Module III: Graph Representation Learning

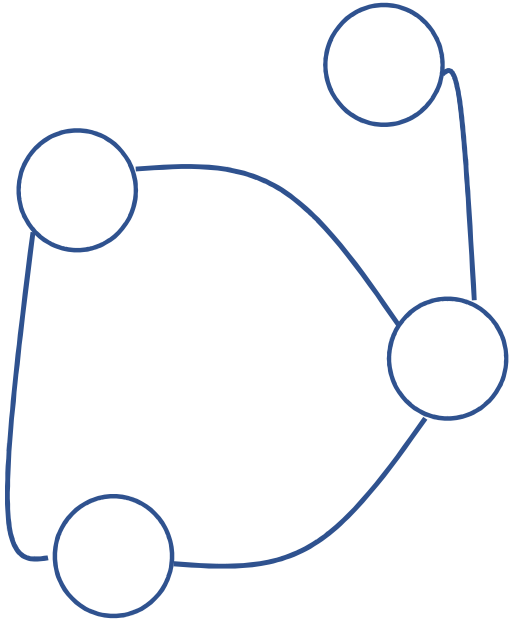
11:30 am - 12:30 pm

What and why

A brief history of Graph Embedding

- Skip-gram based
- Graph Neural Networks (GNN)

Lab 3 – Multi-sense similarity



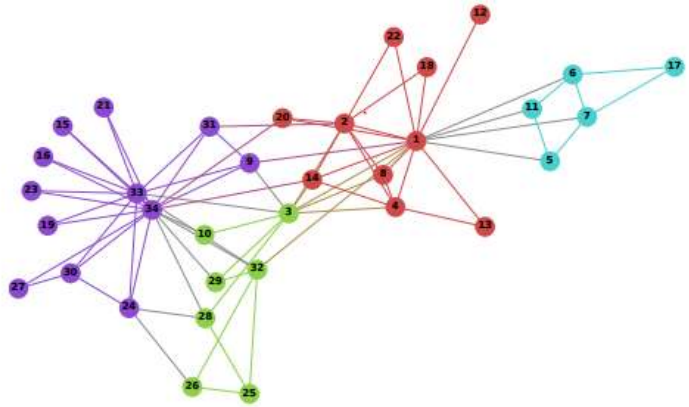
Module 3 Overview

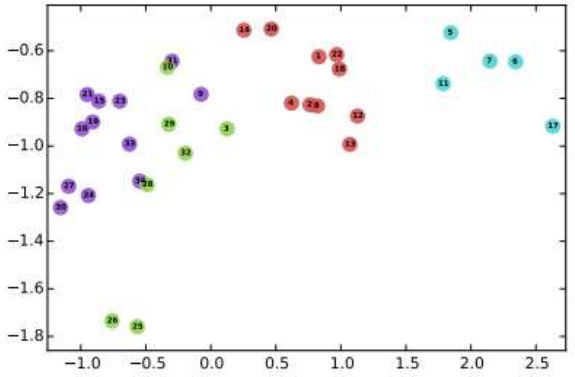
Graph representation learning

Problem (Graph representation learning, network embedding, graph embedding)

