

# Arc-Hybrid Non-Projective Dependency Parsing with a Static-Dynamic Oracle

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UNIVERSITET

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- 1 **System**
  - Arc-Hybrid
  - Dynamic Oracles
  - Reordering
  - A Static-Dynamic Oracle
  - Parsing using BiLSTMs
- 2 **Experiments**
- 3 **Conclusion and Future Work**

- 1 **System**
  - Arc-Hybrid
  - Dynamic Oracles
  - Reordering
  - A Static-Dynamic Oracle
  - Parsing using BiLSTMs
- 2 **Experiments**
- 3 **Conclusion and Future Work**

# Transition-Based Parsing with Arc-Hybrid

Configuration:

STACK

BUFFER

Drive your

friend home root

Transitions:

Kuhlmann et al. (2011)

# Transition-Based Parsing with Arc-Hybrid

Configuration:

STACK

BUFFER

Drive your

friend home root

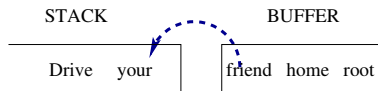
Transitions:

LEFT-ARC

Kuhlmann et al. (2011)

# Transition-Based Parsing with Arc-Hybrid

Configuration:



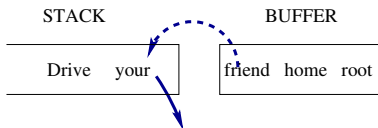
Transitions:

LEFT-ARC

Kuhlmann et al. (2011)

# Transition-Based Parsing with Arc-Hybrid

Configuration:



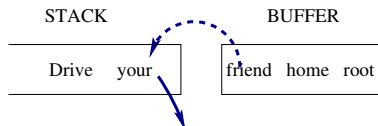
Transitions:

LEFT-ARC

Kuhlmann et al. (2011)

# Transition-Based Parsing with Arc-Hybrid

Configuration:



Transitions:

LEFT-ARC

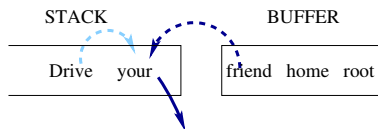
RIGHT-ARC

Kuhlmann et al. (2011)



# Transition-Based Parsing with Arc-Hybrid

Configuration:



Transitions:

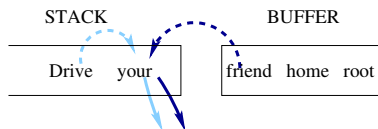
LEFT-ARC

RIGHT-ARC

Kuhlmann et al. (2011)

# Transition-Based Parsing with Arc-Hybrid

Configuration:



Transitions:

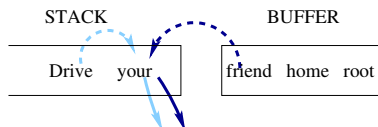
LEFT-ARC

RIGHT-ARC

Kuhlmann et al. (2011)

# Transition-Based Parsing with Arc-Hybrid

Configuration:



Transitions:

LEFT-ARC

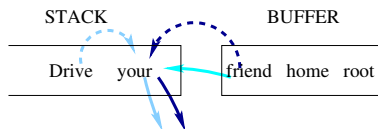
RIGHT-ARC

SHIFT

Kuhlmann et al. (2011)

# Transition-Based Parsing with Arc-Hybrid

Configuration:



Transitions:

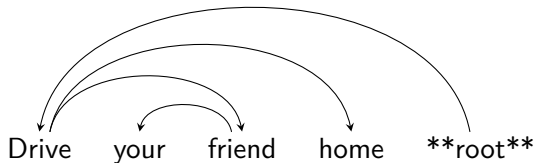
LEFT-ARC

RIGHT-ARC

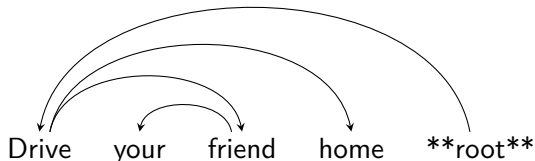
SHIFT

Kuhlmann et al. (2011)

# Static Oracle for Arc-Hybrid



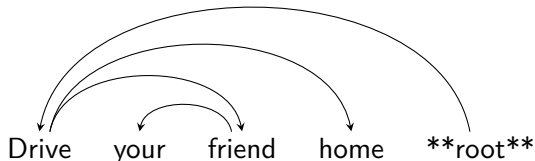
# Static Oracle for Arc-Hybrid



[ ] [Drive your friend home \*\*root\*\*]

