

# Predicting drug-disease associations based on the known association bipartite network

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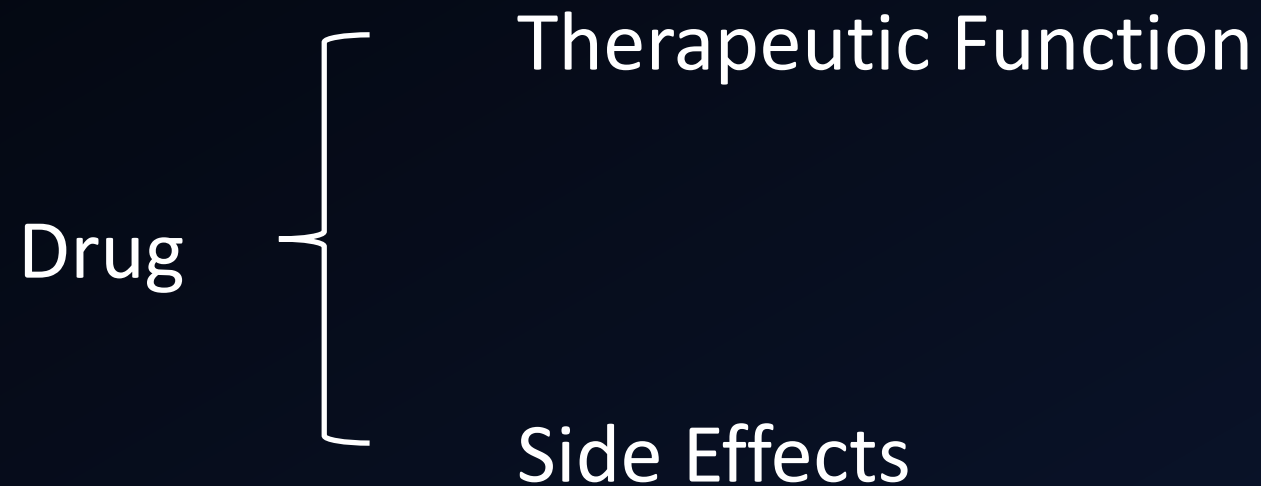
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# Outline

- Introduction
- Materials and Method
- Experiments and Results
- Conclusion

# Introduction

- Background ----- Drug-Disease Associations







ASPIRIN

treat pain, and reduce fever or inflammation  
(Therapeutic Function)

cause dyspepsia, heartburn  
(Side Effects)

# Introduction

- Motivation
  - Drug-Disease associations provide important information for drug discovery and drug repositioning
  - Wet experimental identification is time-consuming and labor-intensive
  - Computational methods can guide experiments to identify drug-disease associations

