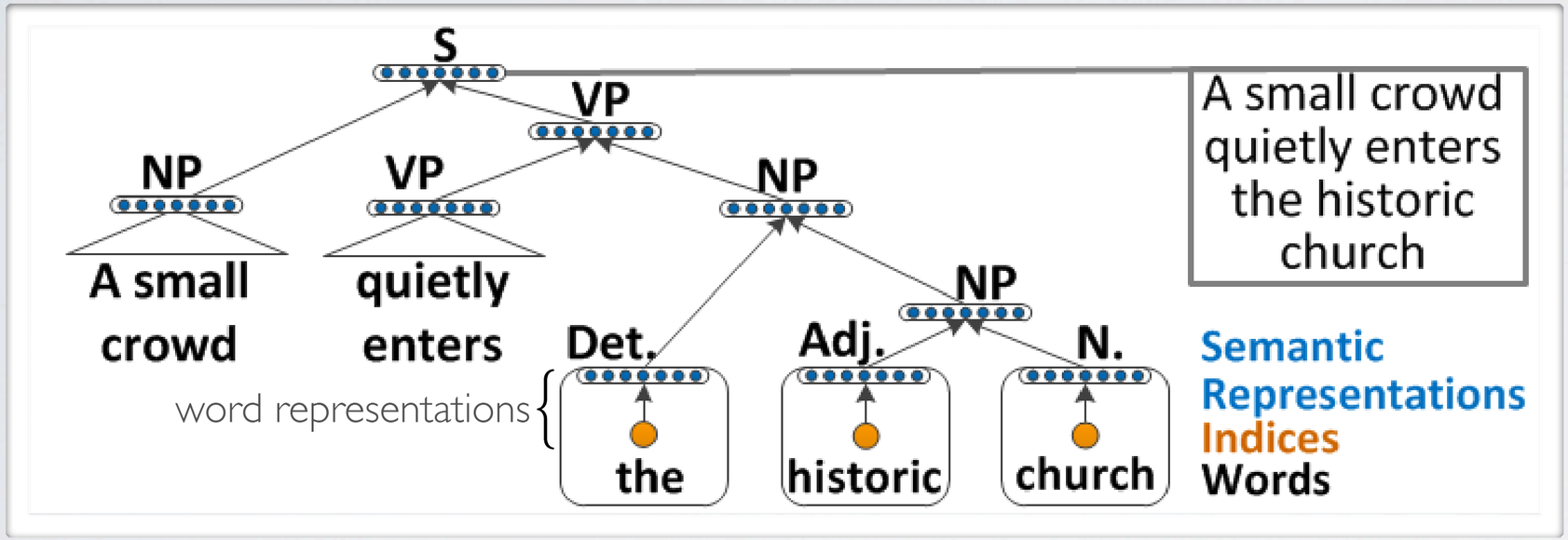
Neural networks

Natural language processing - recursive network training

RECURSIVE NEURAL NETWORK

Topics: recursive neural network (RNN)

- Idea: recursively merge pairs of word/phrase representations



- We need 2 things
  - a model that merges pairs of representations
  - a model that determines the tree structure

Socher, Lin, Ng and Manning, 2011

RECURSIVE NEURAL NETWORK

Topics: training algorithm

- Let y be the true parse tree and $\hat{y}$ be the predicted parse tree
  - we would like the score $s(y)$ of y to be higher than the score $s(\hat{y})$ of $\hat{y}$ (unless $\hat{y}$ is actually y)
- To update the recursive network
  - infer the predicted parse tree $\hat{y}$
  - increase the score $s(y)$ and decrease the score $s(\hat{y})$ by doing an update in the direction of the gradient

