

# Role-based Multiplex Network Embedding

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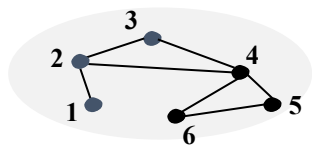
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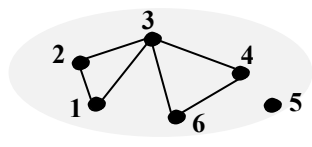
# Introduction

Most real networks have the nature of **multiplicity**, and there are typically different types of connectivity between two entities.

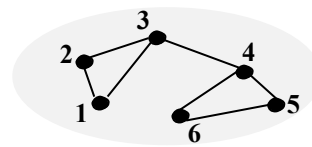
**Multiplex Network** (i.e. multi-layer, multi-view or multi-relation network)



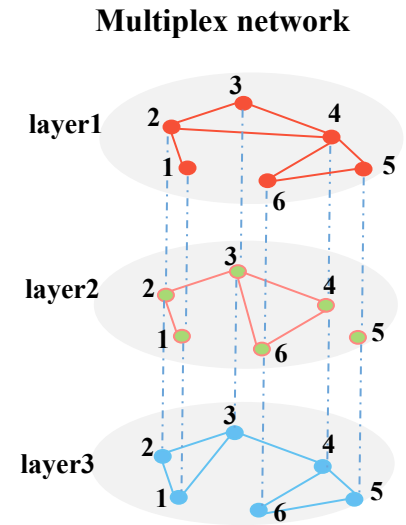
Layer 1: College



Layer 2: Employer



Layer 3: Friend



## Multiplex Network Embedding Method

Shortcoming: previous methods rarely consider the **structural similarity** between nodes that may be far apart.

### Role-based Multiplex Network Embedding

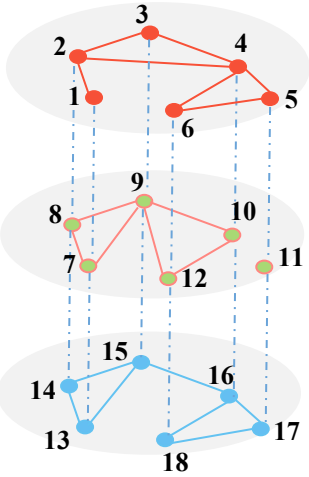
Role-based multiplex network embedding method aims to learn the node embedding which can flexibly preserve the proximity and structural similarity between nodes.

# Proposed methods: RMNE

## Role discovery process

we first perform a role discovery process to assign the structural role to each node.

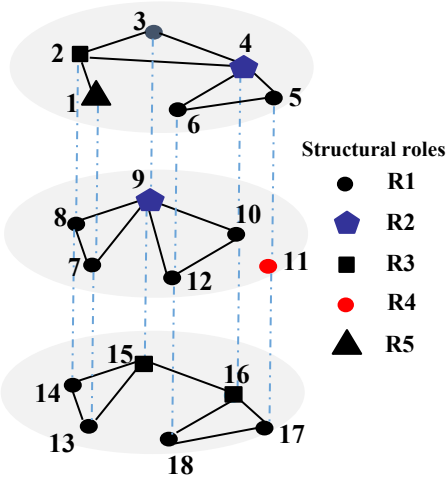
### Feature Construction



- degree-based
  - Weisfeiler-Lehman method
  - motif-count-based
- [4,2]

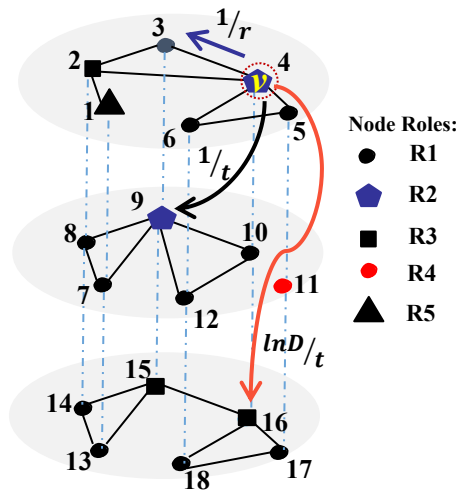
- clustering method
- equivalence rule

### Role assignment



The simplest example of the structural role.