# Introduction

- Research Status

PREDICT

- Gottlieb et al.  
2012

TL-HGBI

- Wang et al.  
2014

LRSSL

- Liang et al.  
2017

# Introduction

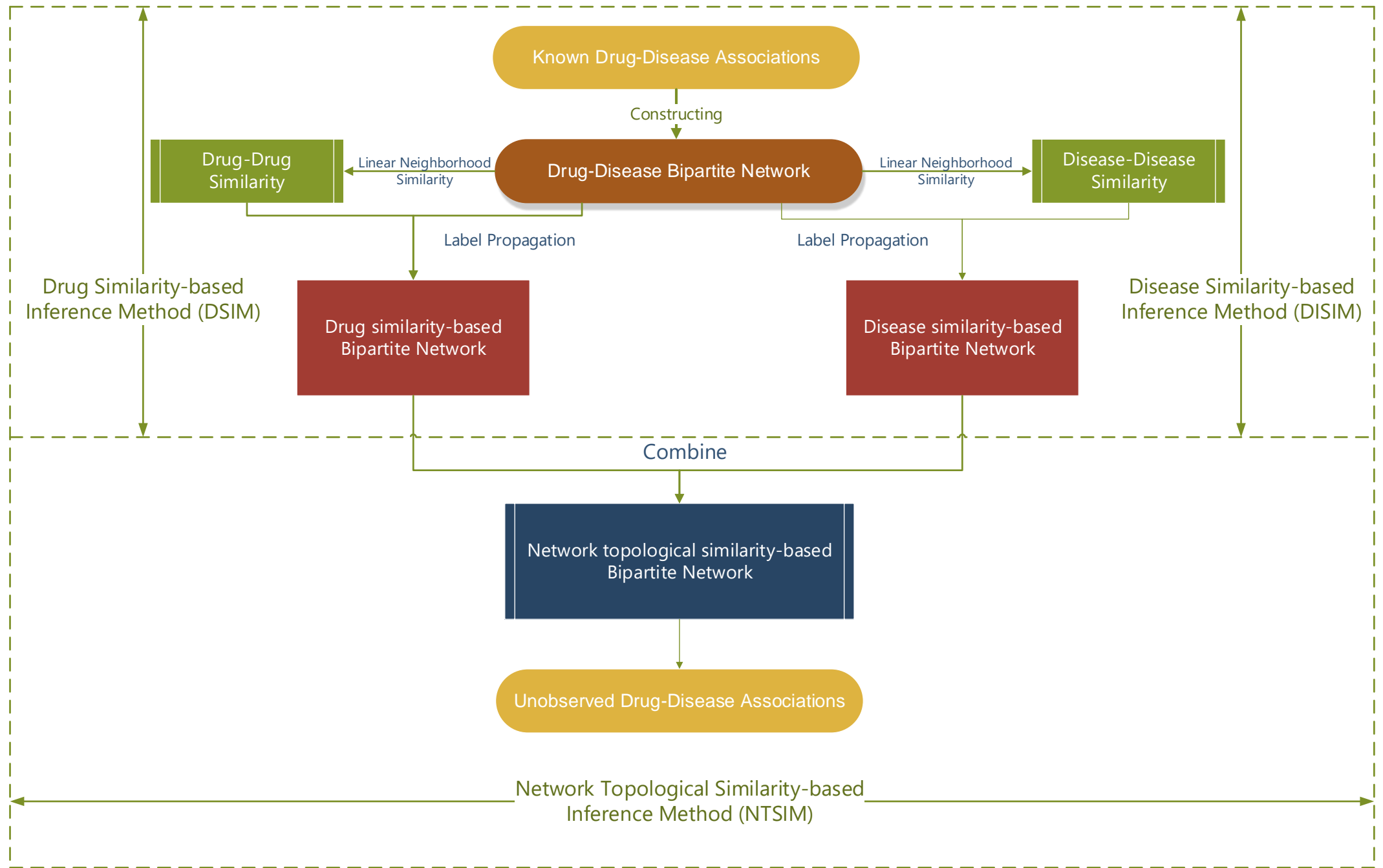
- Our Method
- Network topological similarity-based inference method (NTSIM)



