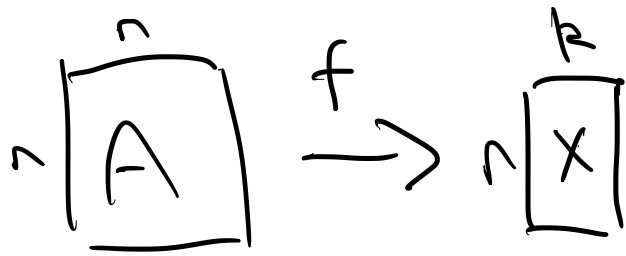


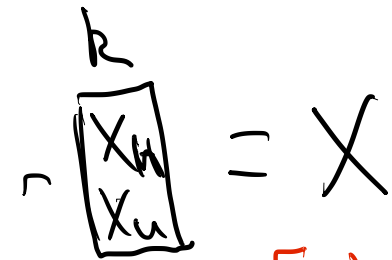
April 14, 2026

Last time: "representation" learning on graphs



- generative modeling
- data interpretation / vis
- "downstream" ML tasks

① Clustering / node prediction \rightarrow unsupervised \rightarrow semi-supervised \rightarrow



$$\min_z \|X_H z - y\|_2^2 + \text{regularization } \|z\|_2^2$$

$$\Pr(y = z | x) = \frac{1}{1 + \exp(-z^T x)}$$

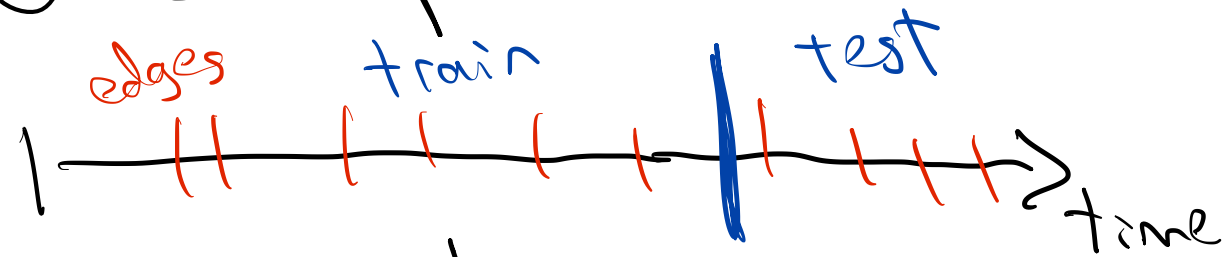
$$z^* \quad X_U z^*$$

Ex: age
page views
traffic flow

$$\max_z \prod_{h \in H} \Pr(y_h | z, x_h)$$

Ex: gender
protein function

② Link prediction / recommendation Ex:



friend rec FB/Twitter
co-purchase
co-view

$$n \times n \begin{bmatrix} A \end{bmatrix} \rightarrow n \times k \begin{bmatrix} X \end{bmatrix}$$

$$\Pr((i,j) \text{ forms edge}) = \frac{1}{1 + \exp(\|x_i - x_j\|_2^2)}$$

Test: (i,j) positive
 (k,l) negative (artificial)

$$\uparrow \\ = x_i^T x_j$$

\Rightarrow accuracy

