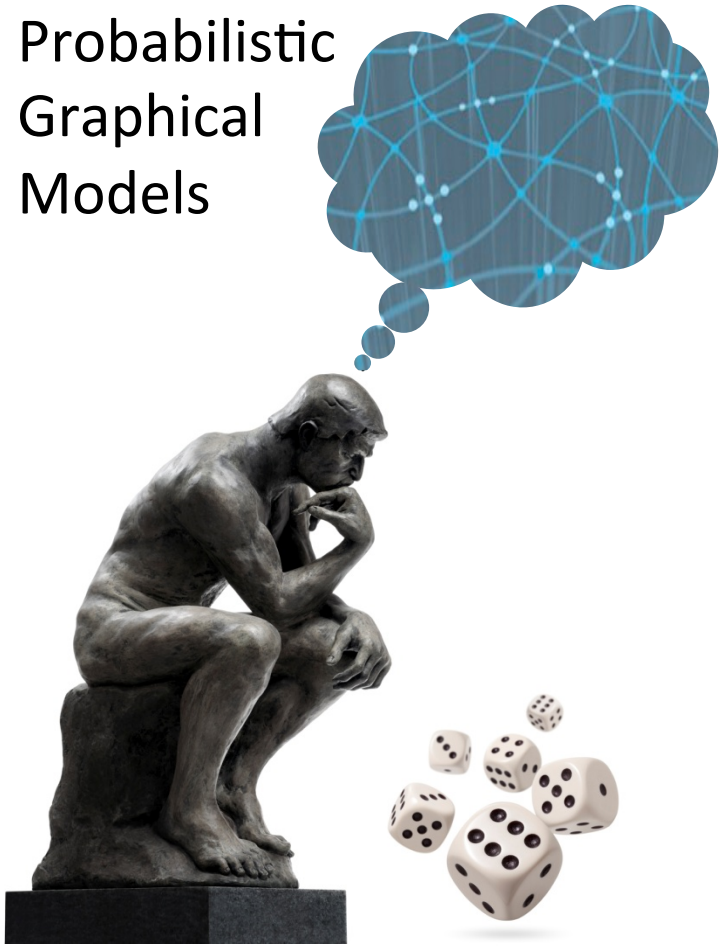
Probabilistic Graphical Models



Representation

Template Models

Shared Features in Log-Linear Models

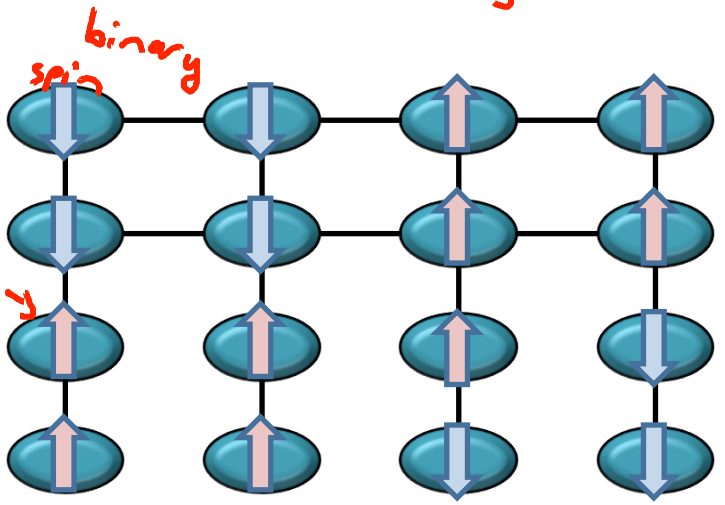
Ising Models

- In most MRFs, same feature and weight are used over many scopes

Ising Model

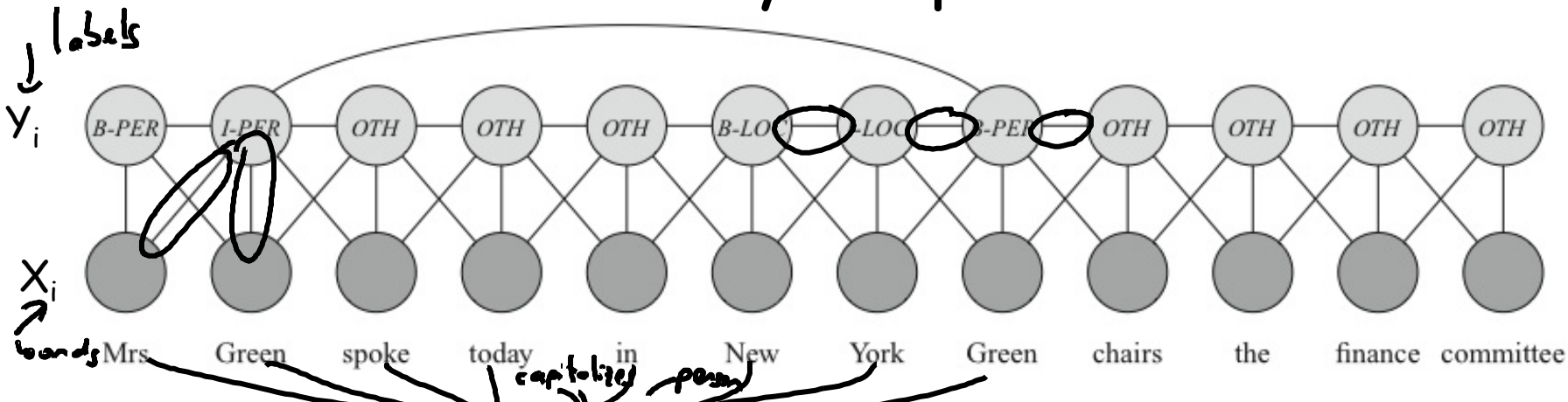
$$E(x_1, \ldots, x_n) = -\sum_{(i,j) \in \text{Edges}} w_{ij} x_i x_j - \sum_i u_i x_i$$

same weight for every adjacent pair



Natural Language Processing

- In most MRFs, same feature and weight are used over many scopes

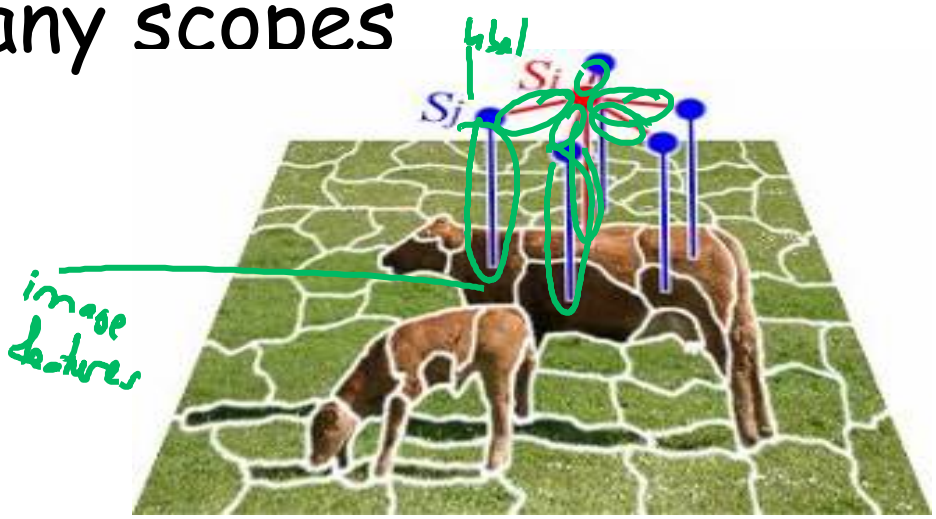


Same energy terms $w_k f_k(X_i, Y_i)$ repeat for all positions i in the sequence
Same energy terms $w_m f_m(Y_i, Y_{i+1})$ a;sp repeat for all positions i

Daphne Koller

Image Segmentation

- In most MRFs, same feature and weight are used over many scopes



Same features and weights for all superpixels in the image

Repeated Features

- Need to specify for each feature f_k a set of scopes $Scopes[f_k]$
- For each $\mathbf{D}_k \in Scopes[f_k]$ we have a term $w_k f_k(\mathbf{D}_k)$ in the energy function

$$w_k \sum_{\boldsymbol{D}_k \in \mathrm{Scopes}(f_k)} f_k(\boldsymbol{D}_k)$$

Summary

- Same feature & weight can be used for multiple subsets of variables
  - Pairs of adjacent pixels/atoms/words
  - Occurrences of same word in document
- Can provide a single template for multiple MNs
  - Different images
  - Different sentences
- Parameters and structure are reused within an MN and across different MNs
- Need to specify set of scopes for each feature