

Hierarchical Search for Word Alignment

Jason Riesa and Daniel Marcu

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USC Viterbi
School of Engineering

ACL 2010



the five previous tests have been limited to the target missile and one other body .

واقترنت

التجارب

الخمس

السابقة

على

الصاروخ

المستهدف

وجسم

آخر

واحد

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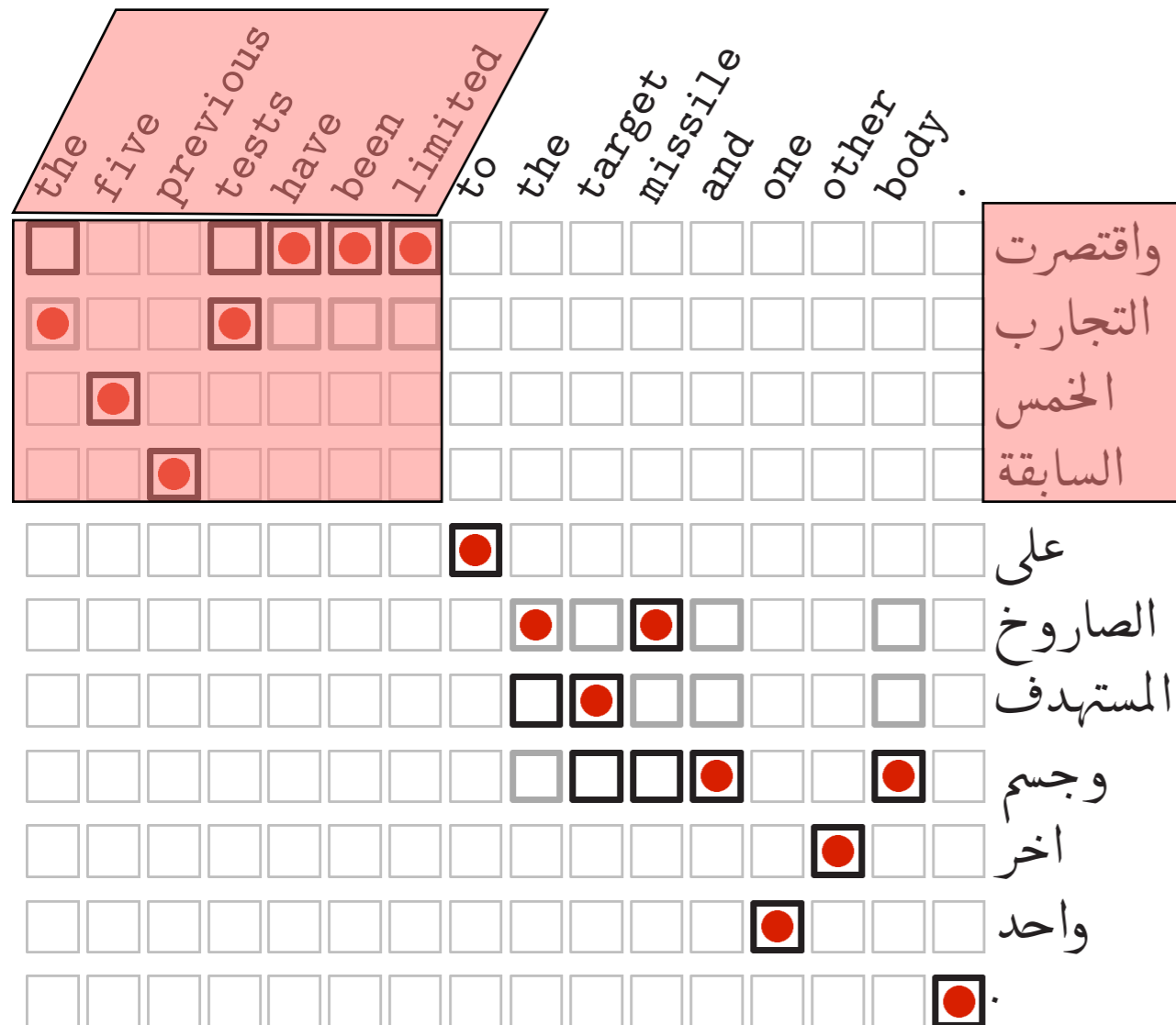
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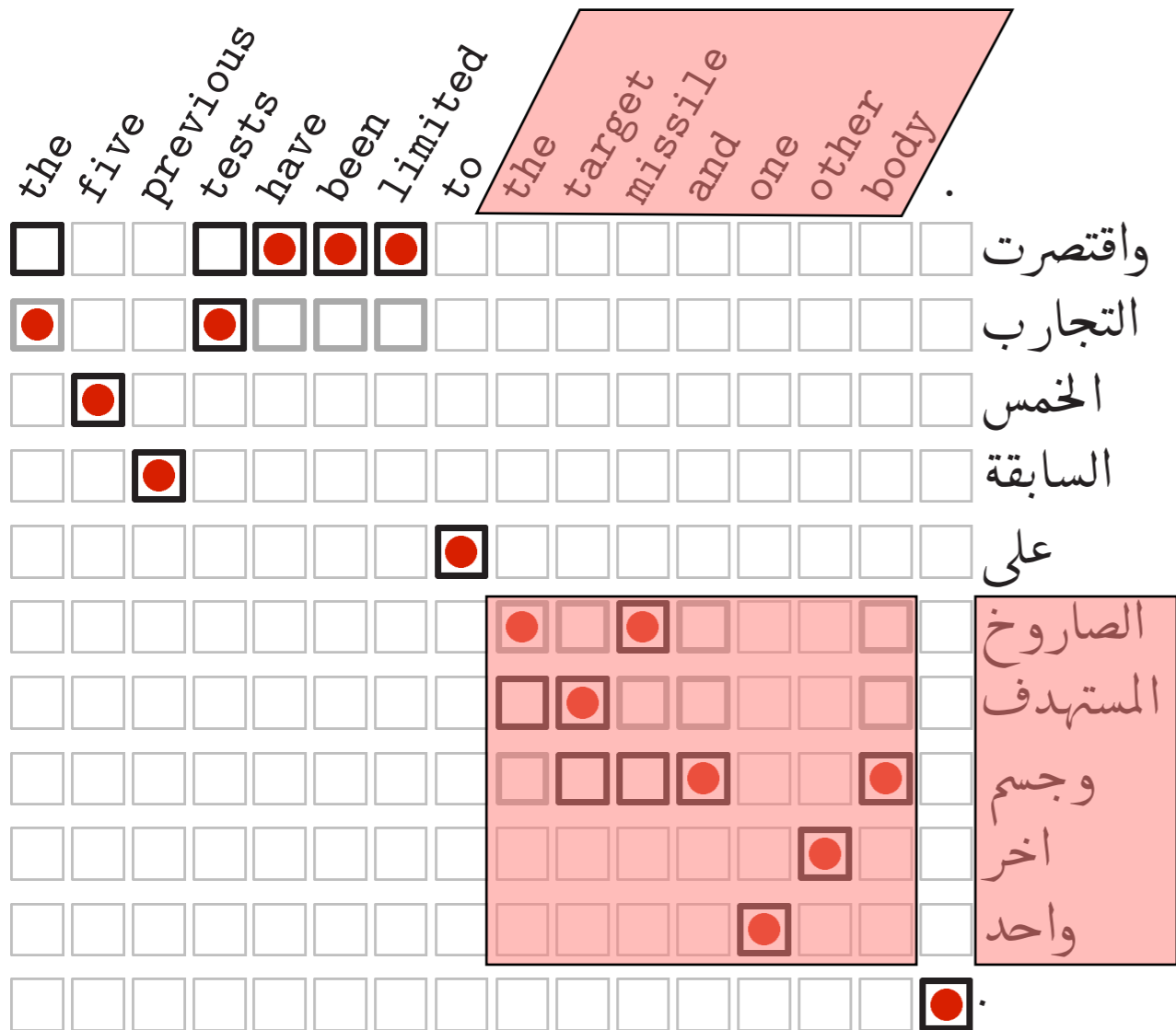
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Learning from bad alignments



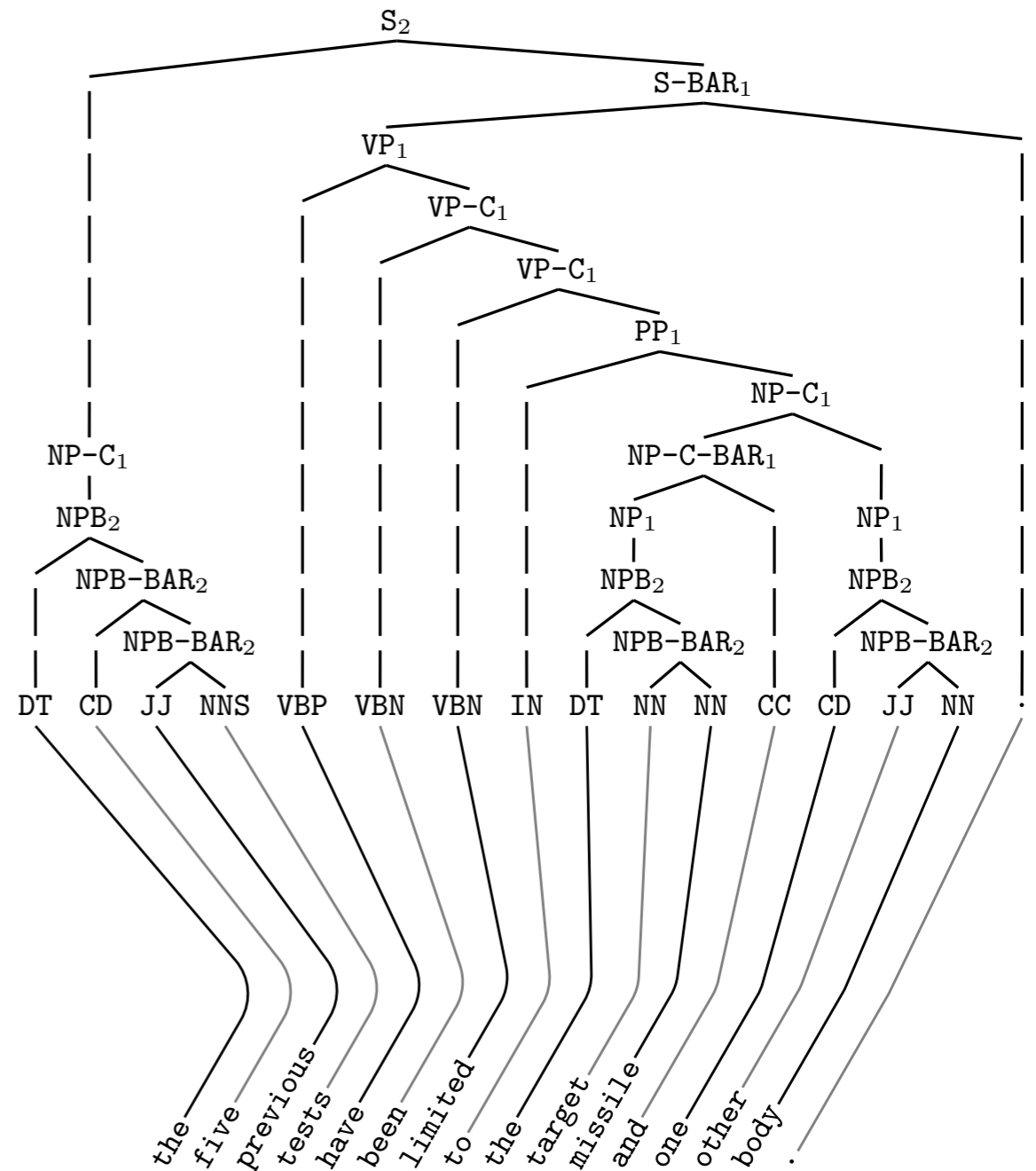
- This is a typical Model4 alignment.
(Brown et al., 93; Och and Ney, 02)
- Extracted translation rules too big
- Not always in-sync with translation model

Learning from bad alignments



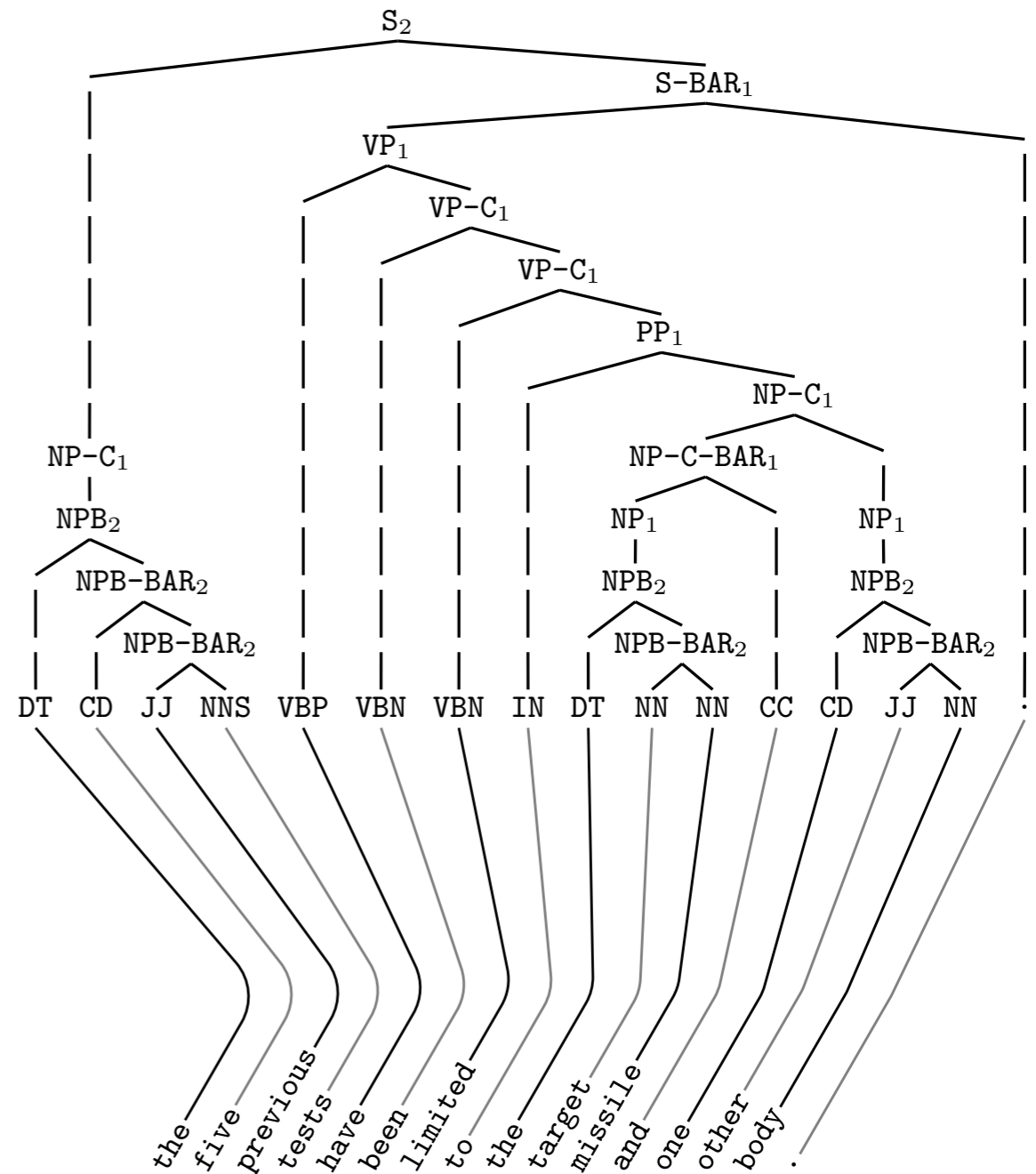
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1. What knowledge sources can we exploit?

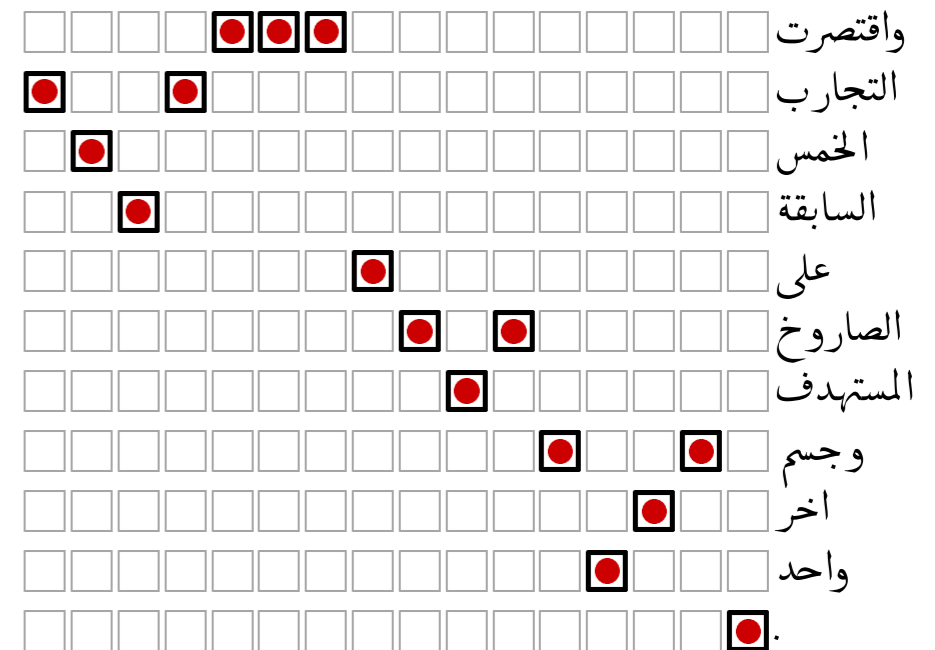


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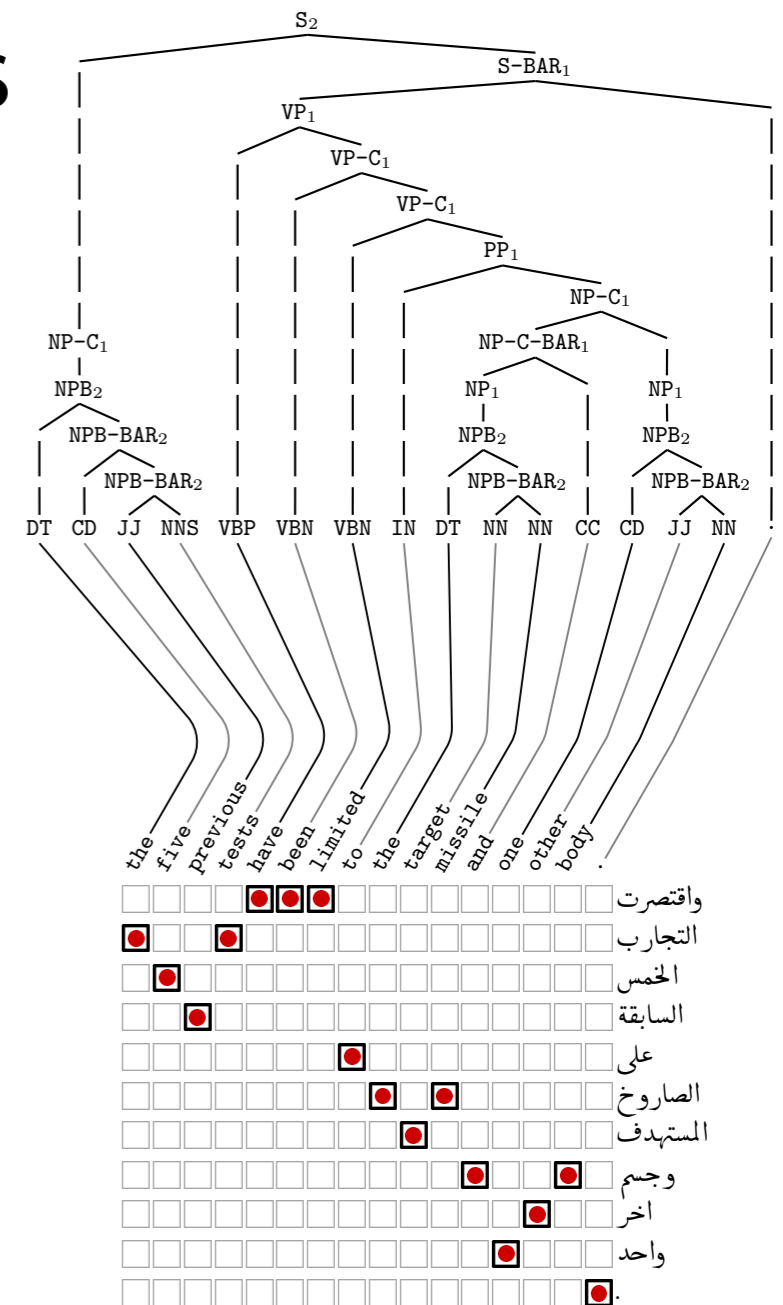


- We are doing **syntax-based translation**.
- Why not use the tree?



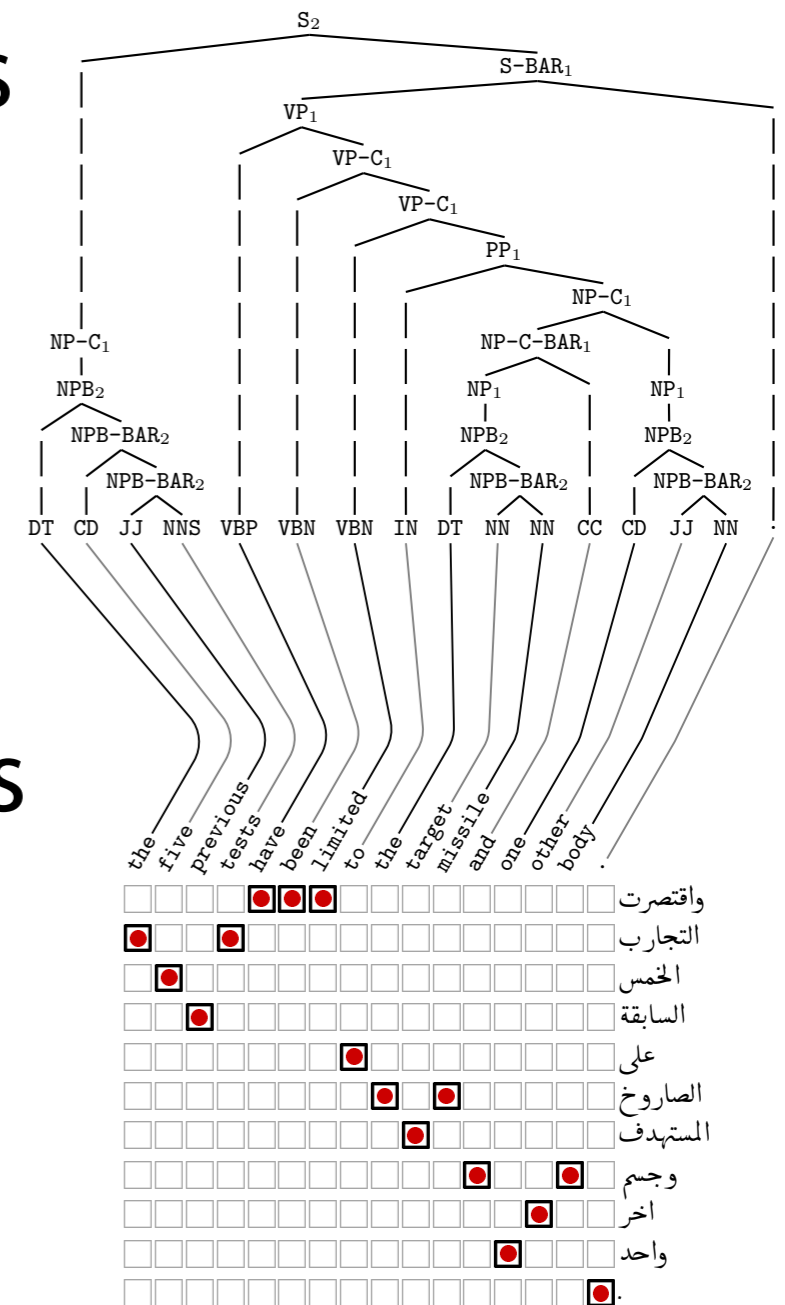
2. What makes a good alignment?

