# Non-Projective Dependency Parsing Using a Swap Operation

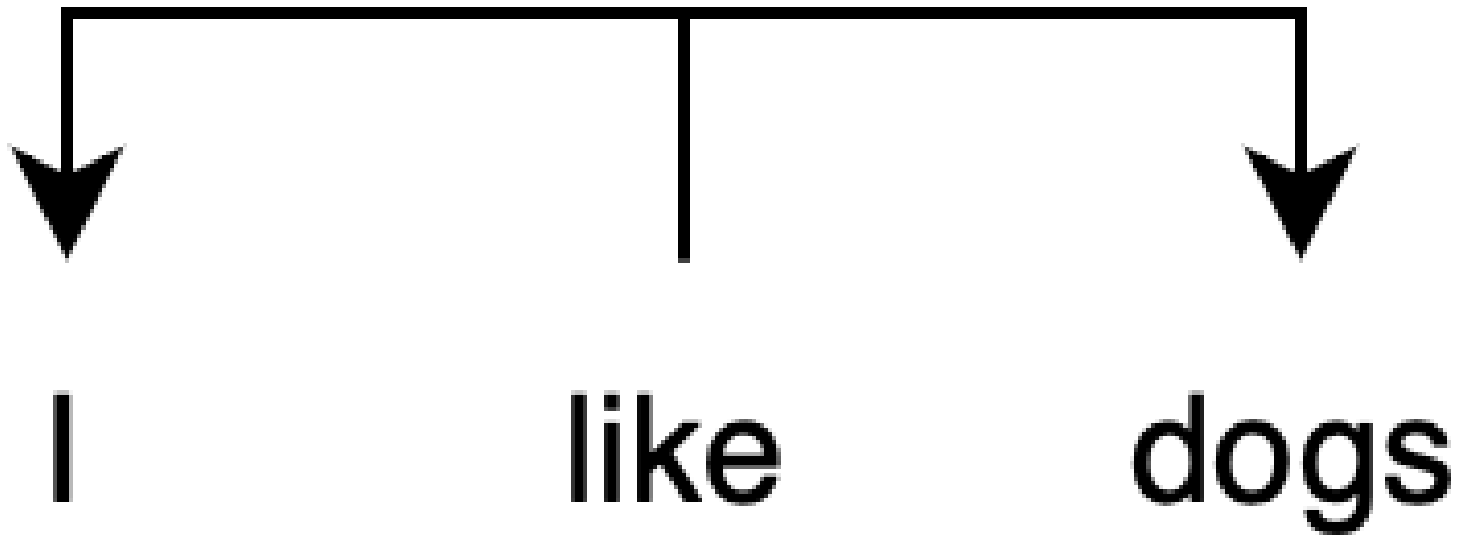
Group 09

# Agenda

- Dependency parsing
- The arc-standard algorithm
- Our baseline system
- Adding the *swap* operation
- Results and discussion