# Static Oracle for Arc-Hybrid

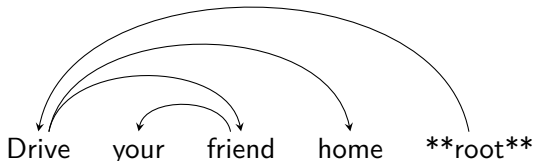
SHIFT



[ Drive ]      [ your friend home \*\*root\*\* ]

# Static Oracle for Arc-Hybrid

SHIFT

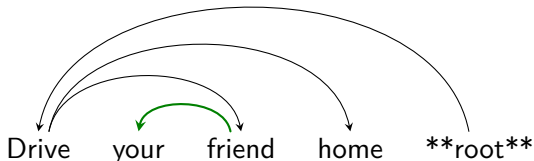


[ Drive your ]      [ friend home \*\*root\*\* ]



# Static Oracle for Arc-Hybrid

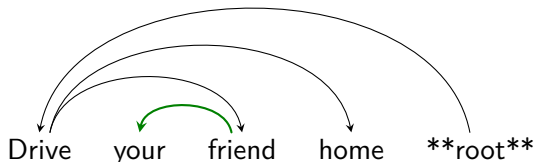
LEFT-ARC



[ Drive ]      [ friend home \*\*root\*\* ]

# Static Oracle for Arc-Hybrid

SHIFT

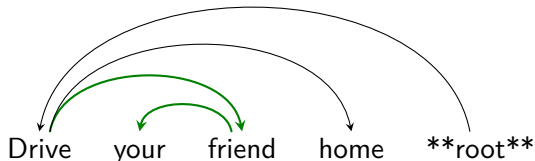


[ Drive friend ]

[ home \*\*root\*\* ]

# Static Oracle for Arc-Hybrid

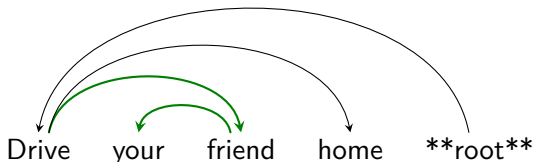
RIGHT-ARC



[ Drive ]      [ home \*\*root\*\* ]

# Static Oracle for Arc-Hybrid

SHIFT

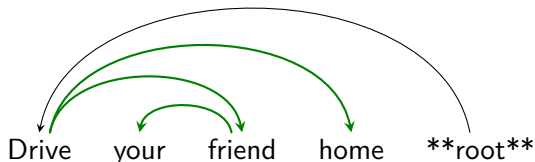


[ Drive home ]

[ \*\*root\*\* ]

# Static Oracle for Arc-Hybrid

RIGHT-ARC

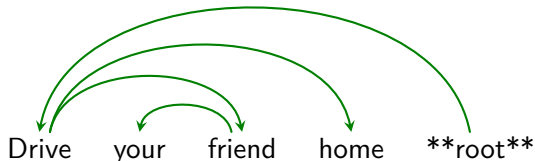


[ Drive ]

[ \*\*root\*\* ]

# Static Oracle for Arc-Hybrid

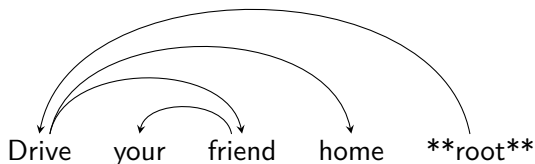
LEFT-ARC



[ ] [ **\*\*root\*\*** ]

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# Dynamic Oracle for Arc-Hybrid



[ Drive your ]

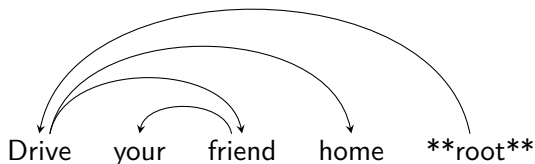
[ friend home \*\*root\*\* ]

Goldberg and Nivre (2013)



# Dynamic Oracle for Arc-Hybrid

## RIGHT-ARC



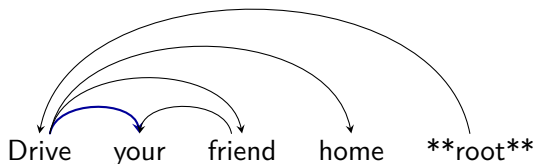
[ Drive your ]