- Lexical, syntactic + structural features



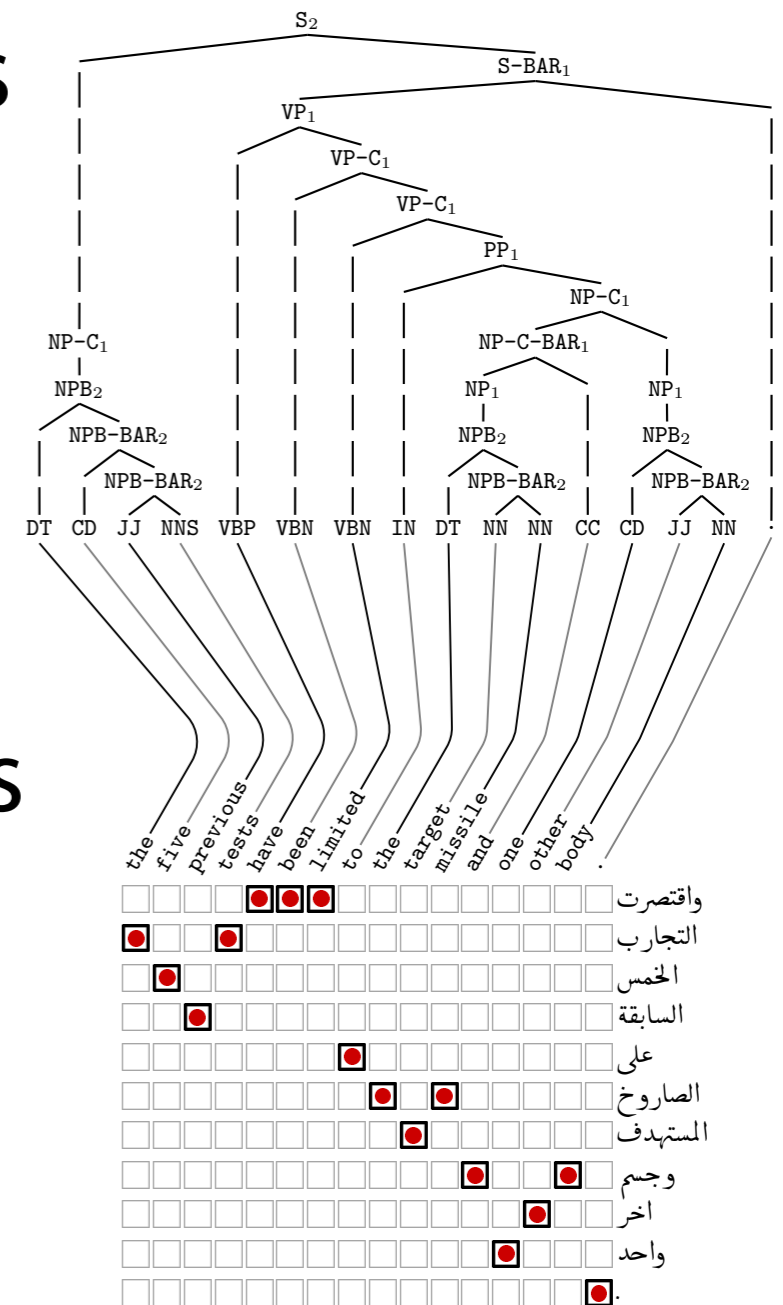
2. What makes a good alignment?

- Lexical, syntactic + structural features
- Difficult to capture in generative alignment models
- Local and nonlocal
- Linear combination of model features



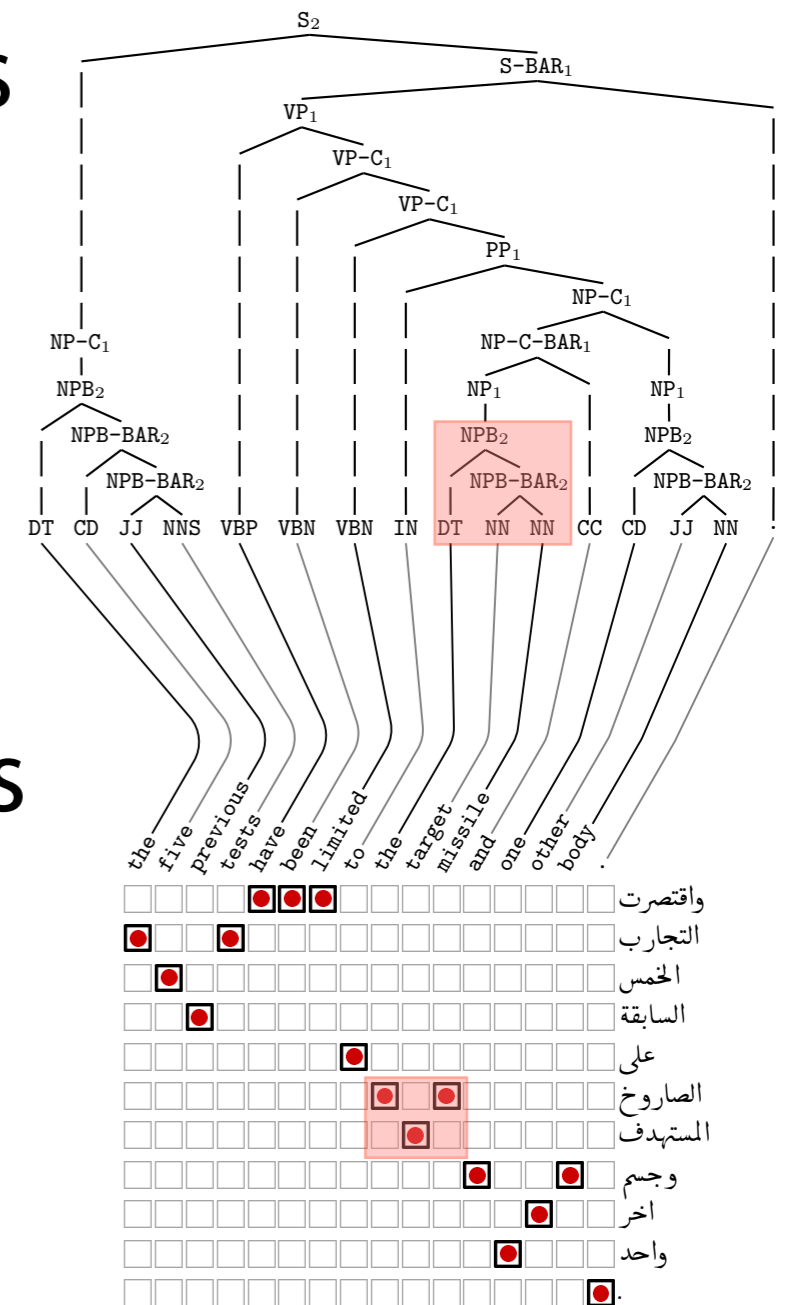
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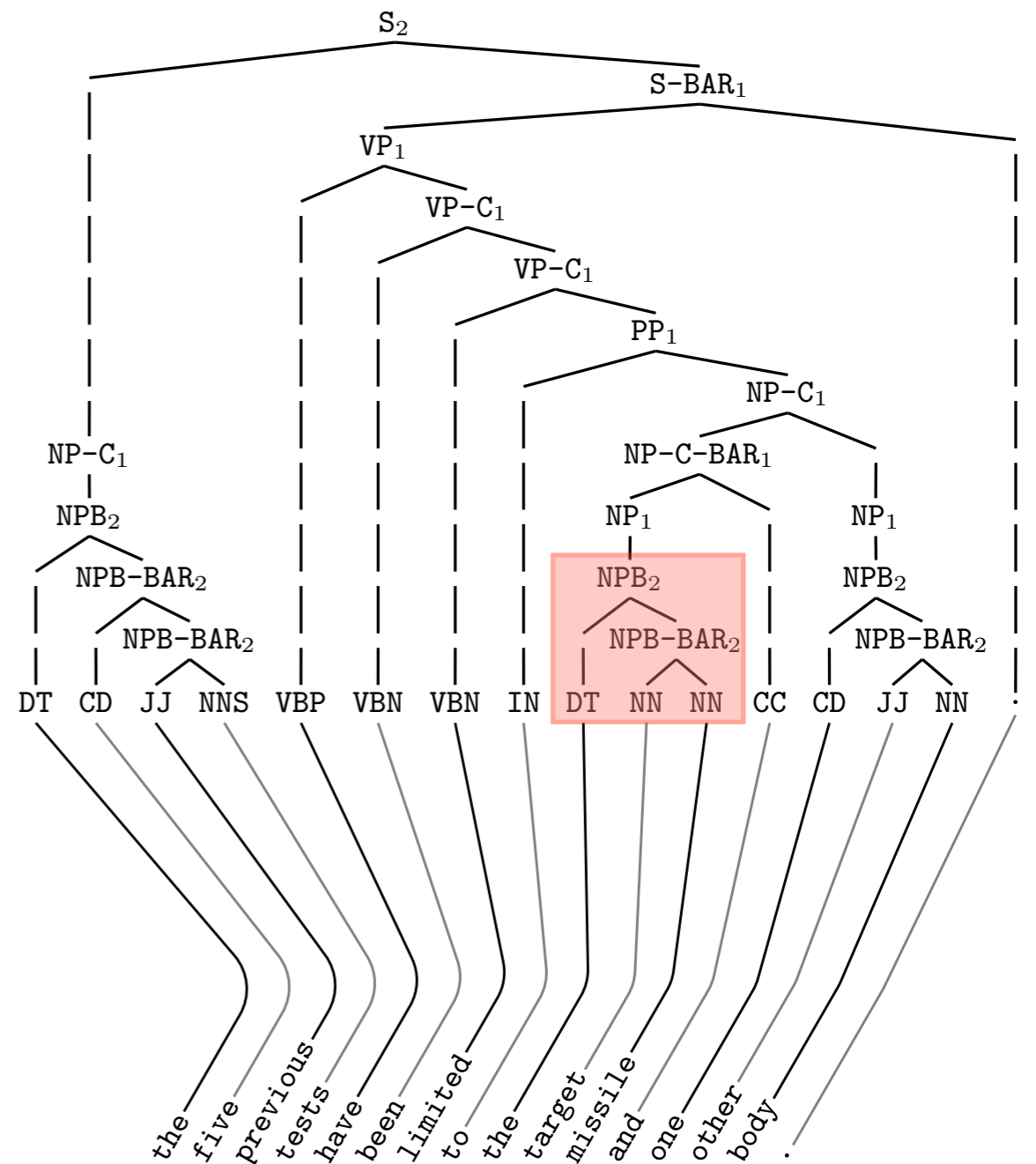
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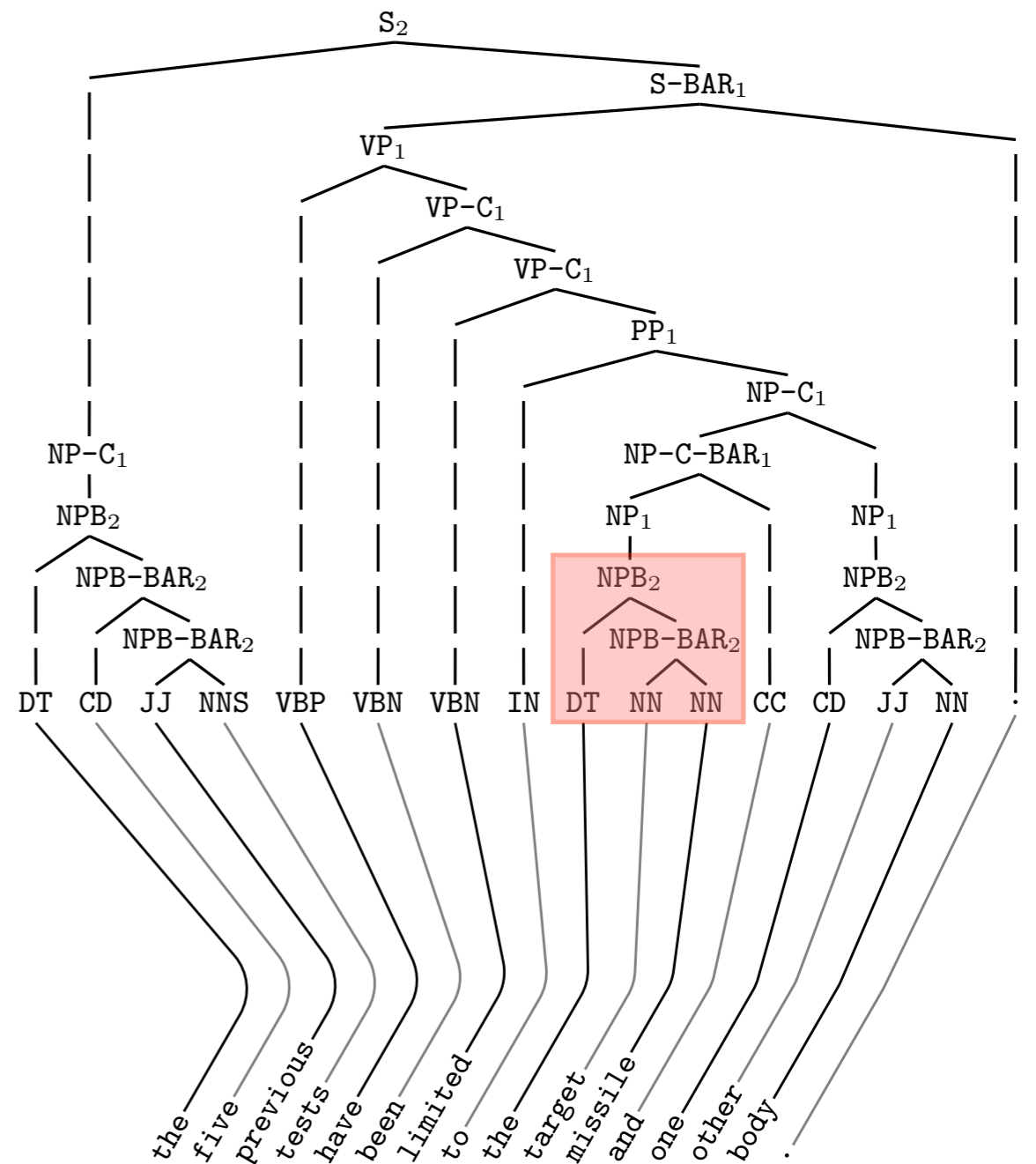
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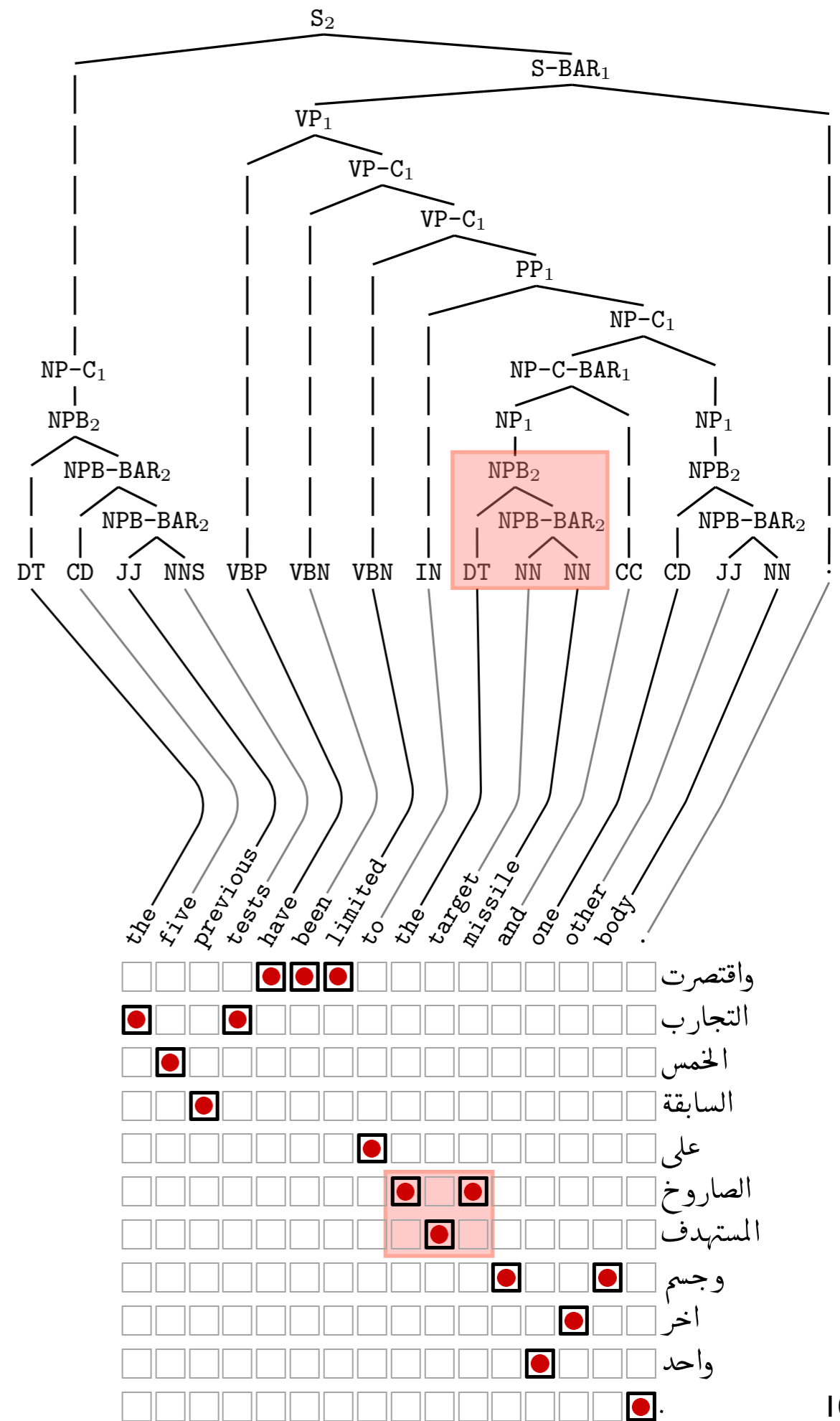


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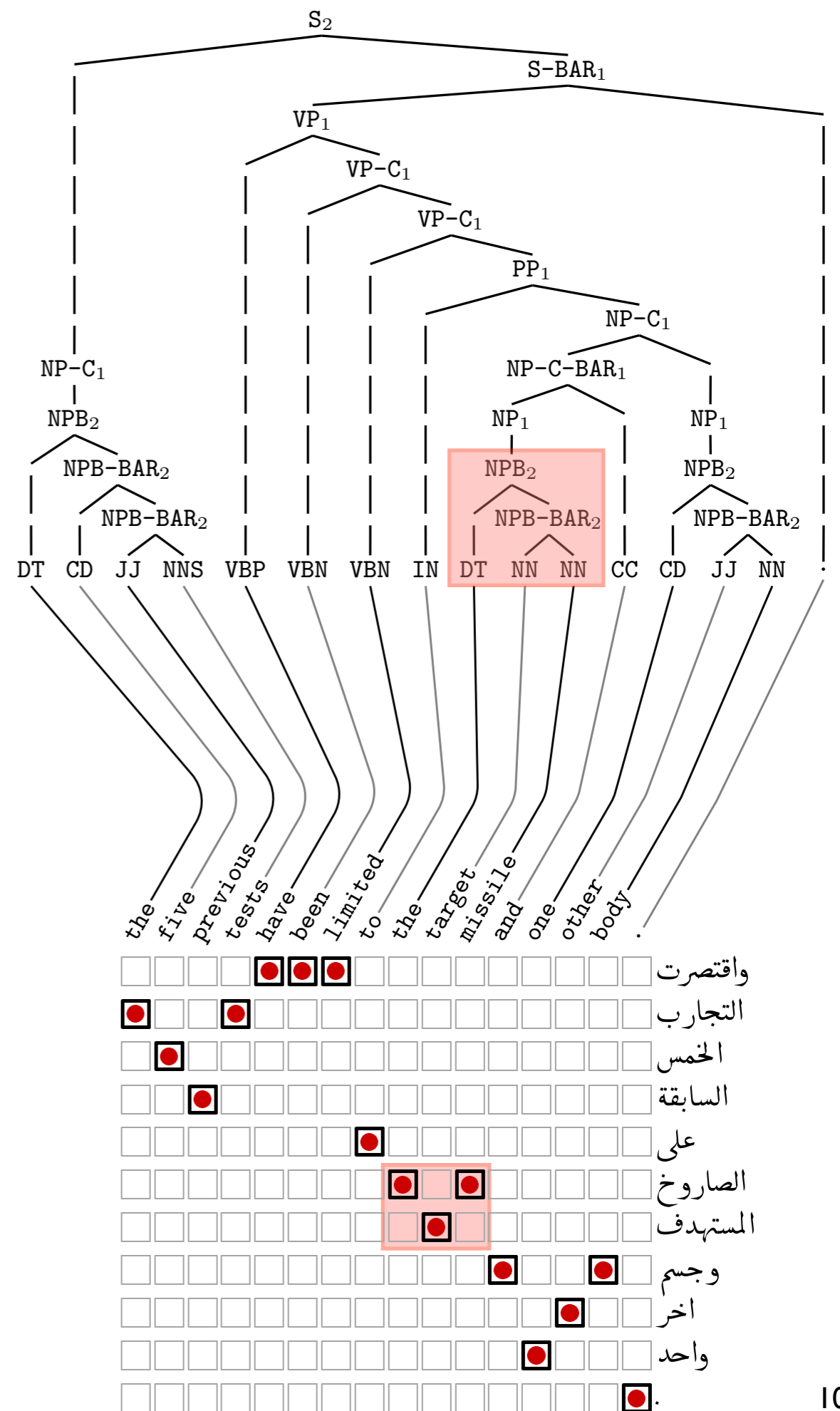


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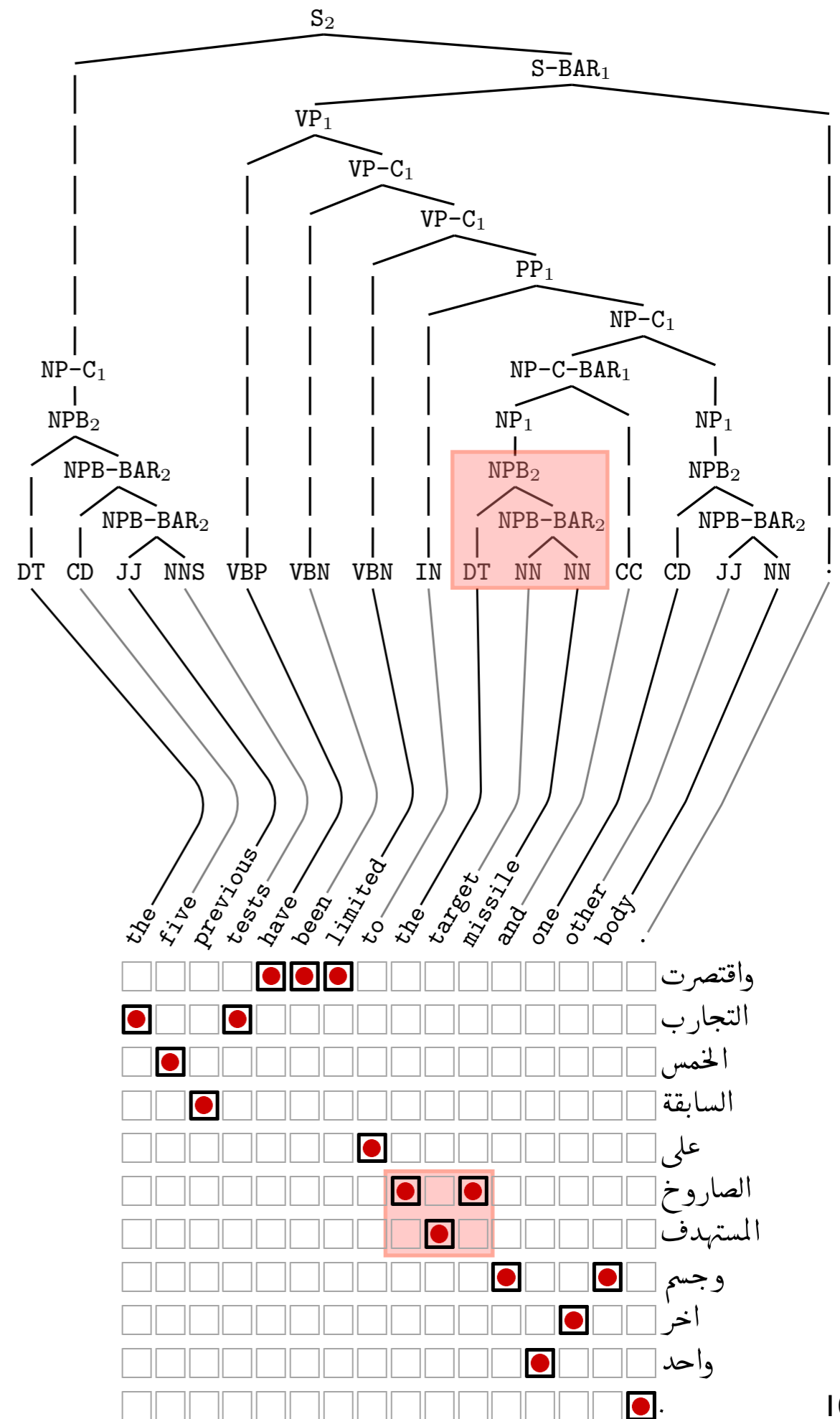
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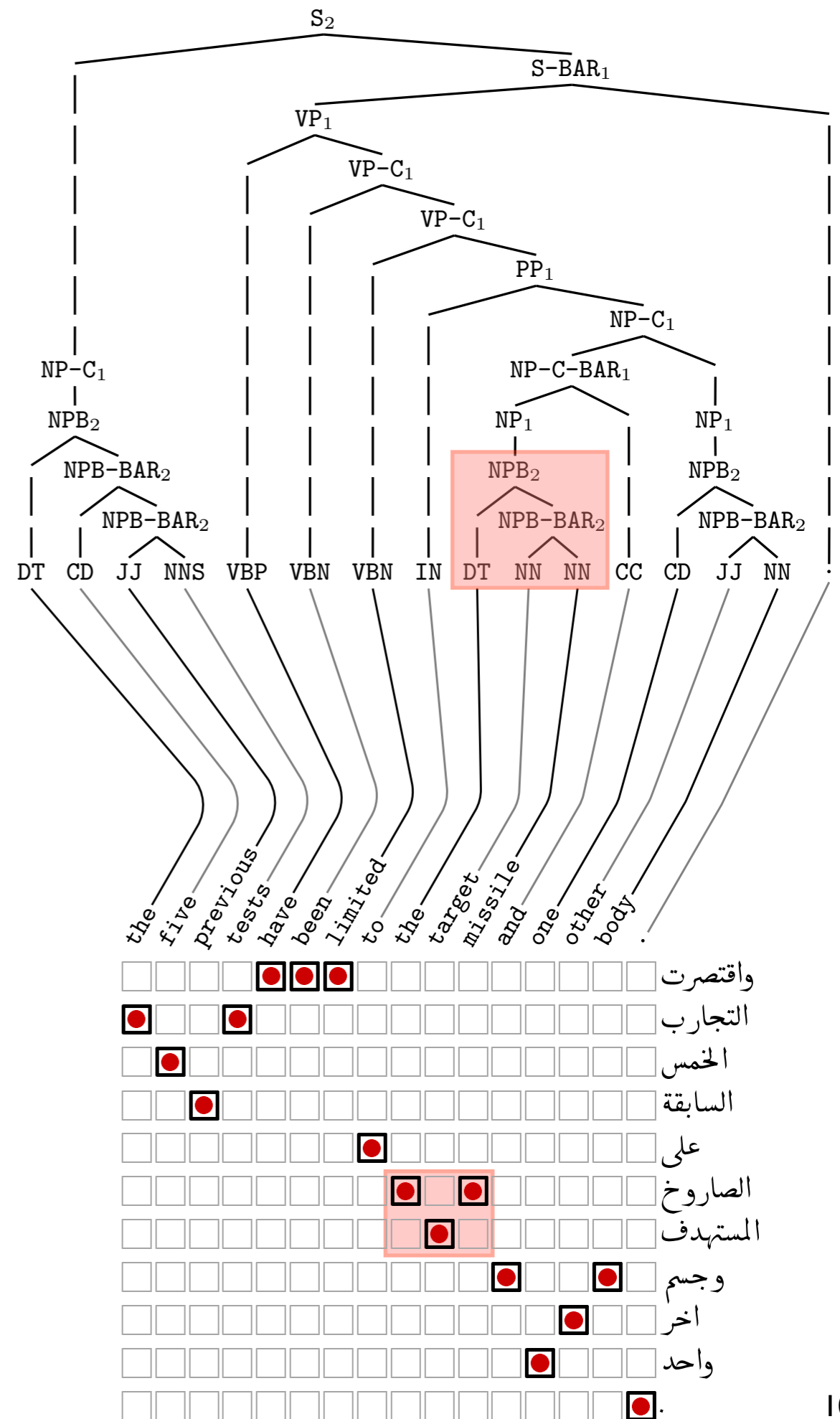
- syntactic nonlocal features
- tree distance feature