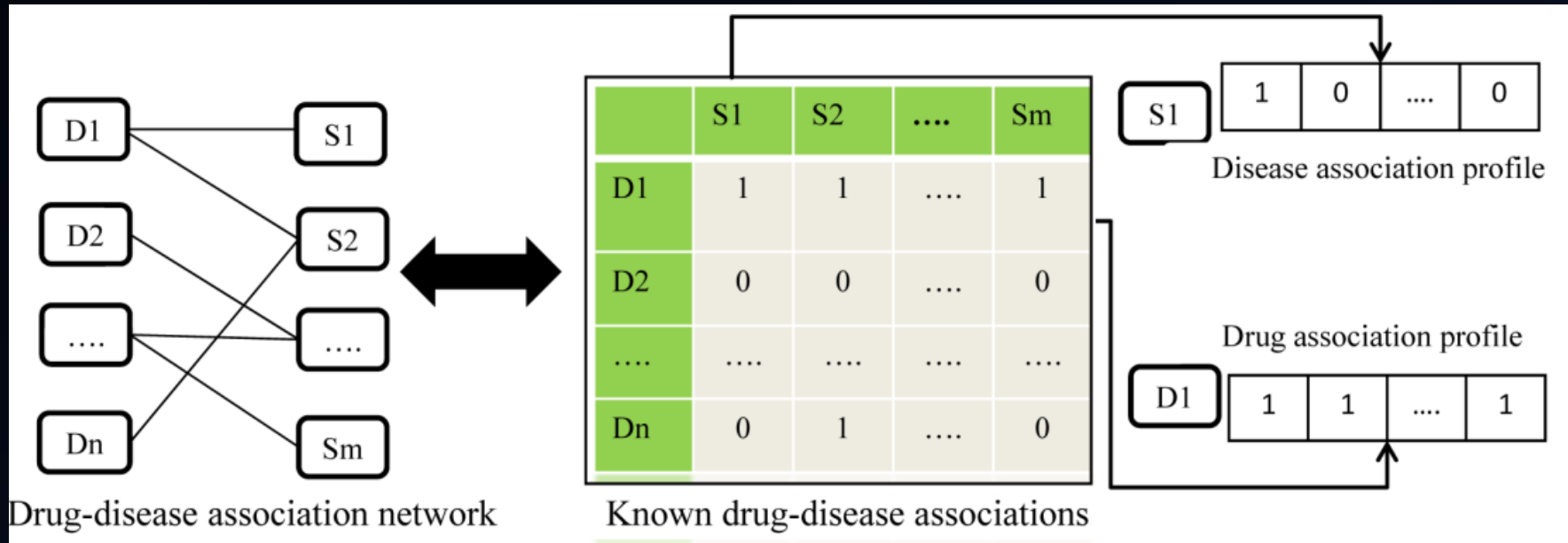
# Materials and Method

- Dataset

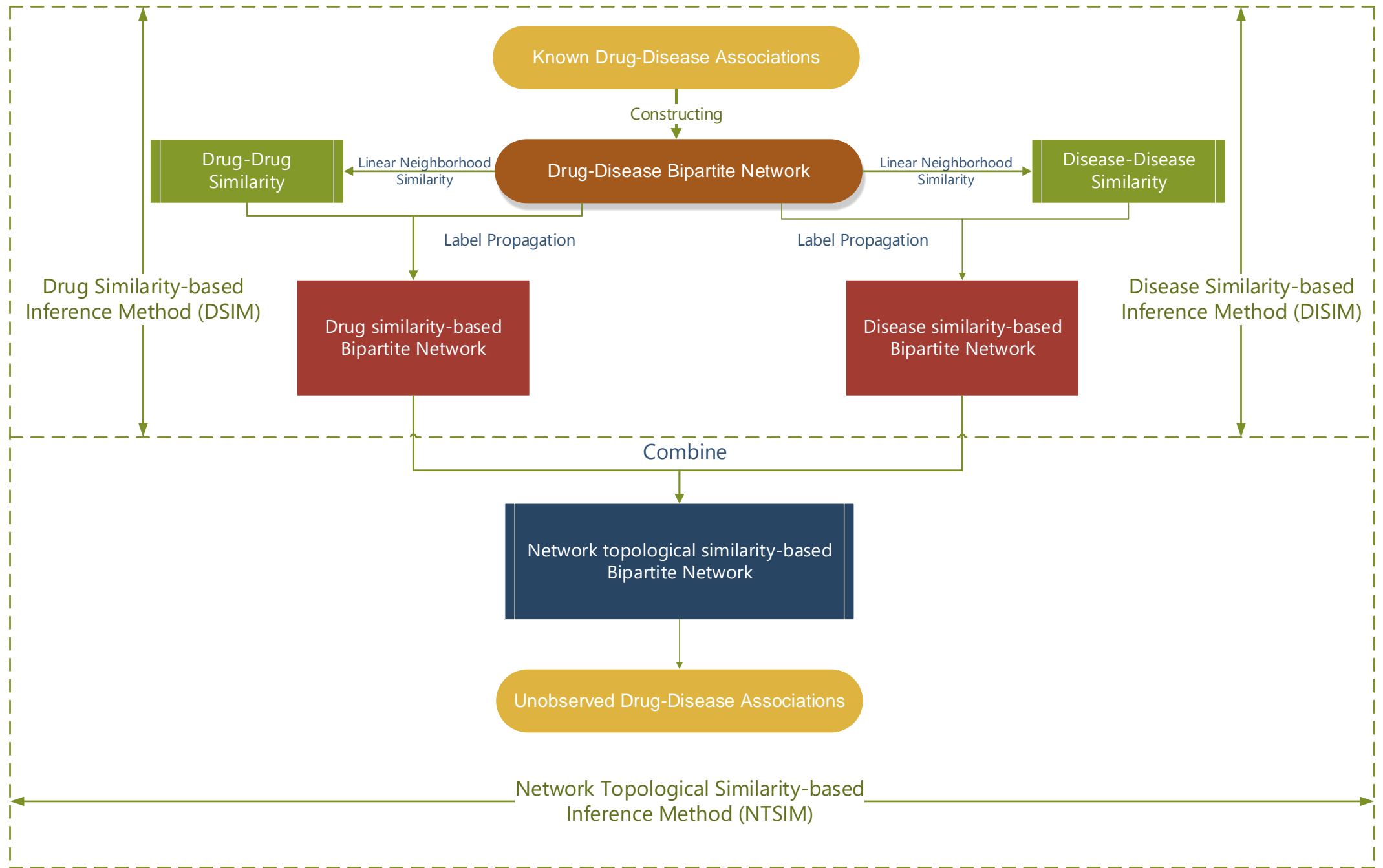
Name	Drugs	Diseases	Known Associations
Our Dataset	269	598	18416
PREDICT Dataset	593	313	1933
TL-HGBI Dataset	1409	5080	1461
LRSSL Dataset	763	681	3051