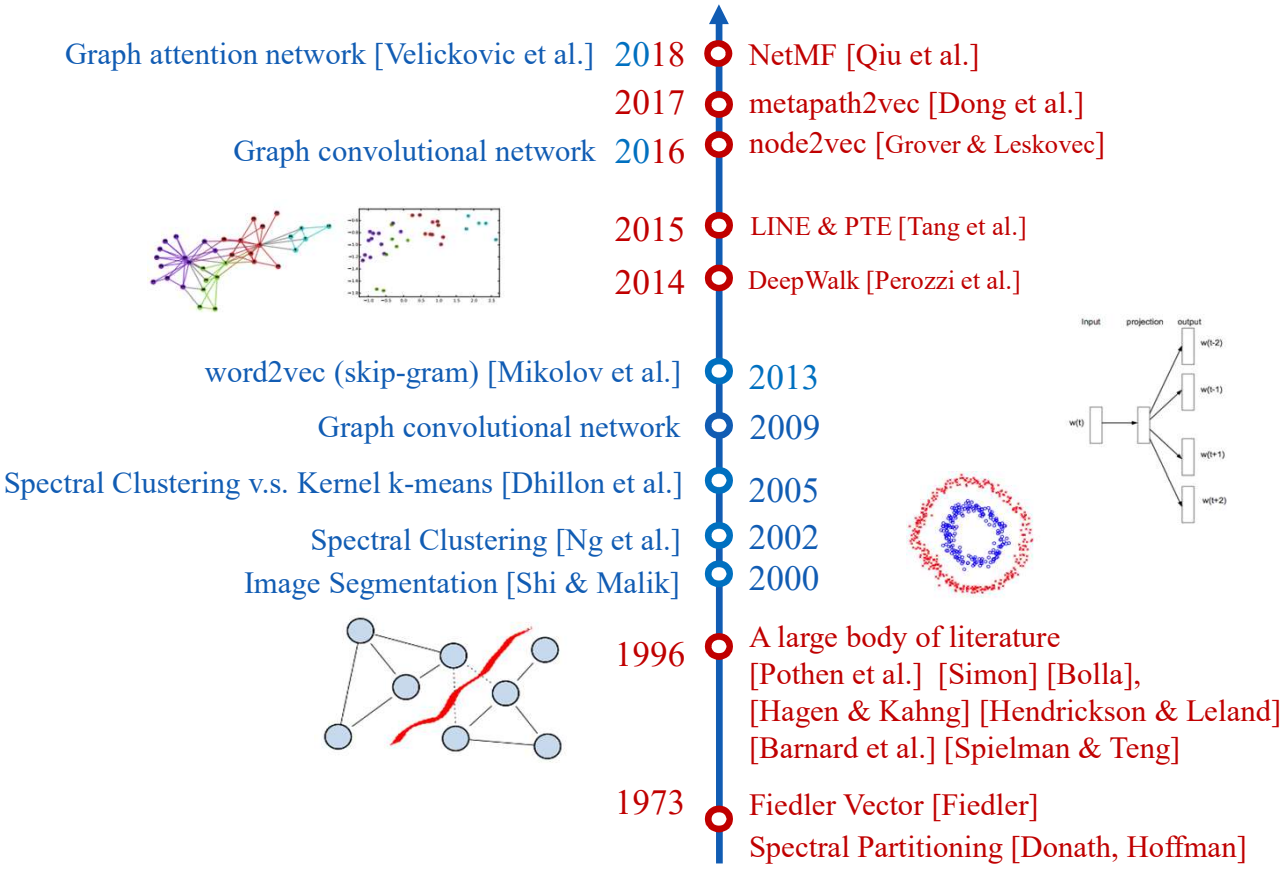
- Input: a network $G = (V, E)$
- Output: $\boldsymbol{X} \in R^{|V| \times k}, k \ll |V|$, k-dim vector $\boldsymbol{X}_v$ for each node *v*.

Each node ➔ a latent low-dimension vector,
network structure information (encoded into) ➔ distributed node representations

