COMMUNITY DETECTION

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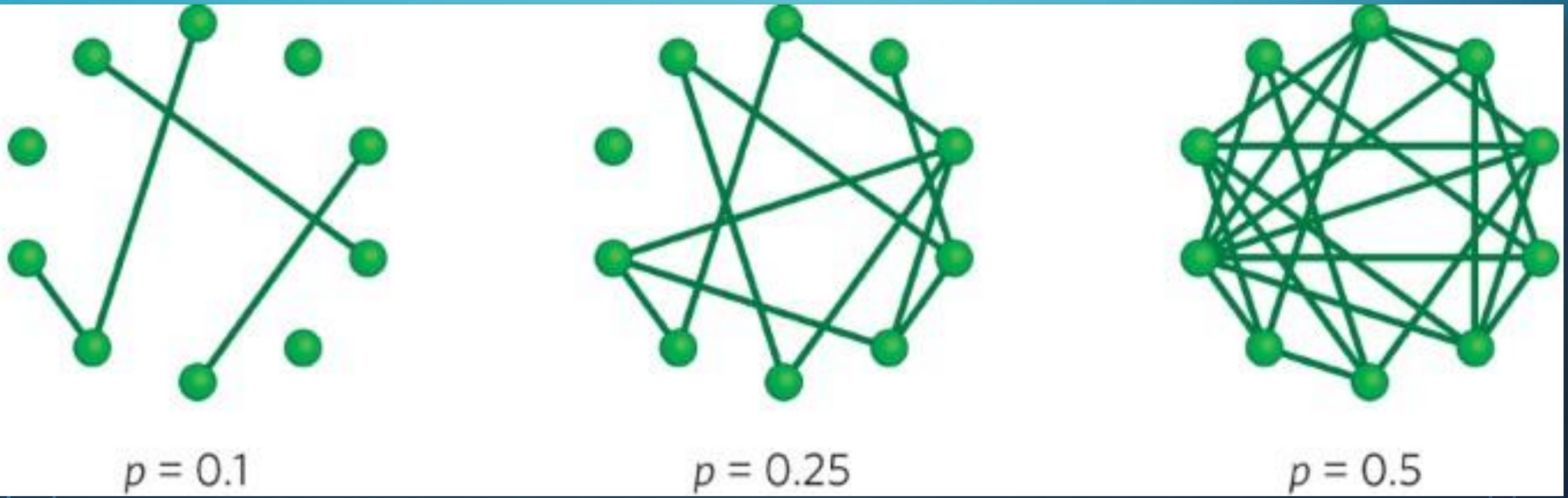
