NANYANG TECHNOLOGICAL UNIVERSITY

Project 2

CE/CZ4071 NETWORK SCIENCE TOTAL MARKS: 100

Logistics:

- **Team Formation:** Since this is a group project, the size of each group should be 4. We have 68 registered students in this course. So, we should have 17 groups. Form the groups early and send me by email (arijit.khan@ntu.edu.sg) the name of your group members and the selected paper (please send one email per group, with **email title: "CZ4071: Project-2"**) latest by March 28, 2020. You may form the same group (or a different group) as in Project 1. After March 28, if you still have not formed a group, you will be randomly assigned to some group. No new group information will be accepted after March 28.

- **Grading Policy:** The grading will be based on the following factors.

  Final Report – 50%
  Codes, Experimental Results Reproduced/ Analyzed – 30%
  Find Similarities/ Differences with Algorithms Learnt in CE/CZ4071 Lectures – 20%

- **Project Details:** Select one of the following research papers (one paper per group) for your Project-2. Inform me about your selected paper together with group formation email latest by March 28, 2021. If this paper is already selected by several previous groups, I shall ask you to select a different paper. Therefore, decide your group, and select your favorite paper as early as possible. *Following the recent interest on Deep Learning and AI, the theme of this year's Project-2 is*: "**Deep Learning on Graphs**".

  [1] Nikhil Goyal, Harsh Vardhan Jain, and Sayan Ranu. "GraphGen: A Scalable Approach to Domain-agnostic Labeled Graph Generation". In WWW 2020.

  [2] Keyulu Xu, Weihua Hu, Jure Leskovec, and Stefanie Jegelka. "HOW POWERFUL ARE GRAPH NEURAL NETWORKS?" In ICLR 2019.

  [3] Xin Liu, Haojie Pan, Mutian He, Yangqiu Song, Xin Jiang, and Lifeng Shang. "Neural Subgraph Isomorphism Counting". In KDD 2020.

  [4] Michael Schlichtkrull, Thomas N. Kipf, Peter Bloem, Rianne van den Berg, Ivan Titov, and Max Welling. "Modeling Relational Data with Graph Convolutional Networks". In ESWC 2018.

[5] Guoliang Ji, Shizhu He, Liheng Xu, Kang Liu, and Jun Zhao. “Knowledge Graph Embedding via Dynamic Mapping Matrix”. In ACL 2015.

[6] Qiang Huang, Makoto Yamada, Yuan Tian, Dinesh Singh, Dawei Yin, and Yi Chang. “GraphLIME: Local Interpretable Model Explanations for Graph Neural Networks”. In ArXiv CoRR abs/2001.06216, 2020.

[7] Hao Yuan**,** Jiliang Tang, Xia Hu, and Shuiwang ji. “XGNN: Towards Model-Level Explanations of Graph Neural Networks”. In KDD 2020.

[8] Rex Ying, Dylan Bourgeois, Jiaxuan You, Marinka Zitnik, Jure Leskovec. “GNNExplainer: Generating Explanations for Graph Neural Networks”, In NeurIPS 2019.

[9] Dang Nguyen, Wei Luo, Tu Dinh Nguyen, Svetha Venkatesh, and Dinh Phung. “Learning Graph Representation via Frequent Subgraphs”. In SDM 2018.

[10] Maxime Gasse, Didier Chételat, Nicola Ferroni, and Laurent Charlin. “Exact Combinatorial Optimization with Graph Convolutional Neural Networks”. In NeurIPS 2019.

[11] Riccardo Cappuzzo, Paolo Papotti, and Saravanan Thirumuruganathan. “Creating Embeddings of Heterogeneous Relational Datasets for Data Integration Tasks”. In SIGMOD 2020.

[12] Zhengdao Chen, Soledad Villar, Lei Chen, and Joan Bruna. “On the Equivalence between Graph Isomorphism Testing and Function Approximation with GNNs”. In NeurIPS 2019.

[13] Yuan Zhang, Xiaoran Xu, Hanning Zhou, Yan Zhang. “Distilling Structured Knowledge into Embeddings for Explainable and Accurate Recommendation”. In WSDM 2020.