## 1. Role-modified random walk



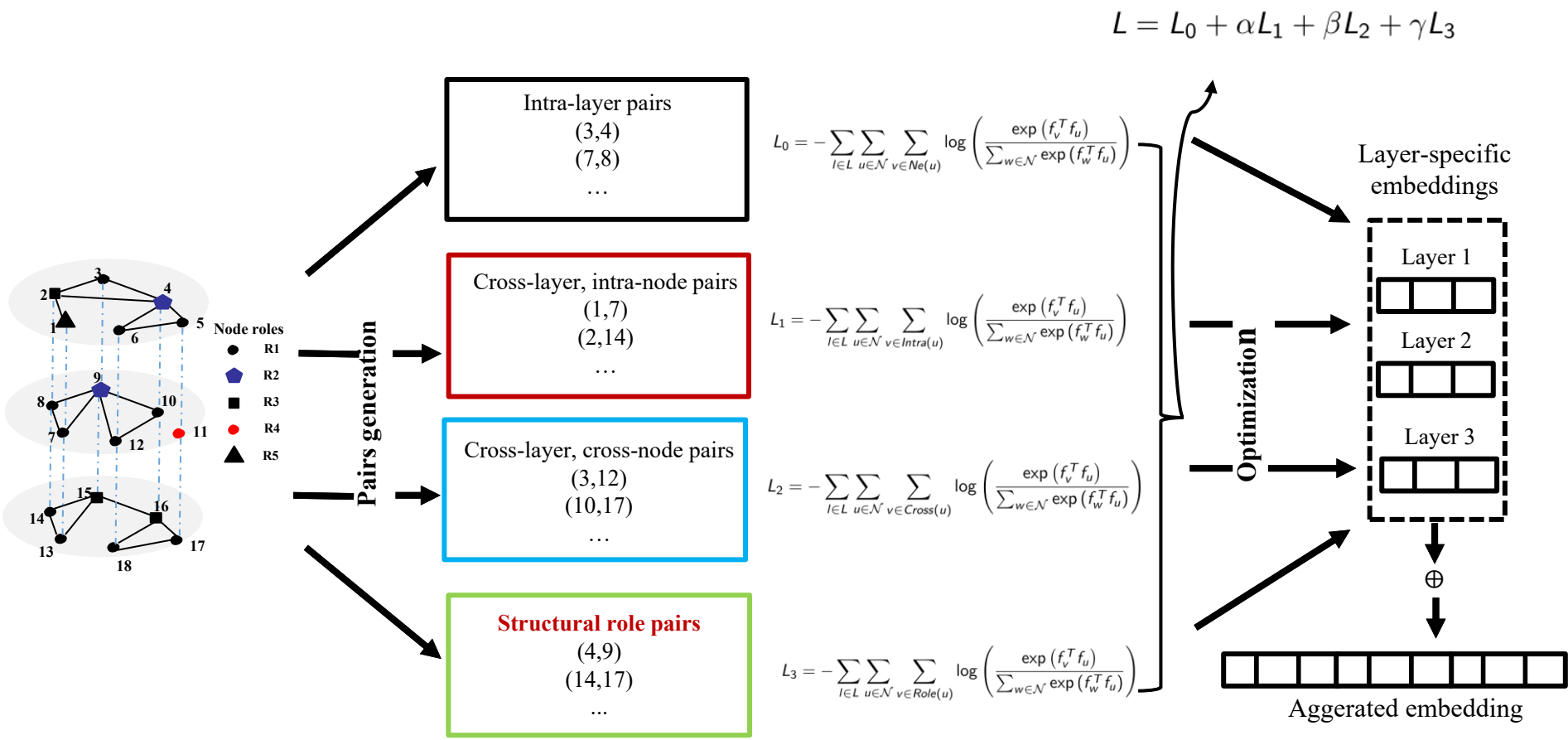
Example: Role-modified search strategies from node  $v$  (R2)

