iNet: Visual Analysis of Irregular Transition in Multivariate Dynamic Networks

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Problems & Ideas

- Problems of anomaly detection inside a dynamic network
  - Little research pays attention to the anomalous change of substructure
  - The traditional detecting process is not totally reliable.

- Ideas: visual analytics based on active learning
  - A system supporting both substructure identification as well as analysis results interpretation.
  - A novel rare category detection algorithm called DIRAD

Main Contributions

- **Visualization System**

- **Algorithm**

Algorithm 1 DIRAD Algorithm

Require: $\boldsymbol{A}^{(t-1)}, \boldsymbol{M}^{(t-1)}, \boldsymbol{M}^{(t)}, \boldsymbol{X}^{(t)}, p_1^{(1)}, \ldots, p_c^{(m)}, \alpha, \varepsilon$.

Ensure: The set I of the selected examples and the set L of their labels.

1: Update the global similarity matrix $\boldsymbol{A}^{(t)}$ from $\boldsymbol{A}^{(t-1)}$ based on the changes happened at time stamp t using Eq. 2 and Eq. 7.

2: Compute the topology-oriented scores $\boldsymbol{s}_t^{(t)}$ for all the vertices based on BIRD [10] algorithm and the updated global similarity matrix $\boldsymbol{A}^{(t)}$.

3: Compute the feature-oriented scores $\boldsymbol{s}_a^{(t)}$ for all the vertices at current time stamp using the existing techniques for rare category detection, such as NNDB [51] and GRADE [52].

4: **for all** c=2 : m **do**

5: **while** class c is not discovered **do**

6: For each vertex v_i that has been labeled by the oracle, $\|v_i, v_j\|_2 \leqslant \varepsilon$, then $s^{(t)}(v_j) = -\infty$.

7: Update the $s_t^{(t)}(v_i)$, $s_a^{(t)}(v_i)$ using the existing techniques such as GRADE [52].

8: Compute the overall score for each vertex $s^{(t)}(v_i)$ based on Eq. 8.

9: Query the label of the vertex with the maximum of $s^{(t)}(v_i)$.

10: If the label of v_i is from class c, break; otherwise, mark the class of v_i as labeled.

11: **end while**

12: **end for**