COMPUTER SCIENCE
INDIANA UNIVERSITY
School of Informatics and Computing
Bloomington

Neural networks and intro to matrix factorization

Reminders/Comments

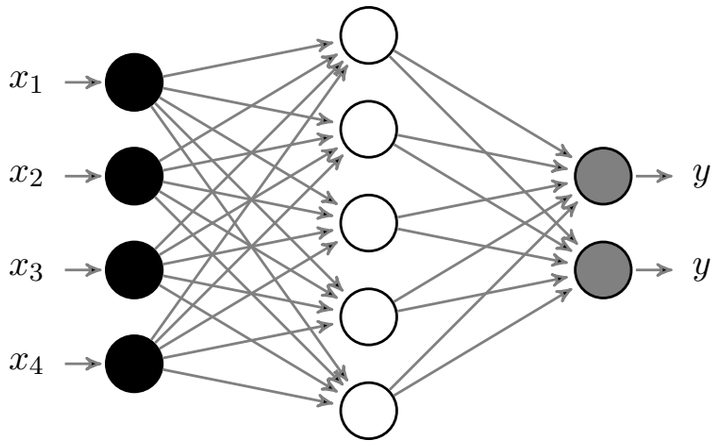
- All due dates listed on schedule in canvas, including final
- Assignment 2 marks should be back this week
- Office hours end at 3:30 p.m. today

Representation learning

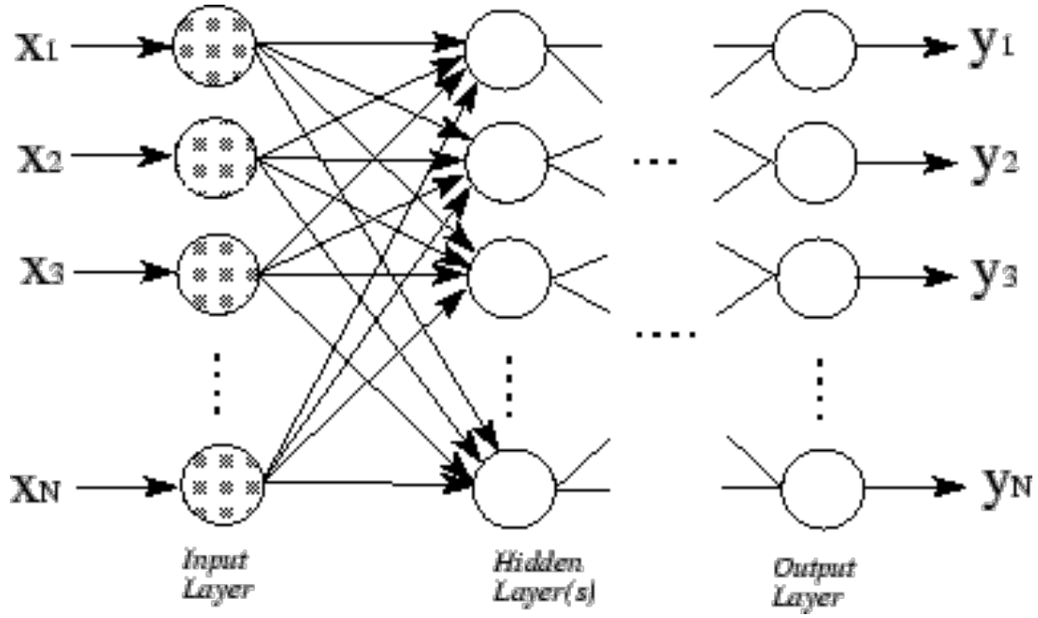
- For generalized linear models, learning f(xW) = E[y | x]
- Augment observations, phi(x) and learn f(phi(x) W) = E[y | x]
- There are many strategies to augmenting x
  - fixed representations, like polynomials, wavelets
  - neural networks
  - matrix factorization