# Dependency Parsing

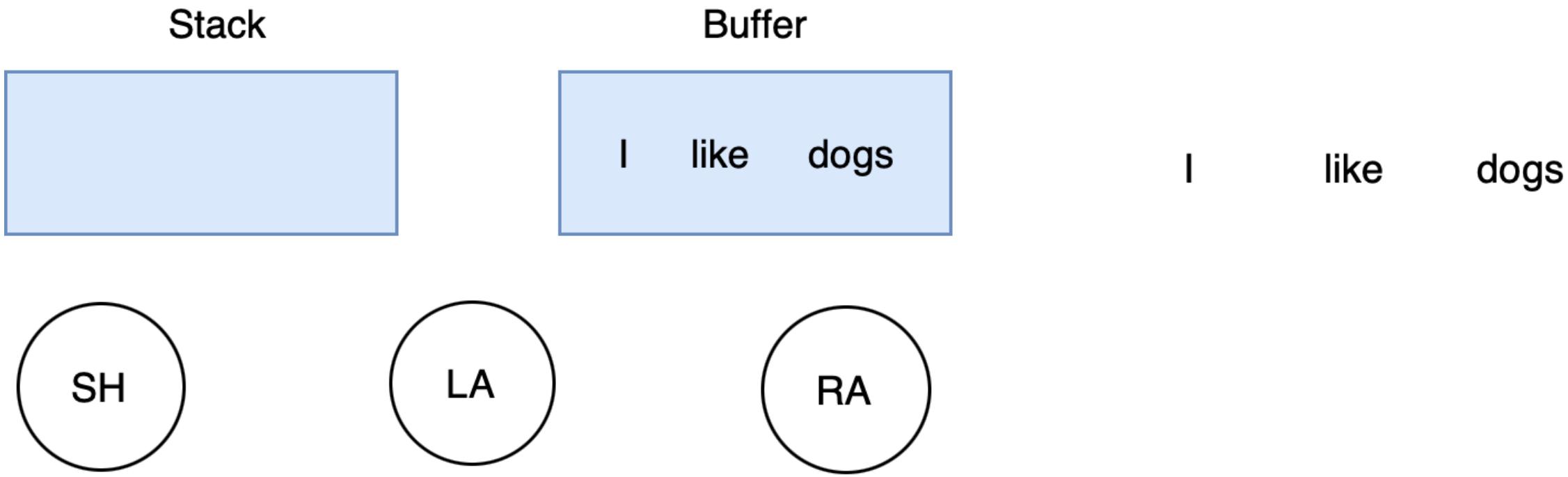
- A method to analyze the grammatical structure of a sentence by representing each word in a sentence as a node and the relationships between these words as directed edges or "arcs".



# Transition-Based Dependency Parsing

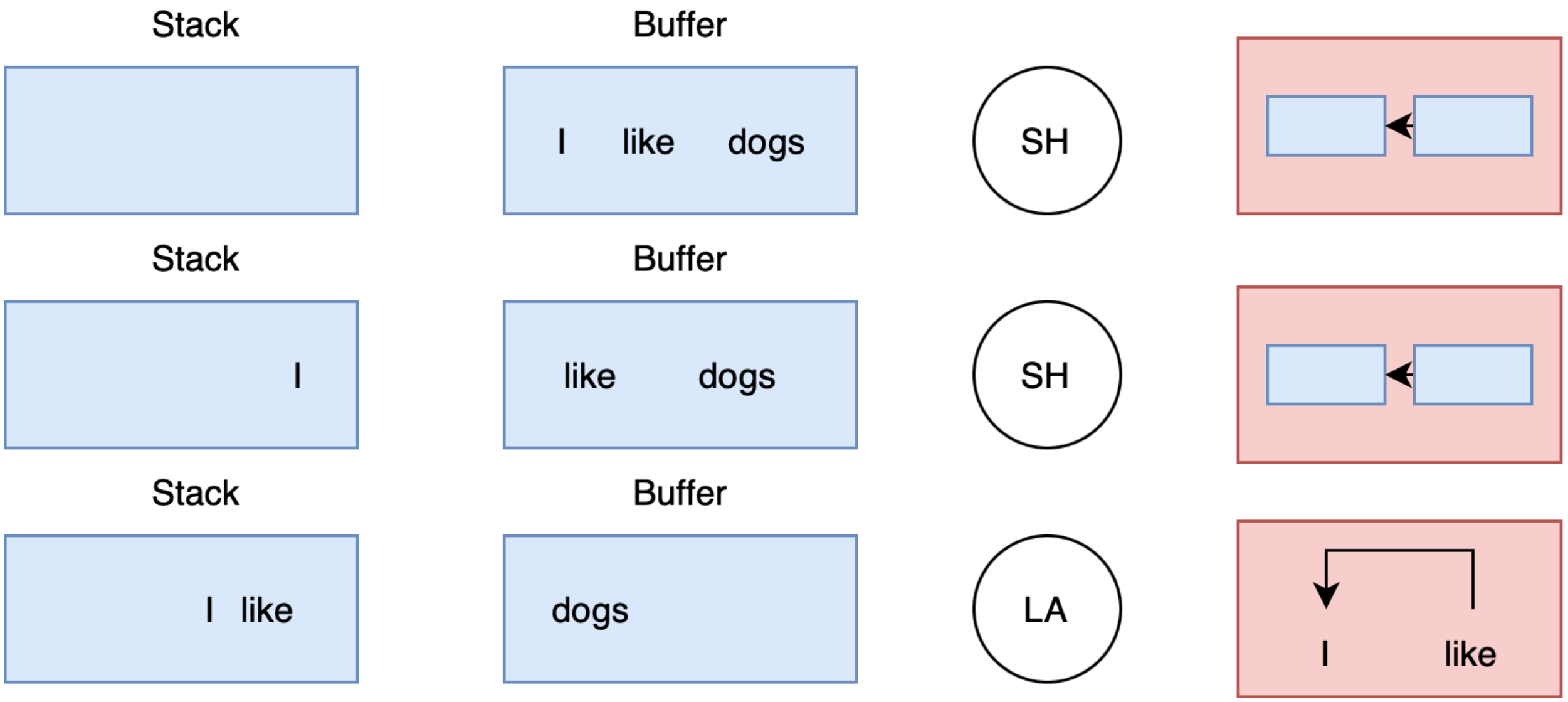
- Method for dependency parsing:
  - Start in a specified initial configuration:
  - While the parser is not in terminal configuration:
    - Predict next transition

