

# Deep Learning for NLP

Universität Bielefeld

## Lecture 5 - Dependency Parsing, Guiding Questions

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## Question 3

- What's ambiguous about "He saw the girl with the telescope"? Give two dependency trees that reveal this ambiguity.

## Question 4

- What's the relationship between dependency parsing and semantics?

## Question 9

- Does the arrow go from head to dependent or vice versa?

## Question 10

- What are universal dependencies?

## Question 16

- Why is it called greedy transition-based dependency parsing?

# Parsing Example

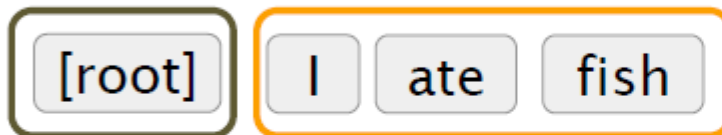


## Arc-standard transition-based parser

(there are other transition schemes ...)

Analysis of “I ate fish”

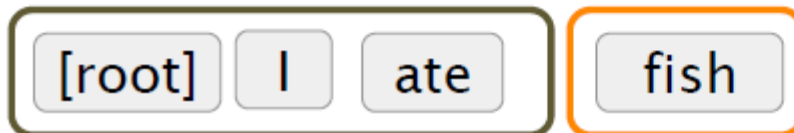
Start



Shift



Shift



Start:  $\sigma = [\text{ROOT}]$ ,  $\beta = w_1, \dots, w_n$ ,  $A = \emptyset$   
1. Shift  $\sigma, w_i | \beta, A \rightarrow \sigma | w_i, \beta, A$   
2. Left-Arc<sub>r</sub>  $\sigma | w_i | w_j, \beta, A \rightarrow \sigma | w_j, \beta, A \cup \{r(w_i, w_j)\}$   
3. Right-Arc<sub>r</sub>  $\sigma | w_i | w_j, \beta, A \rightarrow \sigma | w_i, \beta, A \cup \{r(w_i, w_j)\}$

Finish:  $\beta = \emptyset$

# Parsing Example



## Arc-standard transition-based parser

Analysis of "I ate fish"

Left Arc



Shift



Right Arc



Right Arc







## Model Architecture

### Softmax probabilities

Output layer  $y$   
 $y = \text{softmax}(Uh + b_2)$

Hidden layer  $h$   
 $h = \text{ReLU}(Wx + b_1)$

Input layer  $x$   
lookup + concat