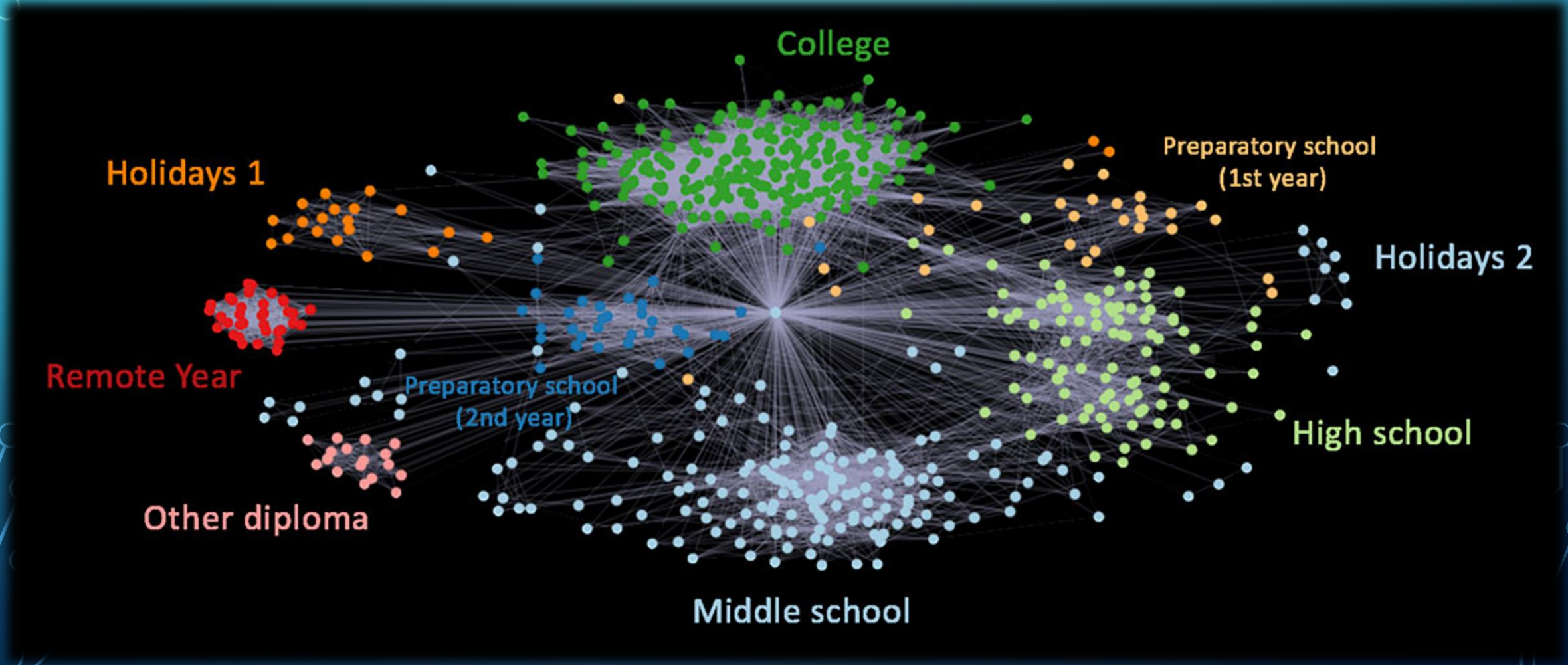
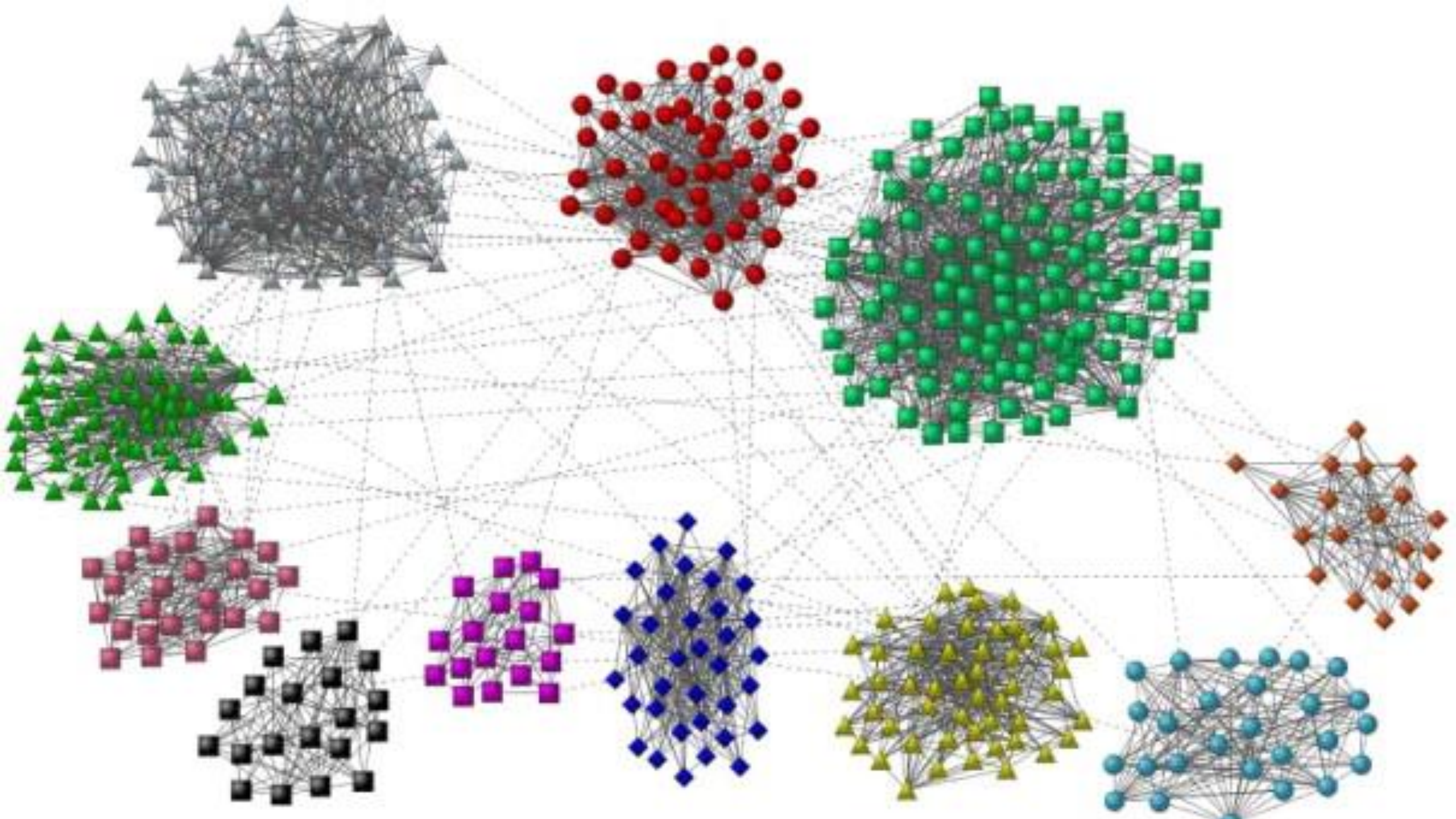
RANDOM GRAPH