# The Arc-Standard Algorithm

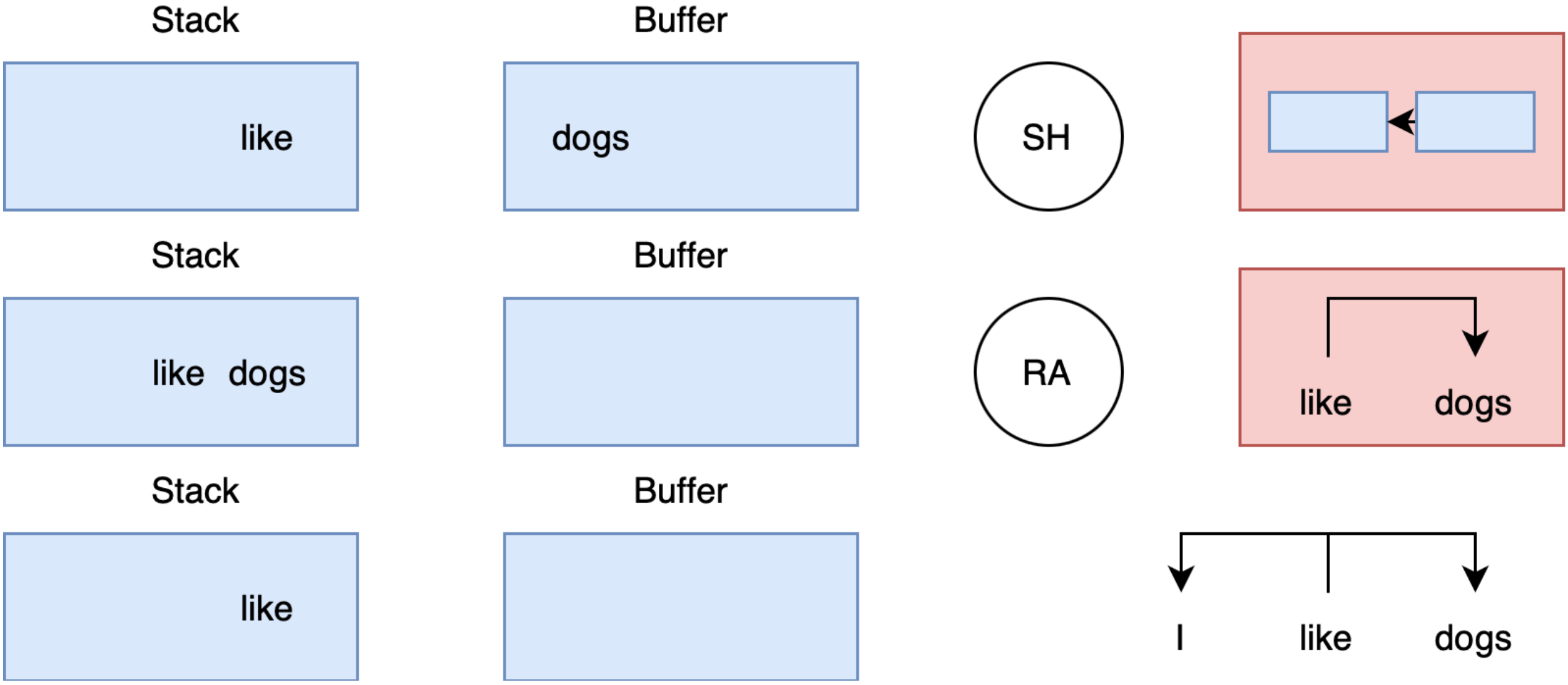



I like dogs

# The Arc-Standard Algorithm



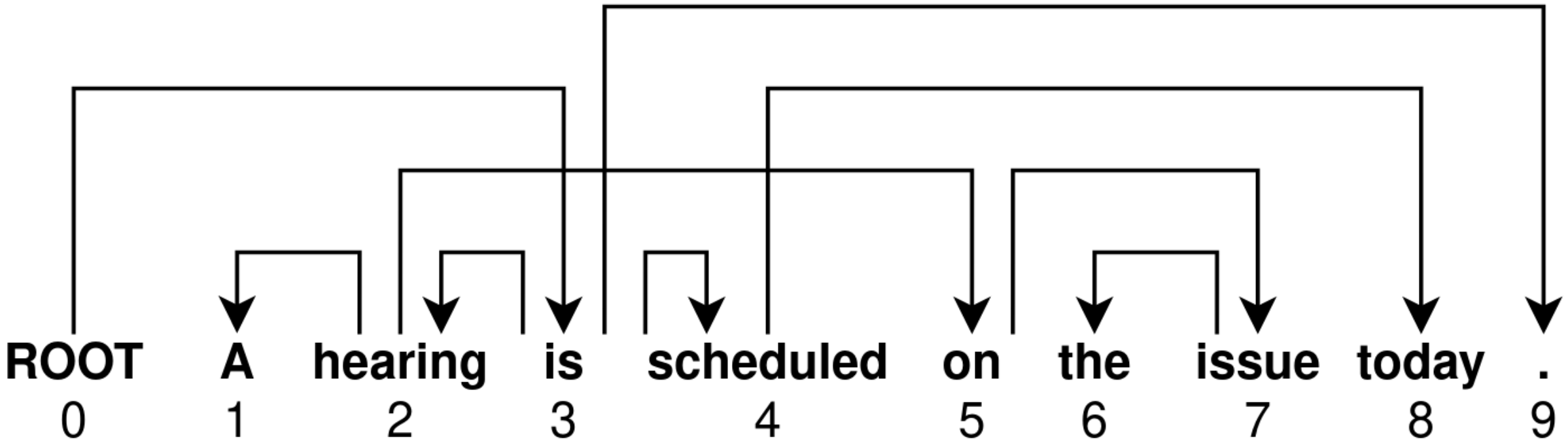
# The Arc-Standard Algorithm



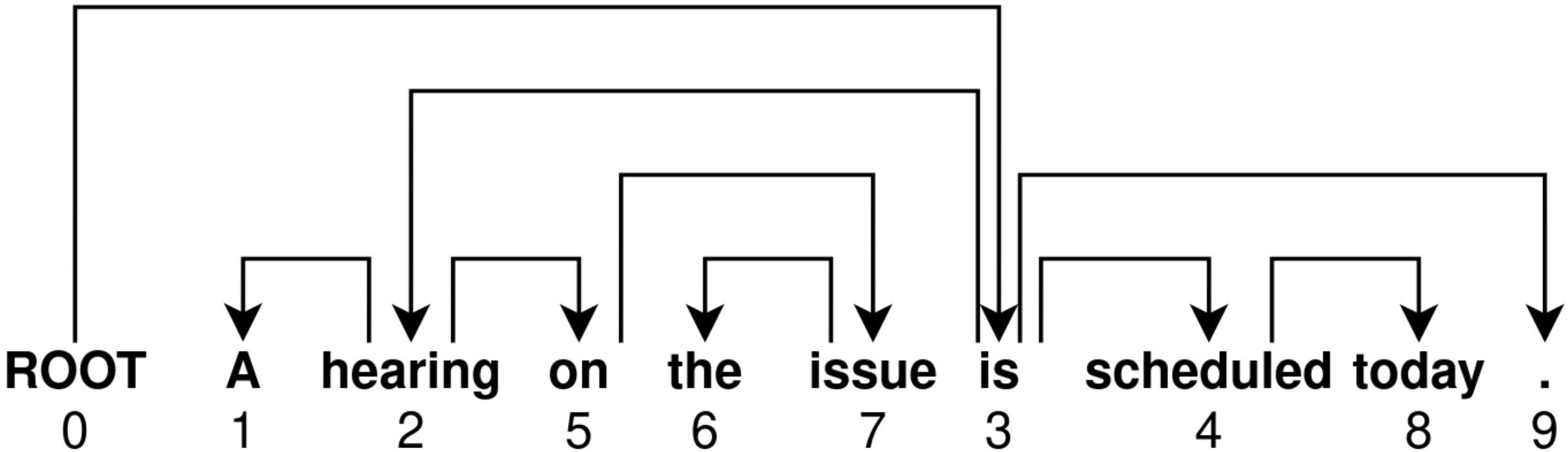
# Baseline System

- Baseline from the standard project