[ friend home \*\*root\*\* ]

Goldberg and Nivre (2013)

# Dynamic Oracle for Arc-Hybrid

## RIGHT-ARC

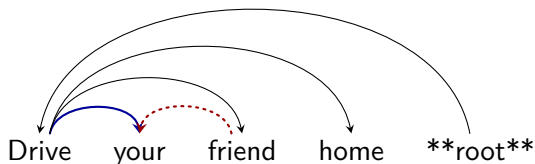


[ Drive ] [ friend home \*\*root\*\* ]

Goldberg and Nivre (2013)

# Dynamic Oracle for Arc-Hybrid

## RIGHT-ARC

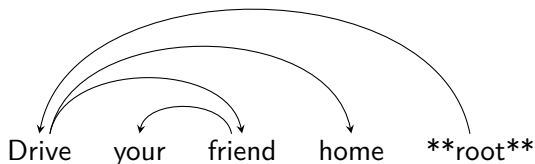


[ Drive ] [ friend home \*\*root\*\* ]

Goldberg and Nivre (2013)

# Dynamic Oracle for Arc-Hybrid

SHIFT



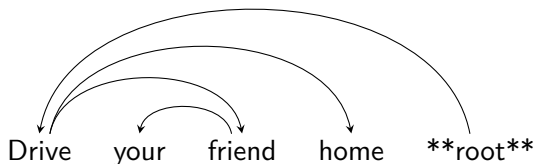
[ Drive your ]

[ friend home \*\*root\*\* ]

Goldberg and Nivre (2013)

# Dynamic Oracle for Arc-Hybrid

SHIFT



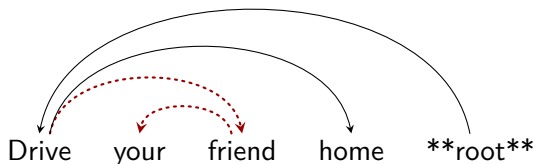
[ Drive your friend ]

[ home \*\*root\*\* ]

Goldberg and Nivre (2013)

# Dynamic Oracle for Arc-Hybrid

SHIFT



[ Drive your friend ]

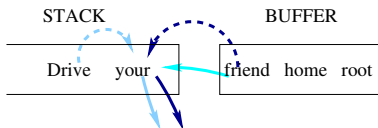
[ home \*\*root\*\* ]

Goldberg and Nivre (2013)

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# Arc-Hybrid Parsing with Reordering

Configuration:



Transitions:

LEFT-ARC

RIGHT-ARC

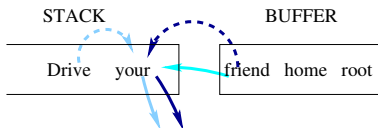
SHIFT

Nivre (2009)



# Arc-Hybrid Parsing with Reordering

Configuration:



Transitions:

LEFT-ARC

RIGHT-ARC

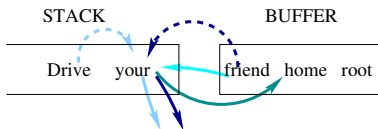
SHIFT

SWAP

Nivre (2009)

# Arc-Hybrid Parsing with Reordering

Configuration:



Transitions:

LEFT-ARC

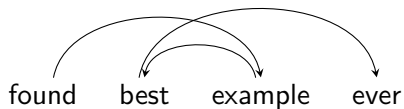
RIGHT-ARC

SHIFT

SWAP

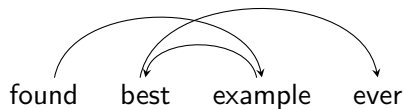
Nivre (2009)

# Arc-Hybrid Parsing with Reordering

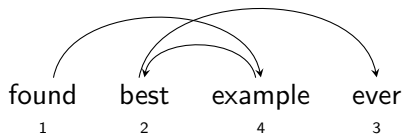


Thanks Carlos Gomez-Rodriguez for the example!

