Attributed Random Walks for Graph Recurrent Networks

Xiao Huang, Qingquan Song, Yuening Li, Xia Hu

Computer Science & Engineering, Texas A&M University, College Station, TX, USA
Emails: {xhuang, qqsong, liyuening, xiahu}@tamu.edu
Random Walks in Network Analysis

- Label Propagation

- Network Embedding

\[
\begin{pmatrix}
0.54 & 0.27 \\
0.22 & 0.91 \\
0.55 & 0.28 \\
0.98 & 0.11 \\
0.32 & 0.87 \\
0.26 & 0.11
\end{pmatrix}
\]
Real-world Systems are Attributed Networks

Nodes have different attributes
Node attributes contain plentiful information that complements the network.

Bring opportunities to the random-walk-based analysis.
Challenges: Complication & Heterogeneity

- How to develop random walks for attributed networks towards an effective joint information extraction?
- Attributes make node interactions more complicated.
- Attributes are heterogeneous with topological structures.
Random-walk-based Deep Attributed Network Embedding

Random Walks on Attributed Networks

Deep Network Embedding

Apply random walks on attributed networks to boost deep node representation learning.
Graph Recurrent Networks with Attributed Random Walks

Attributed Network $G$

Node Attributes As Weighted Edges

AttriWalk: Attributed Random Walks

Component I. AttriWalk

Component II. Graph Recurrent Networks (GRN)
Joint Walking Mechanism: AttriWalk

- Consider node attributes as a bipartite network.
Joint Walking Mechanism: AttriWalk

- Consider node attributes as a bipartite network.
- Use it to propel the walking more diverse and mitigate tendency of converging to nodes with high centralities.
Graph Recurrent Networks

- Advance graph convolution nets to graph recurrent nets.
- Empower node representations to interact in the same way as nodes interact in the original attributed network.
• Convert the complex attributed node interactions into a series of informative node sequences based on AttriWalk.
• Encode them into unified vector representations via graph recurrent networks.