Qeios

Peer Review

Review of: "Methods for Analyzing Large Bipartite Graphs with Applications to Link Prediction"

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This is a well-written and rigorous study that combines theoretical analysis and empirical evaluation to understand the performance of message-passing neural networks (MPNNs) on large bipartite graphs. The paper provides valuable insights into how multiscale structures and preferential attachment properties affect link prediction tasks. The work is commendable, but I have several suggestions to help strengthen it further.

Suggestions

✅ Broaden dataset evaluation

Please consider adding more bipartite datasets from different domains (e.g., citation networks, movie recommendation systems) to strengthen the generalizability of the findings.

✅ Include additional baselines

It would be helpful to compare the performance of MPNNs with classical link prediction methods such as matrix factorization or probabilistic models. This would contextualize the results and highlight the advantages or limitations of MPNNs more clearly.

✅ Analyze PA effects in greater detail

The paper identifies that preferential attachment (PA) degrades MPNN performance. I encourage the authors to explore this further—for example, by analyzing how PA structures affect convergence speed, gradient stability, or overfitting during training.

✅ Improve figure annotations

Figures depicting degree distributions (e.g., Figures 7-12) could be clearer with added annotations.

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Consider marking deviation points from power-law fits or including confidence intervals for the fitted lines.

✅ **Clarify future work directions**

The conclusion mentions potential future work, but it would be more useful if specific models or techniques were suggested that might help address the identified challenges, such as GNN variants designed to handle scale-free or multiscale structures.

Declarations

Potential competing interests: No potential competing interests to declare.