Benchmarking Meta Exploit with Various Graph-Based Models

This document provides a summary of the models used to benchmark the `meta_exploit` model. The models are categorized into different types of graph-based algorithms.

Category	Model Name	Description
Graph Neural Networks (GNNs)	Graph Convolutional Networks (GCNs)	Extend convolutional networks to graph data, capturing local neighborhood information.
	Graph Attention Networks (GATs)	Use attention mechanisms to weigh the importance of neighboring nodes differently.
	GraphSAGE	Generates node embeddings in an inductive manner, handling new, unseen nodes during training.
Knowledge Graph Embedding (KGE)	TransE	Embeds entities and relationships of knowledge graphs into continuous vector spaces.
	TransR	Similar to TransE but considers different types of relationships.
	DistMult	Factorizes the adjacency matrix of the knowledge graph.
	ComplEx	Extends DistMult by using complex-valued embeddings.
Heterogeneous Graph Embedding	Heterogeneous Graph Attention Networks (HAN)	Handles graphs with different types of nodes and edges, capturing rich information.
	MetaPath2Vec	Generates embeddings for heterogeneous networks by leveraging metapaths.
Collaborative Filtering on Graphs	Graph-based Collaborative Filtering (GCF)	Incorporates graph structures into traditional collaborative filtering methods.
	Graph Regularized Matrix Factorization (GRMF)	Integrates graph regularization into matrix factorization.
Graph-based Sequential Recommendation	STAGE (Self-Attentive Graph Embedding)	Combines graph embedding with self-attention to capture sequential patterns in user behavior.
	SR-GNN (Session-based Recommendation with GNN)	Uses GNNs to model user sessions as graphs.
Random Walk Based Algorithms	DeepWalk	Generates node embeddings by performing random walks on the graph.
	Node2Vec	An extension of DeepWalk, adding flexibility in exploring neighborhoods.
Meta Exploit	Meta Exploit	The model being benchmarked against the above models.

Usage

To benchmark the `meta_exploit` model against the above models, follow the steps in the provided Jupyter notebook.

Results

The results of the benchmarking will be visualized in a bar chart, comparing various metrics such as precision, recall, F1 score, accuracy, specificity, and sensitivity across all models.

Benchmark Scales Defination

Metric	Description
Precision	The ratio of correctly predicted positive observations to the total predicted positives.
Recall	The ratio of correctly predicted positive observations to all observations in the actual class.
F1 Score	The weighted average of Precision and Recall. It considers both false positives and false negatives.
Accuracy	The ratio of correctly predicted observations to the total observations.
Specificity	The ratio of correctly predicted negative observations to all observations in the actual negative class.
Sensitivity	Another term for Recall.
ROC AUC	The area under the receiver operating characteristic curve. It measures the ability of the model to distinguish between classes.
MCC	Matthews correlation coefficient. It takes into account true and false positives and negatives and is generally regarded as a balanced measure.

Benchmark Results

This table summarizes the benchmark results for various models, including `CoreRec`, across different metrics.

model	precision	recall	f1_score	accuracy	specificity	sensitivity	roc_auc	mcc
CoreRec	0.621212	0.727273	0.651515	0.727273	0.621212	0.975207	0.85	0.726933
GCN	0.149351	0.272727	0.174242	0.272727	0.149351	0.933058	0.6	0.258199
GraphSAGE	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909
TransE	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909
TransR	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909
DistMult	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909
ComplEx	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909
HAN	0.621212	0.727273	0.651515	0.727273	0.621212	0.975207	0.85	0.726933
MetaPath2Vec	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909
GCF	0.621212	0.727273	0.651515	0.727273	0.621212	0.975207	0.85	0.726933
GRMF	0.621212	0.727273	0.651515	0.727273	0.621212	0.975207	0.85	0.726933
GAT	0.2	0.272727	0.212121	0.272727	0.2	0.929162	0.6	0.237508
STAGE	0.621212	0.727273	0.651515	0.727273	0.621212	0.975207	0.85	0.726933
SR-GNN	0.621212	0.727273	0.651515	0.727273	0.621212	0.975207	0.85	0.726933
DeepWalk	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909
Node2Vec	0.590909	0.727273	0.636364	0.727273	0.590909	0.975207	0.85	0.719909

models	jaccard
CoreRec	0.621212
GCN	0.149351
GraphSAGE	0.590909
TransE	0.621212
TransR	0.590909
DistMult	0.621212

models	jaccard
ComplEx	0.590909
HAN	0.590909
MetaPath2Vec	0.621212
GCF	0.636364
GRMF	0.590909
GAT	0.222727
STAGE	0.621212
SR-GNN	0.590909
DeepWalk	0.590909
Node2Vec	0.590909

Models Performance in Dataset of 500 nodes

Models	Precision	Recall	F1 Score	Accuracy	Specificity	Sensitivity	ROC AUC	MCC
CoreRec	0.00323017	**0.016**	0.00420422	**0.016**	0.00323017	**0.998032**	**0.507014**	0.0268423
GCN	4e-06	0.002	7.98403e-06	0.002	4e-06	0.996004	0.5	0
GraphSAGE	**0.0140041**	**0.016**	**0.0140081**	**0.016**	**0.0140041**	**0.998032**	**0.507014**	**0.0840868**
TransE	0.00026408	**0.016**	0.000519333	**0.016**	0.00026408	**0.998032**	**0.507014**	0.0150155
TransR	0.000313148	**0.016**	0.000611743	**0.016**	0.000313148	**0.998032**	**0.507014**	0.0151607
DistMult	0.000315137	**0.016**	0.000615142	**0.016**	0.000315137	**0.998032**	**0.507014**	0.015194
ComplEx	0.000292928	**0.016**	0.000573907	**0.016**	0.000292928	**0.998032**	**0.507014**	0.0151355
HAN	0.000262374	**0.016**	0.000516088	**0.016**	0.000262374	**0.998032**	**0.507014**	0.0150088
MetaPath2Vec	0.00029189	**0.016**	0.000571624	**0.016**	0.00029189	**0.998032**	**0.507014**	0.0150935
GCF	0.000266522	**0.016**	0.000523983	**0.016**	0.000266522	**0.998032**	**0.507014**	0.0150004
GRMF	0.000274133	**0.016**	0.000538482	**0.016**	0.000274133	**0.998032**	**0.507014**	0.0150655
GAT	4e-06	0.002	7.98403e-06	0.002	4e-06	0.996004	0.5	0
STAGE	0.000268031	**0.016**	0.000526806	**0.016**	0.000268031	**0.998032**	**0.507014**	0.0150272
SR-GNN	0.000272428	**0.016**	0.000535193	**0.016**	0.000272428	**0.998032**	**0.507014**	0.0150485
DeepWalk	0.00025766	**0.016**	0.000507101	**0.016**	0.00025766	**0.998032**	**0.507014**	0.0149883
Node2Vec	0.000281149	**0.016**	0.000551475	**0.016**	0.000281149	**0.998032**	**0.507014**	0.0150604