UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

Graph Analysis on Social Networks

by

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For the Ph.D. degree in Computer Science and Engineering

Graph analysis needs to deal with not only the valuation of the vertices but also the connections between vertices. According to empirical experiments, the distributions of vertices, degrees and other derived measurements, such as closeness, betweenness, and eigenvectors have different distributions. If both topology types and graph properties need to be under consideration for data modeling purpose, we need to define strategies to model all the characteristics of the graphs.
In this dissertation, we theoretically discuss graph space management, graph sampling, and applications in graph analysis, such as entity detection and classification. For graph space, we propose and prove 8 theorems in upper/lower bounds of both space and duration complexity. For graph sampling strategy, we propose and prove 4 theorems, and also propose new methods to do graph sampling: one is based on graph self-similarity and the other is based on graph curvature. For entity detection on graphs, we use rich features to improve Conditional Random Fields (CRF) model and prove the new methodology performs better than character level Bi-directional Long Short-Term Memory (Bi-LSTM). For classification on graphs, we propose Featured Transformer Model (FTM) on top of Bi-directional Encoder Representation Transformer (BERT) and prove that FTM performs better than Conditional Random Fields (CRF) model, Bi-directional Encoder Representation Transformer (BERT), Naïve Bayes Support Vector Machine (NBSVM), Logistic Regression (LOGREG), FASTTEXT, Standard Gated Recurrent Units (STANDARD GRU), and Bi-directional Gated Recurrent Units (BiGRU).

Examining Committee

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THE PUBLIC IS INVITED

Publications

1) **Lu, Shen** and Segall, Richard S., "Combination of Bayesian and Latent Semantic Analysis with Domain Specific Knowledge", Journal of Systemics, Cybernetics and Informatics (JSCI), v. 14, No. 3, 2016, pp.43-50. (Best Paper Award)
2) Segall, Richard S. and **Lu, Shen**, "Data Linkage Discovery Applications", Encyclopedia of Information Science and Technology (IST), 4th edition, IGI Global, Hershey, PA, 2018, Chapter 155, pp.1783- 1793. Also appears in Advanced Methodologies and Technologies in Network Architecture, Mobile Computing, and Data Analytics, (Mehdi Khosrow-Pour, Editor) Vol. 1, IGI Global, Hershey, PA, 2019. Chapter 26, pp. 354-366.
3) Hall, Chelsea; Berleant, Daniel; Segall, Richard S.; and **Lu, Shen**; "Steps toward Quantifying Advancement in Space Exploration", Proceedings of 20th World Multi-Conference on Systemics, Cybernetics and Informatics, Volume II, WMSCI 2017, Orlando, FL, July 8-11, 2017, pp. 106-112.
4) **Lu, Shen** and Segall, Richard S., "Data Streaming Processing Window Join with Graphical Processing Units (GPUs), Encyclopedia of Organizational Knowledge, Administration, and Technologies (Mehdi Khosrow-Pour, Editor), Chapter 43. IGI Global, Hershey, PA, 2021, pp. 602-623.
5) **Lu, S.,** Piegl, L., Segall, R. S. Graph Sampling Through Graph Decomposition and Reconstruction Based on Kronecker Graphs. Journal of Systemics, Cybernetics and Informatics, Vol. 20, No. 2, 2022, pp.23-32. Available at https://doi.org/10.54808/JSCI.20.02.23
6) **Lu, Shen**; Piegl, Les and Segall, Richard S. "Graph Sampling Through Graph Decomposition and Reconstruction Based on Kronecker Graphs", Proceedings of 13th International Multi-Conference on Complexity, Informatics and Cybernetics (IMCIC 2022), March 8-11, 2022, Vol. 1, pp.10-17.

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