# Arc-Hybrid Parsing with Reordering

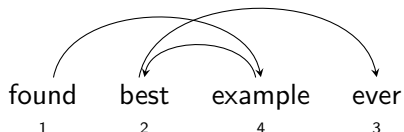


# Arc-Hybrid Parsing with Reordering



# Arc-Hybrid Parsing with Reordering

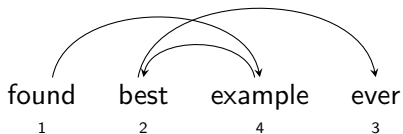
SHIFT



[ ] [ found<sub>1</sub> best<sub>2</sub> example<sub>4</sub> ever<sub>3</sub> ]

# Arc-Hybrid Parsing with Reordering

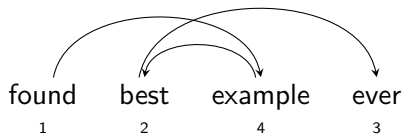
SHIFT



[ found<sub>1</sub> ] [ best<sub>2</sub> example<sub>4</sub> ever<sub>3</sub> ]

# Arc-Hybrid Parsing with Reordering

SHIFT



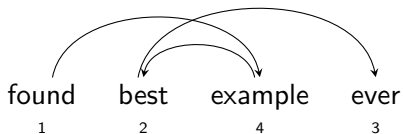
[ found<sub>1</sub> best<sub>2</sub> ]

[ example<sub>4</sub> ever<sub>3</sub> ]



# Arc-Hybrid Parsing with Reordering

SHIFT

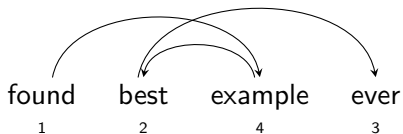


[ found<sub>1</sub> best<sub>2</sub> example<sub>4</sub> ]

[ ever<sub>3</sub> ]

# Arc-Hybrid Parsing with Reordering

SHIFT

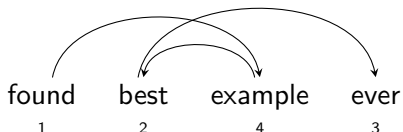


[ found<sub>1</sub> best<sub>2</sub> example<sub>4</sub> ]

[ ever<sub>3</sub> ]

# Arc-Hybrid Parsing with Reordering

SWAP

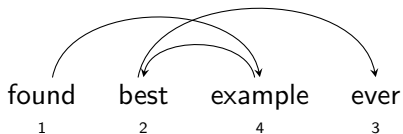


[ found<sub>1</sub> best<sub>2</sub> ]

[ ever<sub>3</sub> example<sub>4</sub> ]

# Arc-Hybrid Parsing with Reordering

SHIFT



[ found<sub>1</sub> best<sub>2</sub> ever<sub>3</sub> ]

[ example<sub>4</sub> ]

# Arc-Hybrid Parsing with Reordering

## RIGHT-ARC

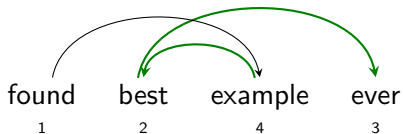


[ found<sub>1</sub> best<sub>2</sub> ]

[ example<sub>4</sub> ]

# Arc-Hybrid Parsing with Reordering

## LEFT-ARC

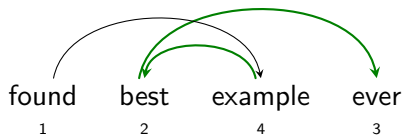


[ found<sub>1</sub> ]

[ example<sub>4</sub> ]

# Arc-Hybrid Parsing with Reordering

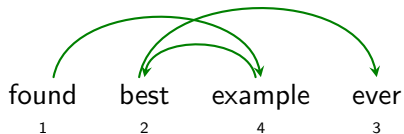
SHIFT



[ found<sub>1</sub> example<sub>4</sub> ]    [ ]

# Arc-Hybrid Parsing with Reordering

RIGHT-ARC

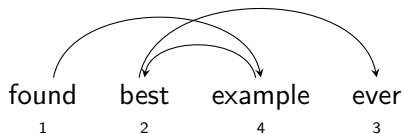


[ found<sub>1</sub> ]    [ ]



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# A Static-Dynamic Oracle

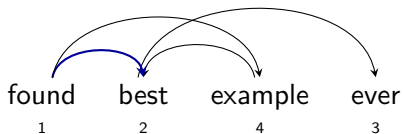


[ found<sub>1</sub> best<sub>2</sub> ]

[ example<sub>4</sub> ever<sub>3</sub> ]

# A Static-Dynamic Oracle

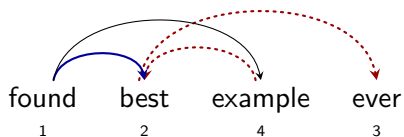
## RIGHT-ARC



[ found<sub>1</sub> ]    [ example<sub>4</sub> ever<sub>3</sub> ]

