TreeRNN: Topology-Preserving Deep Graph Embedding and Learning

Yecheng Lyu, Ming Li, Xinming Huang, Ulkuhan Guler, Patrick Schaumont, and Ziming Zhang
Motivation

Graph → Image → Classification

non-small cell lung cancer?

ovarian cancer?
Our Solution

(a) Graph

(b) Graph tree

(c) Graph tree image

(d) Graph category
Step 1: Tree Construction from Graph

(a) Graph

(b) Breadth first search (BFS)

(c) Graph tree

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Step 2: Projection a tree to image space

(a) Graph tree

(b) Graph tree image
Step 3: TreeRNN Graph Classification

(a) Input feature map

Row 1
1 1 1 1 1 1
Row 2
x 2 2 3 4 5 5
Row 3
x x 7 x x x 6

(b) TreeRNN step on bottom two rows

(c) TreeRNN step on next two rows

(d) TreeRNN layer output
## Results

**TABLE II**

**Graph classification results (%) in MUTAG, PTC-MR and NCI1. Numbers in red are the best in the column, and numbers in blue are the second best.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Method</th>
<th>MUTAG</th>
<th>PTC-MR</th>
<th>NCI1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Graph Convolution</strong></td>
<td>GraphConv [7]</td>
<td>86.1</td>
<td>-</td>
<td>76.2</td>
</tr>
<tr>
<td></td>
<td>GINConv [6]</td>
<td><strong>95.00 ± 4.61</strong></td>
<td>72.94 ± 6.28</td>
<td>80.32 ± 1.73</td>
</tr>
<tr>
<td></td>
<td>ECConv [3]</td>
<td>89.44</td>
<td>-</td>
<td>83.80</td>
</tr>
<tr>
<td></td>
<td>DGCNN [4]</td>
<td>85.83 ± 1.66</td>
<td>58.59 ± 2.47</td>
<td>74.44 ± 0.47</td>
</tr>
<tr>
<td></td>
<td>GIC [9]</td>
<td>94.44 ± 4.30</td>
<td><strong>77.64 ± 6.98</strong></td>
<td>84.08 ± 1.07</td>
</tr>
<tr>
<td><strong>Graph Embedding</strong></td>
<td>PSCN [12]</td>
<td>88.95 ± 4.37</td>
<td>62.29 ± 5.68</td>
<td>76.34 ± 1.68</td>
</tr>
<tr>
<td></td>
<td>WKPI [28]</td>
<td>85.8 ± 2.5</td>
<td>62.7 ± 2.7</td>
<td><strong>87.5 ± 0.5</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Ours</strong></td>
<td><strong>94.74 ± 5.55</strong></td>
<td><strong>74.69 ± 5.78</strong></td>
<td><strong>84.96 ± 4.81</strong></td>
</tr>
</tbody>
</table>
Thanks!

WPI VIS-LAB

Github Repository: https://github.com/YechengLyu/TreeRNN

Ziming Zhang  Xinming Huang