COMMUNITY


College
Holidays 1
Preparatory school
(1st year)
Holidays 2
Remote Year
Preparatory school
(2nd year)
High school
Other diploma
Middle school

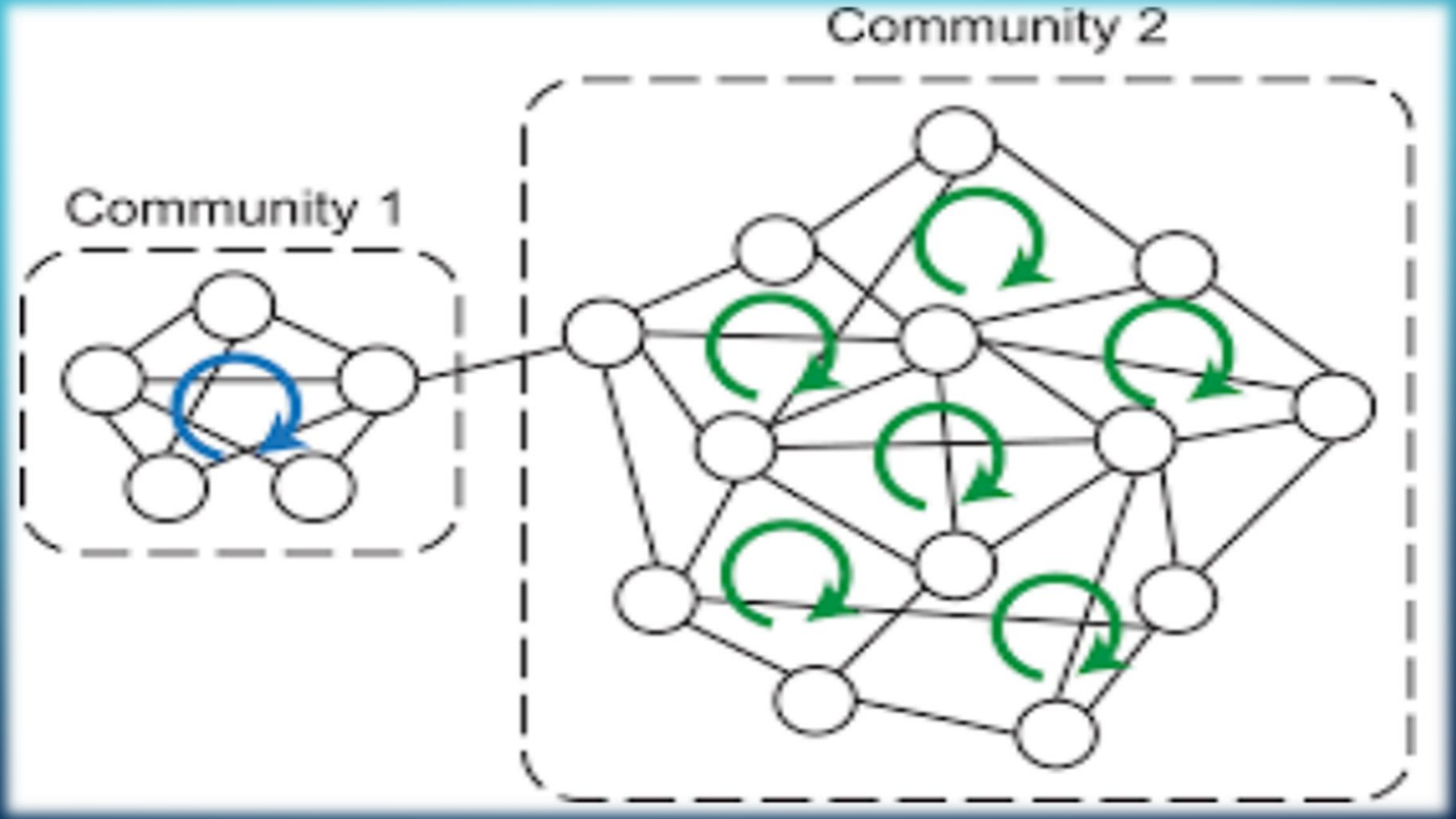