# A Static-Dynamic Oracle

## RIGHT-ARC

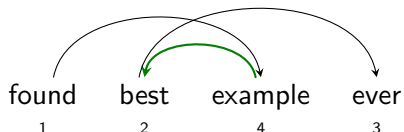


[ found<sub>1</sub> ]

[ example<sub>4</sub> ever<sub>3</sub> ]

# A Static-Dynamic Oracle

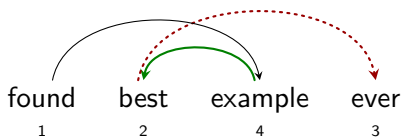
## LEFT-ARC



[ found<sub>1</sub> ]    [ example<sub>4</sub> ever<sub>3</sub> ]

# A Static-Dynamic Oracle

## LEFT-ARC

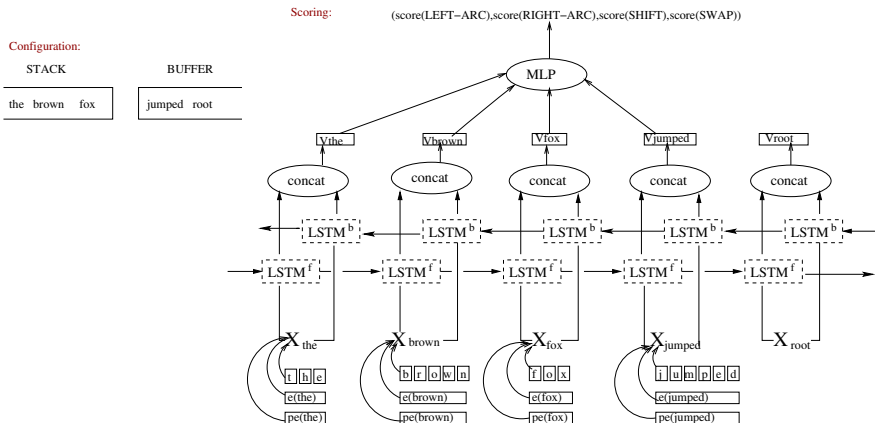


[ found<sub>1</sub> ]

[ example<sub>4</sub> ever<sub>3</sub> ]

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# Transition-Based Parsing using BiLSTMs



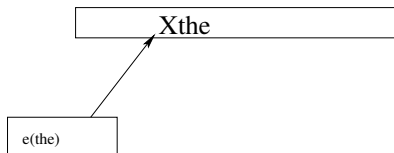
Kiperwasser and Goldberg (2016); de Lhoneux et al. (2017)



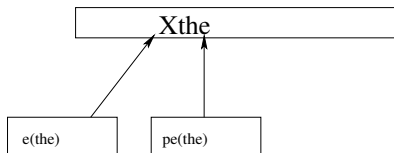
# Transition-Based Parsing using BiLSTMs

Xthe

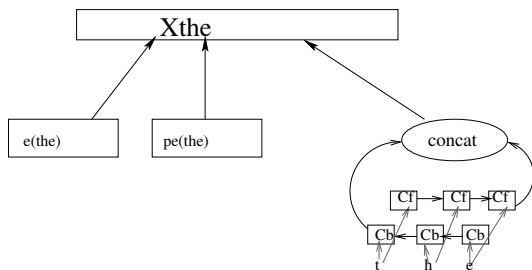
# Transition-Based Parsing using BiLSTMs



