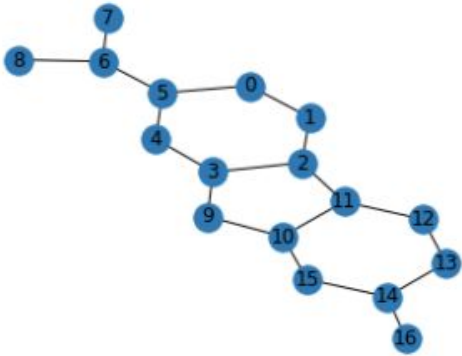# TreeRNN: Topology-Preserving Deep Graph Embedding and Learning

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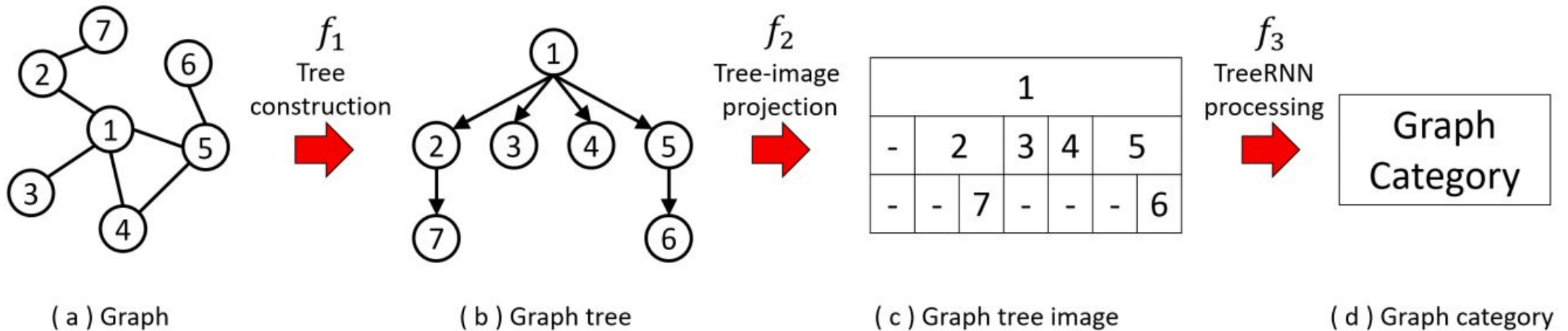
Motivation

Graph   Image   Classification
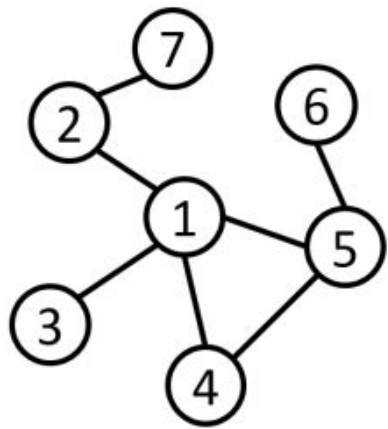
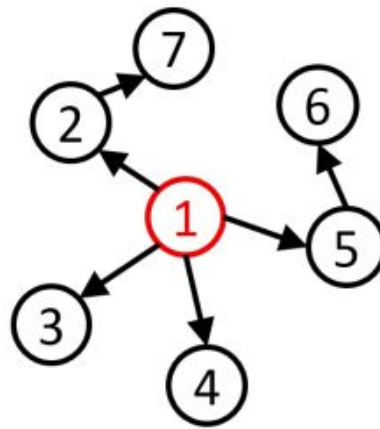non-small cell
lung cancer ?

ovarian cancer ?

Our Solution

(a) Graph   (b) Graph tree   (c) Graph tree image   (d) Graph category

f_1 Tree construction
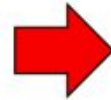
f_2 Tree-image projection

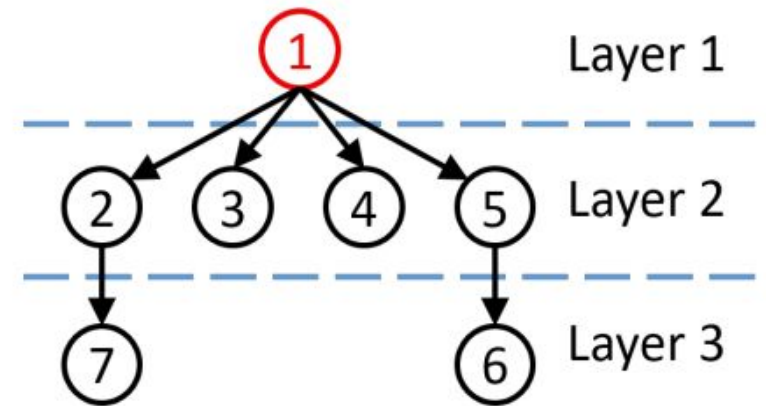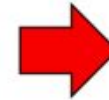f_3 TreeRNN processing