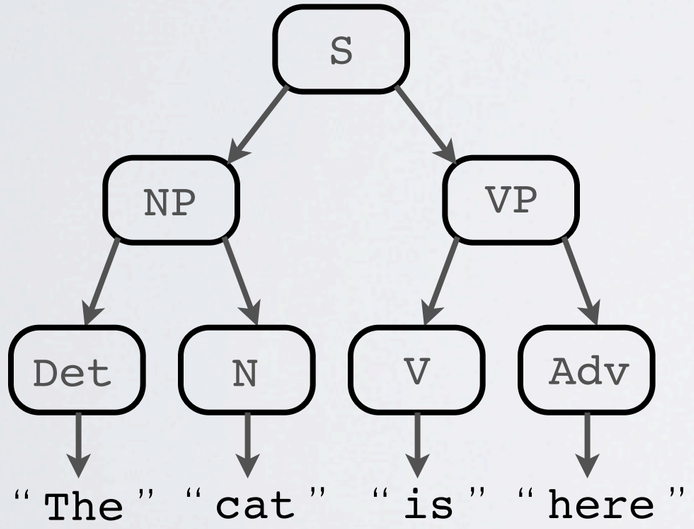
$$\nabla_\theta s(y) - \nabla_\theta s(\hat{y})$$

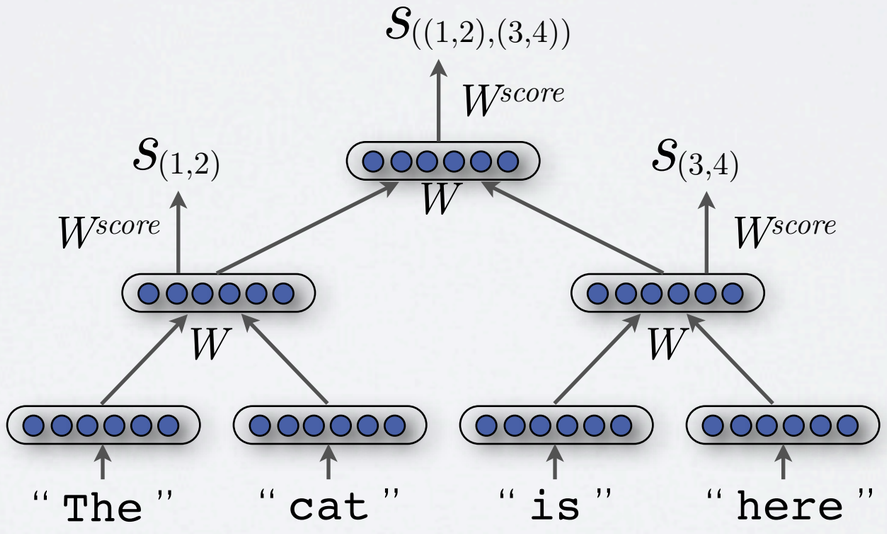
- these gradient can be computed by backpropagating through the recursive network structured according to the parse trees y and $\hat{y}$

RECURSIVE NEURAL NETWORK

Topics: training algorithm

- The nodes of a parse tree are also labeled
  - noun phrase (NP), verb phrase (VP), etc.
  - can add softmax layer that predict the label from each node representation
  - this is an additional gradient to backpropagate, for the true parse tree y





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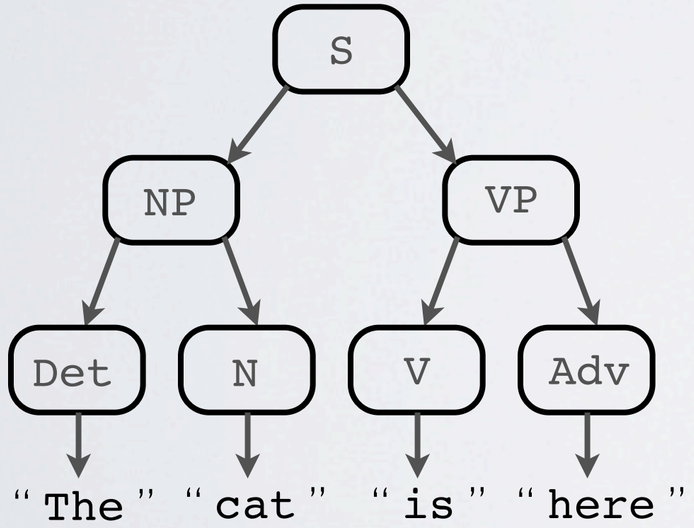