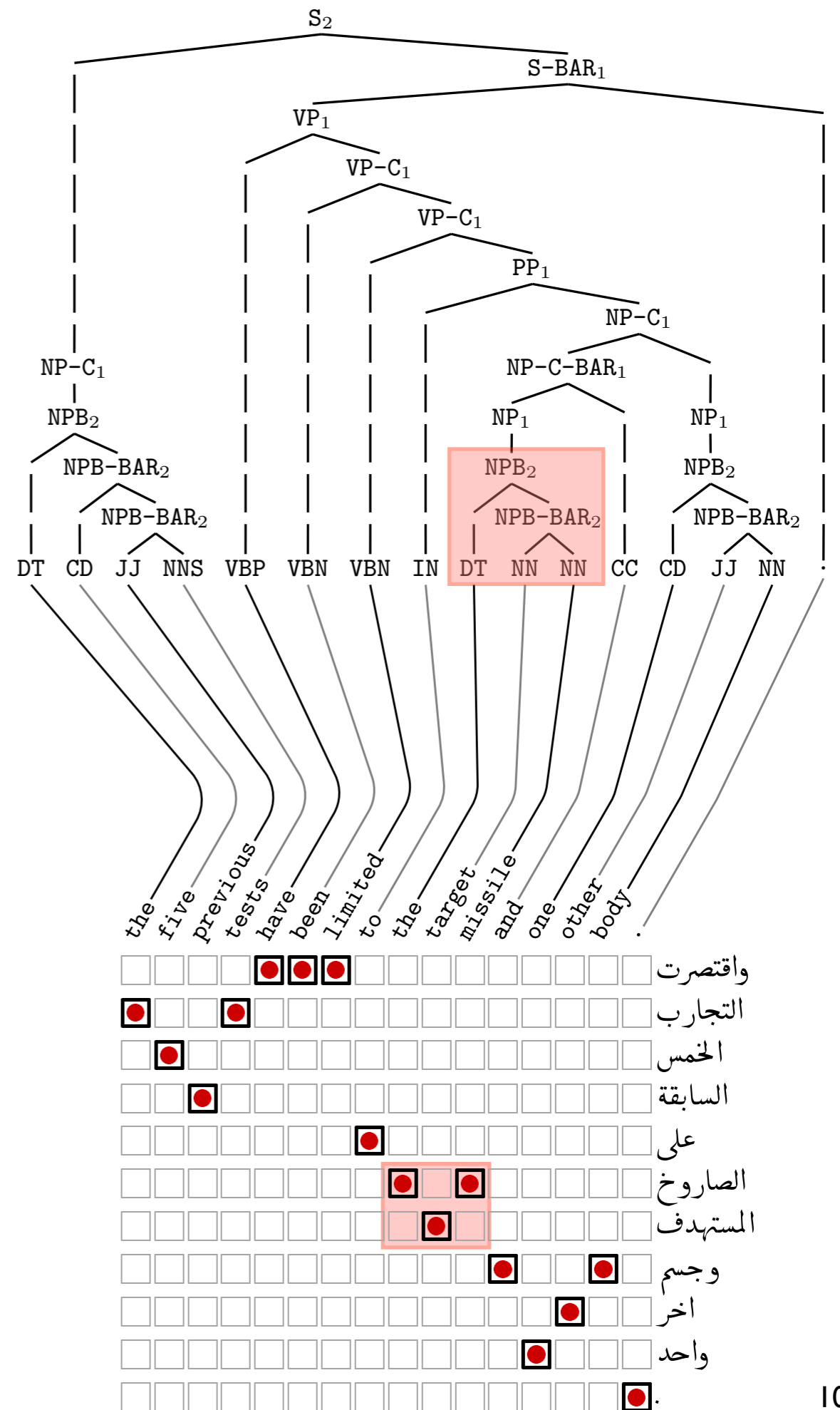
- syntactic nonlocal features
- tree distance feature
- distortion features



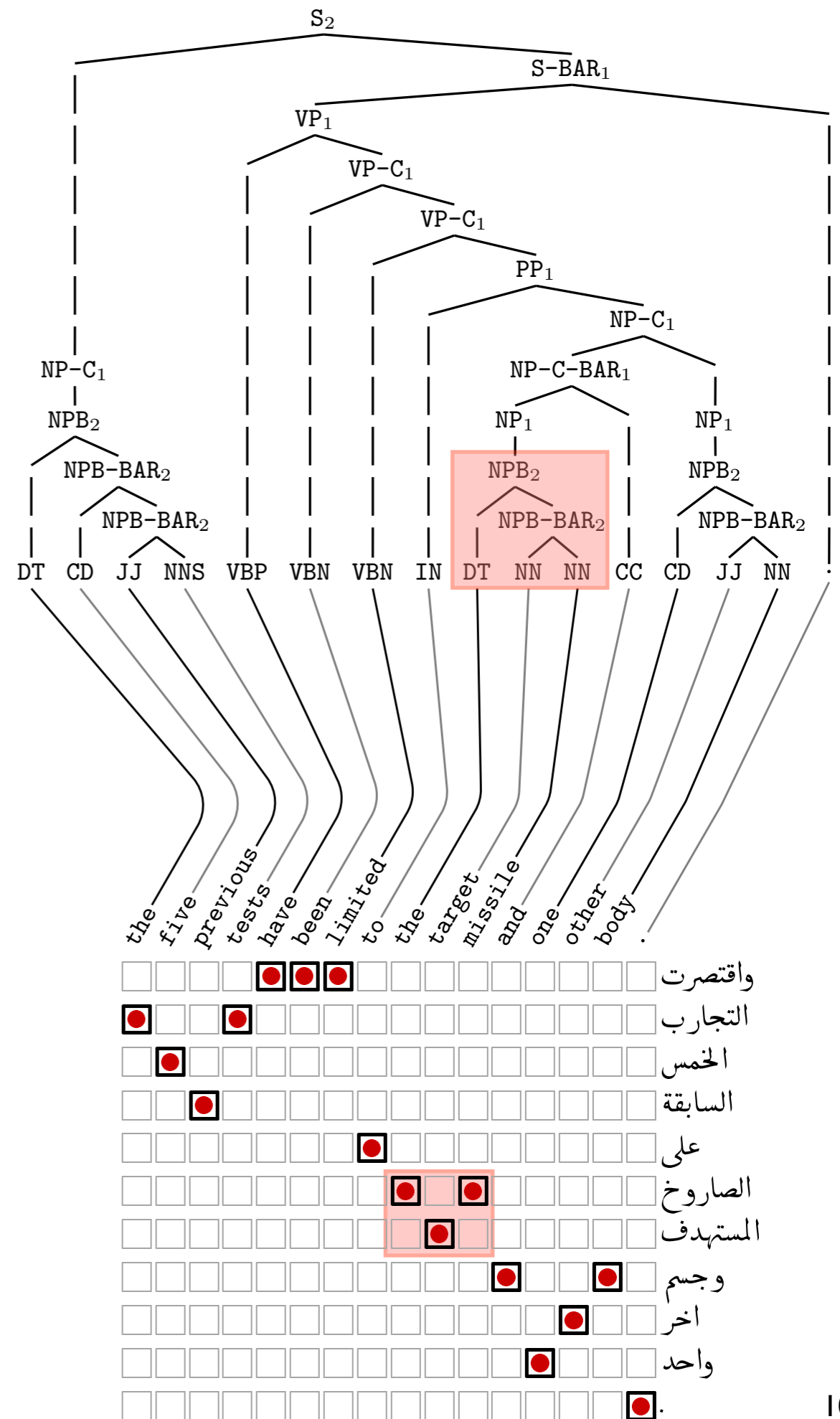
- syntactic nonlocal features
- tree distance feature
- distortion features
- lexical-zero features



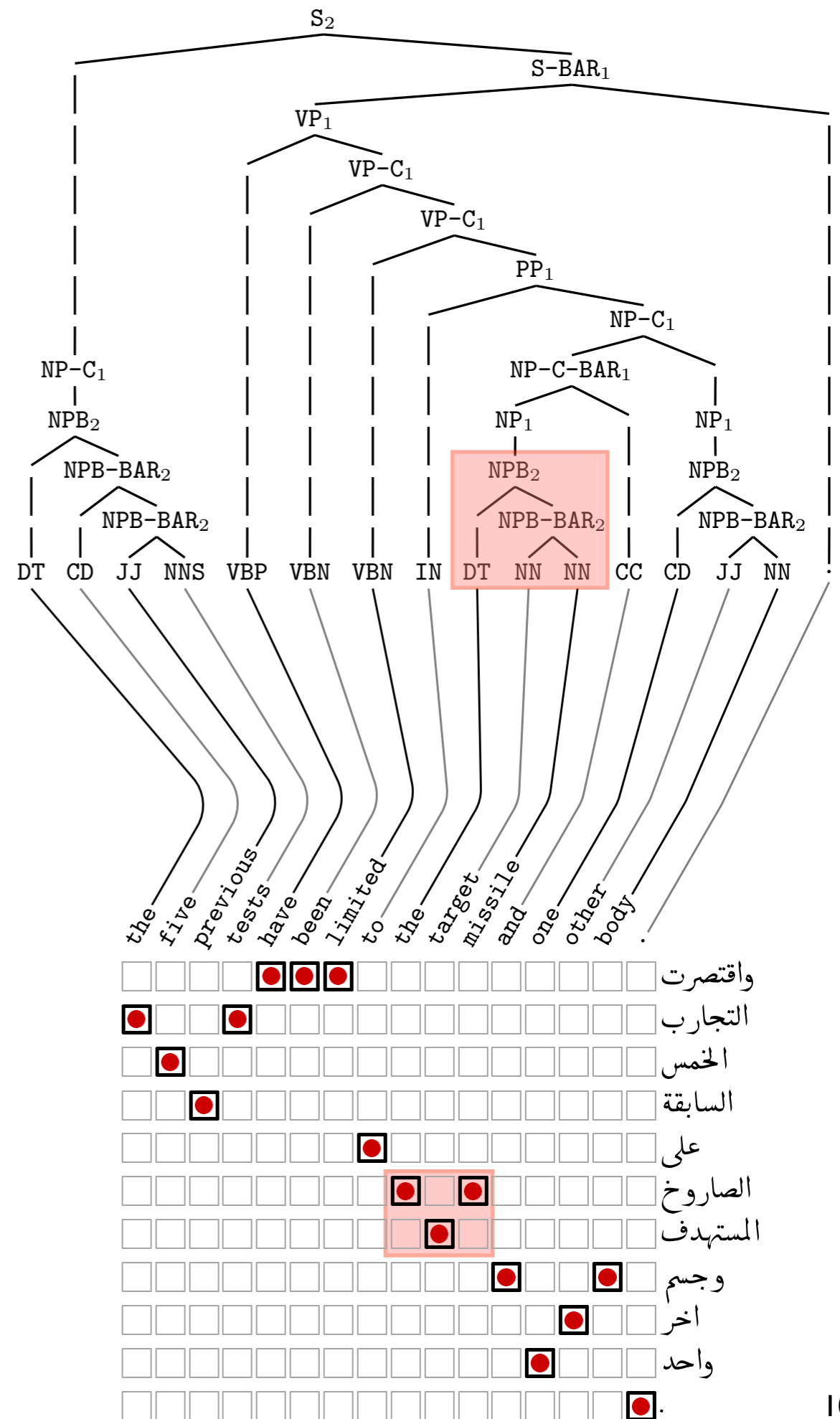
- syntactic nonlocal features
- tree distance feature
- distortion features
- lexical-zero features
- lexical probability features



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- lexical probability features
- fertility features



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3. Search Algorithm

3. Search Algorithm

- How to find the best alignment under our model?

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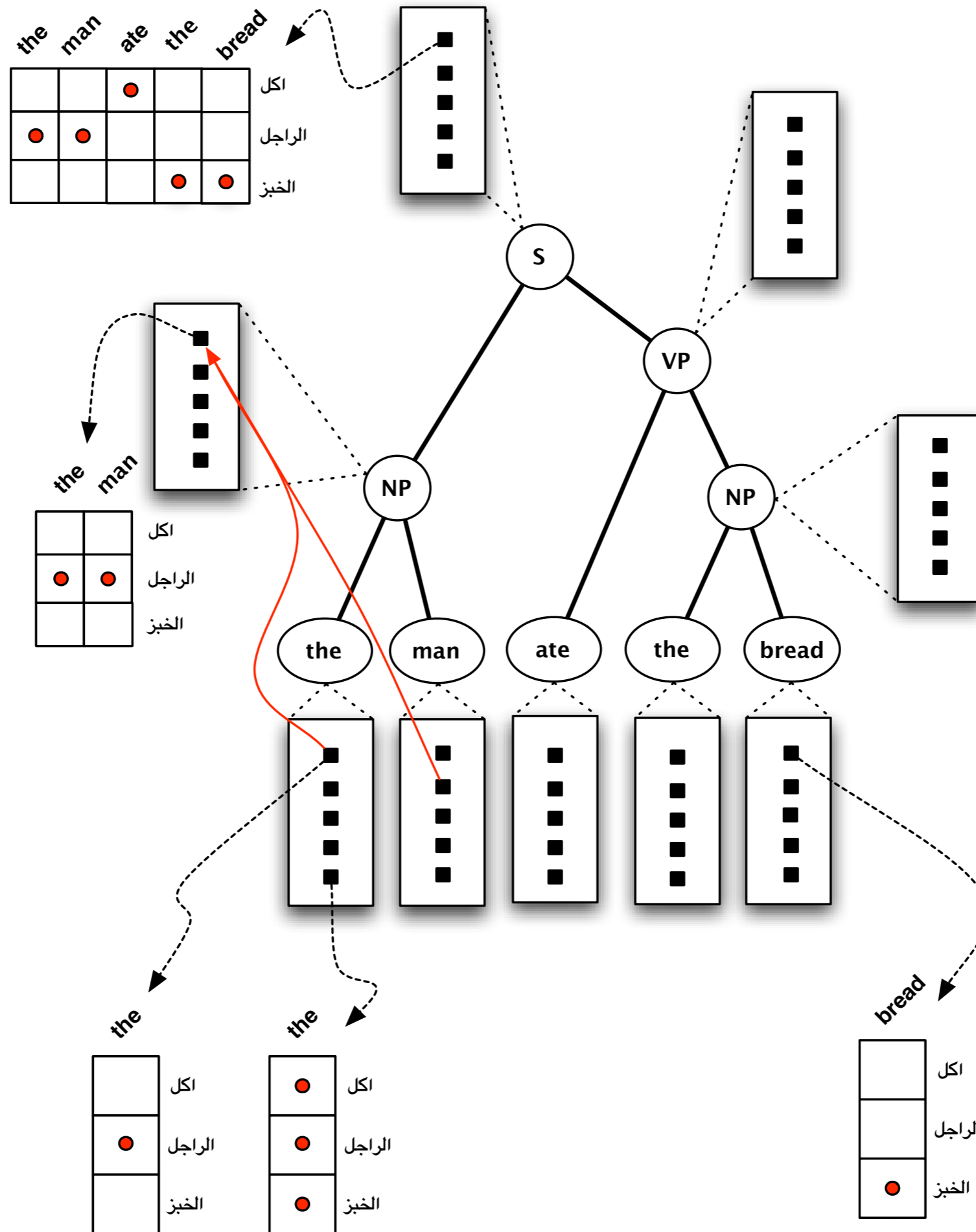
3. Search Algorithm

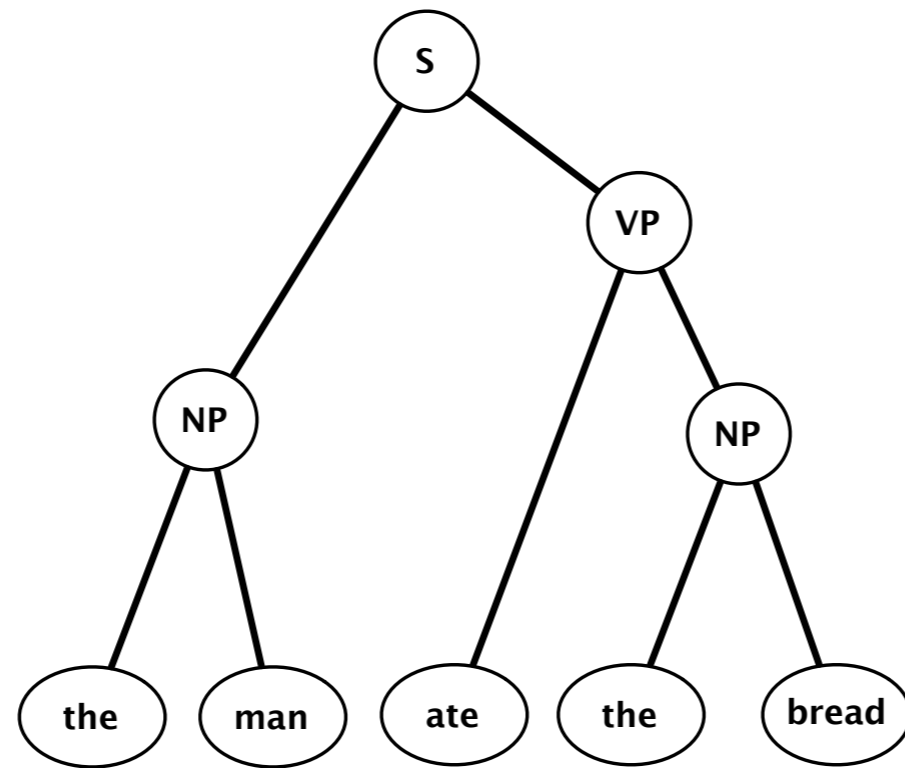
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 - ➡ Use tree for features and to guide search
 - ➡ Hierarchical decoding

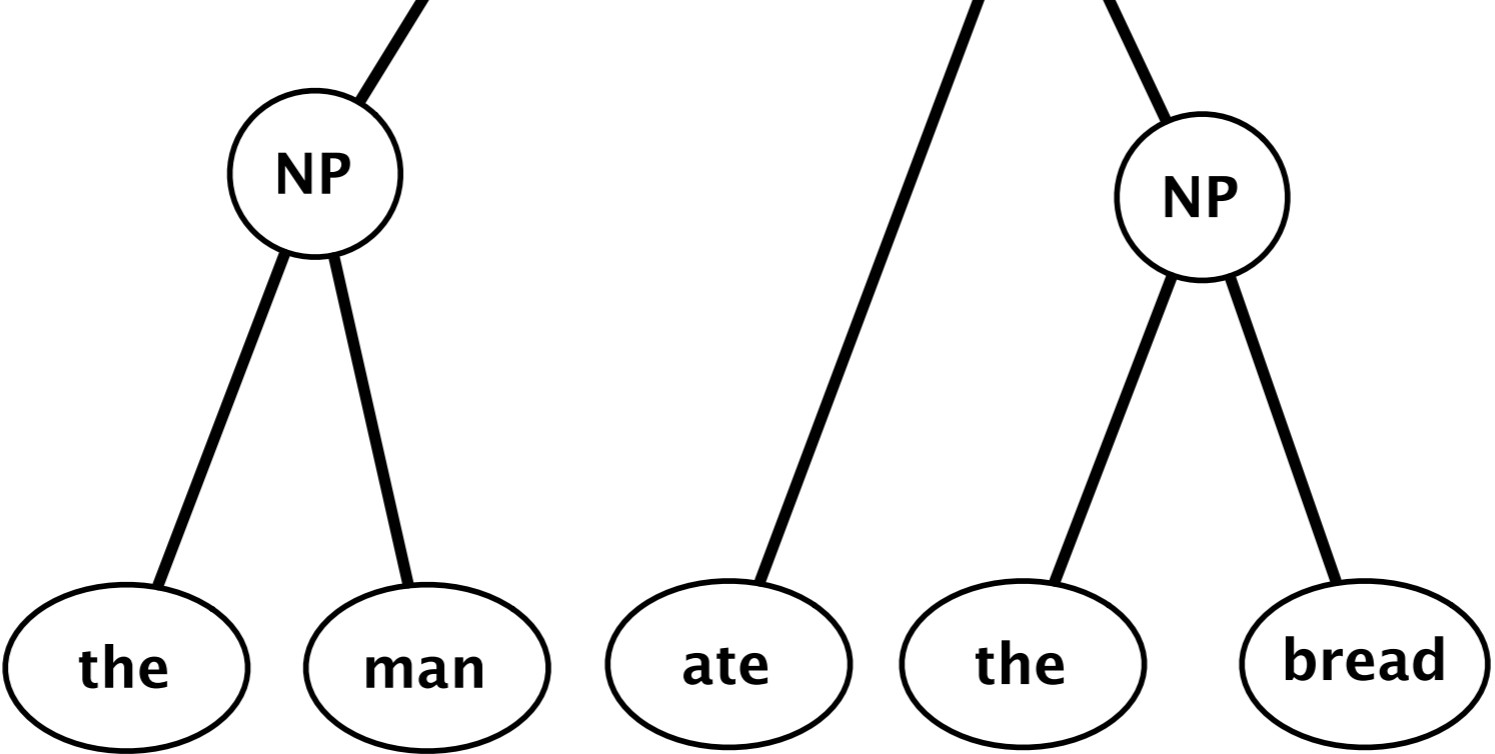
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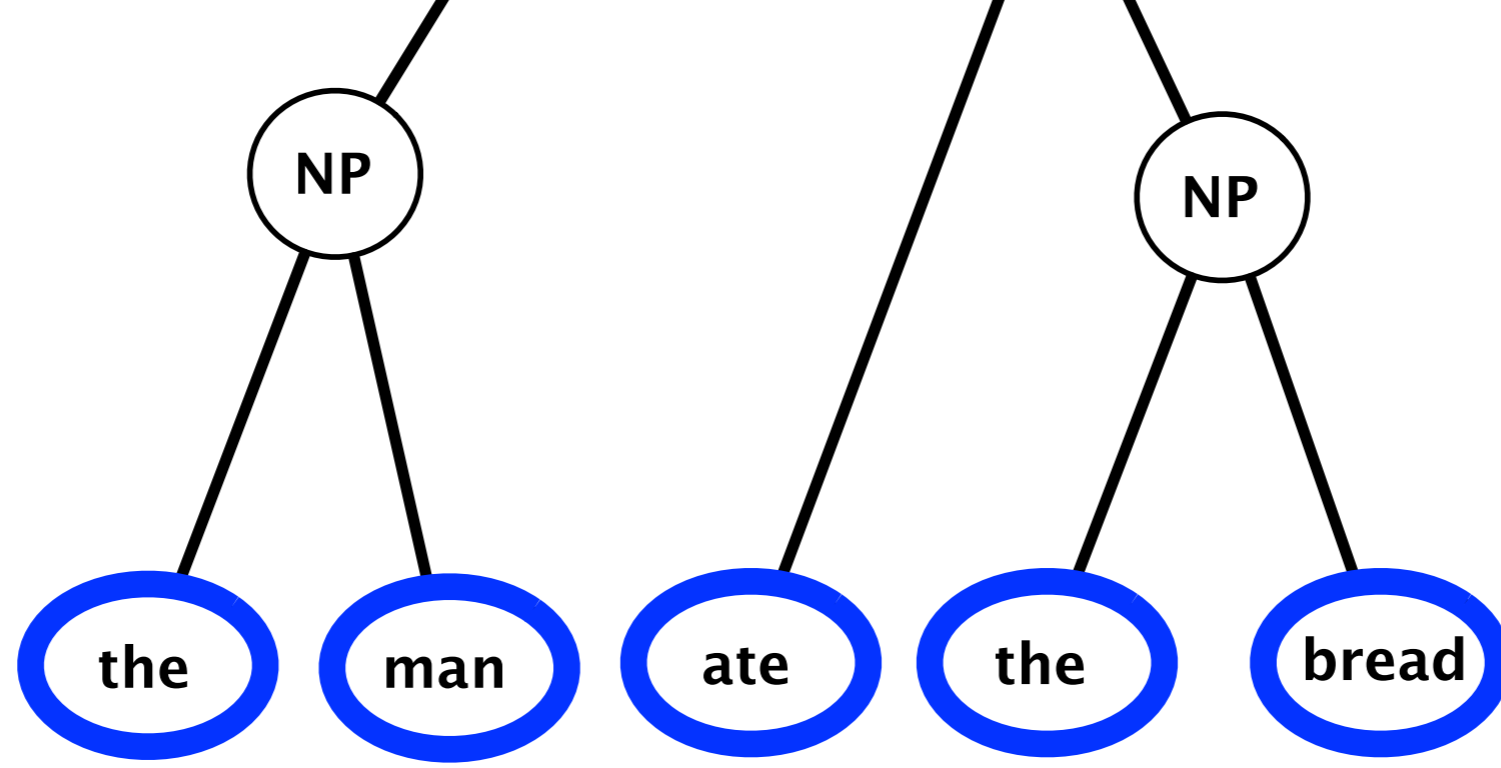
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 - ➔ Hierarchical decoding