  - Tagger-parser pipeline
- Projectivizing treebanks with projectivize.py

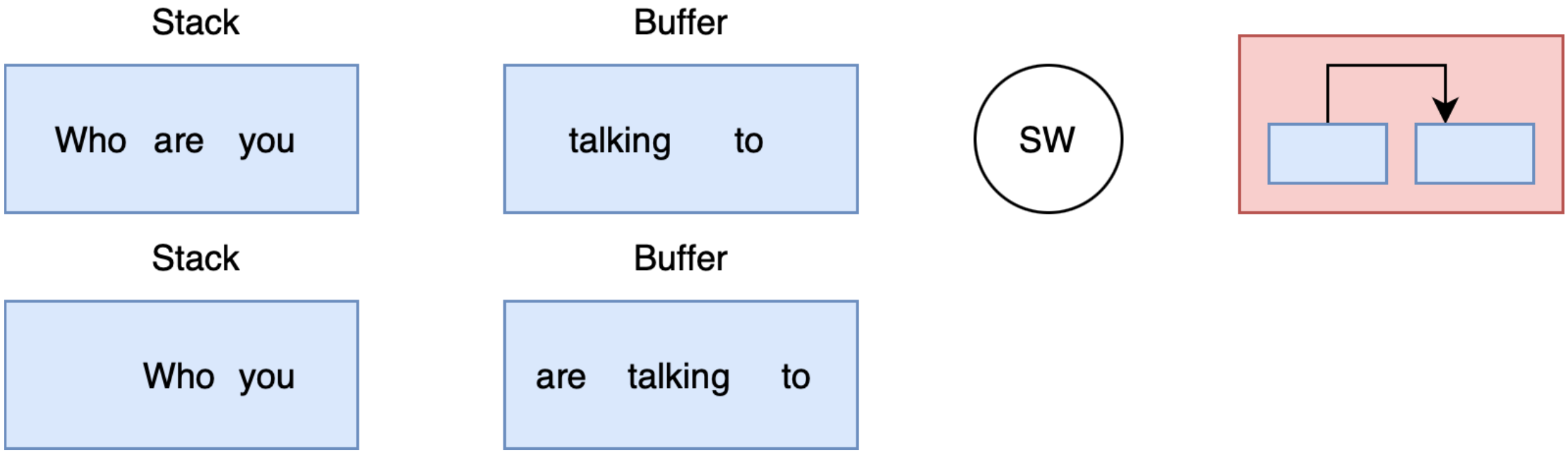
# Non-Projective Dependency Tree



# Projective Dependency Tree



# What Swap Means (Nivre, 2009)



# Our Implementations Result vs Baseline

| Model | Data | Projectivized | UAS (+tagger) |
|---|---|---|---|
| Baseline | CoNLL-U en_ewt | yes | 66,0 |
| uSwap | CoNLL-U en_ewt | no | 66,0 |
| Baseline | CoNLL-U sv_talbanken | yes | 60,9 |
| uSwap | CoNLL-U sv_talbanken | no | 59,4 |