[14] Tianshuo Zhou, Ziyang Li, Gong Cheng, Jun Wang, Yu'Ang Wei. “GREASE: A Generative Model for Relevance Search over Knowledge Graphs”. In WSDM 2020.

[15] Yunqi Qiu, Yuanzhuo Wang, Xiaolong Jin, Kun Zhang. “Stepwise Reasoning for Multi-Relation Question Answering over Knowledge Graph with Weak Supervision”. In WSDM 2020.

[16] Azade Nazi, Will Hang, Anna Goldie, Sujith Ravi, and Azalia Mirhoseini. “GAP: Generalizable Approximate Graph Partitioning Framework”. In ArXiv CoRR abs/1903.00614, 2019.

[17] Akash Mittal, Anuj Dhawan, Sourav Medya, Sayan Ranu, and Ambuj Singh. "Learning Heuristics over Large Graphs via Deep Reinforcement Learning". In ArXiv CoRR abs/1903.03332, 2019.

[18] Hui Li, Mengting Xu, Sourav S Bhowmick, Changsheng Sun, Zhongyuan Jiang, and Jiangtao Cui. "DISCO: Influence Maximization Meets Network Embedding and Deep Learning", In ArXiv CoRR abs/1906.07378, 2019.

[19] Sunil Kumar Maurya, Xin Liu, and Tsuyoshi Murata. "Fast Approximations of Betweenness Centrality with Graph Neural Networks", In CIKM, 2019.

[20] Yunsheng Bai, Derek Xu, Alex Wang, Ken Gu, Xueqing Wu, Agustin Marinovic, Christopher Ro, Yizhou Sun, and Wei Wang. "Fast Detection of Maximum Common Subgraph via Deep Q-Learning", In ArXiv CoRR abs/2002.03129, 2020.

[21] Yunsheng Bai, Hao Ding, Song Bian, Ting Chen, Yizhou Sun, and Wei Wang. "SimGNN: A Neural Network Approach to Fast Graph Similarity Computation", In WSDM 2019.

[22] Chaitanya K. Joshi, Thomas Laurent, and Xavier Bresson. "An Efficient Graph Convolutional Network Technique for the Travelling Salesman Problem", In ArXiv CoRR abs/1906.01227, 2019.

- **Survey of the Paper:** Do a detailed survey of the paper on the following aspects: problems being investigated, real-world applications, related work, how challenging the problem is, algorithms/ ML techniques developed.

- **Implementation of the Paper:** Implement at least one algorithm developed in the paper. You can use any programming language, and you may also use the authors' source code (if available). Try to replicate at least one experimental result (e.g., one plot, or one table in the Experimental Results) given in the paper. You are responsible to find your own datasets for experiments, and use your laptop for the experiments. Therefore, select a paper for which you think that you can obtain similar datasets and replicate some of their experimental results. It is okay if you do not get exactly same experimental results as shown in the paper.

- **Deliverables:**

  1. Final Project Report and Source Code on April 29, 2021: Submit a soft copy of your report (one report per group) via email to arijit.khan@ntu.edu.sg by 5PM latest on April 29, 2021, together with your source codes. The softcopy must be sent as one single Zip file by email. The source code shall be accompanied with a Readme file.

The report must be within 8 pages (without source codes) - Single column, Arial font size 11. Late submission will not be accepted.

The report must contain a survey of the paper (in your own words, do not copy sentences from the paper), and your own experimental results. If there are any other detailed comments, justifications etc., also include them in your report. Some key things to include in the report are as follows.

- Problem studied in the paper
- Most significant contributions made in the paper
- Connections you can make with what you have learnt in CE/CZ4071, e.g., some techniques could be applied to solve the paper's problem in a better way, or the paper's algorithm can be used to solve some problems in CE/CZ4071
- Discussion of your experiments.

2. Peer assessment report from each member of the team: Each individual member of a team needs to assess contributions of the group members. Details of peer assessment form will be provided closer to the submission date.