Whiteboard

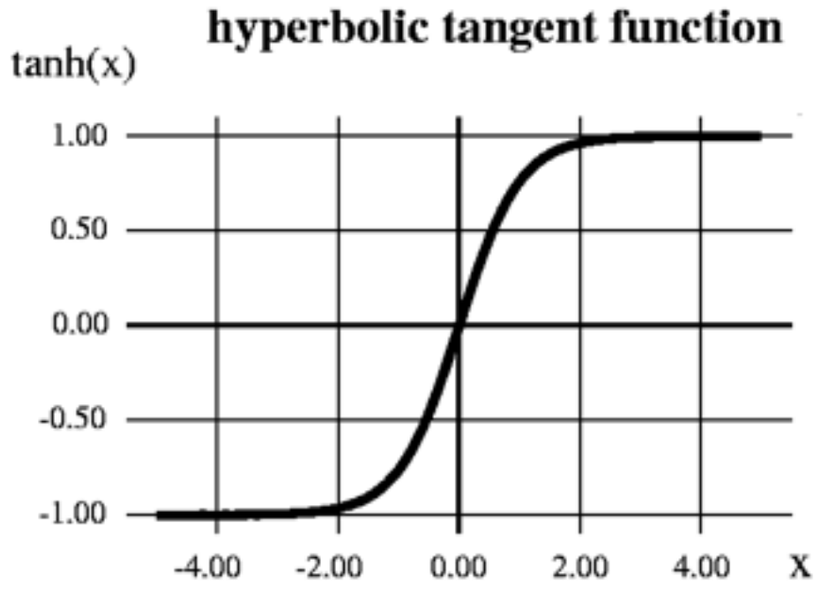
- Derive update for multi-output neural network