LinkedIn

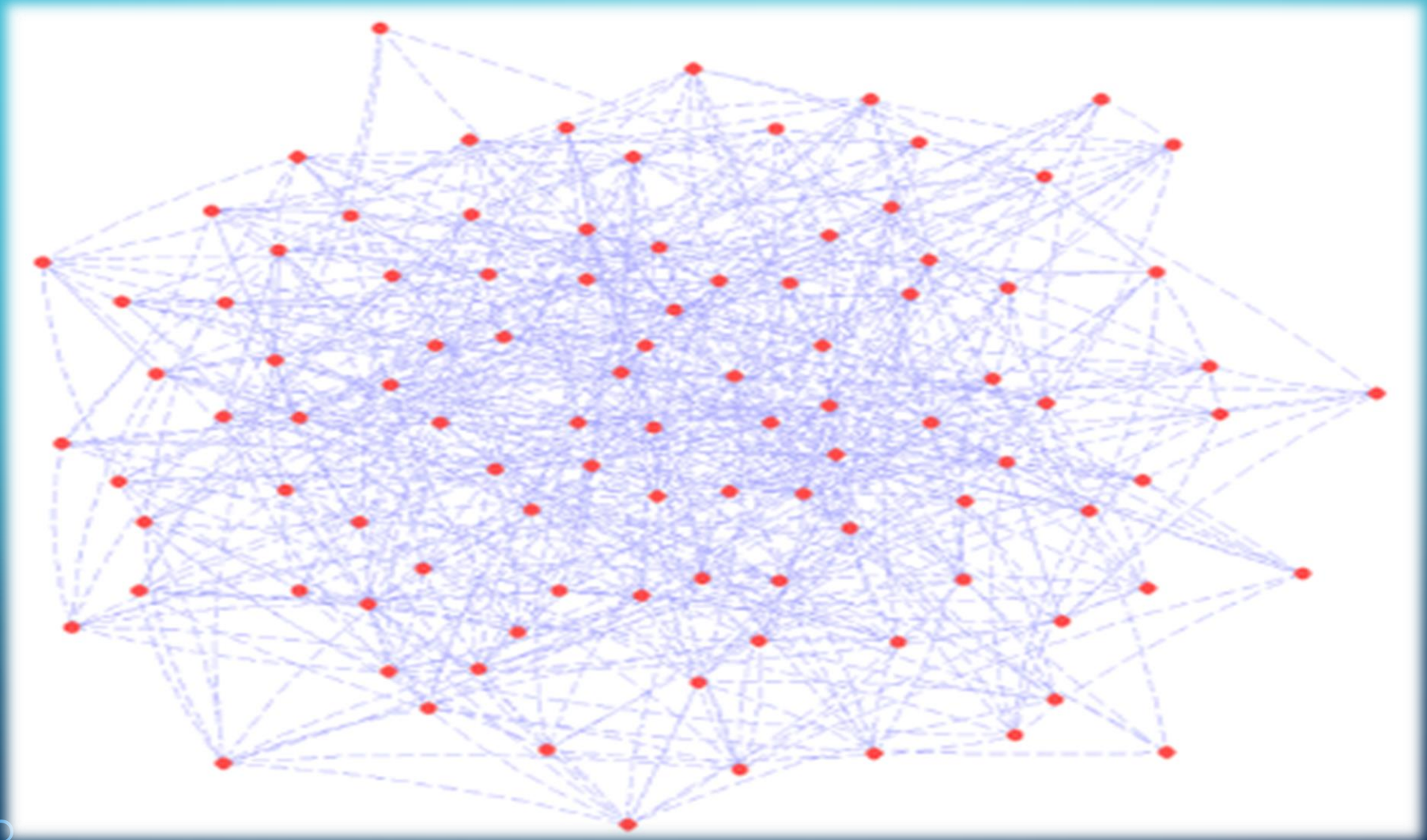
ALGORITHMS

- Random Walk
- Louvain
- Leiden
- Spectral Cluster
- Random Graph
- Growing Network Models

