Graph Convolutional Network for Multi-label Classification Task

1. General Info

Project Title: Graph convolutional network for multi-label classification task

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2. Project Abstract

In this project, we study the power of graph convolutional networks (GCNs) in the multi-label classification task for both graph-based and non-graph-based datasets. For this purpose, we divide the study into two subsets of tasks. In the first task, the input dataset is a set of samples with features, and GCNs are employed to assist the main classifier for the final multi-label classification of input data. In the second one, the input data is a set of samples (called nodes) with a graph between them, and GCNs' structure, as the main classifier, needs to be modified to be prepared for multi-label node classification in the input graph-based data. At the end of the project, we will compare the output of both categories on a multi-modal medical dataset and also improve the existing methods in both categories.

3. Background and Motivation

Graph convolutional networks (GCNs) are powerful models in modeling the relationship between entities [1]. Recently, they have shown promising results in the multi-label classification task for different applications like images and texts [2]. For multi-label classification, GCNs can be used to model the relationship between samples in a graph-based dataset [3], or in a more abstract way, they are employed to model the relationship between labels in any type of dataset [4]. In this project, we will study these two types of methods and compare them on the Ocular Disease Intelligent Recognition (ODIR) [6], which is a multi-modal medical dataset. For this aim, we follow the steps of Huang, Y., and Chung, A.C. (2020) [7] to construct a graph-based dataset from ODIR and compare two types of methods on it and also improve them.

4. Technical Prerequisites

- Good background in deep learning
- Interest in GCNs
- Good skills in Python
- Good skills in PyTorch

5. Benefits:

- Experience in working with graph neural networks
- Possible novelty of the research
- Possible publication

6. Students' Tasks Description

Students' tasks would be the following:

Group 1: Methods for graph-based dataset

- Understanding the underlying methods [8,5]
- Re-implementing the existing method [5]

- Running the method on a benchmarks
- Familiarize with the ODIR dataset and prepare it for the task
- Running the method on ODIR dataset
- Implementing the improved version
- Testing and documentation.

Group 2: Methods for both graph and non-graph datasets

- Understanding the underlying methods [8,4]
- Re-implementing the existing method [4]
- Running the method on a benchmark
- Familiarize with the ODIR dataset and prepare it for the task
- Running the method on ODIR dataset
- Implementing the improved version
- Testing and documentation.

7. Work-packages and Time-plan:

	Description	#Students	From	To
WP1	Familiar with the literature.	4		
WP2	Familiar with PyTorch, and TensorBoard and benchmarks	4		
WP3	Group1: Method for graph datasets: implementation and evaluation on benchmarks Group2: Method for general datasets: implementation and evaluation on benchmarks	2		
WP4	Prepare intermediate presentation	2		
M1	Intermediate Presentation	4		
WP5	Group1: Familiar with medical data, data pre-processing (graph construction) Group2: Familiar with medical data, data pre-processing (feature extraction) and share it with the other group	4		
WP6	Group1: Evaluate WP3 on medical data Group2: Evaluate WP3 on medical data	2		
WP7	Group1: Implement the new method (graph-based data) Group2: Implement the new method (general data)	2		
WP8	Testing and Documentation	4		
M2	Final Presentation	4		

References:

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[2] Zhao, J., 2021. GitHub - JiaweiZhao-git/Awesome-Multi-label-Image-Recognition: Awesome Multi-label Image Recognition Paper List. [online] GitHub. Available at: <https://github.com/JiaweiZhao-git/Awesome-Multi-label-Image-Recognition> [Accessed 9 October 2021].

[4] Chen, Zhaomin, Xiu-Shen Wei, Peng Wang, and Yanwen Guo. "Learning Graph Convolutional Networks for Multi-Label Recognition and Applications." *IEEE Transactions on Pattern Analysis and Machine Intelligence* (2021).

[5] Shi, Min, Yufei Tang, Xingquan Zhu, and Jianxun Liu. "Multi-Label Graph Convolutional Network Representation Learning." *IEEE Transactions on Big Data* (2020).

[6] Ocular disease intelligent recognition. https://odir2019.grandchallenge.org/dataset/ (2019)

[7] Huang, Yongxiang, and Albert CS Chung. "Edge-variational graph convolutional networks for uncertainty-aware disease prediction." In *International Conference on Medical Image Computing and Computer-Assisted Intervention*, pp. 562-572. Springer, Cham, 2020.

[8] Kipf, Thomas N., and Max Welling. "Semi-supervised classification with graph convolutional networks." *arXiv preprint arXiv:1609.02907* (2016).