# Baseline vs uSwap on CoNLL 2006

| | Arabic | |
|---|---|---|
| | UAS | UAS(+tagger) |
| Baseline | 68,8 | 67,3 |
| uSwap | 68,2 | 66,8 |

| | Danish | |
|---|---|---|
| | UAS | UAS(+tagger) |
| Baseline | 74,0 | 71,3 |
| uSwap | 70,6 | 68,7 |

| | Czech | |
|---|---|---|
| | UAS | UAS(+tagger) |
| Baseline | 71,5 | 69,5 |
| uSwap | 69,0 | 69,7 |

| | Slovene | |
|---|---|---|
| | UAS | UAS(+tagger) |
| Baseline | 65,0 | 58,6 |
| uSwap | 65,7 | 59,1 |

| | Turkish | |
|---|---|---|
| | UAS | UAS(+tagger) |
| Baseline | 73,3 | 68,0 |
| uSwap | 73,9 | 69,1 |

# Nivre (2009) vs lSwap

| | Arabic | |
|---|---|---|
| | LAS | EM |
| Nivre | 67,1 | 11,6 |
| lSwap | 56,2 | 8,2 |

| | Danish | |
|---|---|---|
| | LAS | EM |
| Nivre | 84,2 | 26,7 |
| lSwap | 61,4 | 9,6 |

| | Czech | |
|---|---|---|
| | LAS | EM |
| Nivre | 82,4 | 35,3 |
| lSwap | 56,2 | 5,5 |

| | Slovene | |
|---|---|---|
| | LAS | EM |
| Nivre | 75,2 | 29,9 |
| lSwap | 53,0 | 3,0 |

| | Turkish | |
|---|---|---|
| | LAS | EM |
| Nivre | 64,9 | 21,5 |
| lSwap | 57,4 | 7,5 |

# Why Our Results Might Differ

- Underlying model SVM
- Features

| | FO | L | C | P | FE | D |
|---|---|---|---|---|---|---|
| S: *top* | + | + | + | + | + | + |
| S: *top*−1 | | | | + | | |
| I: *next* | + | + | + | + | + | |
| I: *next*+1 | + | | | + | | |
| I: *next*+2 | | | | + | | |
| I: *next*+3 | | | | + | | |
| G: head of *top* | + | | | | | |
| G: leftmost dep of *top* | | | | | | + |
| G: rightmost dep of *top* | | | | | | + |
| G: leftmost dep of *next* | | | | | | + |

Table 1: Base model; S: stack, I: input, G: graph;
FO: FORM, L: LEMMA , C: CPOS, P: POS,
FE: FEATS, D: DEPREL

Labeled Pseudo-Projective Dependency Parsing with Support Vector Machines (Nivre et al, 2006)

| | FO | L | C | P | FE | D |
|---|---|---|---|---|---|---|
| S: *top* | + | | | + | | |
| S: *top*−1 | + | | | + | | |
| I: *next* | + | | | + | | |
| I: *next*+1 | | | | | | |
| I: *next*+2 | | | | | | |
| I: *next*+3 | | | | | | |
| G: head of *top* | | | | | | |
| G: leftmost dep of *top* | | | | | | |
| G: rightmost dep of *top* | | | | | | |
| G: leftmost dep of *next* | | | | | | |

Our models features

# Conclusion

- From our experiments
  - Swap allows parsing on non-projective sentences
  - The swaps effect on accuracy

- From previous work
  - Swap allows parsing on non-projective sentences
  - Can not draw fair conclusions of performance

# Sources


- Joakim Nivre. 2009. Non-projective dependency parsing in expected linear time. In Proceedings of the Joint Conference of the 47th Annual Meeting of the ACL and the 4th International Joint Conference on Natural Language Processing of the AFNLP, pages 351–359, Suntec, Singapore. Association for Computational Linguistics.
- Joakim Nivre. 2008b. Sorting out dependency parsing. In *Proceedings of the 6th International Conference on Natural Language Processing (GoTAL)*, pages 16–27.
- Ivan Titov, James Henderson, Paola Merlo, and Gabriele Musillo. 2009. Online graph planarization for synchronous parsing of semantic and syntactic dependencies. In *Proceedings of IJCAI*.
- Giuseppe Attardi. 2006. Experiments with a multilanguage non-projective dependency parser. In *Proceedings of CoNLL*, pages 166–170.
- Joakim Nivre, Johan Hall, Jens Nilsson, Gulsen Eryigit, and Svetoslav Marinov. 2006. Labeled pseudo-projective dependency parsing with support vector machines. In Proceedings of CoNLL, pages 221–225.

# Questions?