RANDOM WALK

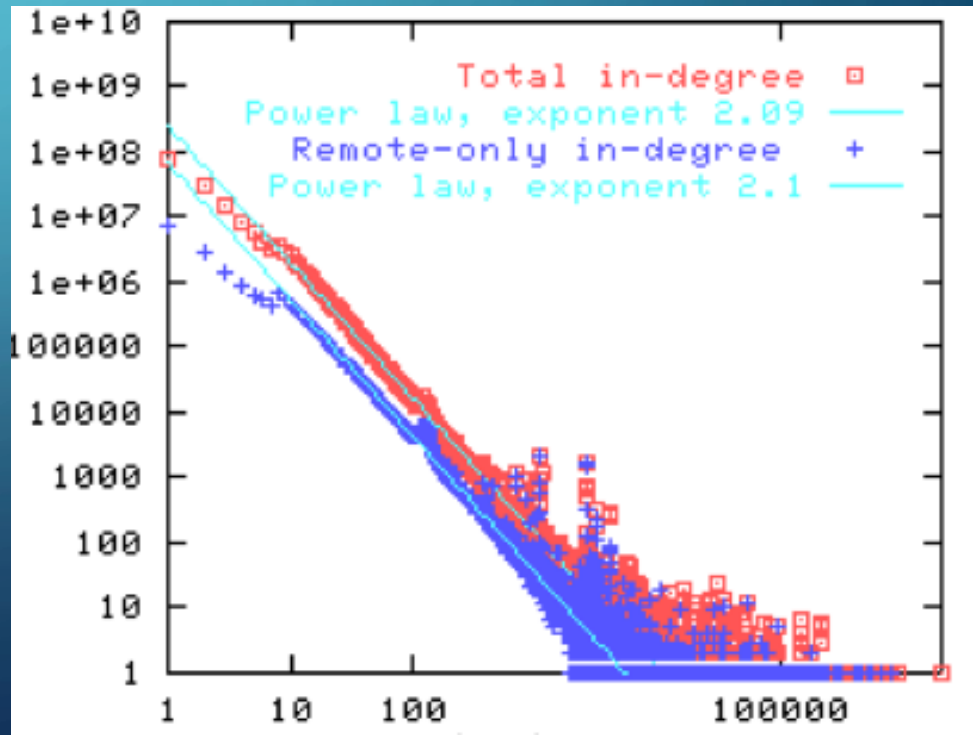


RANDOM GRAPH



GROWING NETWORK MODELS

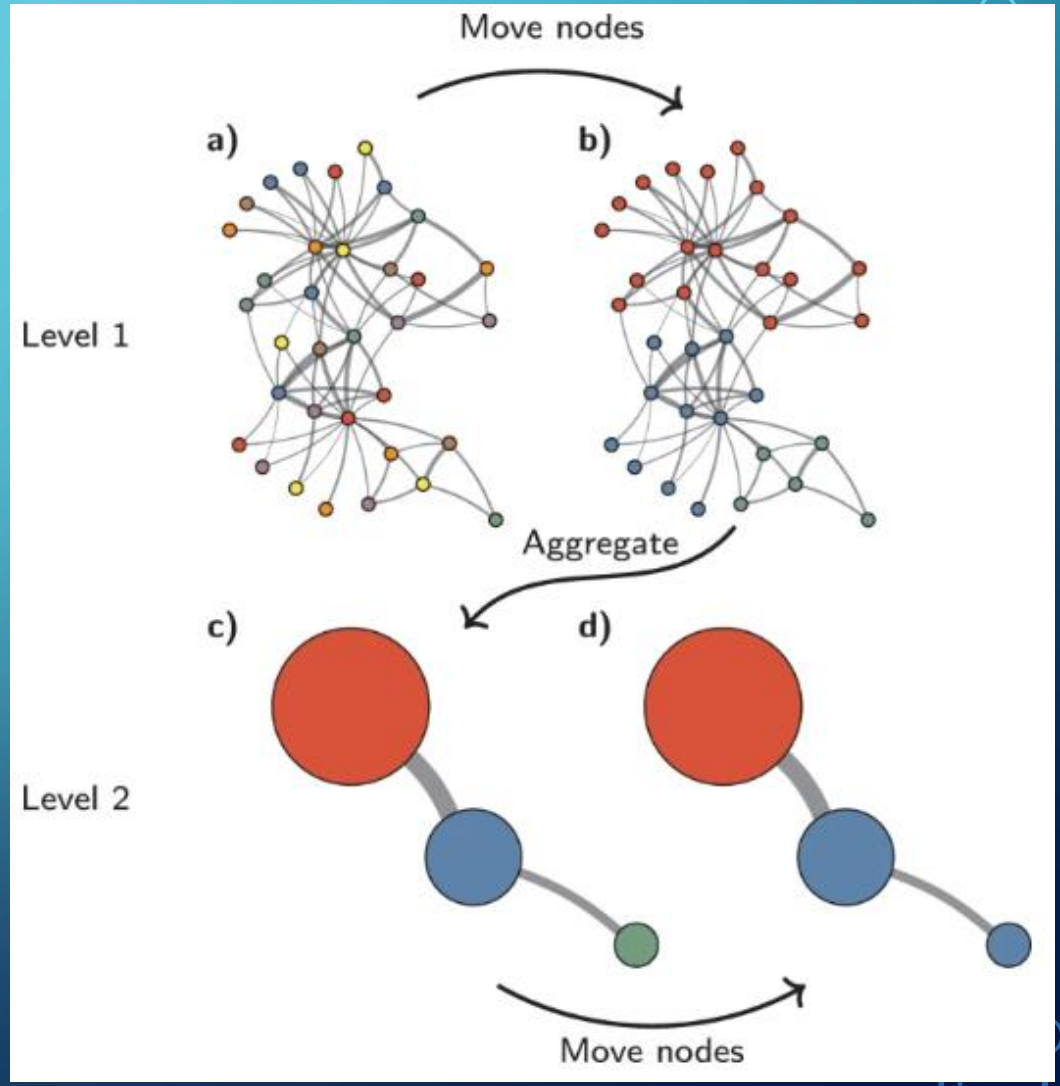
- Power Law Degree Distribution $P(d) = cd^{-\gamma}$
- Richer get richer $m\frac{d_i(t)}{\sum_{j=1}^{t} d_j(t)}$