# Materials and Method



**Fig.1. The drug-disease association-based network, disease association profiles and drug association profiles**

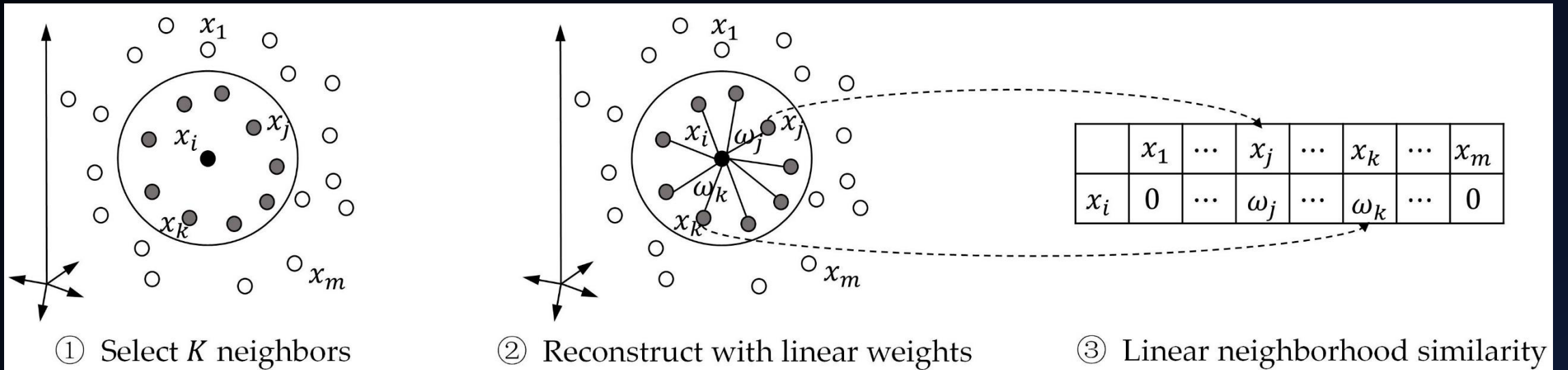


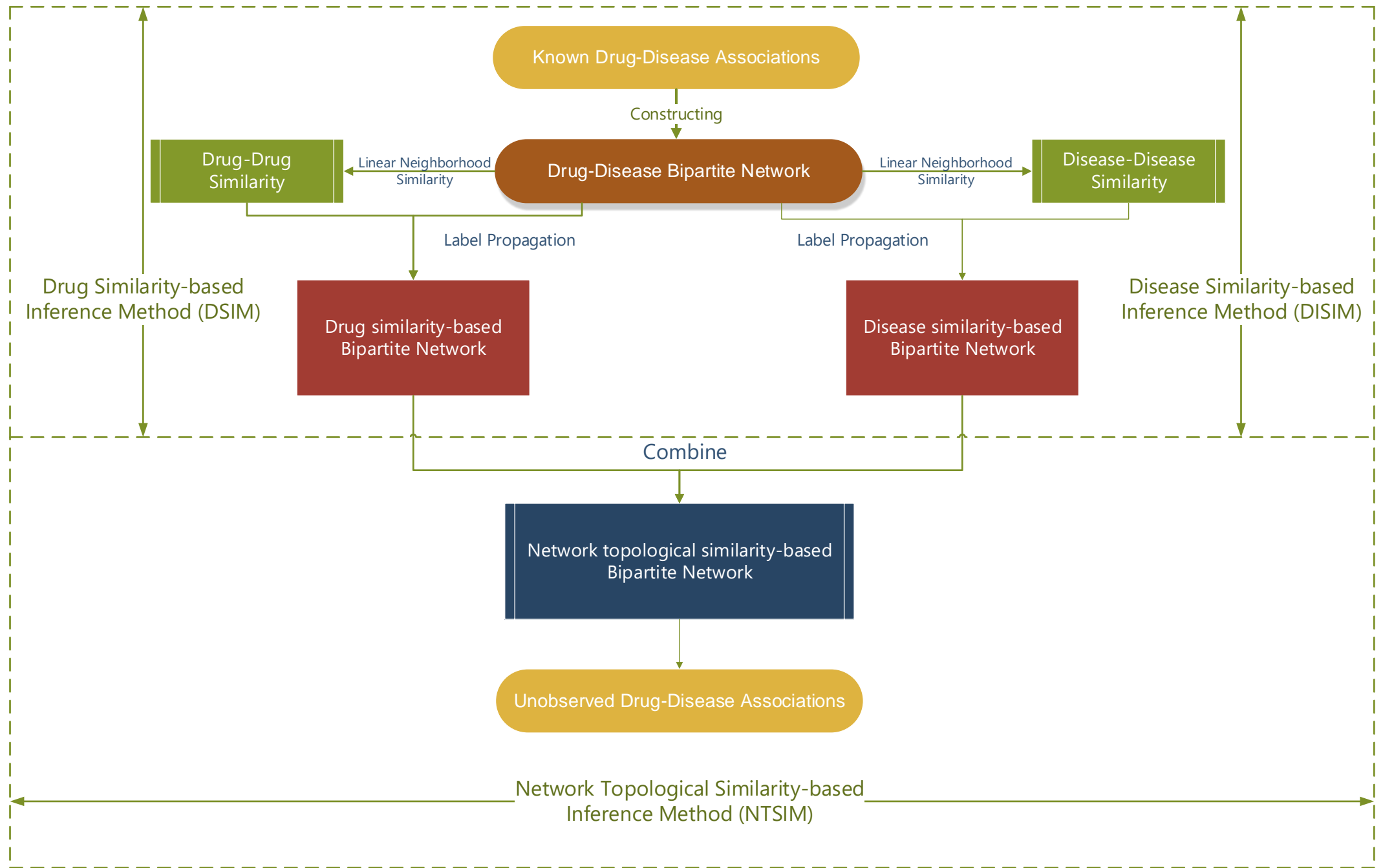
# Materials and Method

- Linear Neighborhood Similarity
  - Hypotheses:
    - I) Data points in the feature space can be considered to be linear (S.T Roweis, 2000)
    - II) Each data point can be reconstructed by a linear combination of its neighbors (Wang, 2008)

# Materials and Method

- Linear Neighborhood Similarity





# Materials and Method

- The drug-disease association inference methods

the network topological similarity-based inference method (NTSIM)