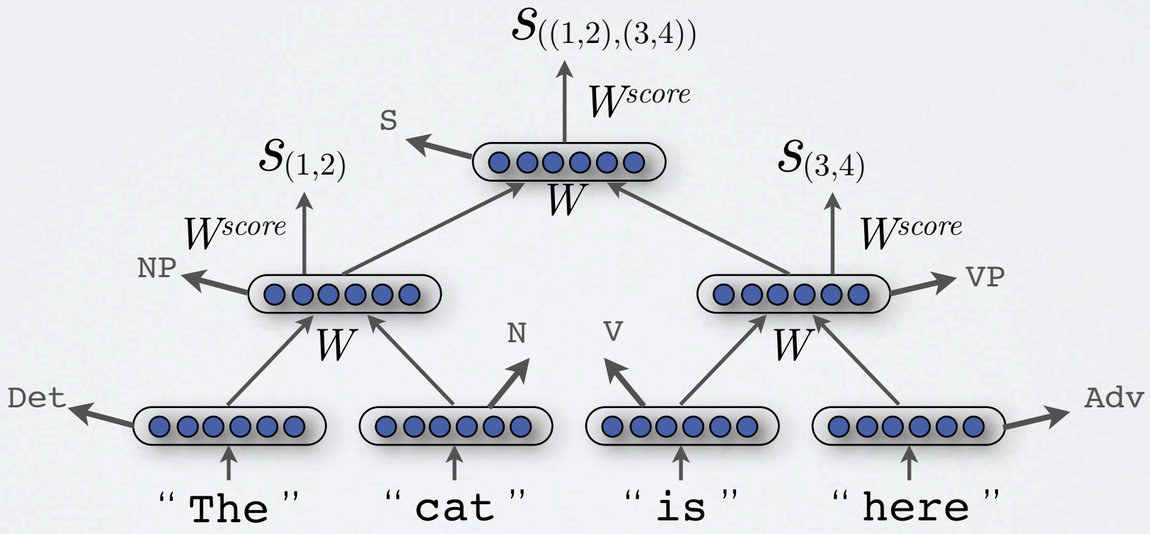

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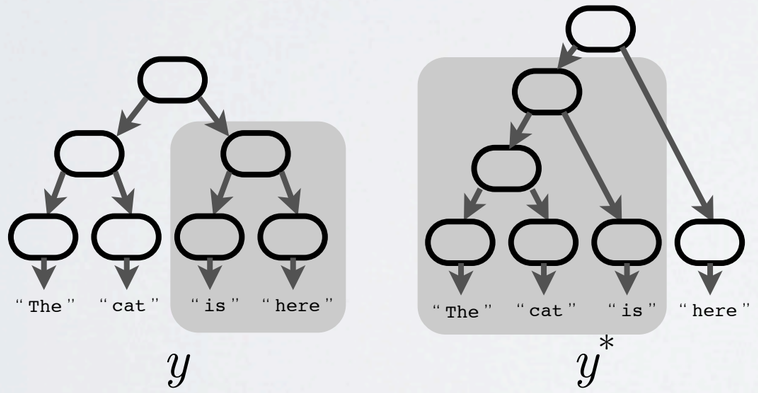
Topics: training algorithm

- Other details
  - word representations are pre-trained using Collobert and Weston's approach and fine-tuned while training the recursive network
  - training is actually based on a margin criteria: $s(y) > s(y^*) + \Delta(y,y^*)$
    - score of the true parse tree y trained to be larger than score of any other tree y^* plus its number of incorrect spans $\Delta(y,y^*)$



number of incorrect span $\Delta(y,y^*) = 1$

    - a simple modification to the beam search finding the best tree (see Socher et al. for details)

RECURSIVE NEURAL NETWORK

Topics: experimental comparison

- Parsing F1 performance
  - recursive neural network: 90.29%
  - Berkeley parser: 91.63%

- Nearest neighbor phrases based on RNN representation

Fujisawa gained 50 to UNK	The dollar dropped
1. Mead gained 1 to 37 UNK	1. The dollar retreated
2. Ogden gained 1 UNK to 32	2. The dollar gained
3. Kellogg surged 4 UNK to 7	3. Bond prices rallied

Socher, Lin, Ng and Manning, 2011