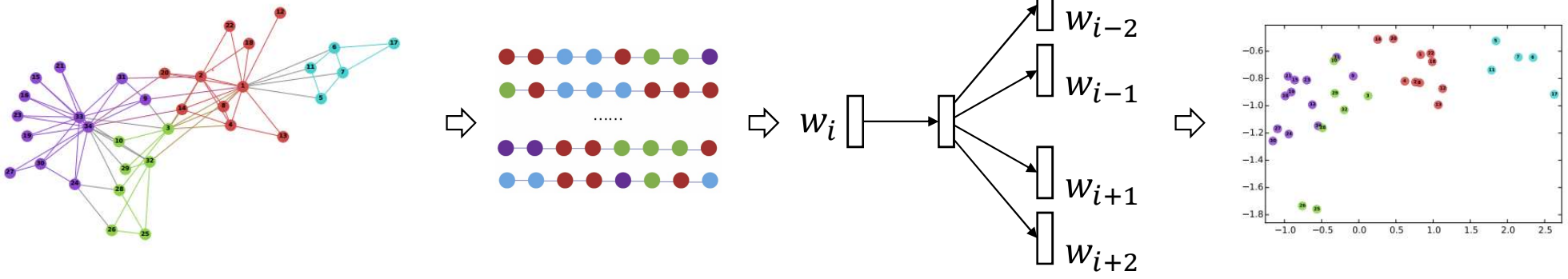




What and Why - Graph Representation learning



A brief history of graph embedding

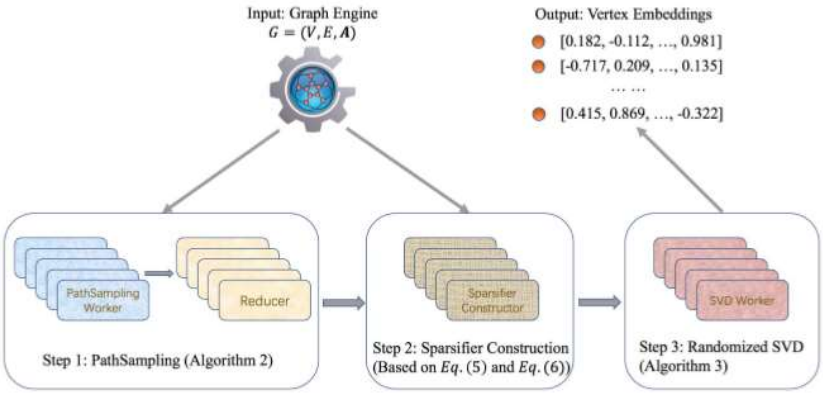


Skip-gram based graph embedding

NetMF

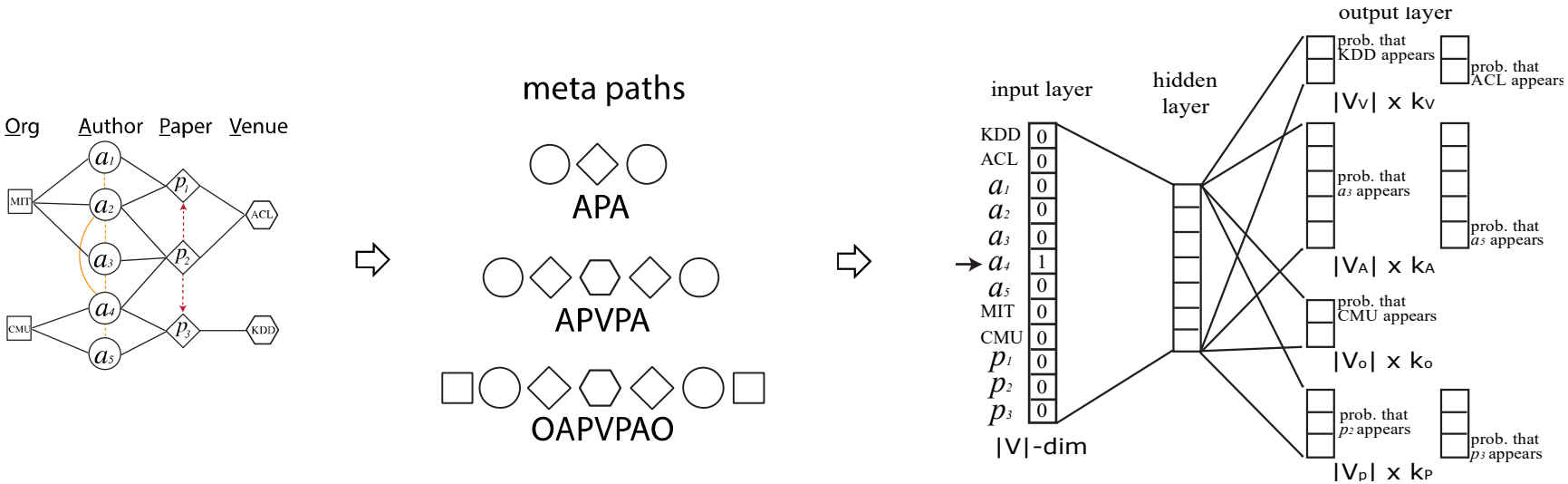
- DeepWalk $\log\left(\frac{\mathrm{vol}(G)}{b}\left(\frac{1}{T}\sum_{r=1}^{T}\left(\boldsymbol{D}^{-1}\boldsymbol{A}\right)^{r}\right)\boldsymbol{D}^{-1}\right)$
- LINE $\log\left(\frac{\mathrm{vol}(G)}{b}\boldsymbol{D}^{-1}\boldsymbol{A}\boldsymbol{D}^{-1}\right)$
- PTE $\log\left(\begin{bmatrix}\alpha\,\mathrm{vol}(G_{\mathsf{ww}})(\boldsymbol{D}_{\mathsf{row}}^{\mathsf{ww}})^{-1}\boldsymbol{A}_{\mathsf{ww}}(\boldsymbol{D}_{\mathsf{col}}^{\mathsf{ww}})^{-1}\\ \beta\,\mathrm{vol}(G_{\mathsf{dw}})(\boldsymbol{D}_{\mathsf{row}}^{\mathsf{dw}})^{-1}\boldsymbol{A}_{\mathsf{dw}}(\boldsymbol{D}_{\mathsf{col}}^{\mathsf{dw}})^{-1}\\ \gamma\,\mathrm{vol}(G_{\mathsf{lw}})(\boldsymbol{D}_{\mathsf{row}}^{\mathsf{lw}})^{-1}\boldsymbol{A}_{\mathsf{lw}}(\boldsymbol{D}_{\mathsf{col}}^{\mathsf{lw}})^{-1}\end{bmatrix}\right)-\log b$
- node2vec $\log\left(\frac{\frac{1}{2T}\sum_{r=1}^{T}\left(\sum_u \boldsymbol{X}_{w,u}\underline{\boldsymbol{P}}^{r}_{c,w,u}+\sum_u \boldsymbol{X}_{c,u}\underline{\boldsymbol{P}}^{r}_{w,c,u}\right)}{b\left(\sum_u \boldsymbol{X}_{w,u}\right)\left(\sum_u \boldsymbol{X}_{c,u}\right)}\right)$