LOUVAIN AND LEIDEN

$$\mathcal{H} = \frac{1}{2m} \sum_c (e_c - \gamma \frac{K_c^2}{2m})$$

$$\mathcal{H} = \sum_c [e_c - \gamma \binom{n_c}{2}]$$



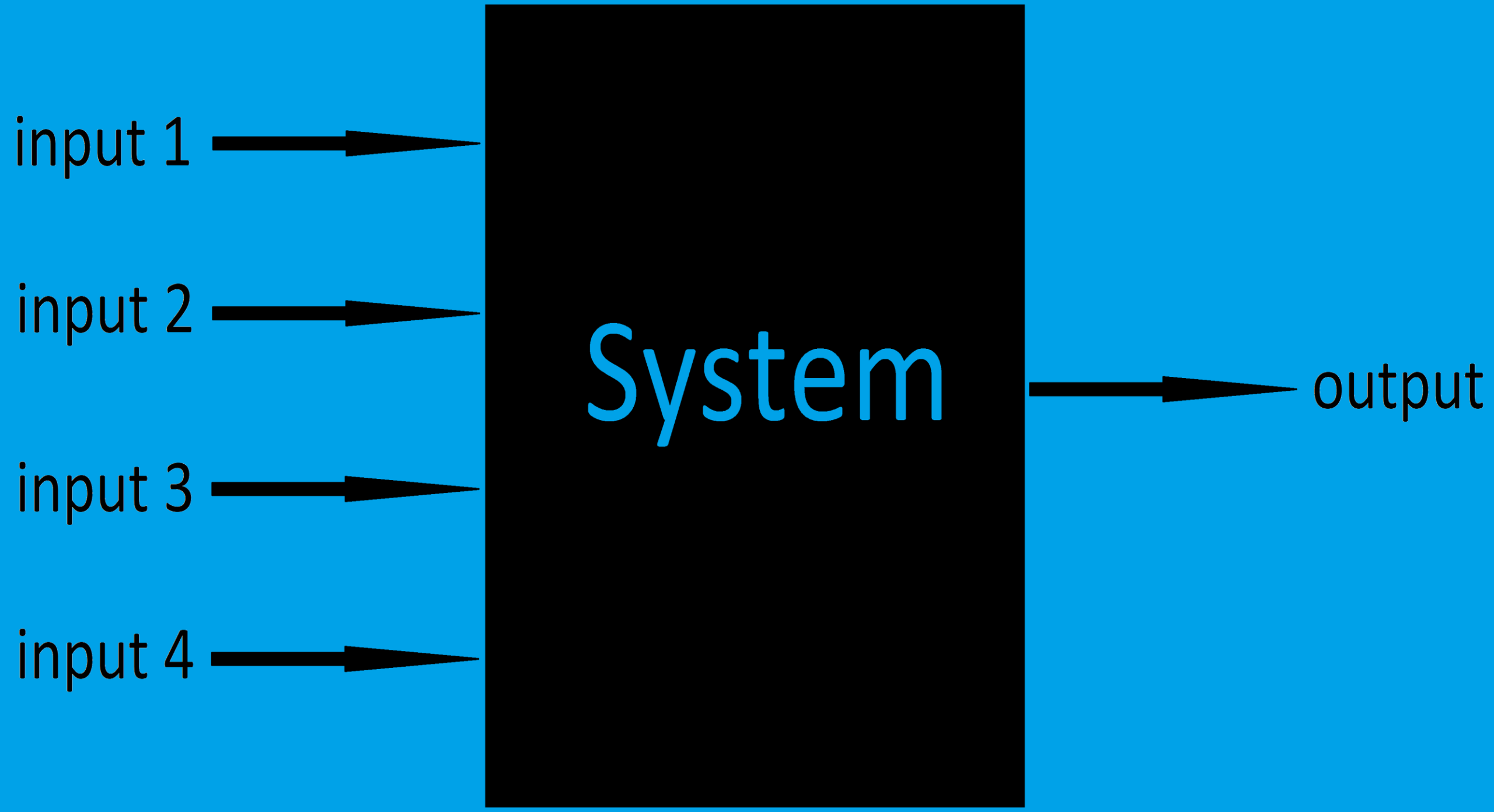

input 1
input 2
input 3
input 4
System
output

TABLE IV: Summary of CNN-based community detection methods.

Method	Input	Learning	Preprocess	Co-technique	Overlap	Network
Xin *et al.* [8]	$\boldsymbol{A}$	Supervise	Node to image	–	×	TINs
SparseConv [70]	$\boldsymbol{A}$	Supervise	Node to image	Sparse matrix	×	Sparse network
SparseConv2D [76]	$\boldsymbol{A}$	Semi-supervise	Node to image	Sparse matrix	×	Sparse network
ComNet-R [77]	$\boldsymbol{A}$	Supervise	Edge to image	Local modularity	×	Large-scale network

TABLE V: Summary of GCN-based community detection methods.

Method	Input	Learning	Convolution	Clustering	Co-technique	Overlap
LGNN [78]	$\boldsymbol{A}, \boldsymbol{X}$	Supervise	First-order + Line graph	–	Edge features	✓
MRFasGCN [10]	$\boldsymbol{A}, \boldsymbol{X}$	Semi-supervise	First-order + Mean Field Approximate	–	eMRF	×
SGCN [79]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	First-order	–	Label sampling	×
NOCD [80]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	First-order	–	Bernoulli–Poisson	✓
GCLN [81]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	First-order	k-means	U-Net architecture	×
IPGDN [82]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	First-order + Disentangled representation	k-means	HSIC as regularizer	×
AGC [64]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	k-order + Laplacian smoothing filter	Spectral Clustering	–	×
AGE [84]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	Laplacian smoothing filter	Spectral Clustering	Adaptive learning	×
CayleyNet [85]	$\boldsymbol{A}, \boldsymbol{X}$	Semi-supervise	Laplacian smoothing filter	–	Cayley polynomial	×