$$P_{\text{NTSIM}} = (P_{\text{DSIM}} + P_{\text{DISIM}}) / 2 \quad (14)$$



# Experiments and Discussion

- Cross Validation and Evaluation Metrics

five-fold cross-validation

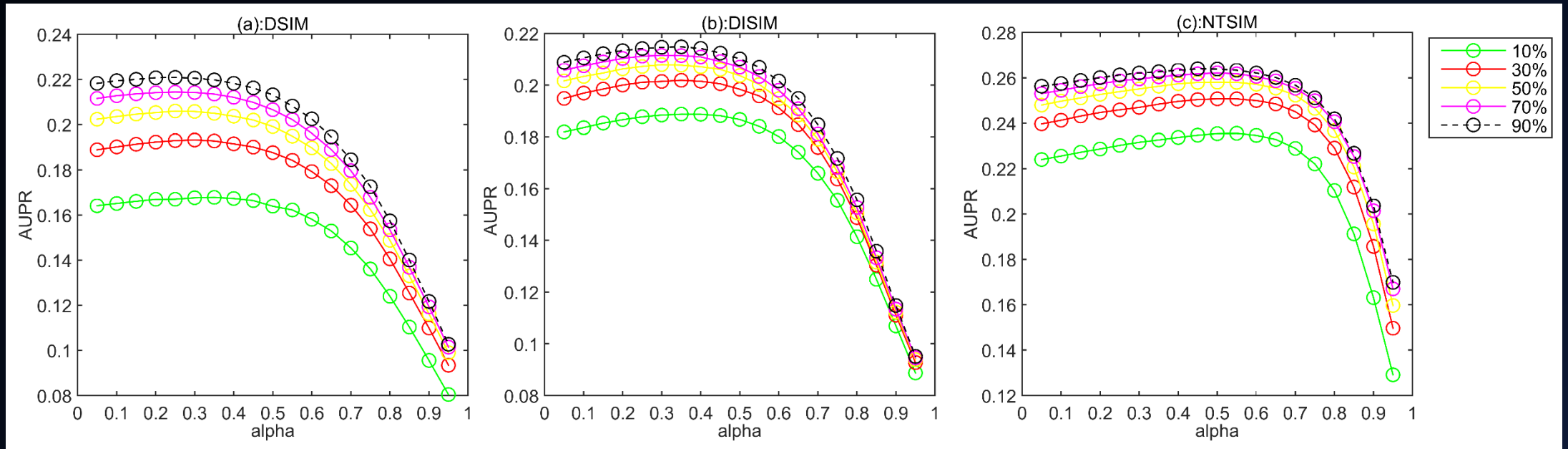
randomly splits known drug-disease associations into five subsets

evaluation metrics

(AUC), (AUPR), (SEN)  
(SPEC), (PRE), (ACC) (F)