NetSMF



Skip-gram based graph embedding

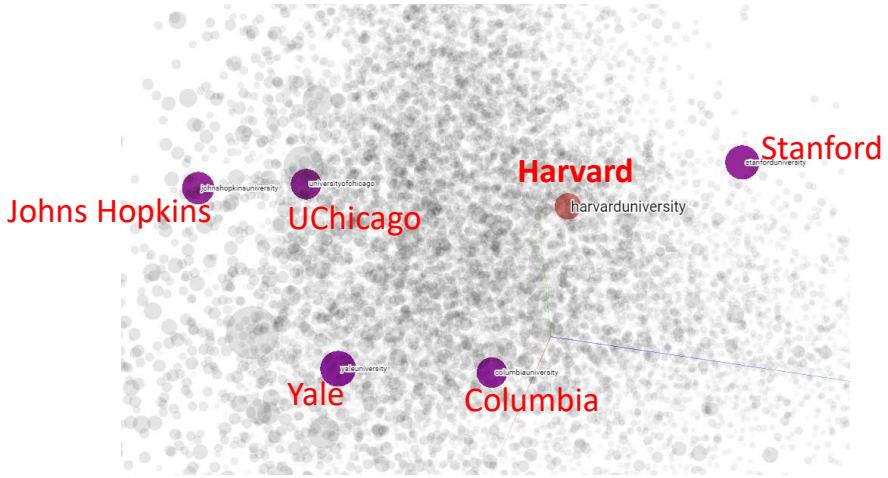
Matrix Factorization

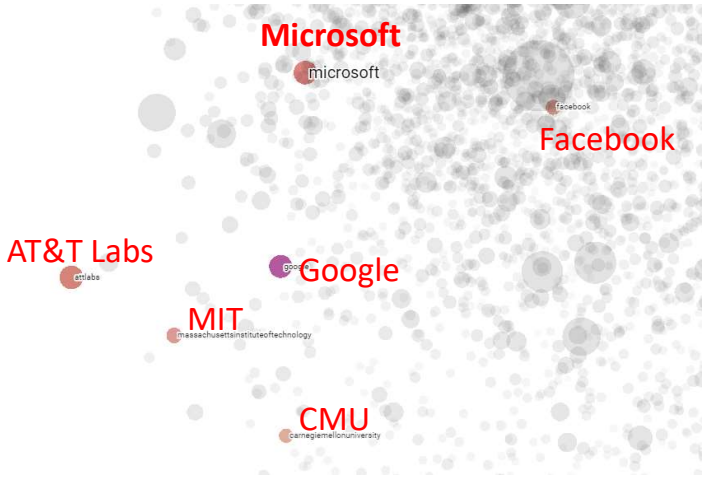


meta-path-based random walks

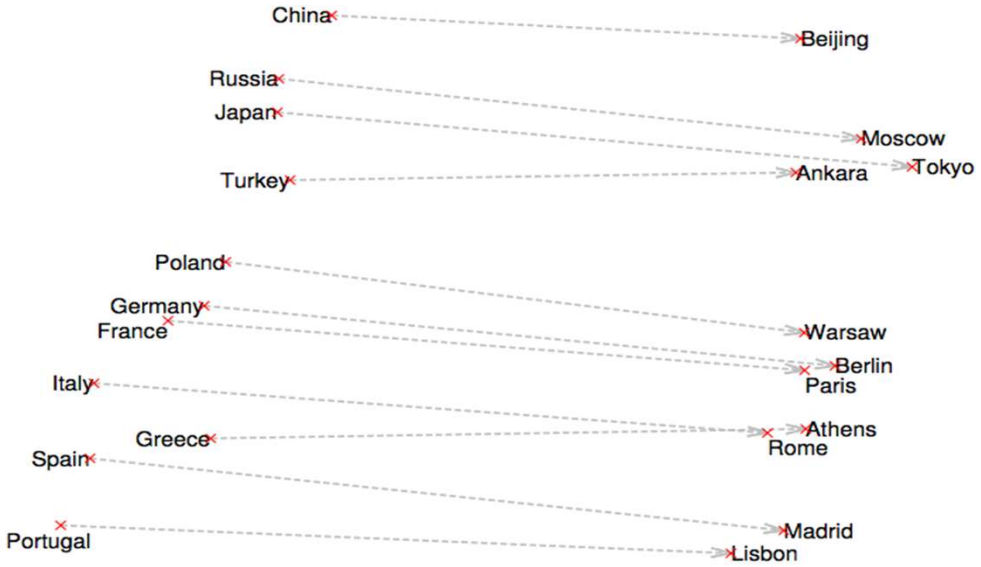
heterogeneous skip-gram

Heterogeneous Skip-gram graph embedding

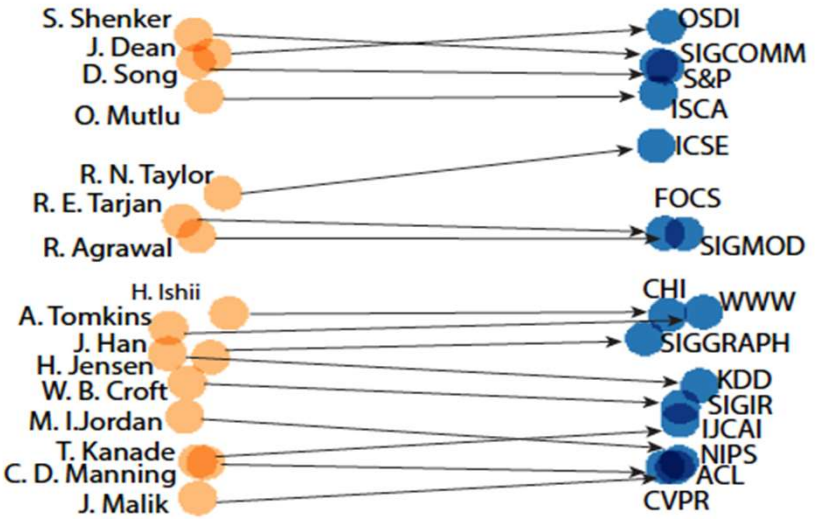




Embedding Heterogeneous Academic Graph



word2vec [Mikolov, 2013]



Metapath2vec++ [Dong et al., 2017]

Embedding Heterogeneous Academic Graph

- Task : who are the most similar ones to me
  - Affiliation – affiliation
    - Co-author
    - Co-citation
    - Co-venue
  - Conference – conference
    - Co-author
    - Co-citation
    - Co-FieldsOfStudy (Co-FoS)

Lab 3: Multi-sense similarity in MAG

Using NetworkSimilarity