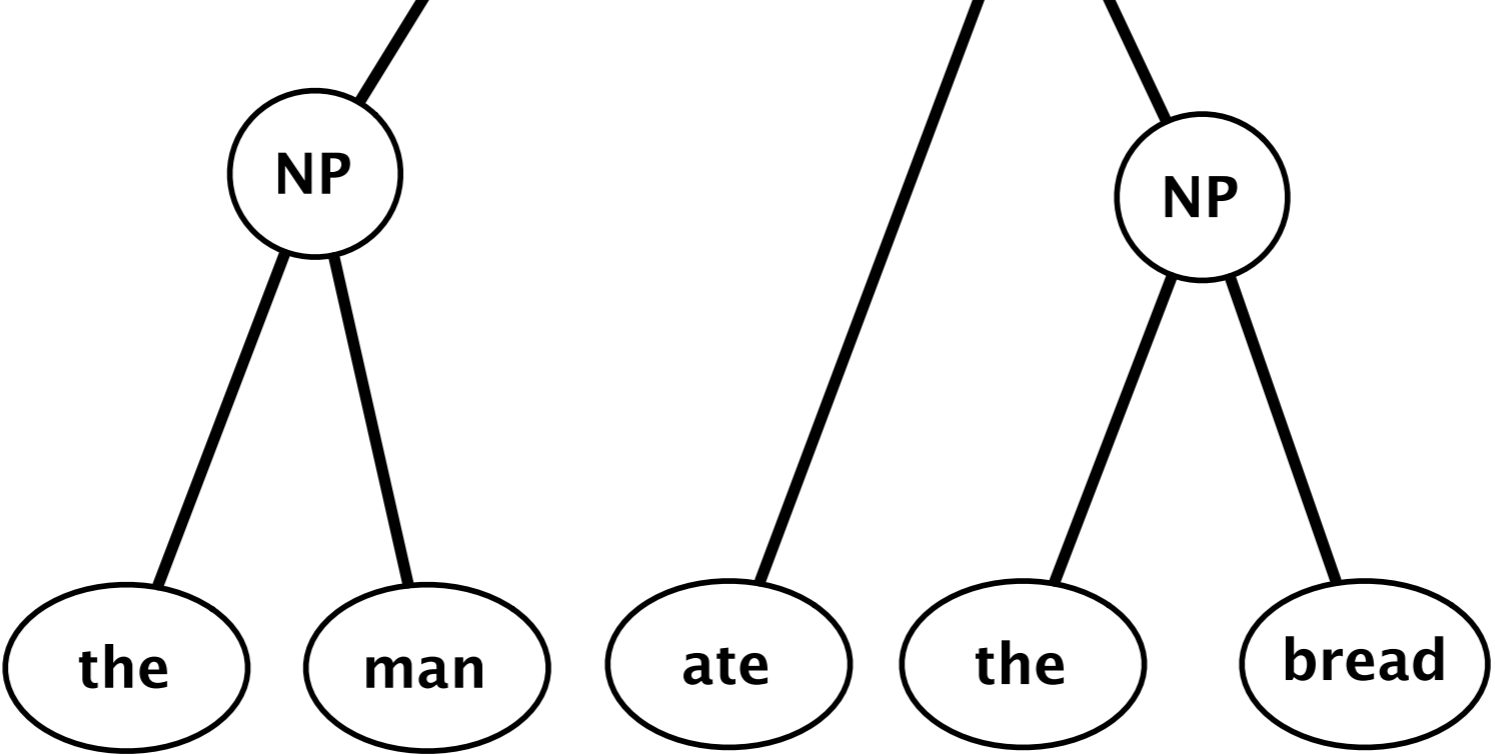
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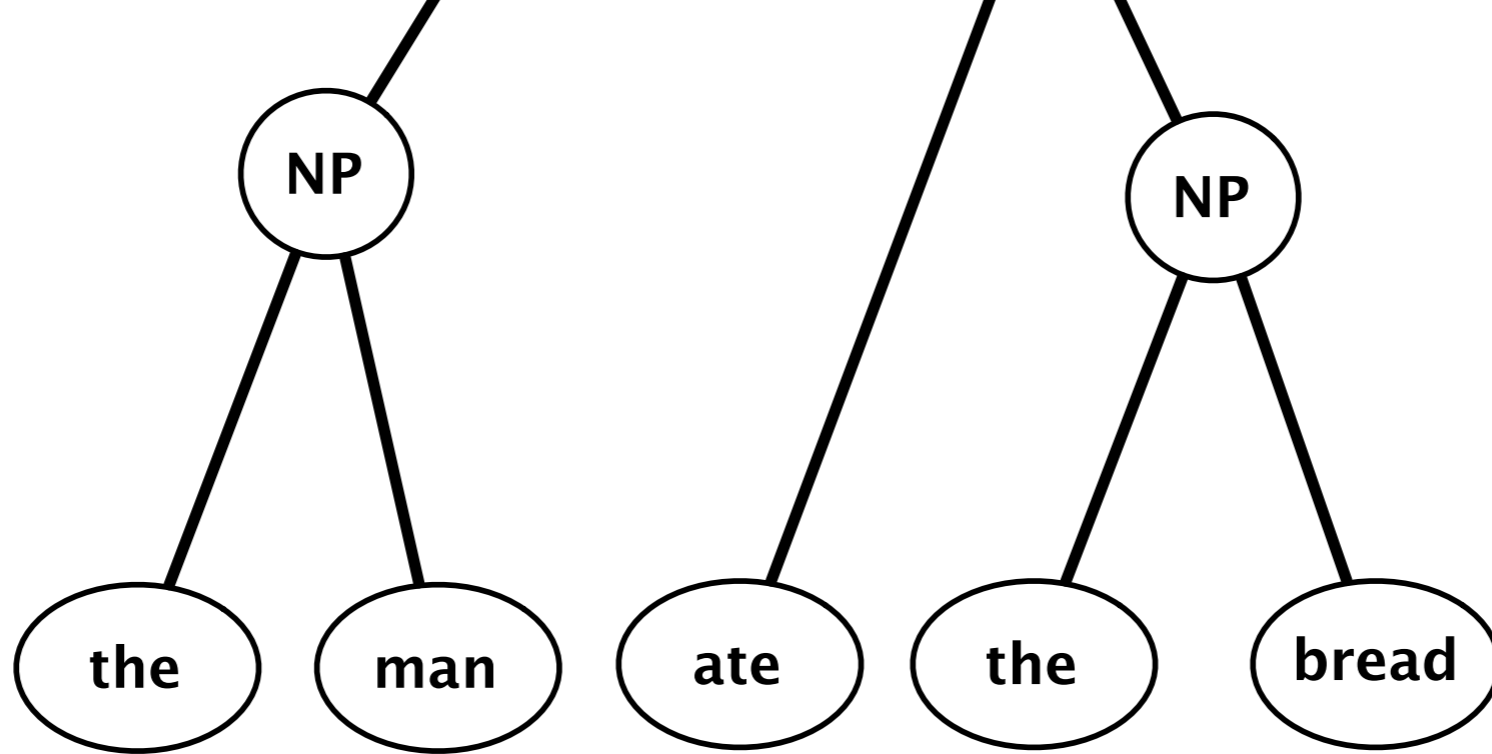


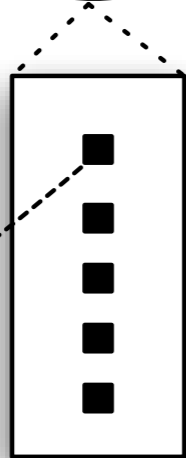
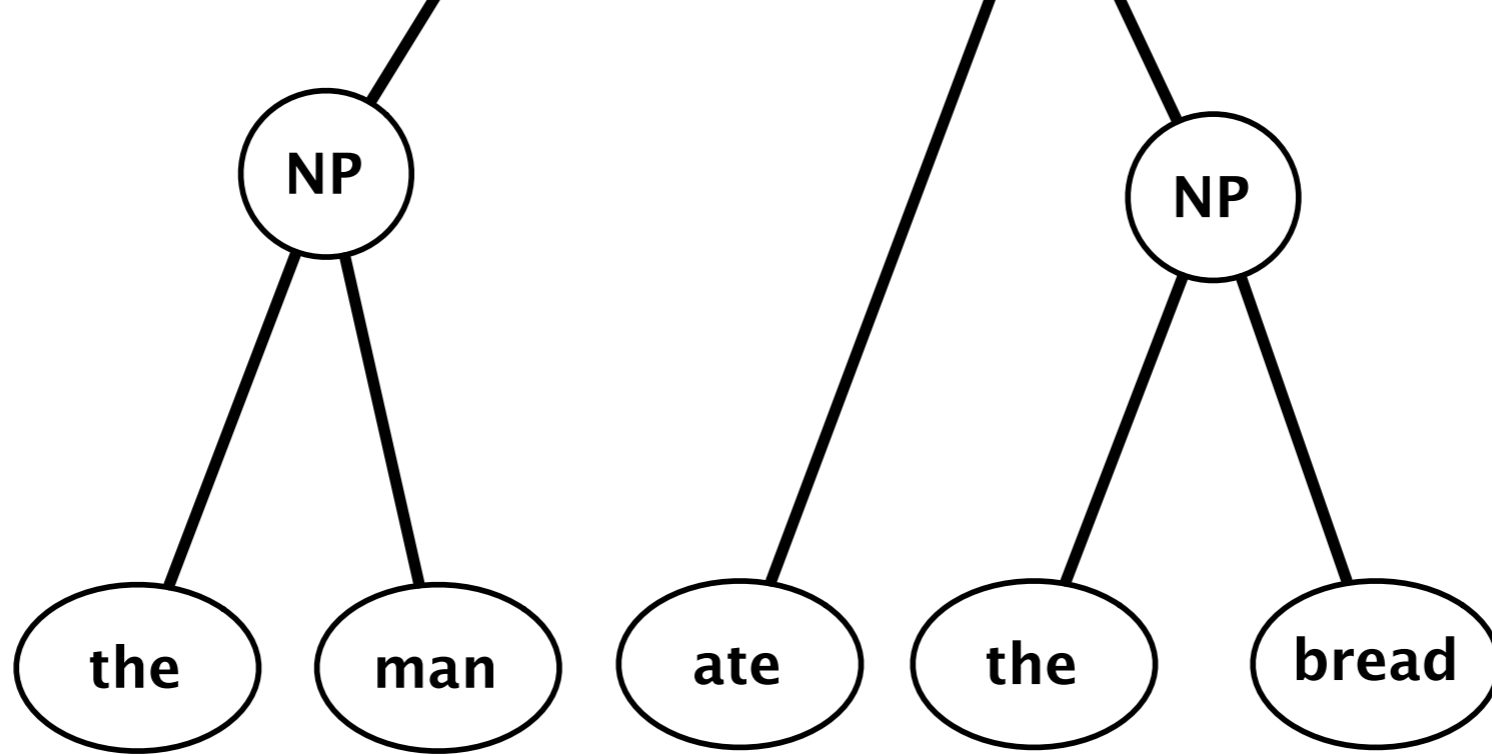




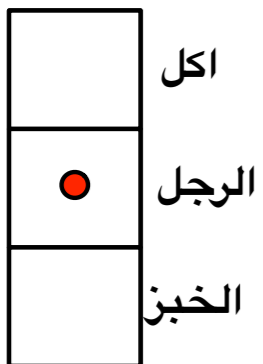


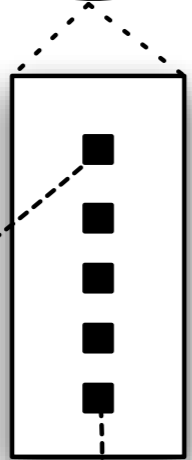
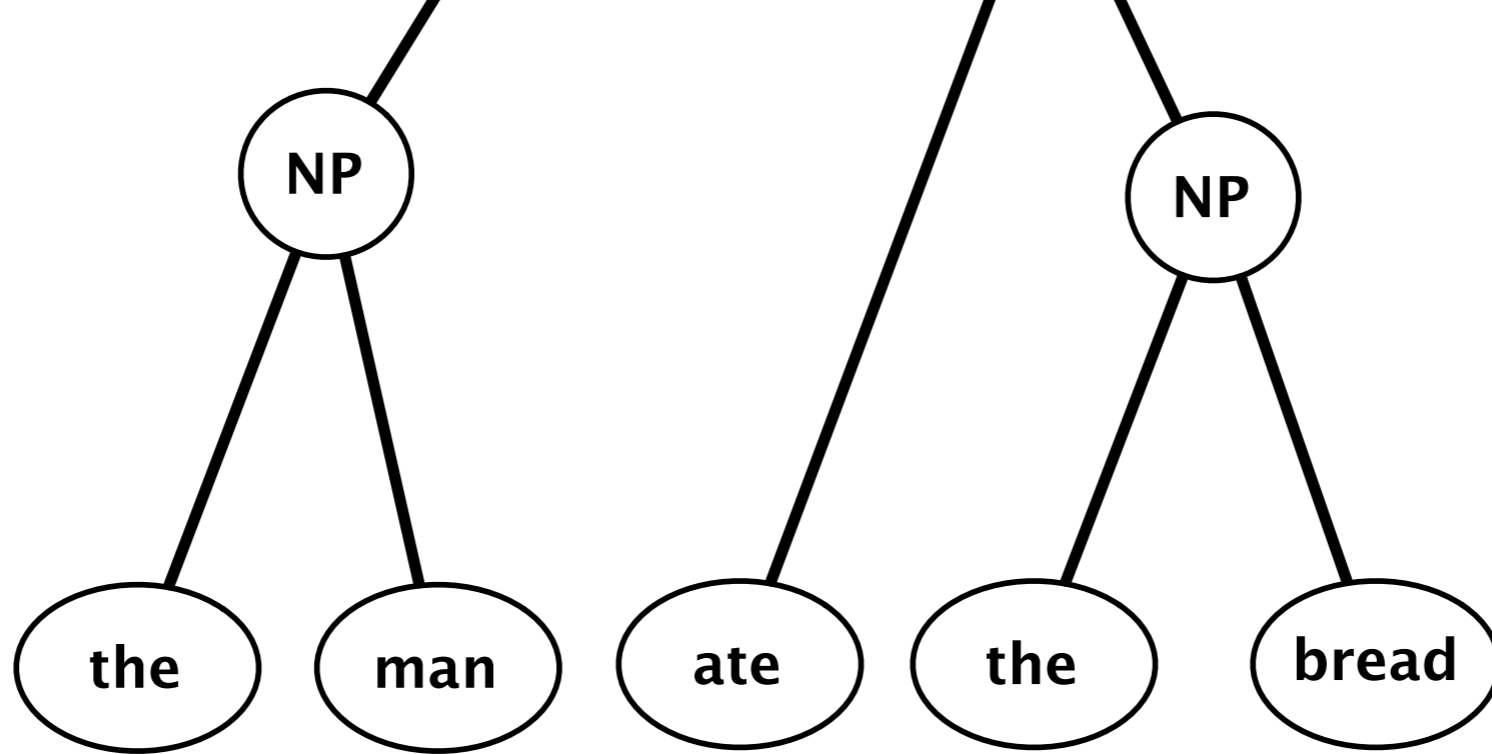






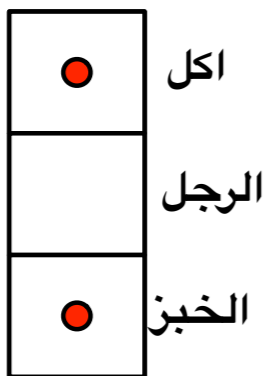
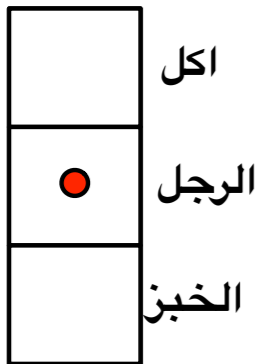
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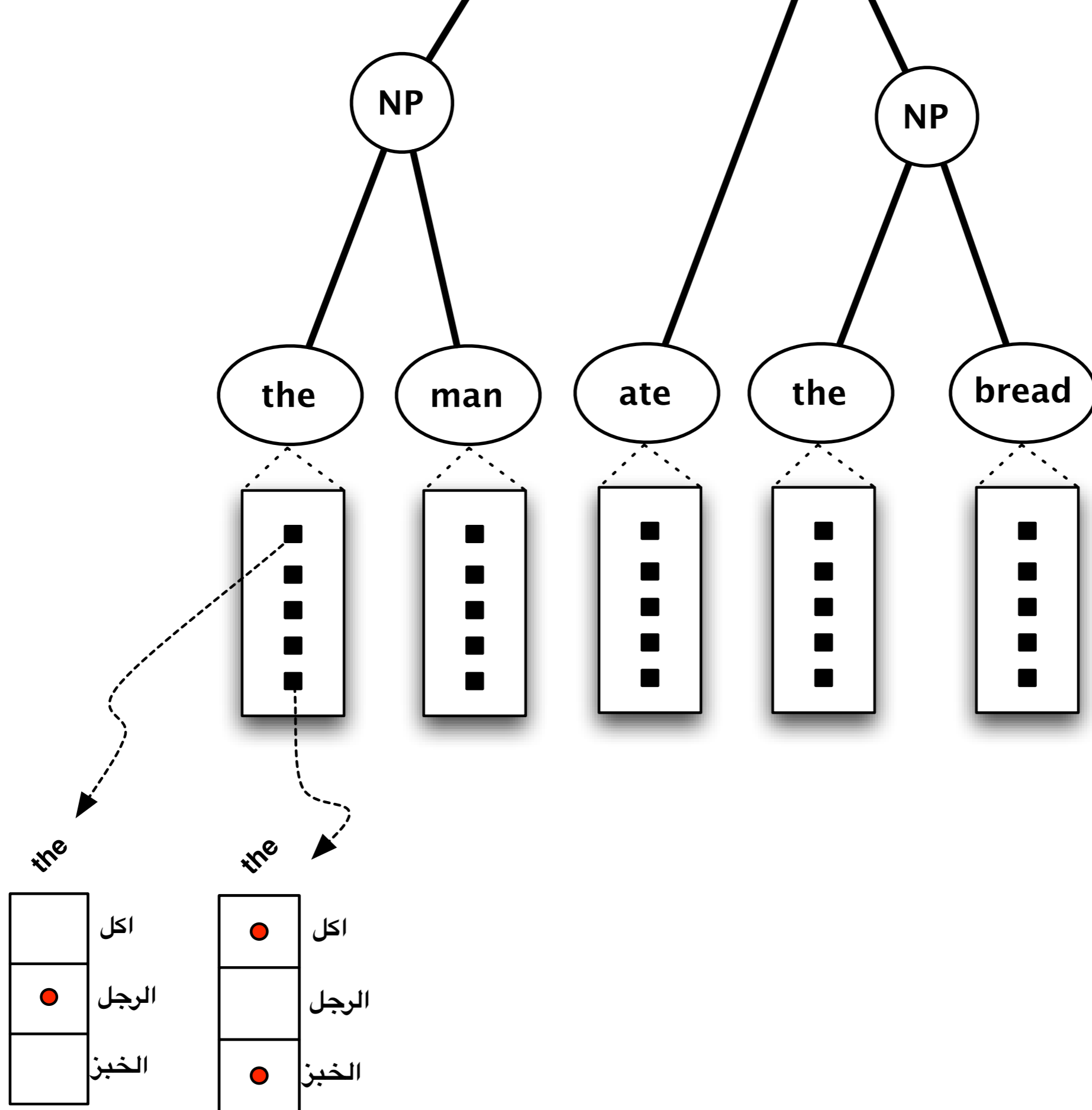


