Suzumura Laboratory – Large-Scale Graph Learning for Artificial Intelligence

Lab Web Page: https://sites.google.com/view/toyolab/
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Research Themes: Large-Scale Graph Learning, Deep Learning, Artificial Intelligence, High-Performance Computing

Suzumura Laboratory has been established in 2021 by Prof. Toyotaro Suzumura, mainly focusing on large-scale graph learning that lays the foundations of various artificial intelligence techniques, and also its applications to real-world problems by collaborating with industry partners.

A graph or network is a fundamentally important data structure that represents relationships between any objects in both physical world and digital world. In graph theory, an object is called a vertex or node and a relationship is called an edge or link. A variety of objects and their relationships in digital world, physical world, biological network can be represented as a graph.

Many examples exist such as online social networks, user behaviors on e-commerce sites, supply chain networks, financial transaction networks, road networks, neural network in brains, protein interaction networks, chemical molecular structures, knowledge graph, and so forth.

Owning to the unprecedented growth of digital data, graphs can be huge ranging from 1 million edges to 1 billion edges where each node / edge have geospatial and temporal semantics. Recently many researchers propose various methods to learn those graph structures automatically with neural networks – called graph neural networks. For example, graph neural networks can be used for financial fraud detection by learning characteristics of fraudulent activities (The above first figure), and supply chain analysis for stock market prediction and vulnerability analysis. It is also used for recommendation systems on online shopping sites or social networks.

Our research themes are centered around graph neural networks or GNN, and expanded to various artificial intelligence researches, and also its practical applications. Themes are not limited to, but example themes include (1) efficient and effective GNN model for large-scale graphs, (2) a GNN model that automatically find the right granularity of graph modelling optimized for given problems, (3) method for handling multiple relationships in an unified manner, (4) integration with deep reinforcement learning, (5) graph generation with generative adversarial network, (6) a fair, unbiased and explainable GNN model, (7) transfer learning of GNN models to other domains.

Since the director of the lab, Prof. Suzumura has 17-year industrial experience in IBM Research by exploring 3 different sites in the world including Tokyo, Dublin and New York, we proactively establish collaborations with international and industry players to solve practical AI problems.