# Transition-Based Parsing using BiLSTMs



# Transition-Based Parsing using BiLSTMs



# Transition-Based Parsing using BiLSTMs

$X_{\text{the}}$

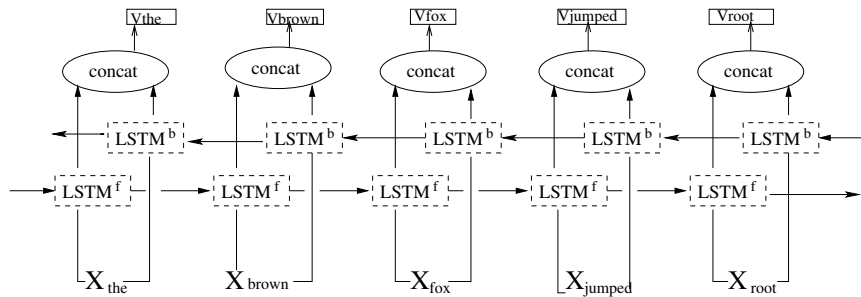
$X_{\text{brown}}$

$X_{\text{fox}}$

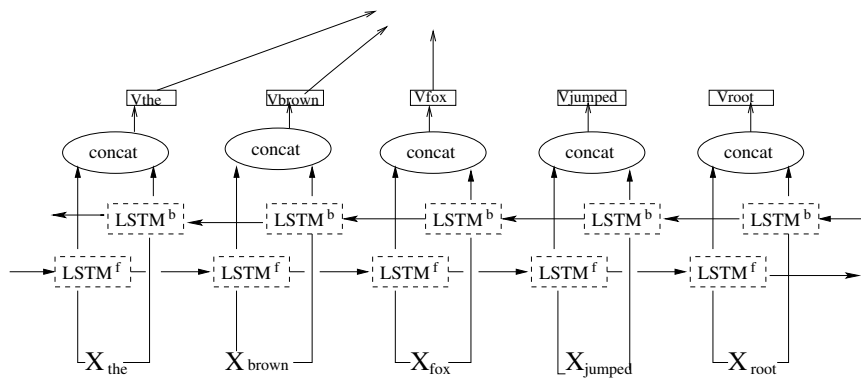
$X_{\text{jumped}}$

$X_{\text{root}}$

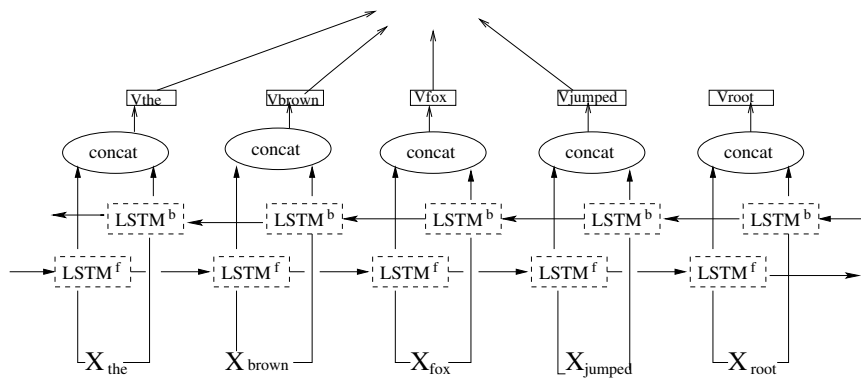
# Transition-Based Parsing using BiLSTMs