SENet [86]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	Third-order + Spectral clustering loss	k-means	Kernel matrix learning	×
CommDGI [87]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	First-order + Sampling	–	Joint optimization	×
Zhao *et al.* [88]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	First-order + Sampling	–	Joint optimization	×

TABLE VII: Summary of GAN-based community detection methods.

Method	Input	Learning	Generator	Discriminator	Generated Samples	Clustering	Overlap
SEAL [94]	$\boldsymbol{A}, \boldsymbol{X}$	Semi-supervise	iGPN	GINs	Communities	–	✓
DR-GCN [95]	$\boldsymbol{A}, \boldsymbol{X}$	Semi-supervise	MLP	MLP	Embeddings	k-means	×
JANE [62]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	Various	MLP	Topology, attributes, embeddings	–	×
ProGAN [66]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	MLP	MLP	Triplets	k-means	×
CommunityGAN [96]	$\boldsymbol{A}$	Unsupervise	AGM	AGM	Motifs	–	✓
CANE [97]	$\boldsymbol{A}$	Unsupervise	Softmax	MLP	Node pairs	k-means	×
ACNE [98]	$\boldsymbol{A}$	Unsupervise	Softmax	MLP	Nodes, Communities	–	✓

TABLE VI: Summary of GAT-based community detection methods.

Method	Input	Metapath	Learning	Attention Mechanism	Co-technique	Clustering	Overlap	Network
DMGI [61]	$V, E^{(r)}, \boldsymbol{X}$	×	Unsupervise	[166]	Contrastive learning	k-means	×	Multiplex
HDMI [65]	$V, E^{(r)}, \boldsymbol{X}$	×	Unsupervise	[90]	MI	k-means	×	Multiplex
MAGNN [72]	$\mathcal{V}, \mathcal{E}, \mathcal{X}$	✓	Unsupervise	[167]	–	k-means	×	Heterogeneous
HeCo [91]	$\mathcal{V}, \mathcal{E}$	✓	Unsupervise	[166]	Contrastive learning	k-means	×	Heterogeneous
CP-GNN [92]	$\mathcal{V}, \mathcal{E}$	×	Unsupervise	[167]	–	k-means	×	Heterogeneous

TABLE VIII: Summary of AE-based community detection methods.