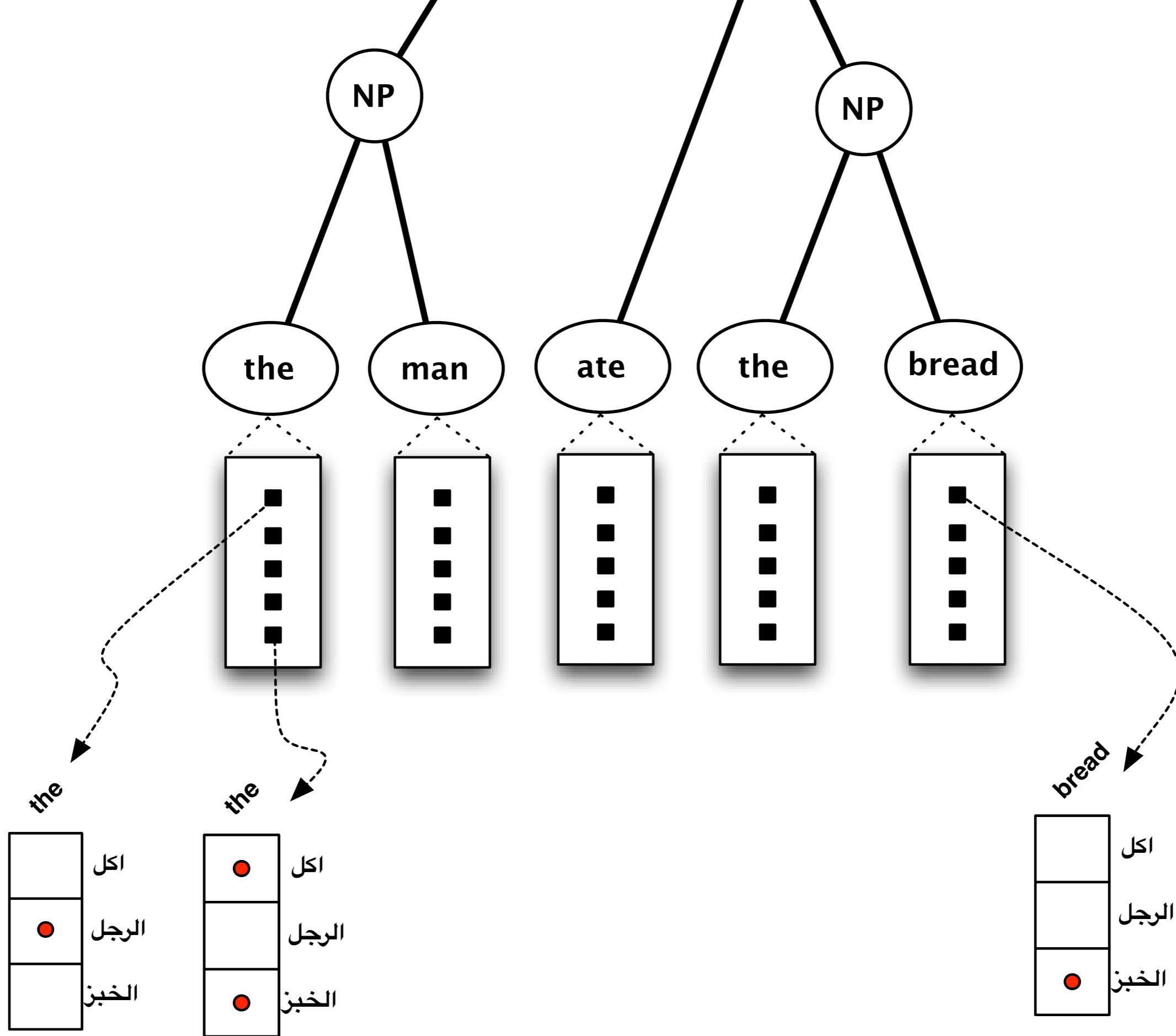


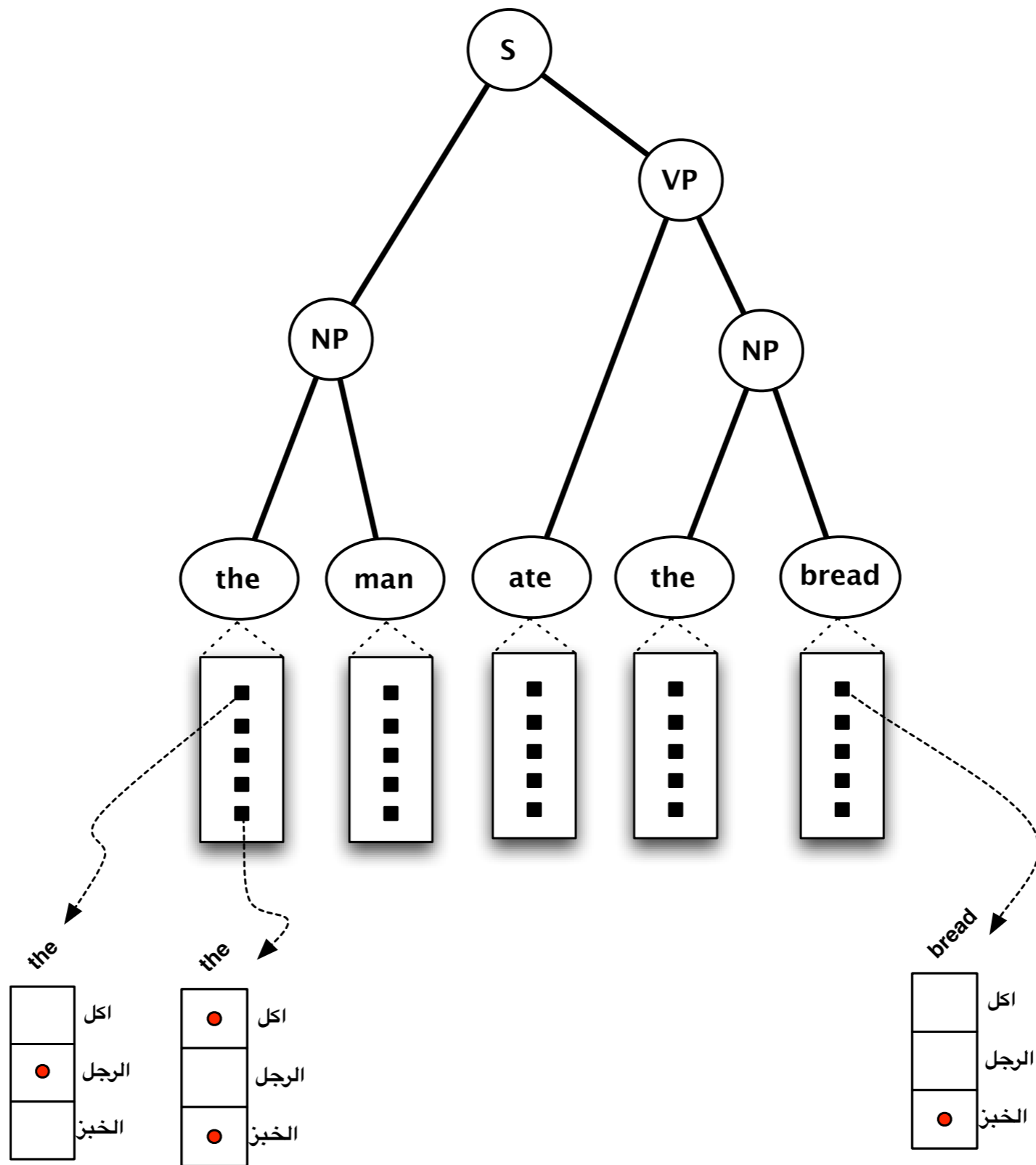
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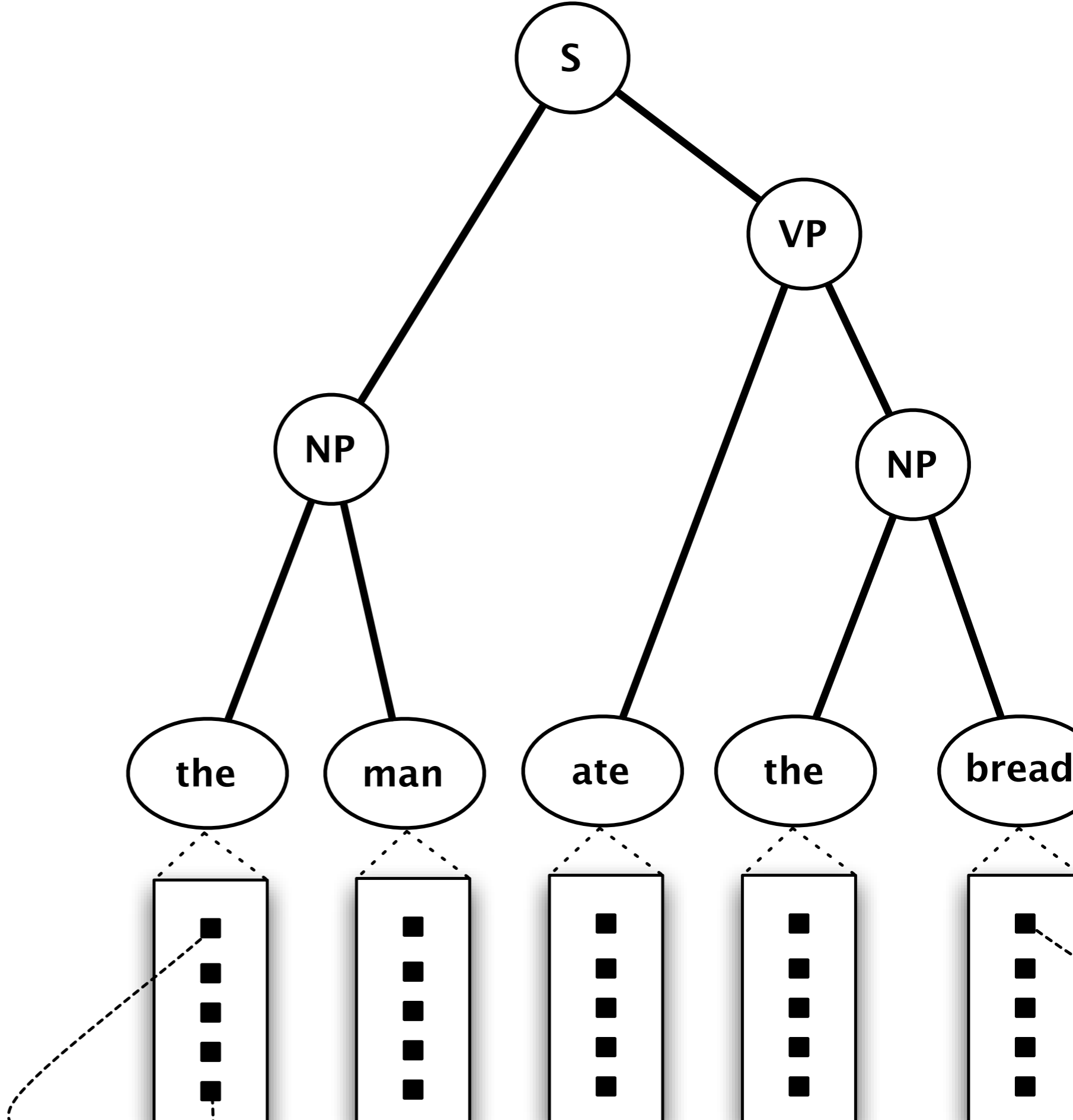
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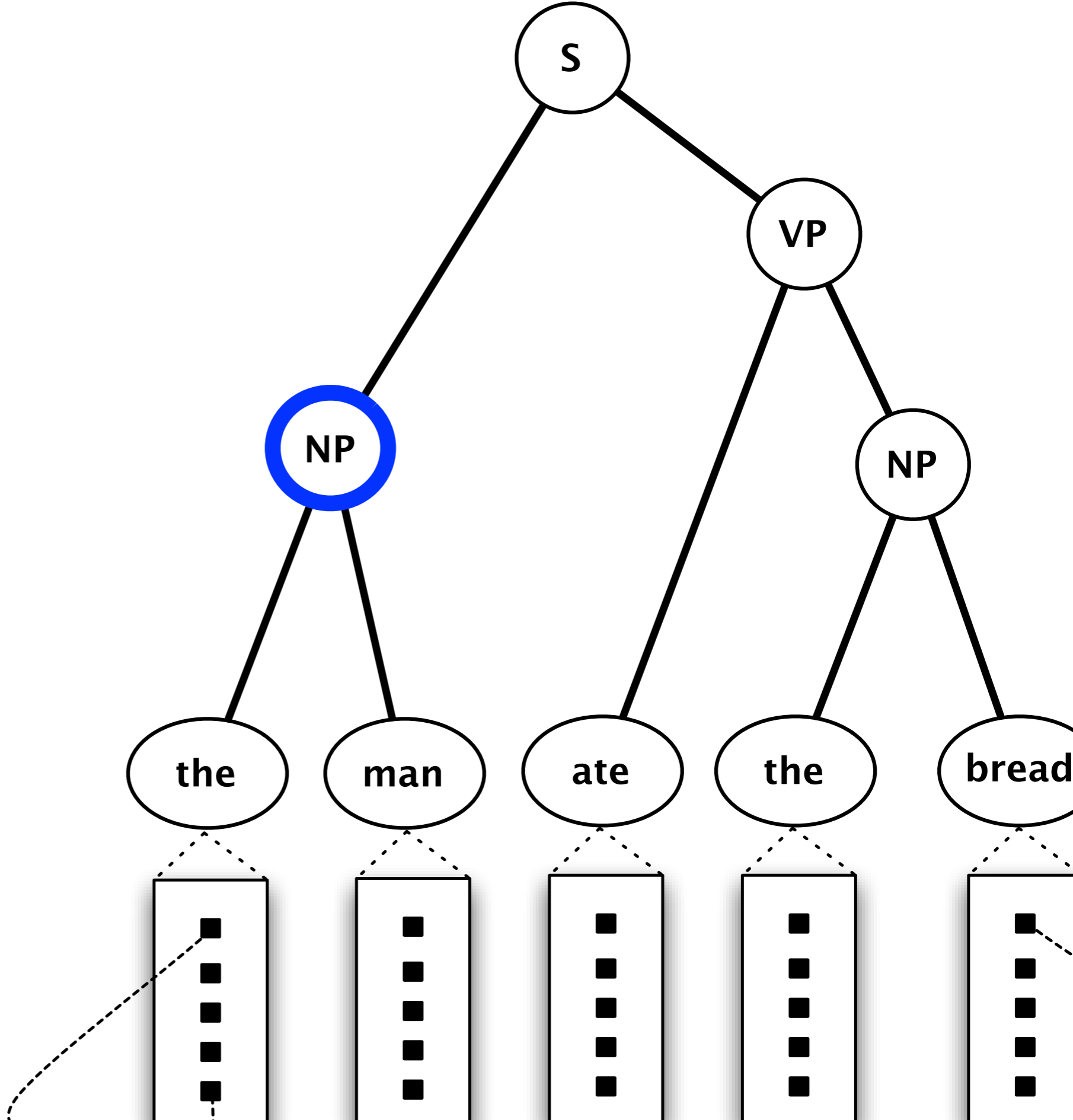


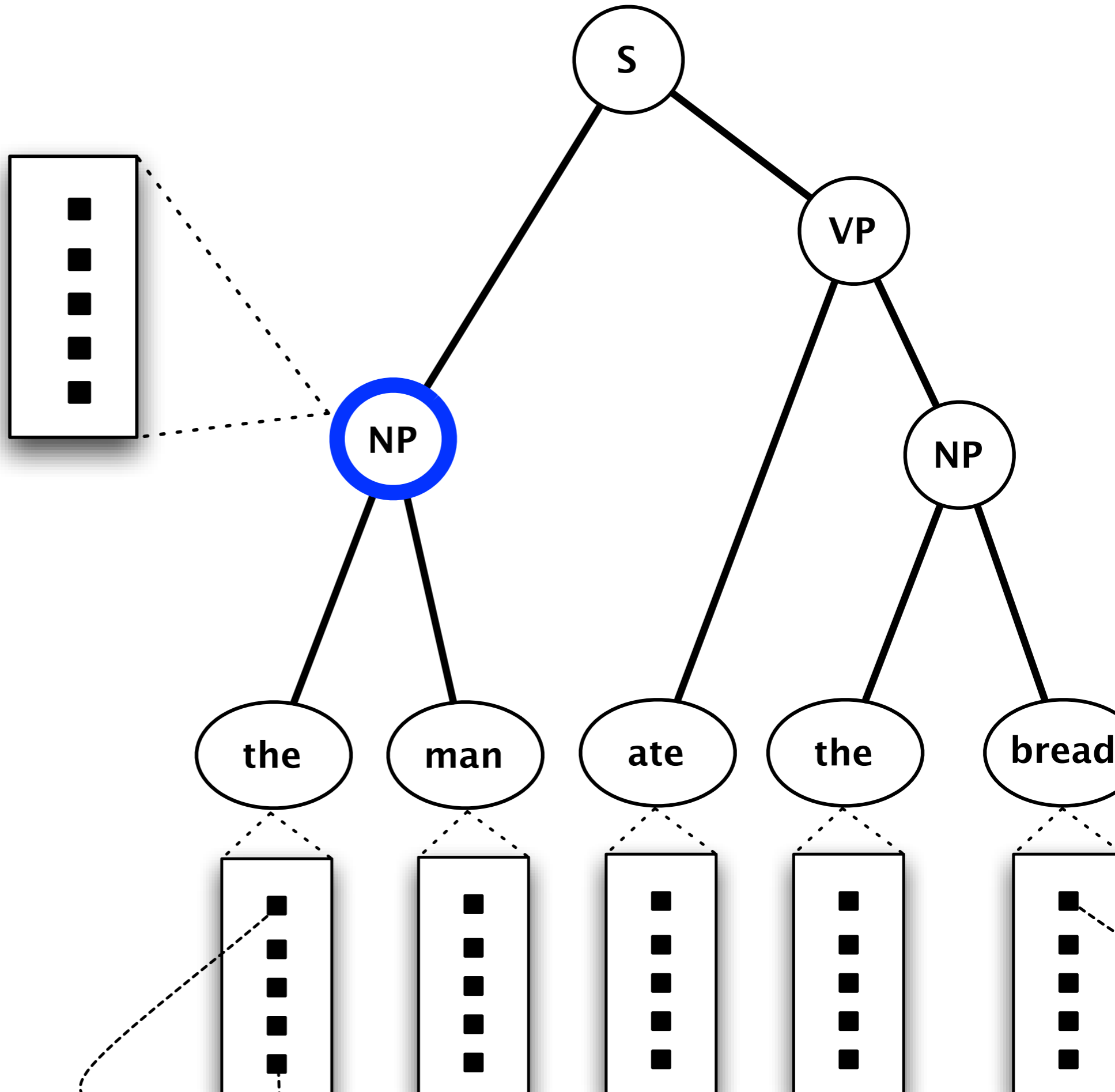


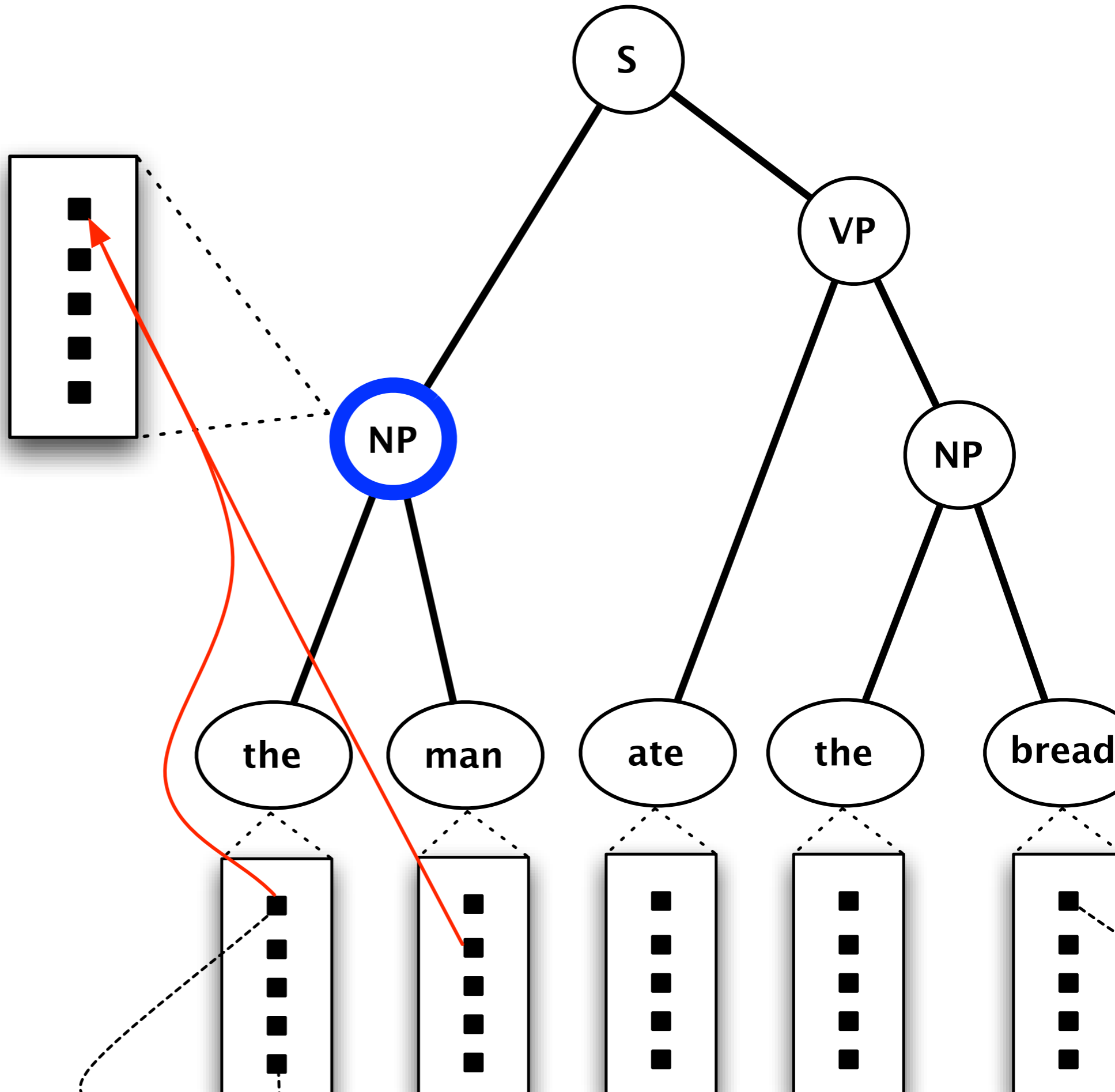


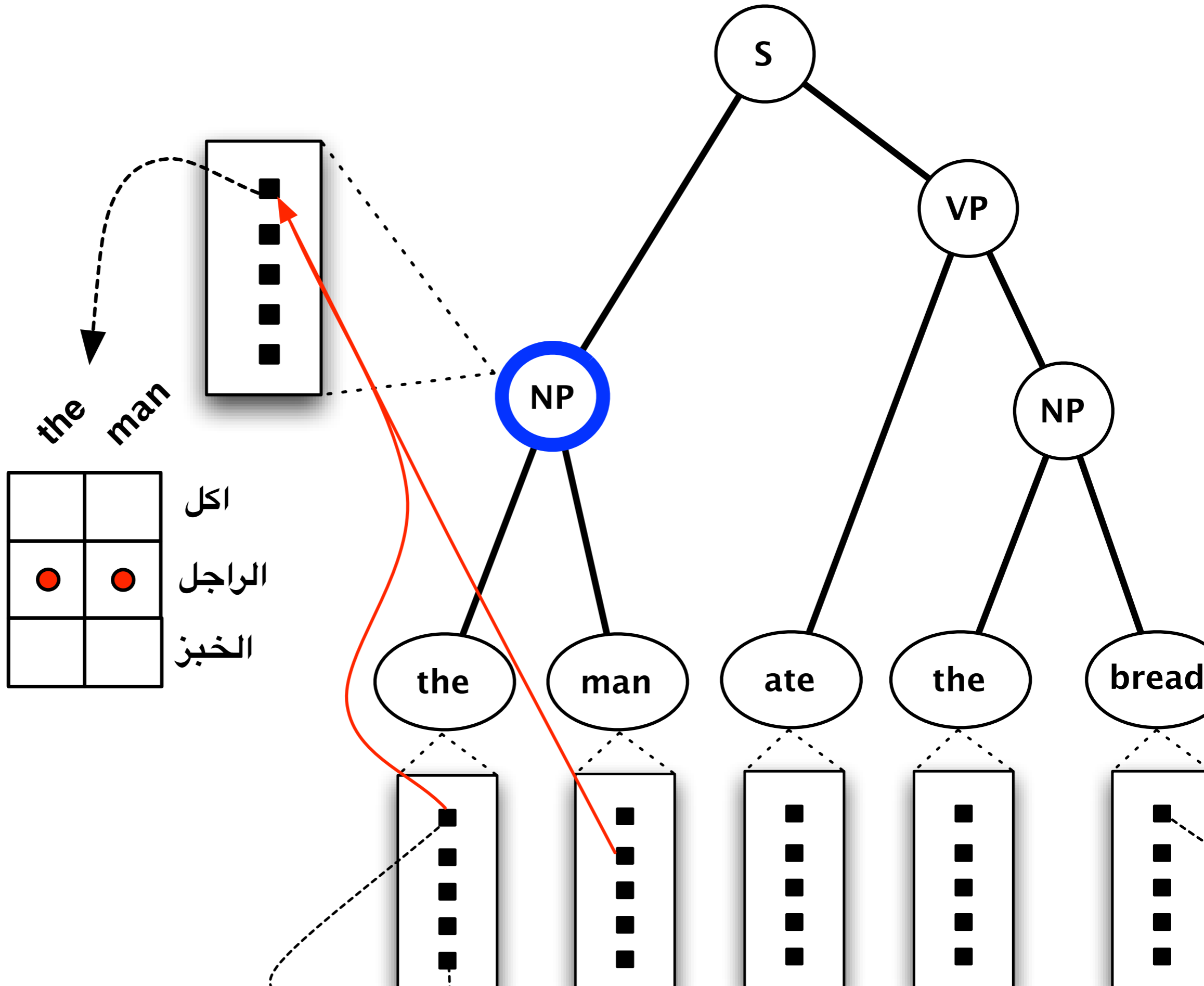


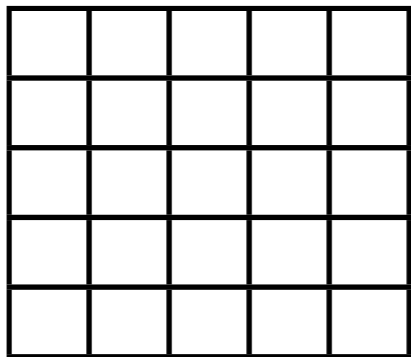




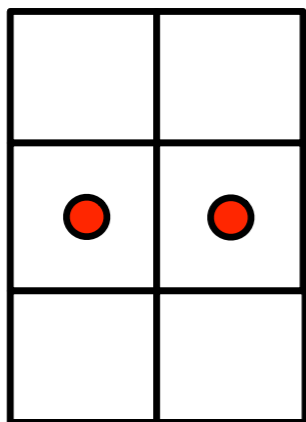
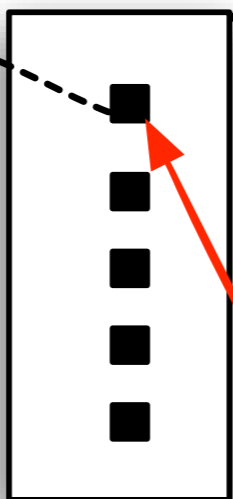








