Informed Representation Learning for Sequential Recommendation 7. Selective Modeling based Representation Learning for Sequential Recommendation 8. Conclusions and Future Works.

02. BAGRI (Rashika)
Deep Learning Frameworks for Tumour Grading with Nuclei Segmentation and Subtyping of Renal Cell Carcinoma using Histopathology Imaging.
Supervisor: Prof. Dr. Ankit Rajpal
Th 28985

Abstract

Cancer remains one of the leading causes of mortality worldwide, with histopathological assessment of hematoxylin and eosin (H&E) stained tissue serving as the clinical reference standard for diagnosis. Manual interpretation of histopathology is time-consuming and prone to inter-observer variability. Deep learning (DL) methods automate histopathological image analysis to improve diagnostic accuracy. Renal cell carcinoma (RCC) requires precise tumour grading and subtyping for reliable prognosis and treatment planning. This thesis presents automated DL-based models for nuclei segmentation, clear cell RCC (ccRCC) grading, and RCC subtyping from histopathology images. It begins with nuclei segmentation to facilitate fine-grained cellular-level analysis for precise tumour grading, and subsequently extends to RCC subtype classification. We propose a deep attention network-based nuclei segmentation that integrates residual encoder blocks, a global-context bottleneck, and wavelet-driven attention modules in the decoder to preserve fine structural details. Experiments on PanNuke and TNBC datasets demonstrate improved Jaccard scores using five-fold cross-validation at a 95% confidence level, with significantly fewer trainable parameters than existing approaches. Next, we propose a model for grading clear cell RCC for each of the Fuhrman and ISUP grading systems. Utilizing the segmentation model for nuclei localization, handcrafted morphological features are fused with convolutional neural network features and evaluated using multiple machine learning classifiers. Experiments on the TCGA-KIRC and KMC Kidney datasets show improved performance with ten-fold cross-validation at the 95% confidence level and strong generalization across independent cohorts. Finally, we propose a cross-magnification attention–based multiple instance learning (CMA-MIL) framework for WSI-level RCC subtype classification. By integrating features across 5×, 10×, and 20× magnifications and employing discriminative attribute scoring, the model achieves state-of-the-art performance. Experiments on the TCGA-RCC dataset demonstrate improved performance using five-fold cross-validation at a 95% confidence level. The interpretable attention maps highlight diagnostically relevant regions, improving clinical trust in automated histopathological analysis.

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1.Introduction 2. Background 3. Automated Nuclei Segmentation in Histopathology Images 4. Grading of clear cell Renal Cell Carcinoma(ccRCC) using Histopathology Image 5. Histological Subytyping of Renal Cell Carcinoma (RCC)using Whole-slide Images. Conclusion and Bibliography.