Category	Method	Input	Learning	Encoder	Decoder	Loss	Overlap
Stacked AE	semi-DNR [63]	$\boldsymbol{B}$	Semi-supervise	MLP	MLP	reconstruction+pairwise	×
	DNE-SBP [67]	$\boldsymbol{A}(+,-)$	Semi-supervise	MLP	MLP	reconstruction+regularization+pairwise	×
	UWMNE/WMCNE-LE [102]	$\boldsymbol{B}, \boldsymbol{X}$	Unsupervise	MLP	MLP	reconstruction+pairwise	×
	sE-Autoencoder [73]	$\{\boldsymbol{A}_t\}$	Semi-supervise	MLP	MLP	reconstruction+regularization+pairwise	×
	DANE [103]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	MLP	MLP	reconstruction+proximity	×
	Transfer-CDDTA [104]	$\boldsymbol{S}_s, \boldsymbol{S}_t$	Unsupervise	MLP	MLP	reconstruction+regularization+proximity	×
	DIME [105]	$\mathcal{V}$, $\mathcal{E}$, $\mathcal{X}, \{\mathcal{A}_{ij}\}$	Unsupervise	MLP	MLP	reconstruction+regularization +information fusion	×
Sparse AE	GraphEncoder [107]	$\boldsymbol{A}, \boldsymbol{D}, \boldsymbol{S}$	Unsupervise	MLP	MLP	reconstruction+regularization+sparsity	×
	WCD [108]	$\boldsymbol{S}$	Unsupervise	MLP	MLP	reconstruction+sparsity	×
	DFuzzy [109]	$\boldsymbol{A}$	Unsupervise	MLP	MLP	reconstruction+sparsity	✓
	CDMEC [110]	$\boldsymbol{S}_s, \boldsymbol{S}_t$	Unsupervise	MLP	MLP	reconstruction+sparsity	×
Denoising AE	DNGR [112]	$\boldsymbol{A}$	Unsupervise	MLP	MLP	reconstruction	×
	DNC [113]	$\boldsymbol{A}$	Unsupervise	MLP	MLP	reconstruction+clustering	×
	GRACE [68]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	MLP	MLP	reconstruction+clustering	×
	MGAE [111]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	GCN	GCN	reconstruction+regularization	×
Graph Convolutional AE	GUCD [115]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	MRFasGCN	MLP	reconstruction+pairwise	×
	SDCN [114]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	GCN+DNN	DNN	reconstruction+clustering	×
	O2MAC [69]	$\{\boldsymbol{A}\}, \boldsymbol{X}$	Unsupervise	GCN	Inner Product	reconstruction+clustering	×
Graph Attention AE	DAEGC [116]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	GAT	Inner Product	reconstruction+clustering	×
	GEC-CSD [117]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	GAT	Inner Product +GAT	reconstruction+regularization +clustering+adversarial	×
	MAGCN [118]	$\boldsymbol{A}, \{\boldsymbol{X}\}$	Unsupervise	GAT+MLP	Inner Product +GCN	reconstruction+clustering +consistency	×
	SGCMC [119]	$\boldsymbol{A}, \{\boldsymbol{X}\}$	Unsupervise	GAT	GAT	reconstruction+regularization +clustering+consistency	×
	DMGC [120]	$\{A\}$	Unsupervise	MLP	MLP	reconstruction+regularization +proximity+clustering	×
Variational AE	TGA/TVGA [126]	$\boldsymbol{A}$,$\boldsymbol{X}$	Unsupervise	GCN	Triad	reconstruction	×
	VGECLE [124]	$\boldsymbol{A}$	Semi-supervise	DNN	DNN	reconstruction+pairwise	×
	DGLFRM [123]	$\boldsymbol{A}, \boldsymbol{X}$	Semi-supervise	GCN	DNN	reconstruction+regularization	✓
	LGVG [127]	$\boldsymbol{A}, \boldsymbol{X}$	Semi-supervise	GCN	DNN	reconstruction+regularization	✓
	VGAECD [125]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	GCN	Inner Product	reconstruction+clustering	×
	VGAECD-OPT [136]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	GCN	Inner Product	reconstruction+clustering	×
	ARGA/ARVGA [128]	$\boldsymbol{A}, \boldsymbol{X}$	Unsupervise	GCN	Inner Product	reconstruction	×

THANKS FOR YOUR ATTENTION