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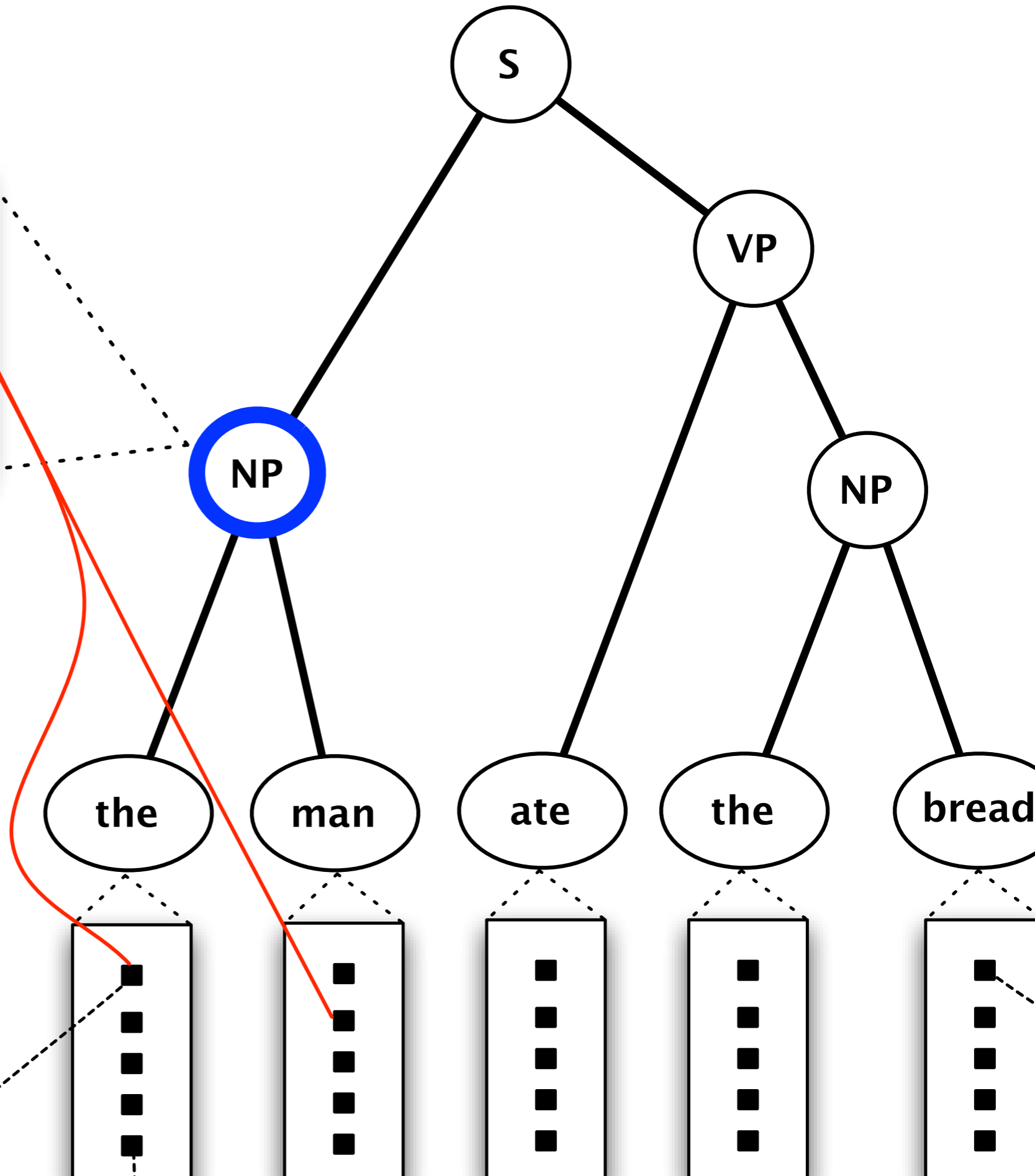
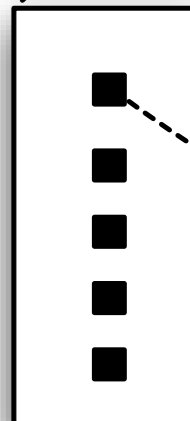
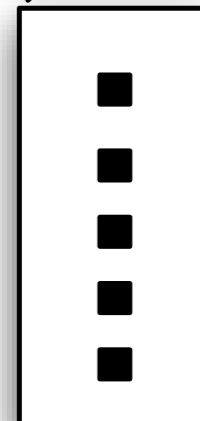
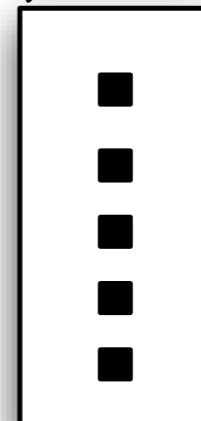
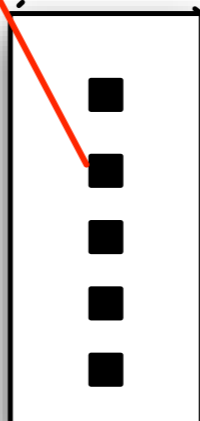
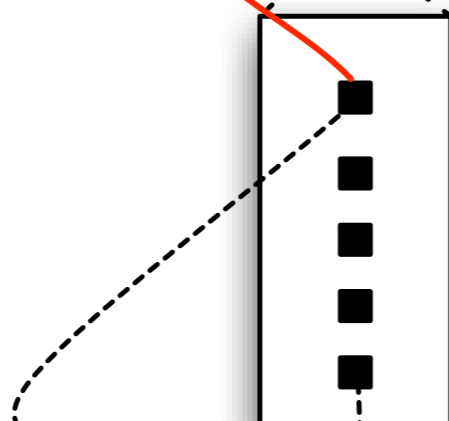
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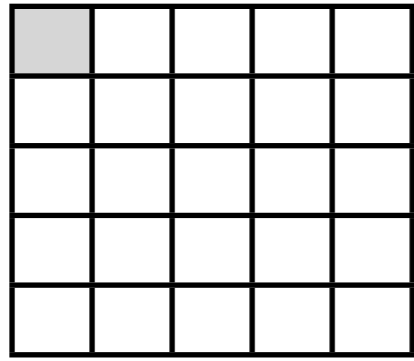
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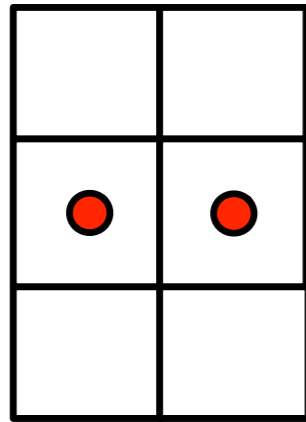
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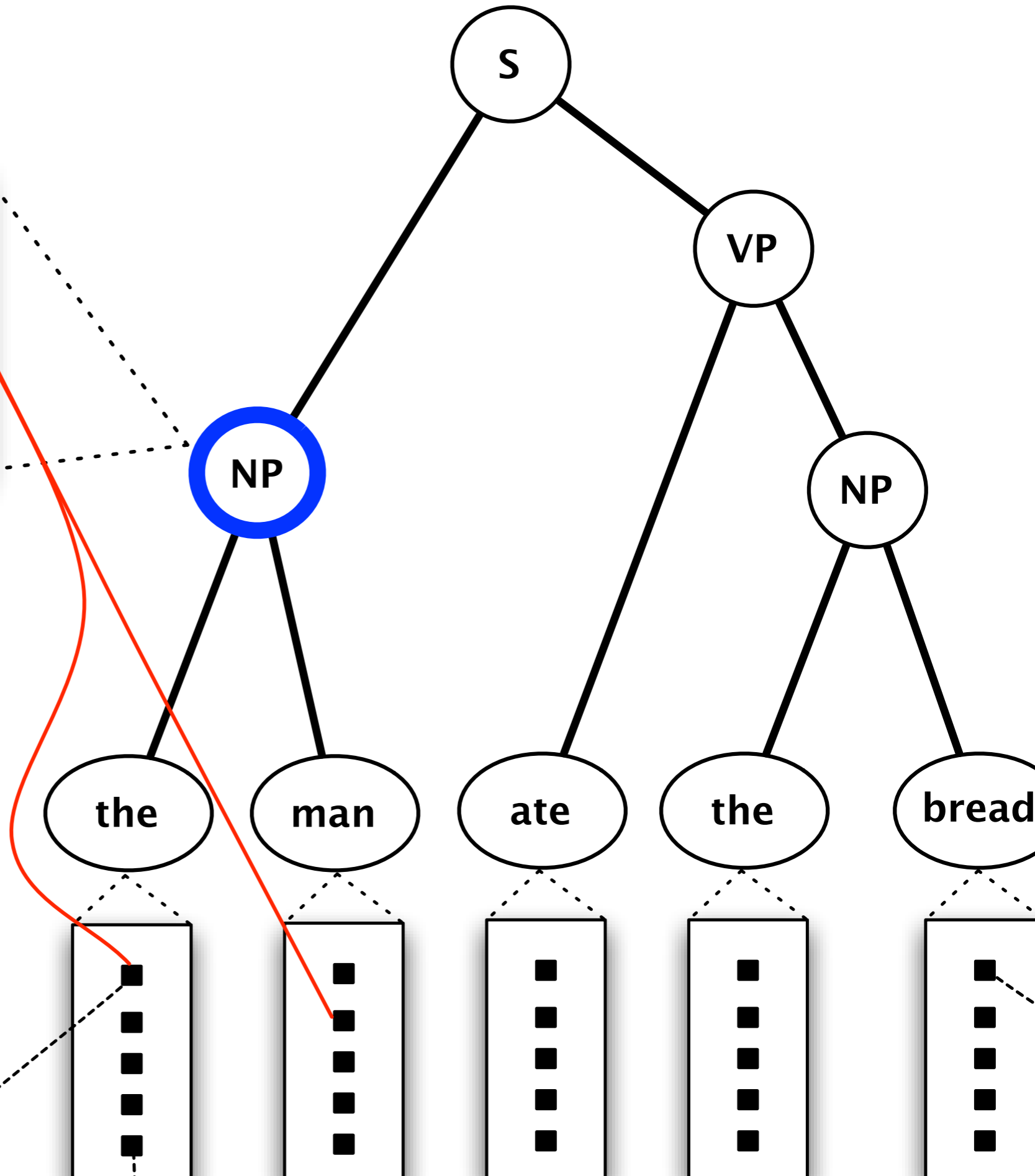
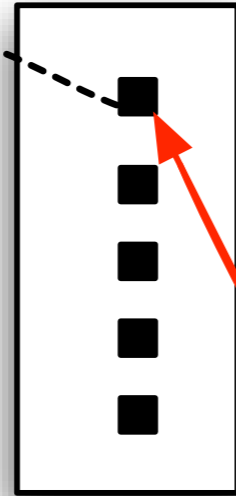


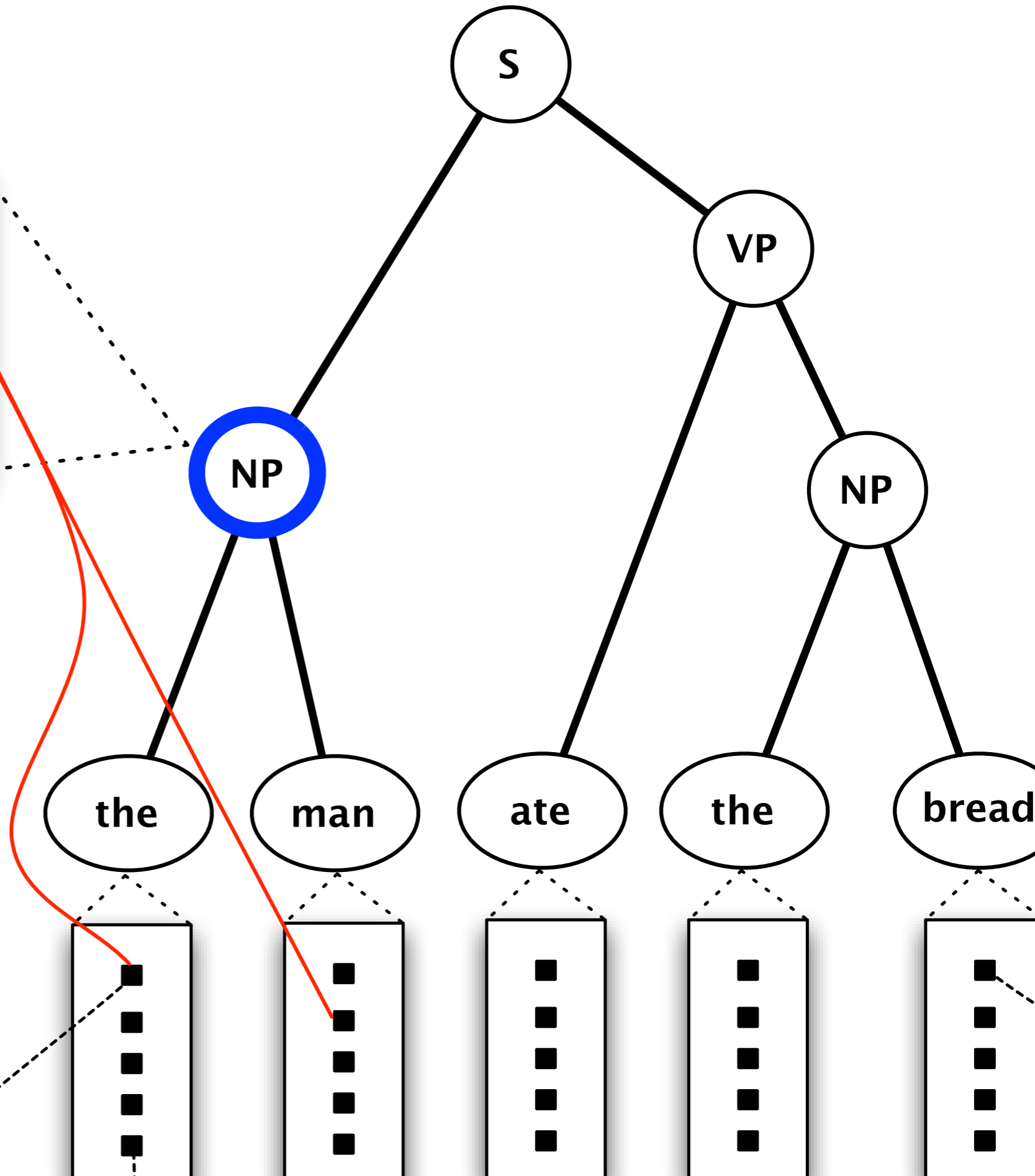
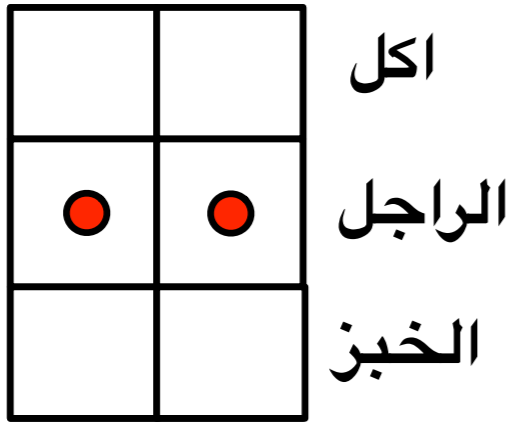
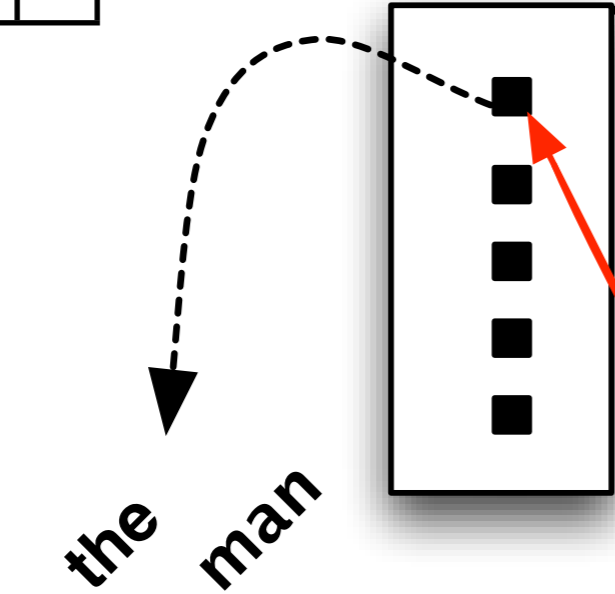
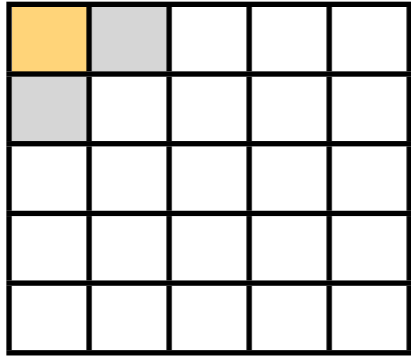


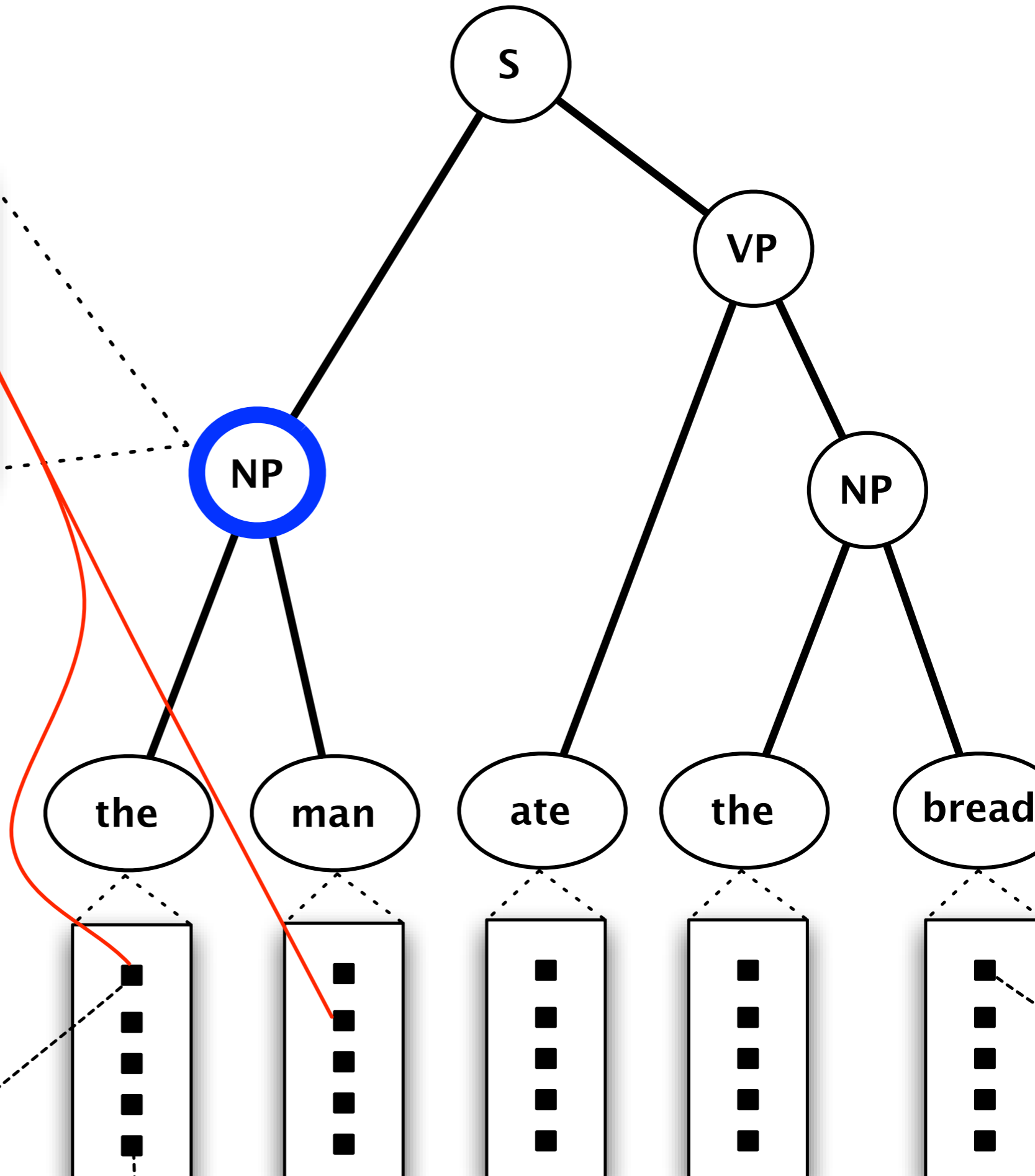
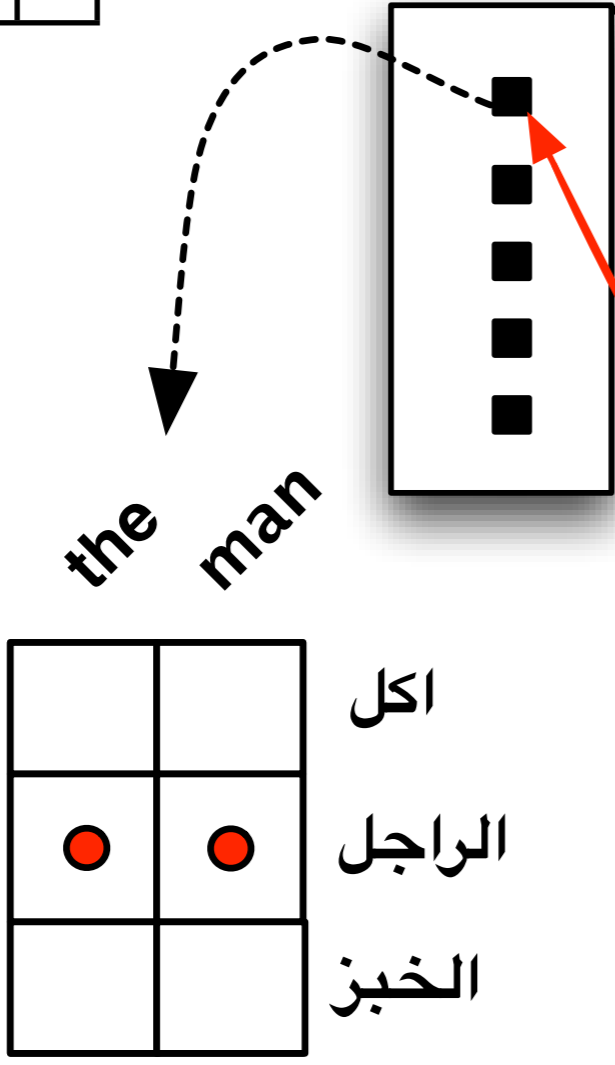
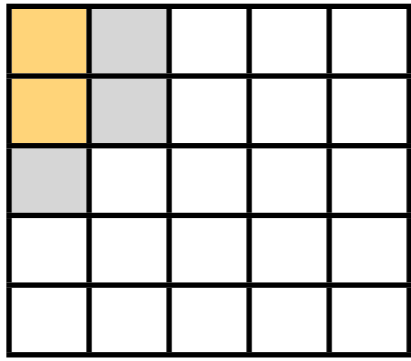
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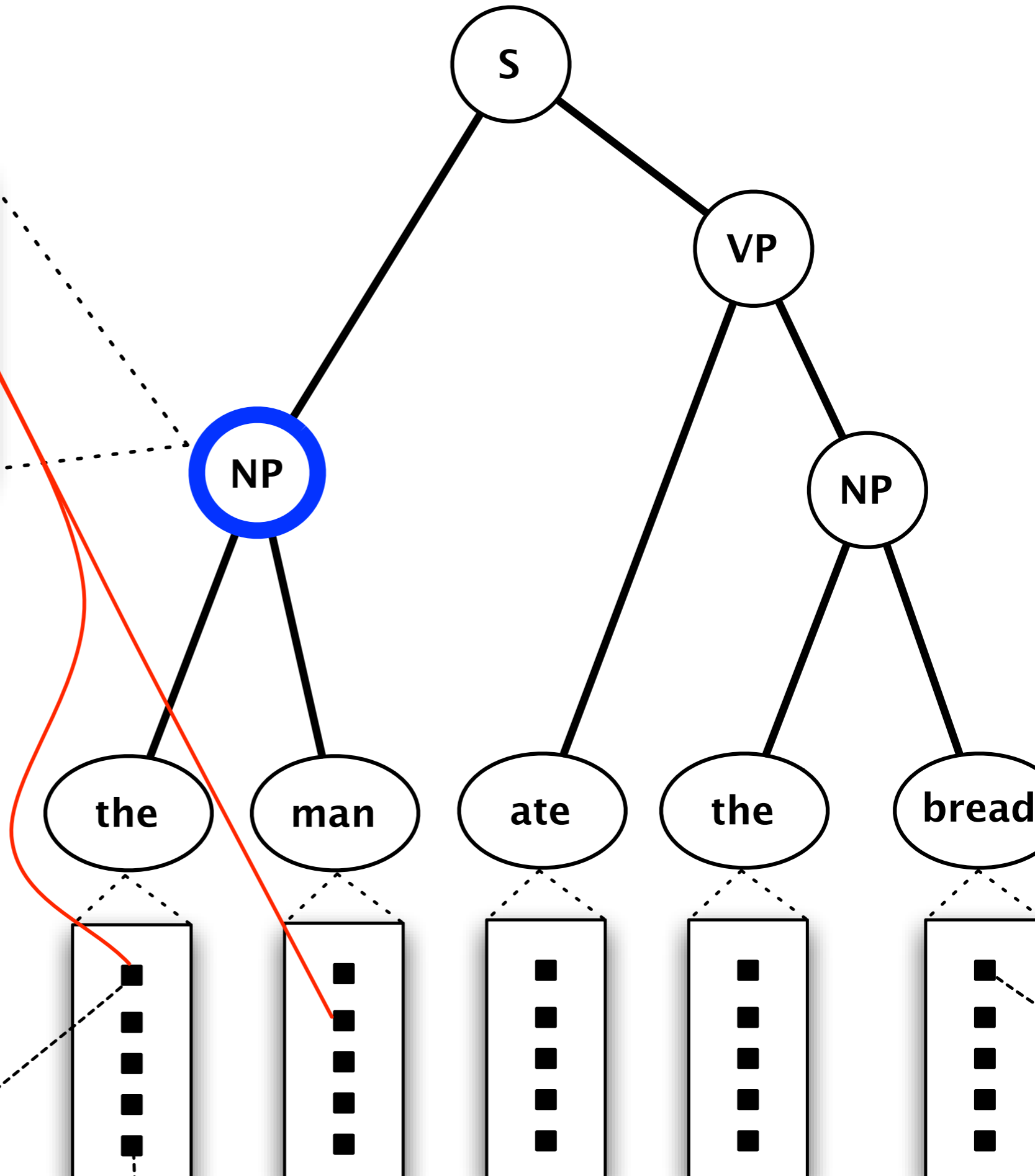
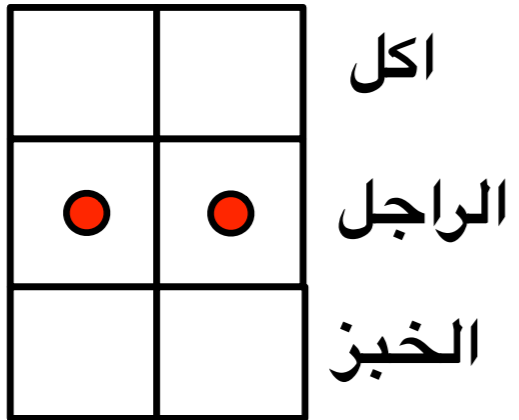
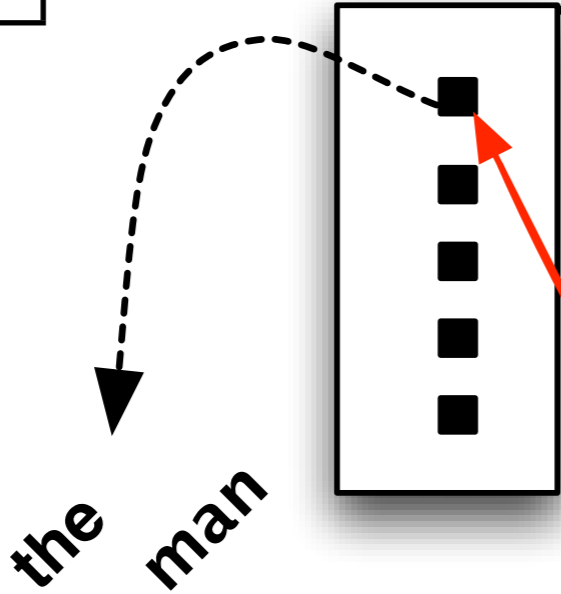
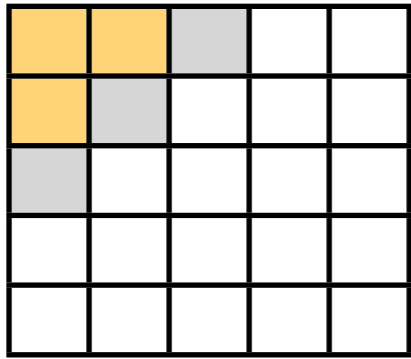


