(11)

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATIONS- 2026

B.Tech-VI Semester (CSE-AIML)

COURSE CODE (CREDITS): 25B1WCI641 (3) MAX MARKS: 25

COURSE NAME: GRAPH NEURAL NETWORKS

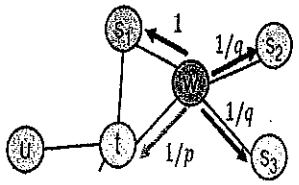
COURSE INSTRUCTOR: Prof. Vivek Kumar Sehgal MAX. TIME: 1 Hour 30 Min

Note: (a) All questions are compulsory.

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c) Use of calculator is allowed

Q.No	Question	CO	Marks
Q1	(a) Define node embeddings. Why are they important for downstream tasks such as node classification and link prediction? (b) Explain the encoder-decoder framework used in node embedding methods. Describe the role of each component.	CO-2, 3	4
Q2	(a) Explain how the SoftMax function is used with $\arg\max_z \sum_{u \in V} \log P(N_R(u) \mid \mathbf{z}_u) \Rightarrow$ Maximum likelihood Objective to model the probability of node co-occurrence in embedding methods. (b) Discuss the negative sampling technique. Why is it used, and how does it reduce computational complexity of optimizing random walk embeddings from following loss function $\mathcal{L} = \sum_{u \in V} \sum_{v \in N_D(u)} -\log\left(\frac{\exp(\mathbf{z}_u^T \mathbf{z}_v)}{\sum_{n \in V} \exp(\mathbf{z}_u^T \mathbf{z}_n)}\right)$ i. Give the approximation of $-\log\left(\frac{\exp(\mathbf{z}_u^T \mathbf{z}_v)}{\sum_{n \in V} \exp(\mathbf{z}_u^T \mathbf{z}_n)}\right)$ using negative sampling with sigmoid function. ii. What should be the value of k (# negative samples) for more robust estimates iii. What should be the range of k corresponds to higher bias on negative events In practice	CO- 3	6
Q3	(a)Explain the role of parameters p (return parameter) and q (in-out parameter) in node2vec. How do they control BFS and DFS behavior? Approximate the values of p and q in following graph for: i. Local Walks ii. Global Walks	CO- 3	5



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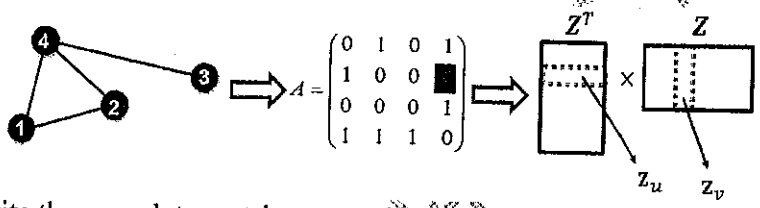
Target x	Prob.	Dist. (t,x)
t	1/p	0
S_1	1	1
S_2	1/q	2
S_3	1/q	2

(b) Write the value of Decoder, Similarity measure, and Loss function for following methods:

Method	Decoder	Similarity measure	Loss function
Lap. Eigenmaps			
Graph Fact.			
GraRep			
HOPE			
DeepWalk			
node2vec			

Q4

(a) Explain the relationship between node embeddings and matrix factorization. How is the adjacency matrix approximated?



Write the complete matrix expression which is equivalent to DeepWalk, containing following components:

i. Volume of graph
ii. context window size
iii. Power of normalized adjacency matrix
iv. Diagonal matrix D
v. Number of negative samples

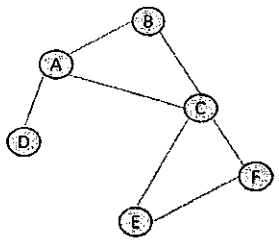
(b) Predict edge (i, j) based on (zi, zj)

i. Concatenate: $f(zi, zj)$
ii. Hadamard: $f(zi, zj)$
iii. Sum/Avg: $f(zi, zj)$
iv. Distance: $f(zi, zj)$

CO-3,4 | **5**

Q5

Draw the computation graph based on its neighborhood for every node



CO- 4 | **5**