- Derive update for multi-layer neural network

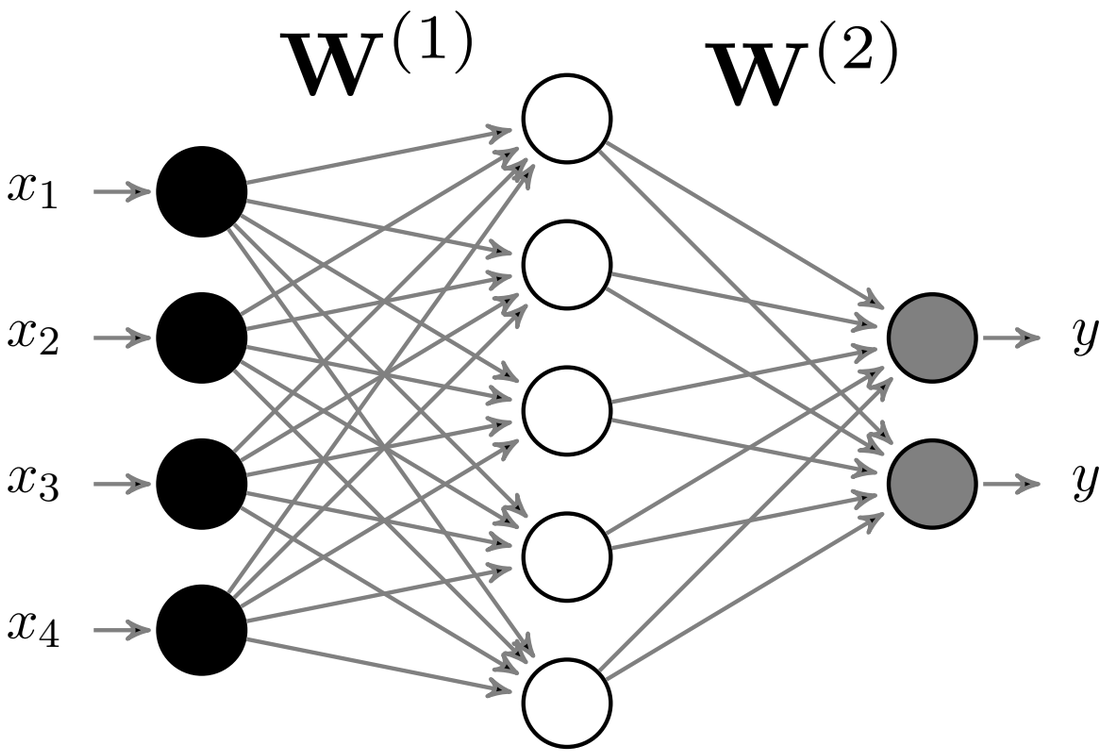


- Derive update for tanh transfer



Representation learning

Neural network

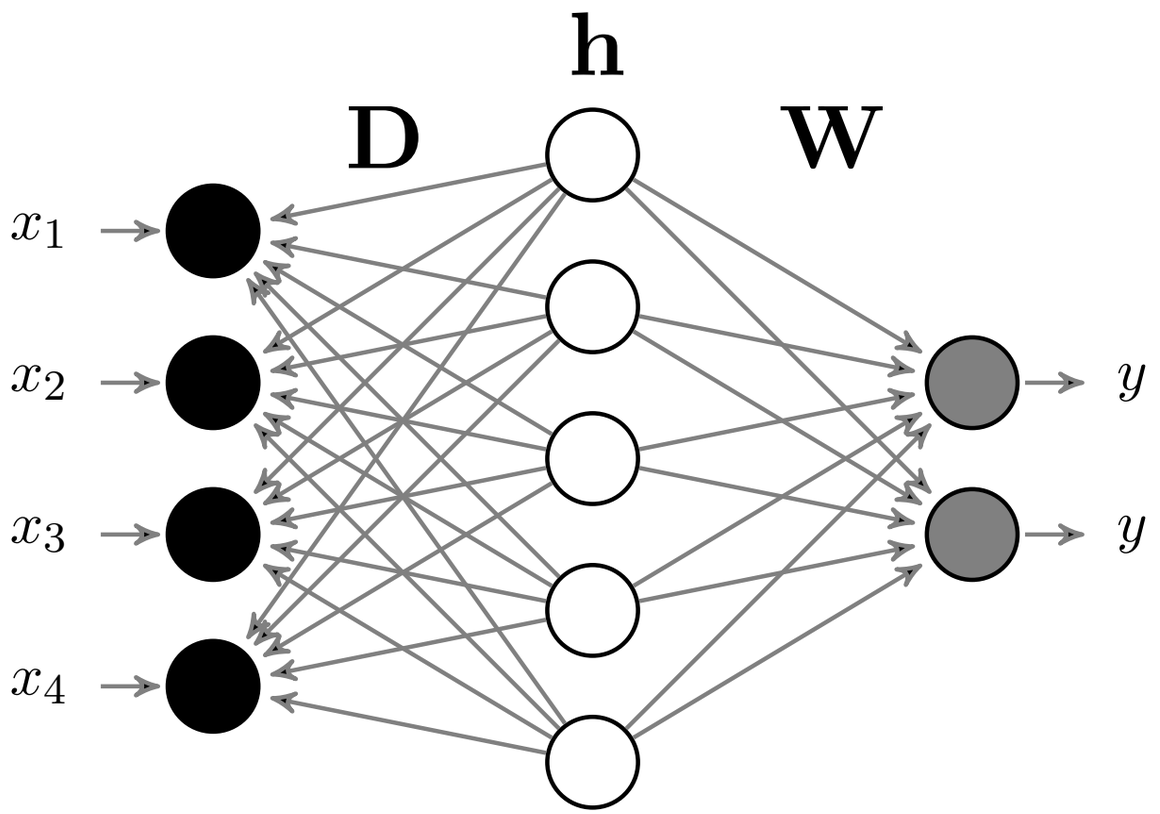


$$\mathbf{W}^{(1)} \in \mathbb{R}^{k \times d}, \mathbf{W}^{(2)} \in \mathbb{R}^{m \times k}$$