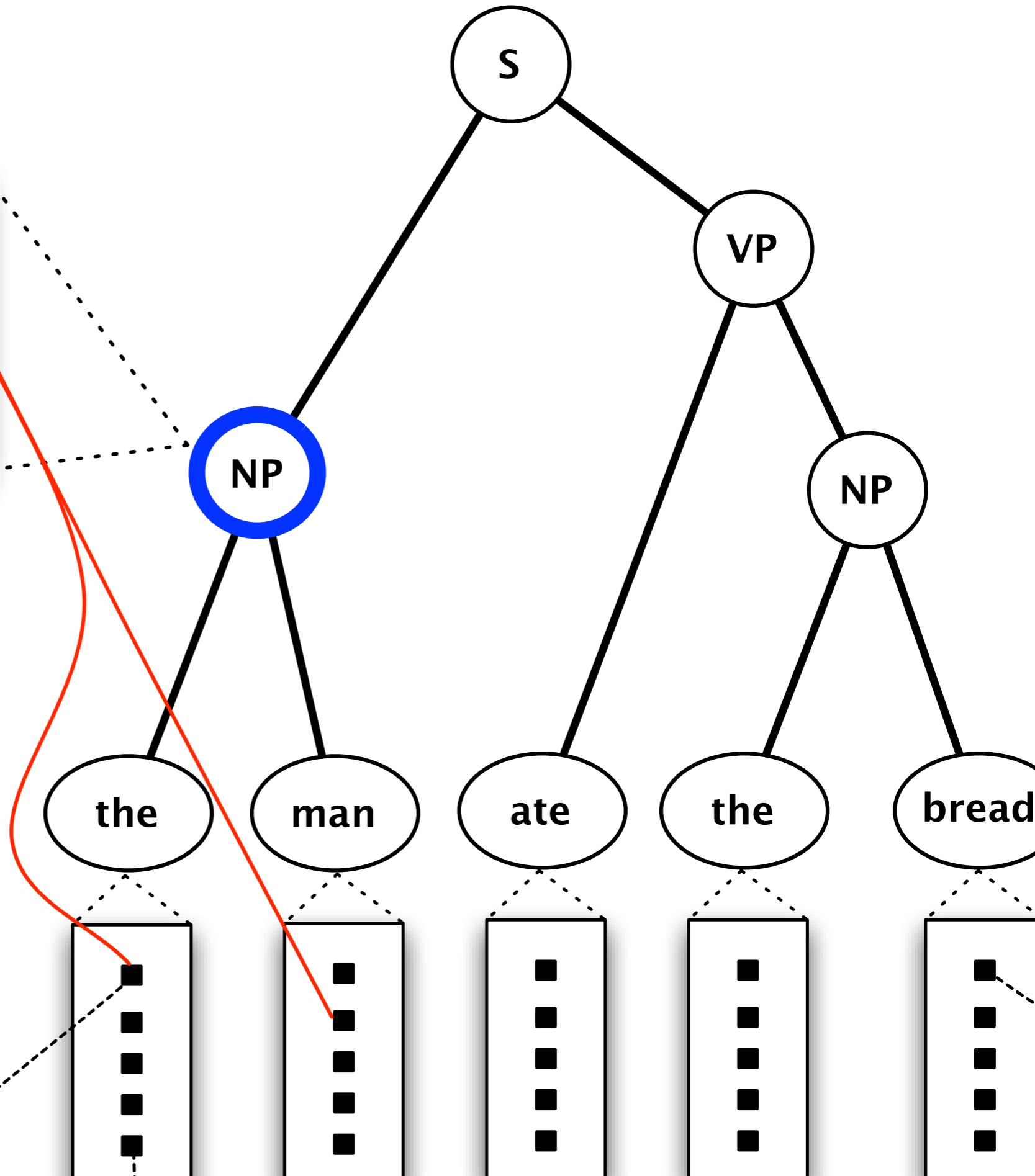
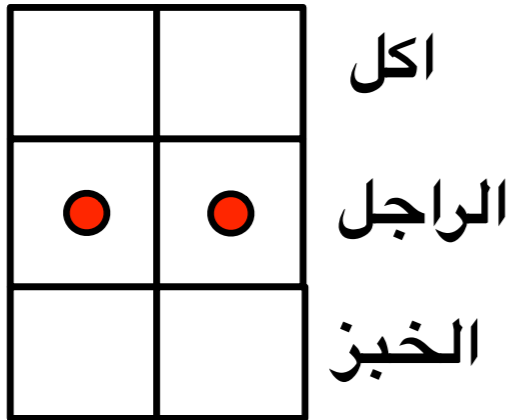
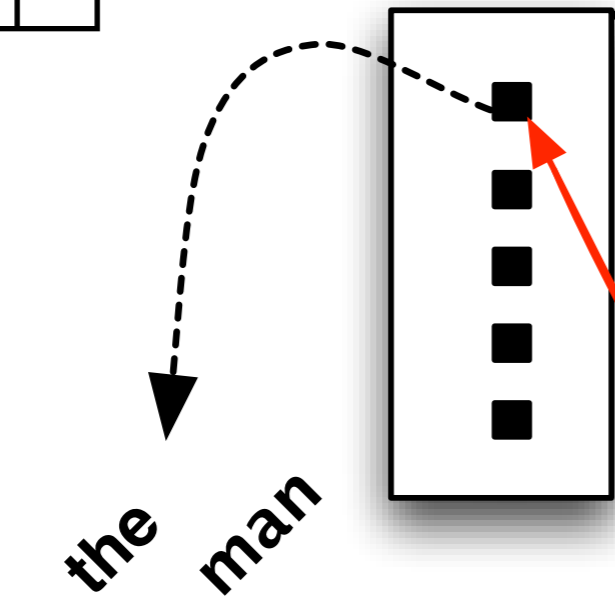
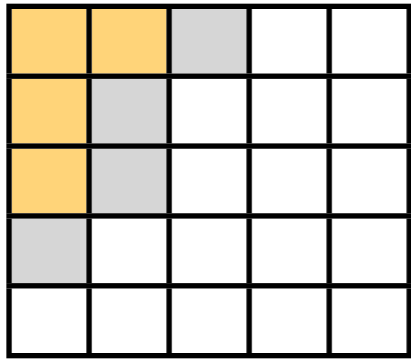
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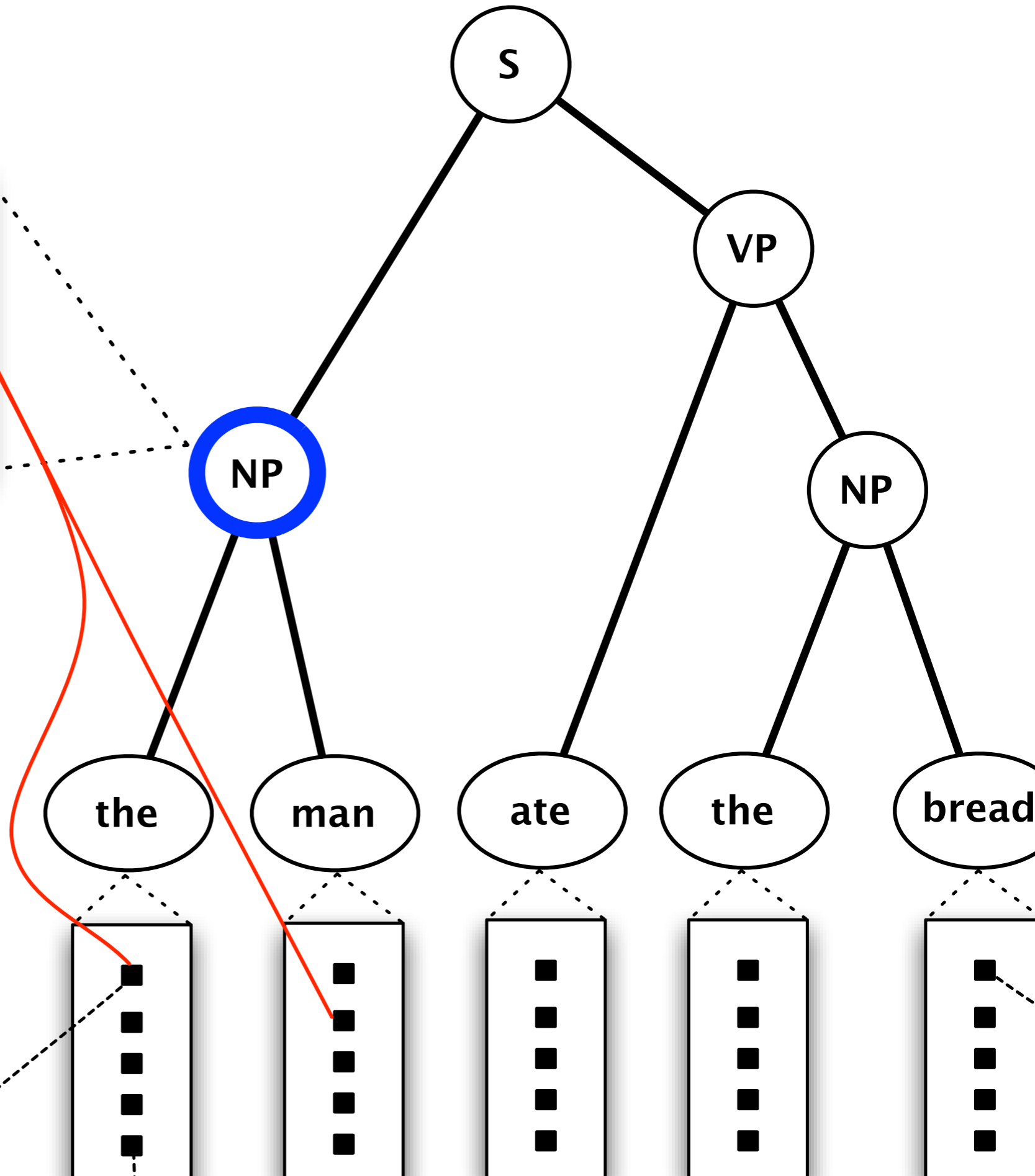
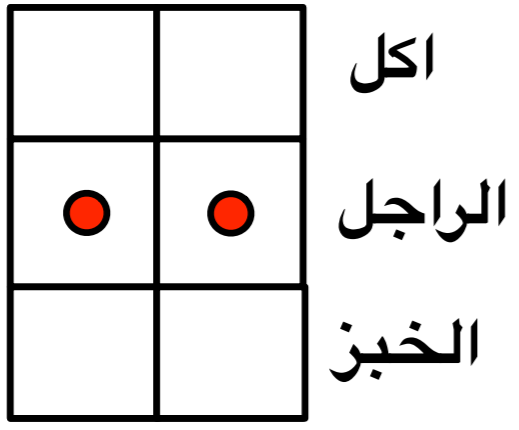
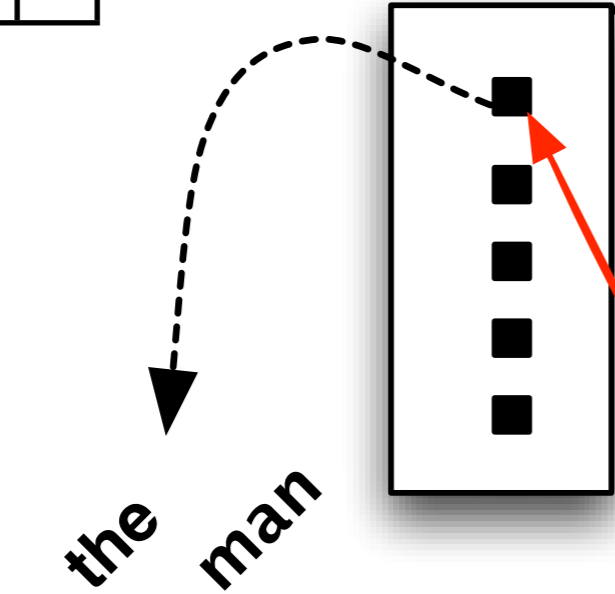
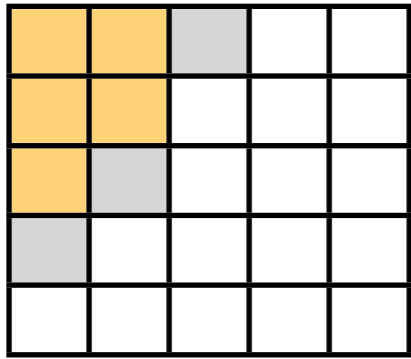