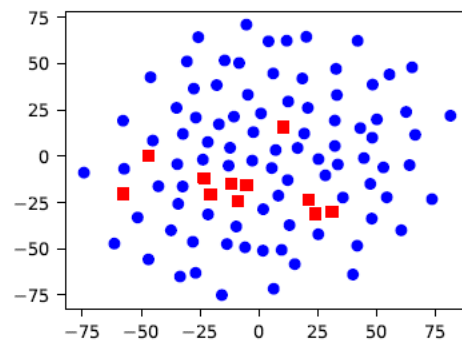
## 2. Learning embedding

Skip-gram model

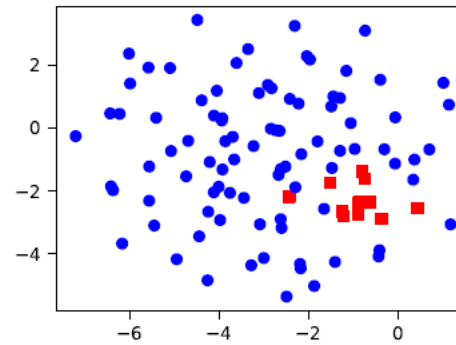
# Proposed methods: RMNE<sup>+</sup>

An overview of the RMNE<sup>+</sup> method, which unify the intra-layer, cross-layer, and structural role pairs into one framework based MANE (Ata et al., 2021).





(a) MANE



(b) RMNE+.

Figure: Visualization of Alzheimer's proteins.

For the performance evaluation for **network reconstruction, node classification, multi-class edge classification, and link prediction tasks**, see the paper for details.

(1) Without role pairs:  $\gamma = 0$

$L = L_0 + \alpha L_1 + \beta L_2 + \gamma L_3$  (2) Only role pairs:  $\alpha = \beta = 0$

(3) RMNE<sup>+</sup>:  $\alpha = \beta = 1, \gamma = 0.5$

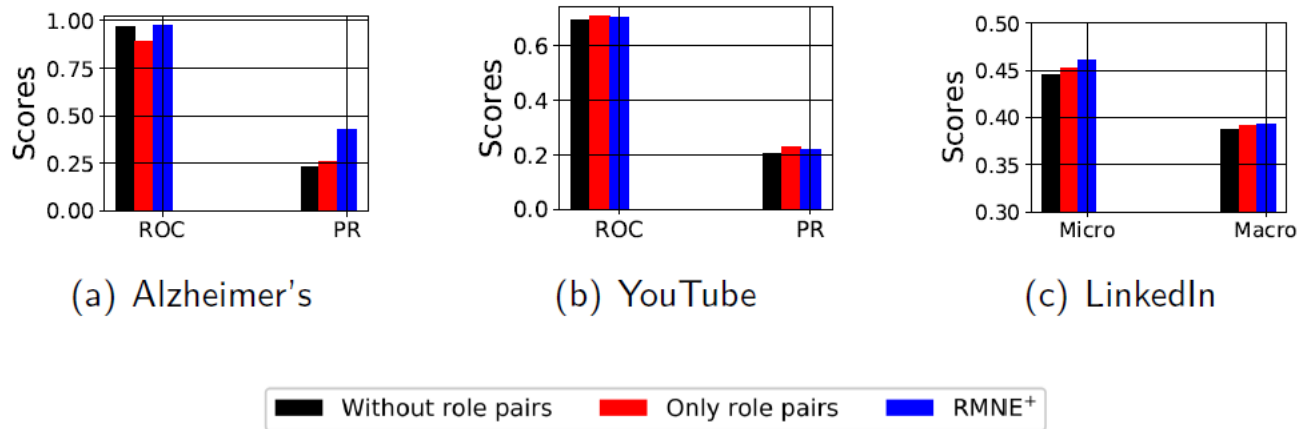


Figure: Impact of structural role on the RMNE<sup>+</sup> performance.



Thank you!