$$d = 4, k = 5, m = 2$$

$$\hat{\mathbf{y}} = f_2(\mathbf{W}^{(2)} f_1(\mathbf{W}^{(1)} \mathbf{x}))$$

Regularized factor model



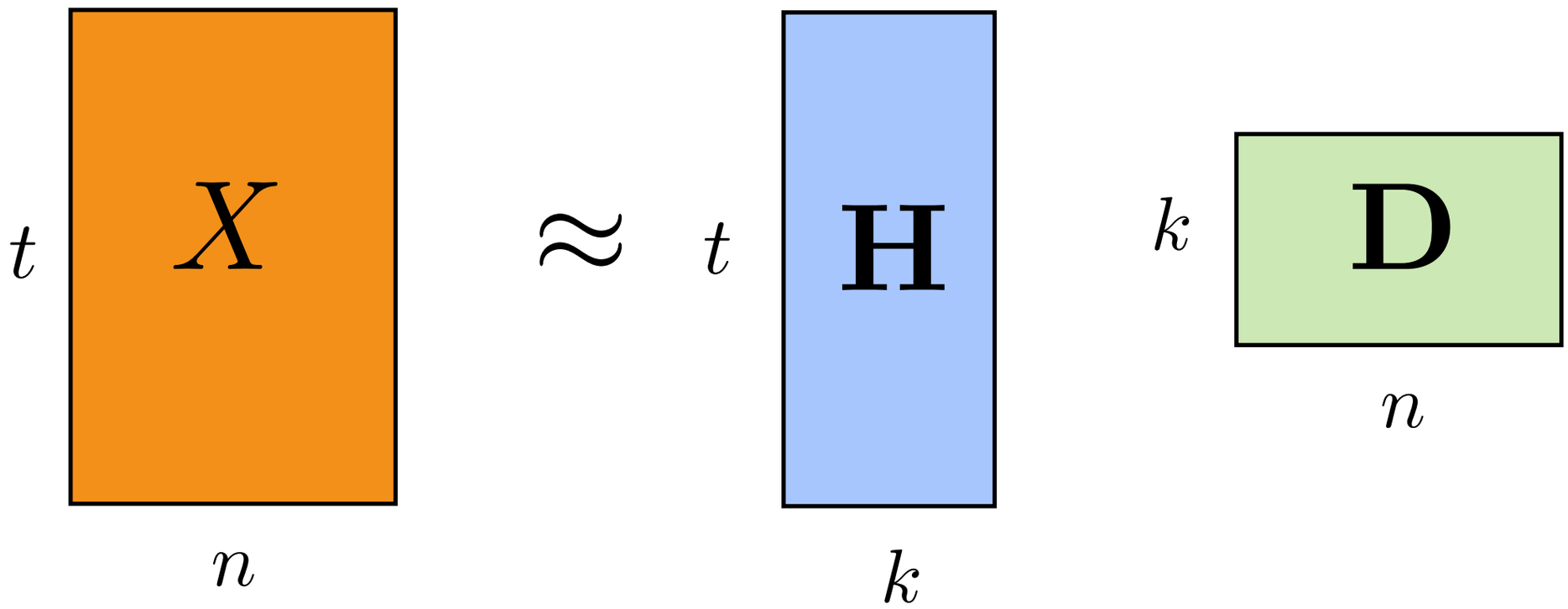
$$\mathbf{D} \in \mathbb{R}^{k \times d}, \mathbf{W} \in \mathbb{R}^{k \times m}$$

$$d = 4, k = 5, m = 2$$

$$\hat{\mathbf{y}} = f_2(\mathbf{h}\mathbf{W})$$

$$\mathbf{h} = \arg \min_{\mathbf{h} \in \mathbb{R}^{1 \times k}} L_x(\mathbf{h}\mathbf{D}, \mathbf{x})$$

Unsupervised RFMs



Whiteboard

- Regularized factor models
  - formulation for unsupervised learning
  - example with principal components analysis