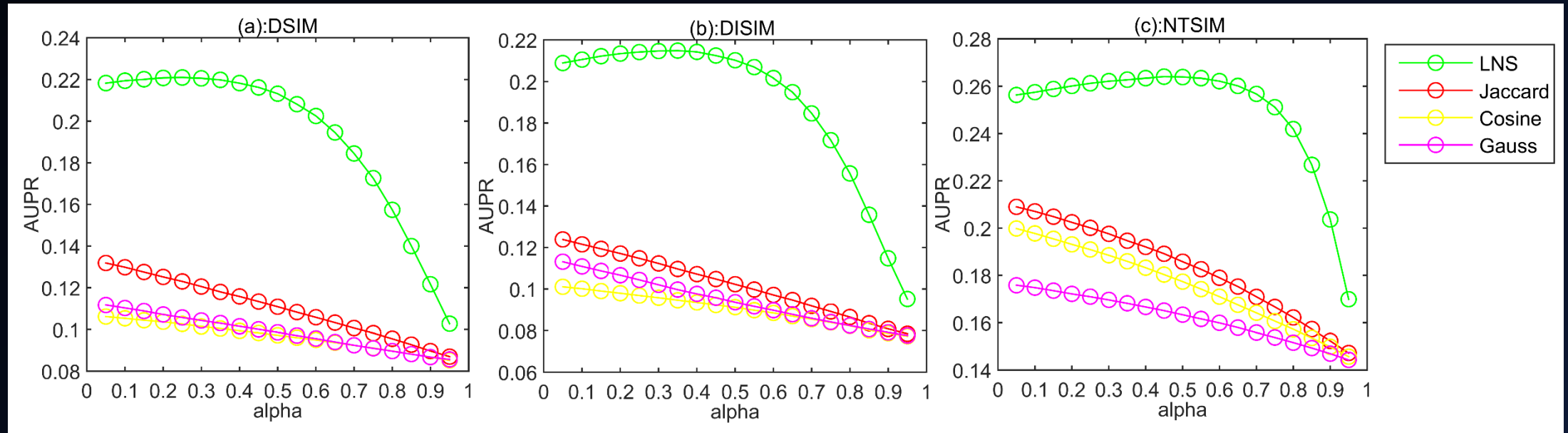
# Experiments and Discussion

- Performances of prediction models



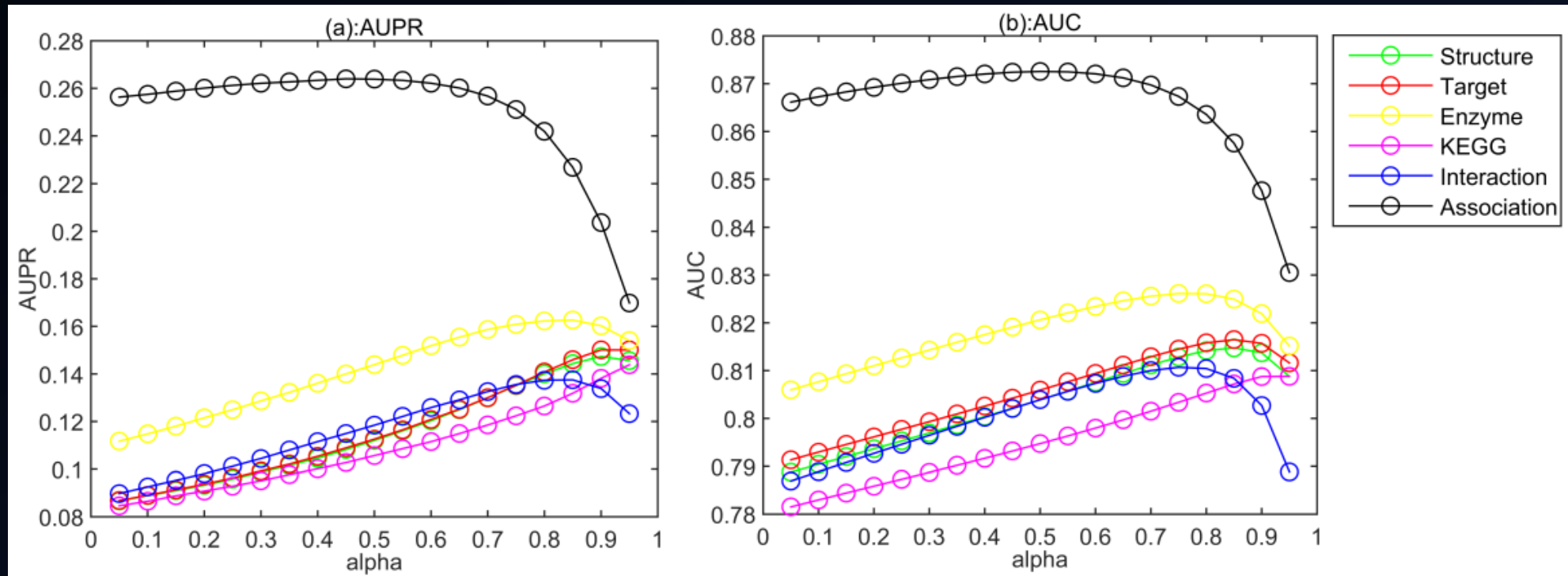
# Experiments and Discussion

- Performances of prediction models



# Experiments and Discussion

- Comparison of Different Features



# Experiments and Discussion

- Compared with benchmark methods

Methods	Datasets	AUPR	AUC
Resource allocation	our dataset	0.1895	0.8408
Our method	our dataset	0.2621	0.8709
Resource allocation	PREDICT dataset	0.3212	0.8462
Our method	PREDICT dataset	0.3376	0.9205
Resource allocation	TL-HGBI dataset	0.0951	0.7747
Our method	TL-HGBI dataset	0.2631	0.9616
Resource allocation	LRSSL dataset	0.2094	0.8059
Our method	LRSSL dataset	0.2693	0.9021