# Transition-Based Parsing using BiLSTMs

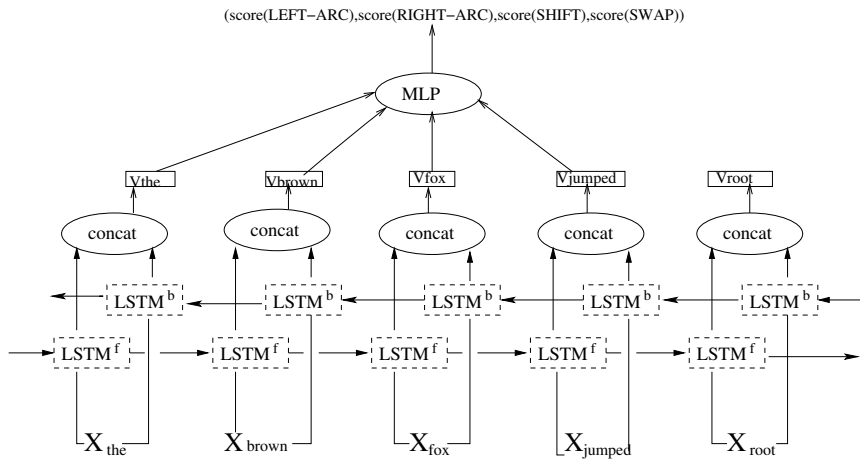


# Transition-Based Parsing using BiLSTMs



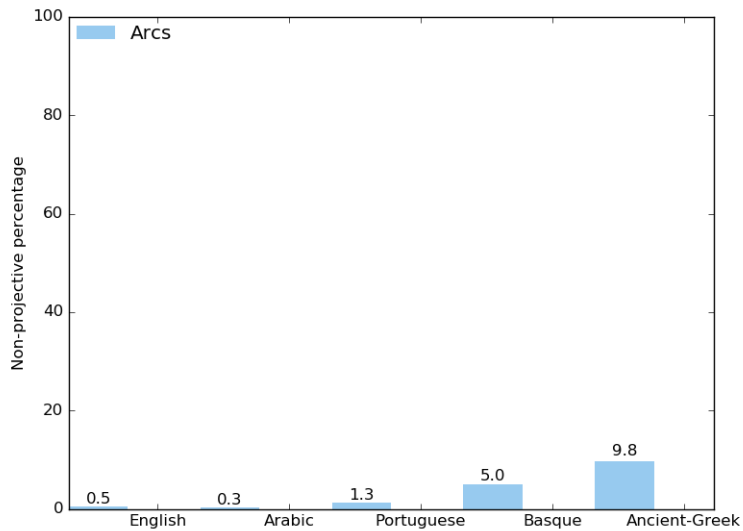


# Transition-Based Parsing using BiLSTMs

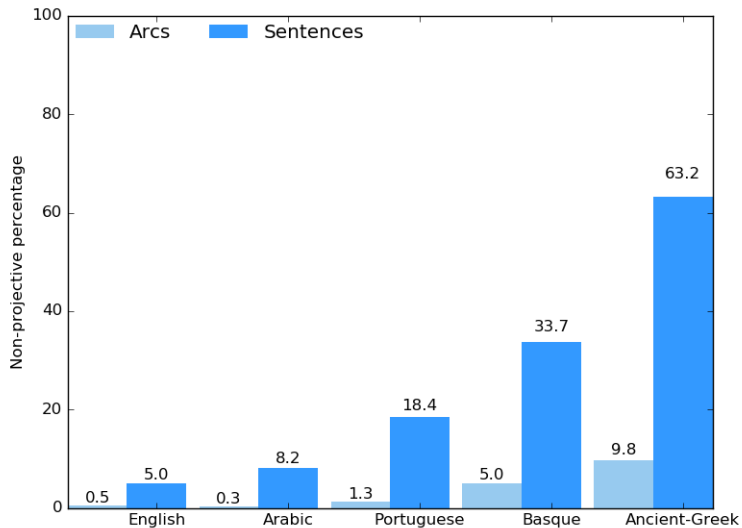


# Experiments

# Experiments



# Experiments



- Static (baseline)
- Static-Dynamic (this work)
- Pseudo-Projective
- Projective (baseline)

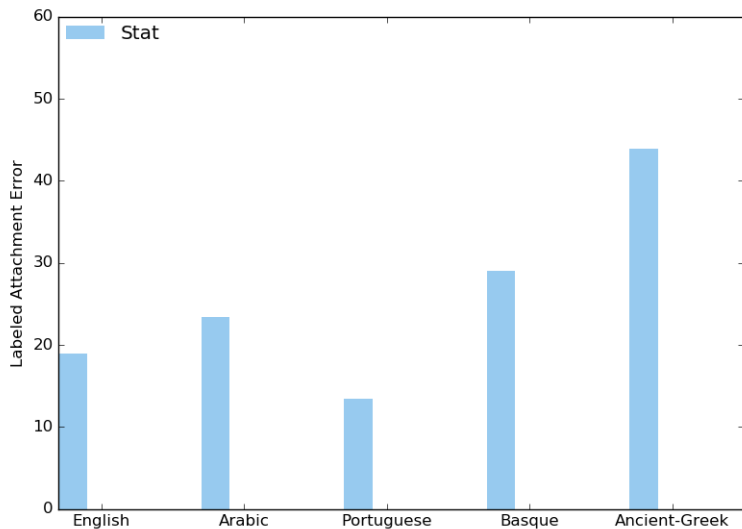
- Static (baseline)
- Static-Dynamic (this work)
- Pseudo-Projective
- Projective (baseline)

- Static (baseline)
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- Pseudo-Projective
- Projective (baseline)