Step 1: Tree Construction from Graph

(a) Graph

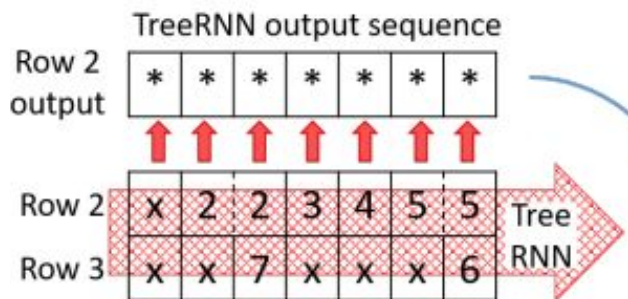(b) Breadth first search (BFS)

(c) Graph tree

Step 2: Projection a tree to image space
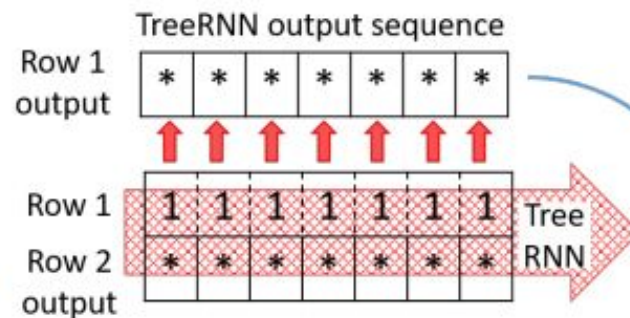

(a) Graph tree   (b) Graph tree image
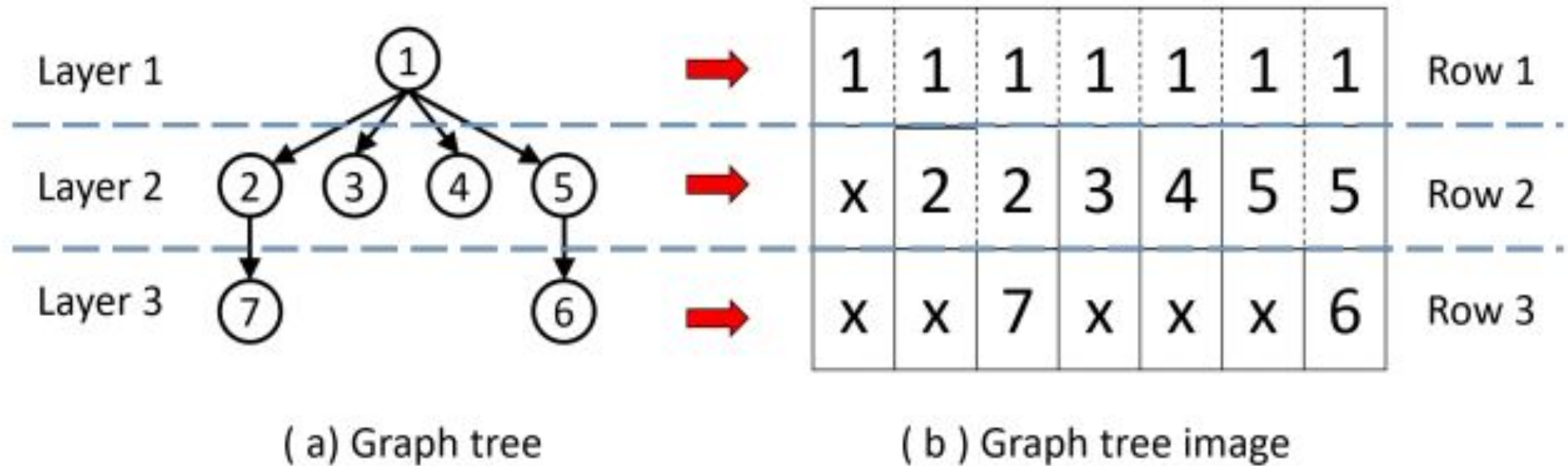
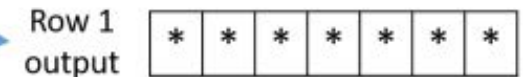# Step 3: TreeRNN Graph Classification

(a) Input feature map

(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.

Category	Method	MUTAG	PTC-MR	NCI1
Graph Convolution	GraphConv [7]	86.1	-	76.2
	GINConv [6]	95.00 ± 4.61	72.94 ± 6.28	80.32 ± 1.73
	ECConv [3]	89.44	-	83.80
	DGCNN [4]	85.83 ± 1.66	58.59 ± 2.47	74.44 ± 0.47
	GIC [9]	94.44 ± 4.30	77.64 ± 6.98	84.08 ±1.07
Graph Embedding	PSCN [12]	88.95 ± 4.37	62.29 ± 5.68	76.34 ± 1.68
	DDGK [11]	91.58 ± 6.74	63.14 ± 6.57	68.10 ± 2.30
	WKPI [28]	85.8 ± 2.5	62.7 ± 2.7	87.5 ± 0.5
	Ours	94.74 ± 5.55	74.69 ± 5.78	84.96 ± 4.81

Worcester Polytechnic Institute

Thanks!

WPI
VIS-LAB

Ziming Zhang

Xinming Huang

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