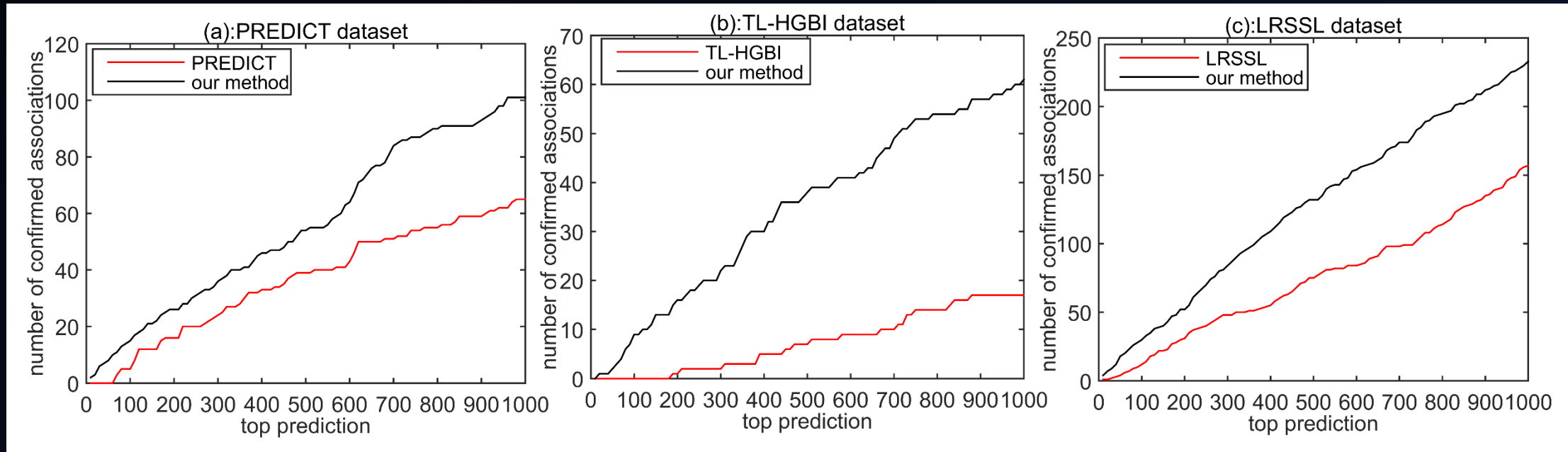
# Experiments and Discussion

- Compared with benchmark methods

Methods	Datasets	AUPR	AUC
PREDICT	PREDICT dataset	0.1507	0.9020
Our method	PREDICT dataset	0.3376	0.9205
TL-HGBI	TL-HGBI dataset	0.0492	0.9584
Our method	TL-HGBI dataset	0.2631	0.9616
LRSSL	LRSSL dataset	0.1789	0.8250
Our method	LRSSL dataset	0.2693	0.9021

# Experiments and Discussion

- Independent Experiments



# Experiments and Discussion

- Case Study

NO.	Drugs	Diseases	Evidence
1	Methadone	Seizures	<a href="https://www.drugs.com/methadone.html">https://www.drugs.com/methadone.html</a>
2	Amiodarone	Hypertension	<a href="http://factmed.com/drugcover.php?drugname=Amiodarone">http://factmed.com/drugcover.php?drugname=Amiodarone</a>
3	Clozapine	Headache	<a href="https://www.drugs.com/clozapine.html">https://www.drugs.com/clozapine.html</a>
4	Morphine	Tremor	<a href="http://www.medindia.net/doctors/drug_information/morphine.htm">http://www.medindia.net/doctors/drug_information/morphine.htm</a>
5	Methamphetamine	Hypotension	<a href="https://www.drugbank.ca/drugs/DB01577">https://www.drugbank.ca/drugs/DB01577</a>
6	Risperidone	Anxiety Disorders	N.A.
7	Amphetamine	Catalepsy	N.A.
8	Caffeine	Drug-Induced Liver Injury	N.A.
9	Chlorpromazine	Nausea	<a href="https://www.drugs.com/mtm/chlorpromazine.html">https://www.drugs.com/mtm/chlorpromazine.html</a>
10	Clozapine	Sleep Initiation and Maintenance Disorders	N.A.



# Conclusion

## Strengths:

- I) A novel similarity measure for graph, robust for graph-based similarity method
- II) for large-scale data, fast speed
- III) little input, but high-accuracy performance

## Limitations:

- I) Cold start problem
- II) Failing to distinguish two kinds of drug-disease associations



Q&A

Thanks!