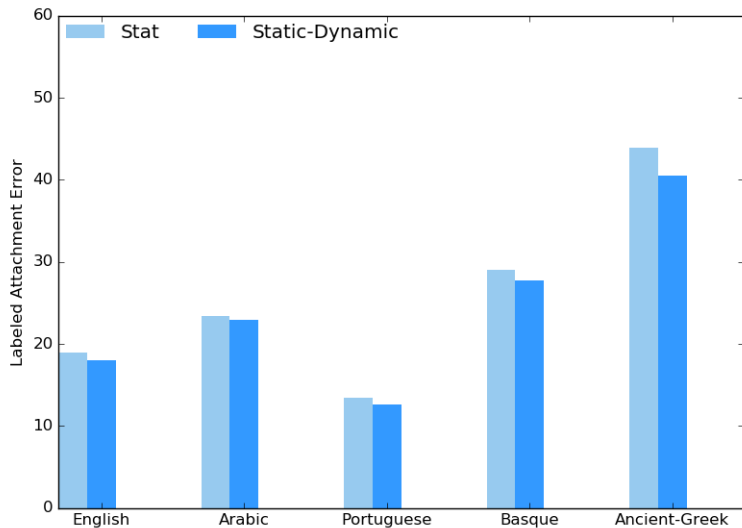
- Static (baseline)
- Static-Dynamic (this work)
- Pseudo-Projective
- Projective (baseline)



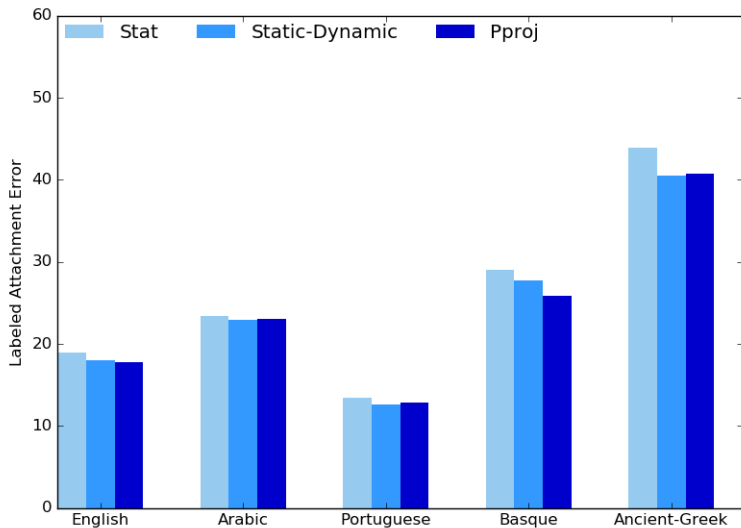
# Experiments



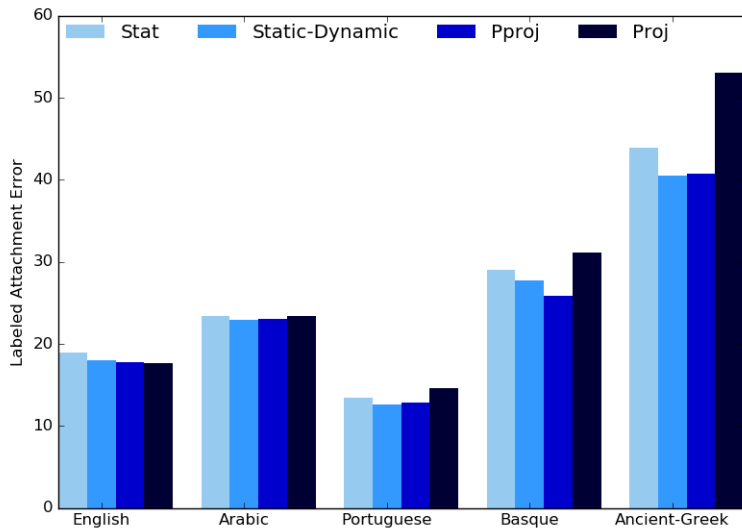
# Experiments



# Experiments



# Experiments



# Conclusion

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- We integrated a swap transition into arc-hybrid

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- We defined an oracle that is partially dynamic for this system



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## Future Work

## Conclusion

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## Future Work

- Proper hyperparameter tuning

## Conclusion

- We integrated a swap transition into arc-hybrid
- We defined an oracle that is partially dynamic for this system
- Our system benefits from error exploration

## Future Work

- Proper hyperparameter tuning
- A fully dynamic oracle?

- Miryam de Lhoneux, Yan Shao, Ali Basirat, Eliyahu Kiperwasser, Sara Stymne, Yoav Goldberg, and Joakim Nivre. 2017. From raw text to universal dependencies - look, no tags! In *Proceedings of the CoNLL 2017 Shared Task: Multilingual Parsing from Raw Text to Universal Dependencies*. Association for Computational Linguistics, Vancouver, Canada, pages 207–217.
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