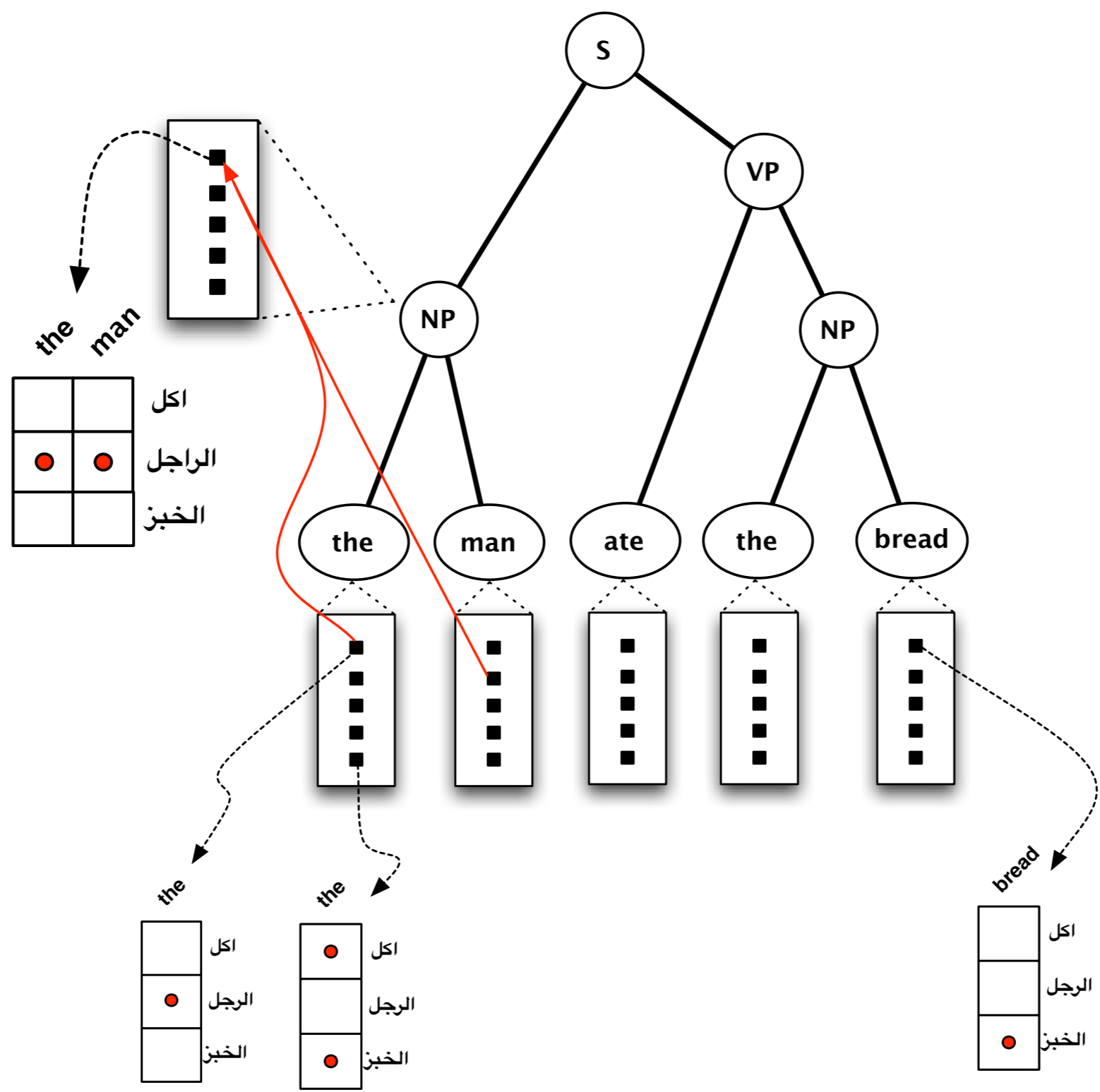


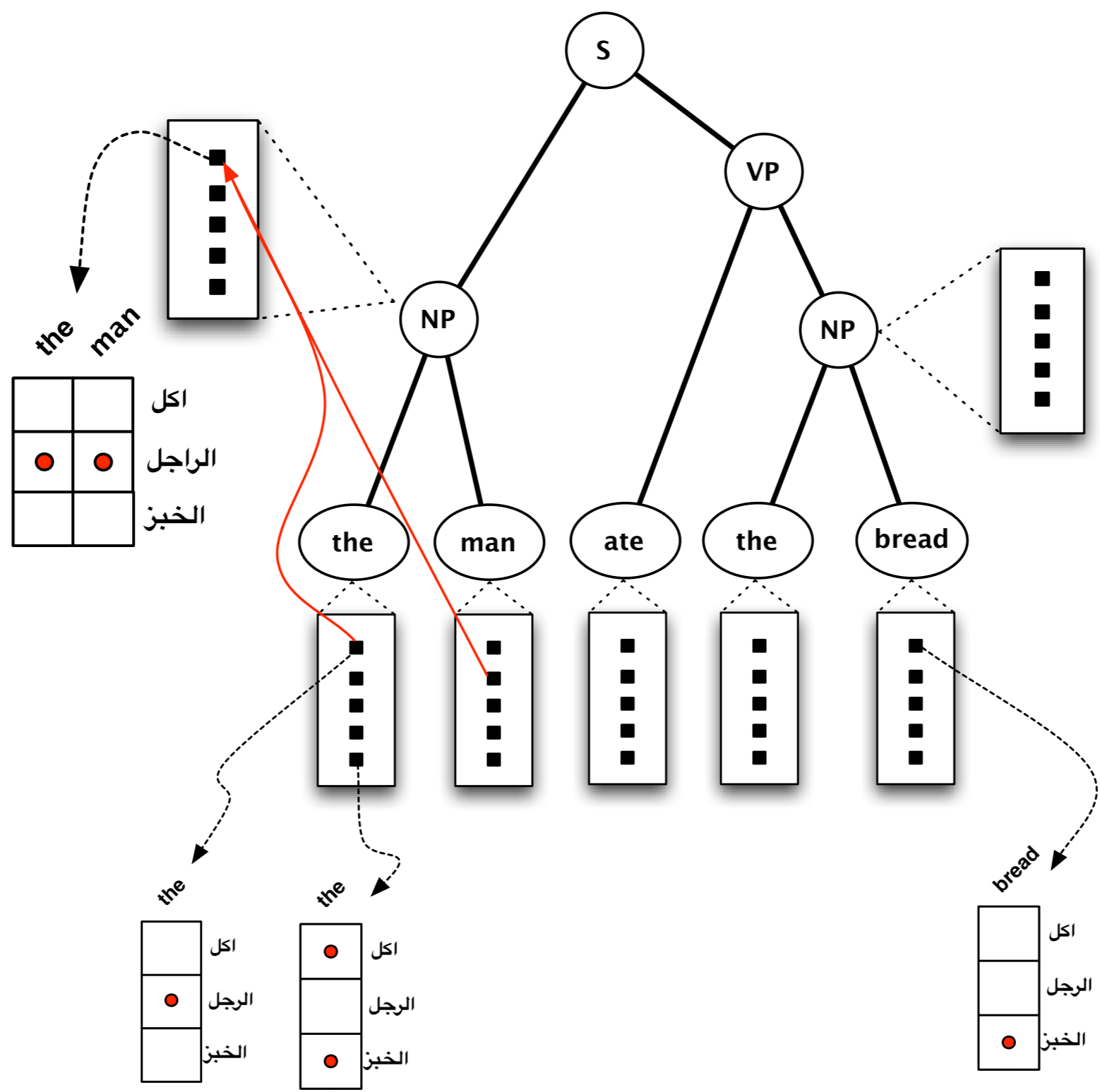










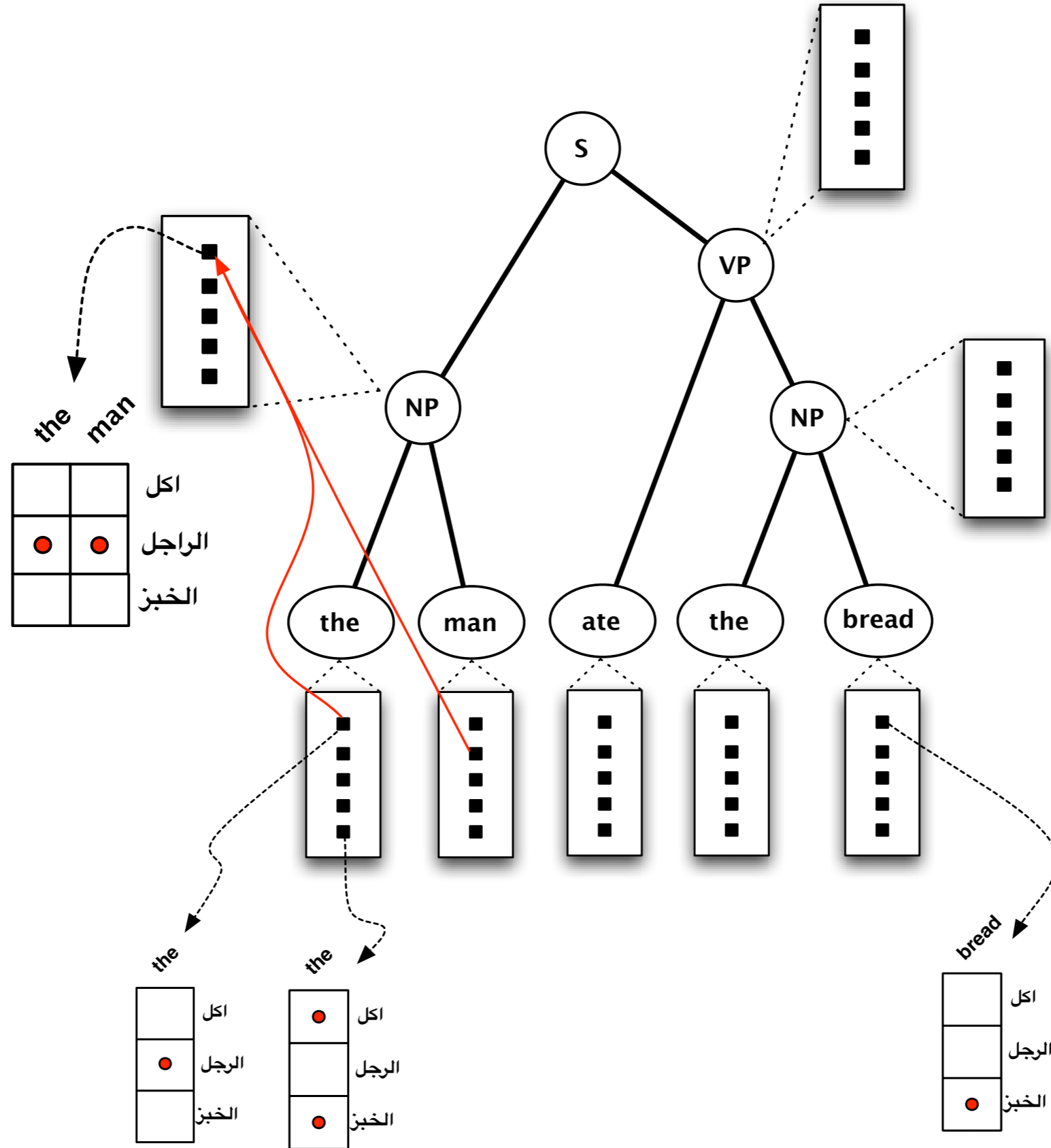


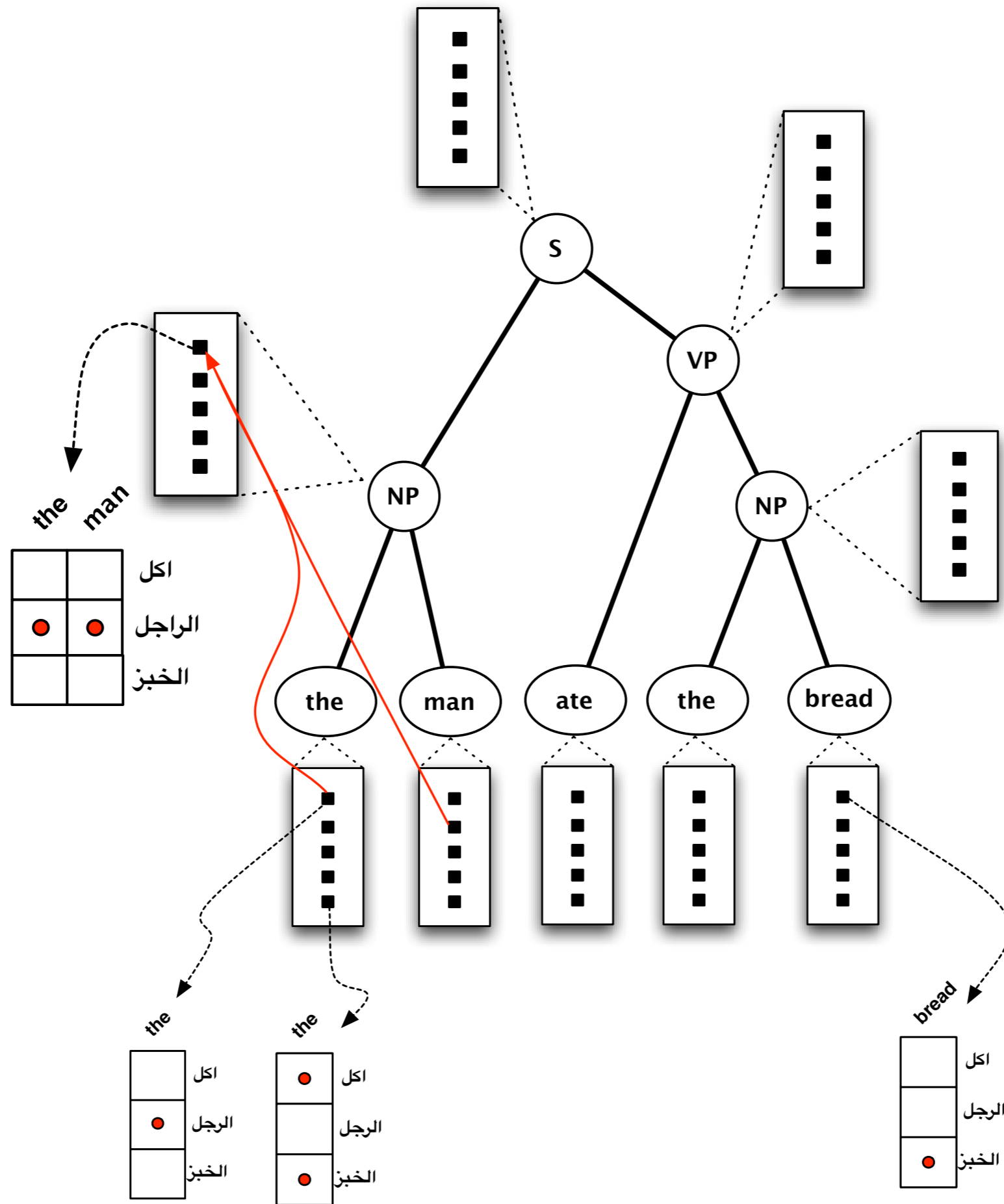
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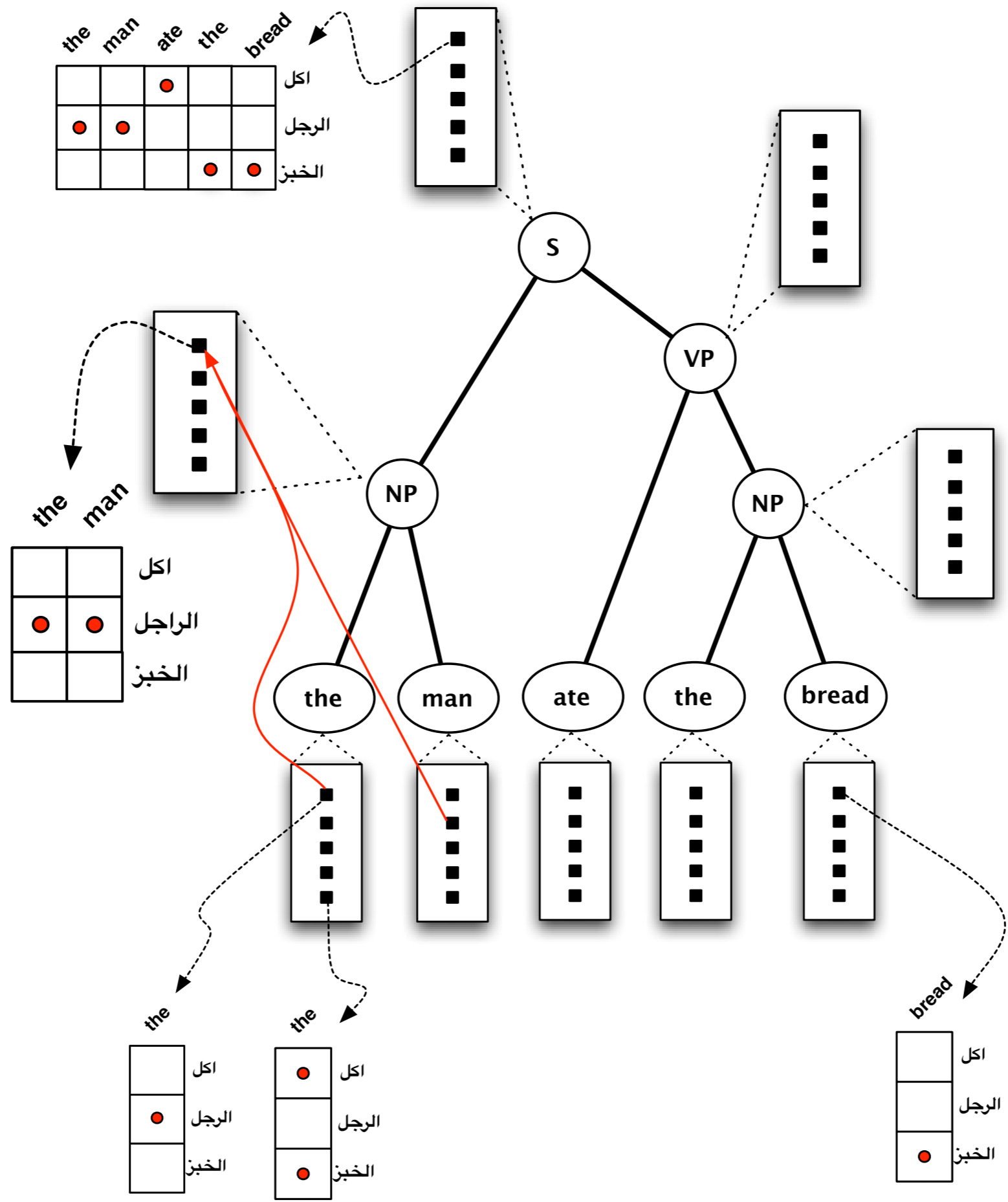
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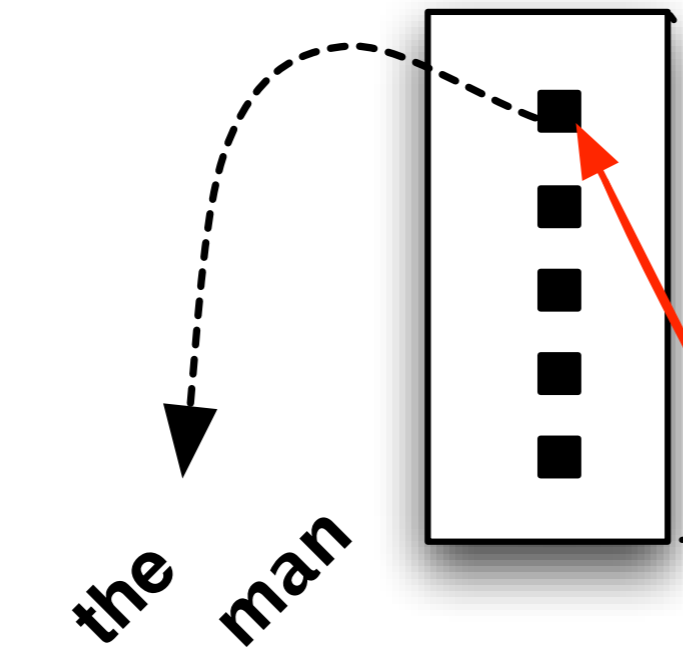
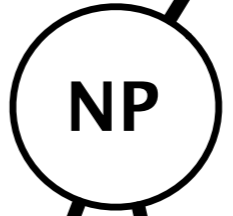
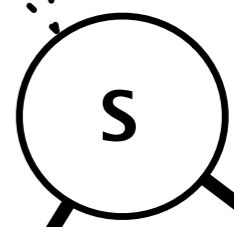
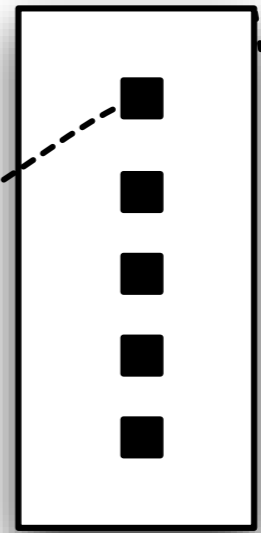
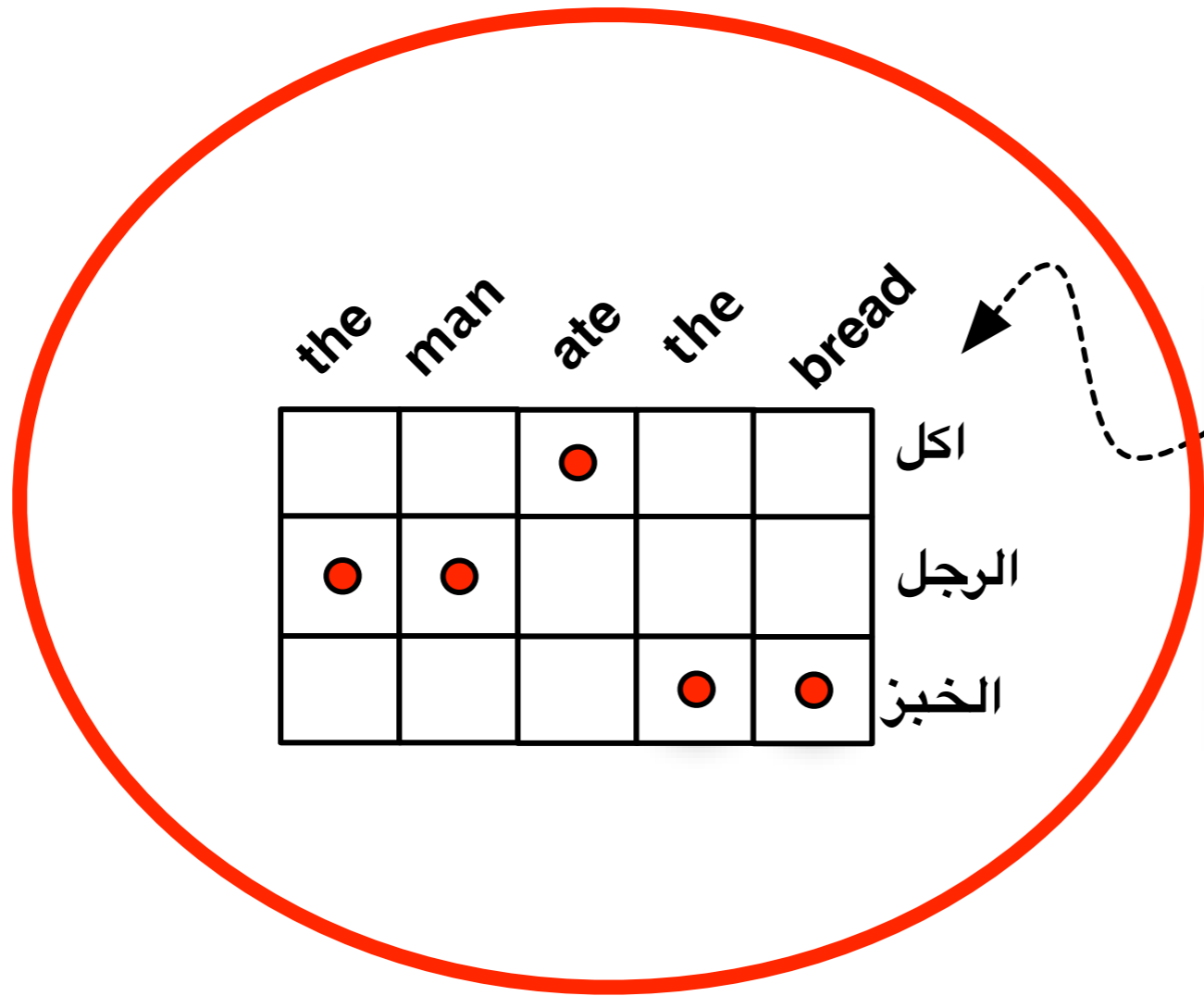
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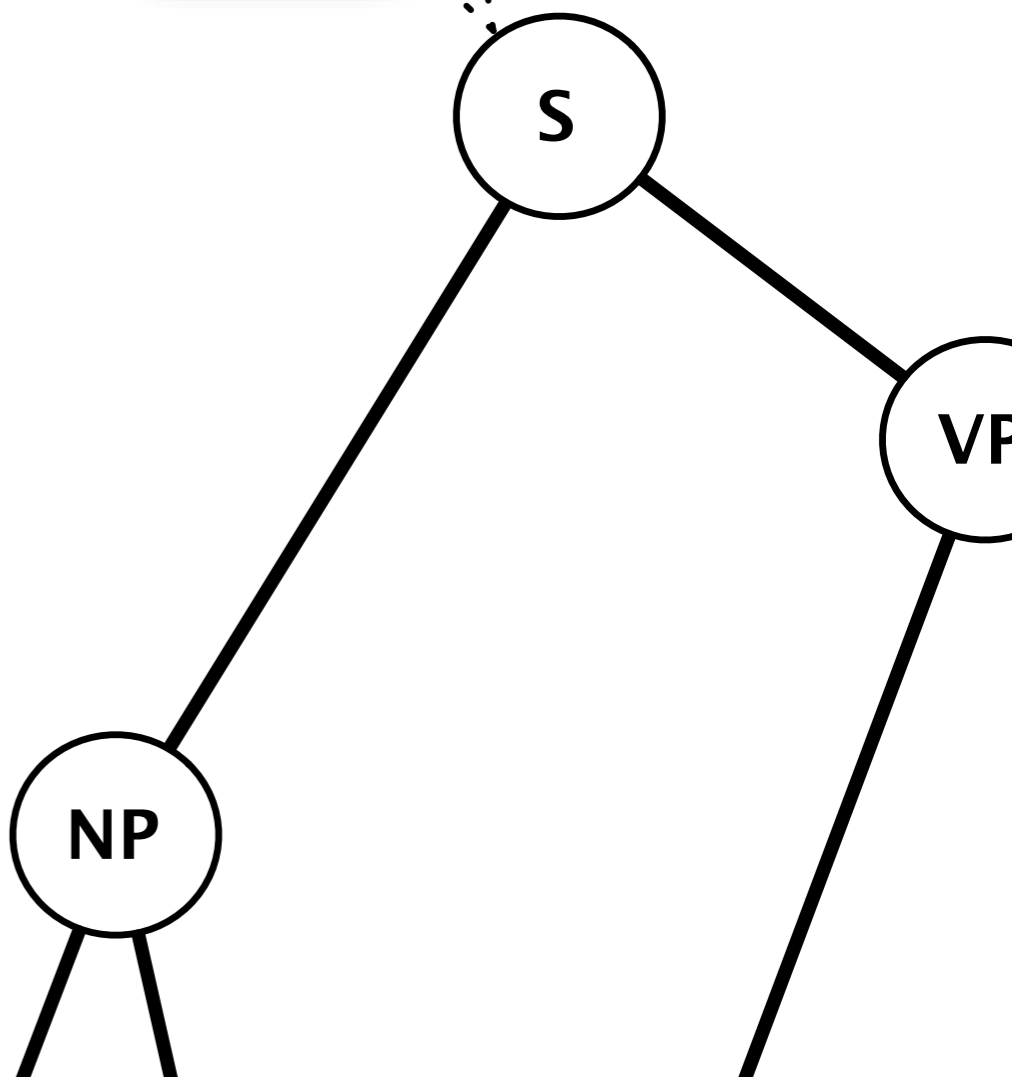




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- Last 1% due to lower recall from approximation during initialization

Experiments

Alignment Experiments

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- **Baseline:**

- ▶ GIZA++, Model 4, grow-diag-final symmetrization
- ▶ 50 million words

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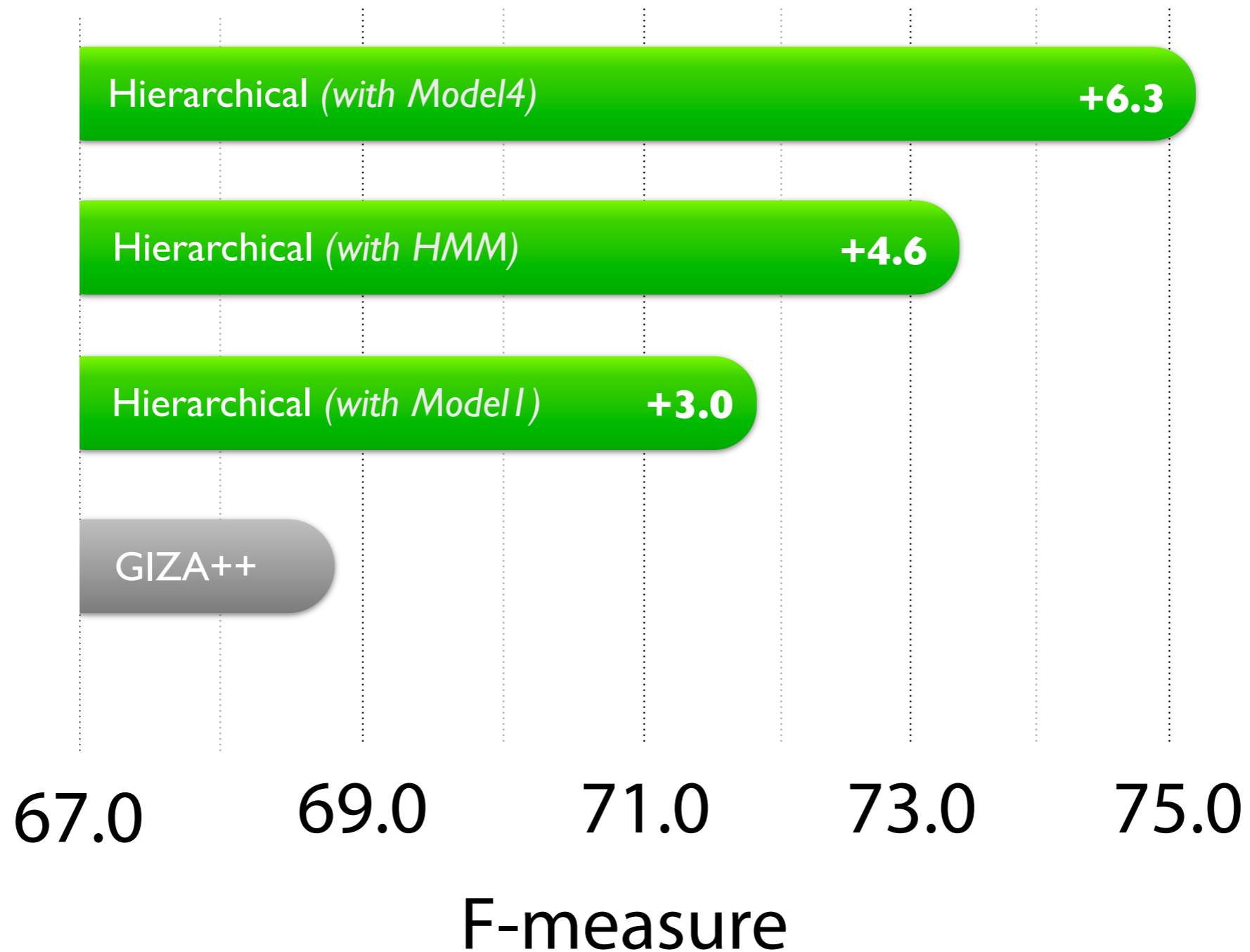
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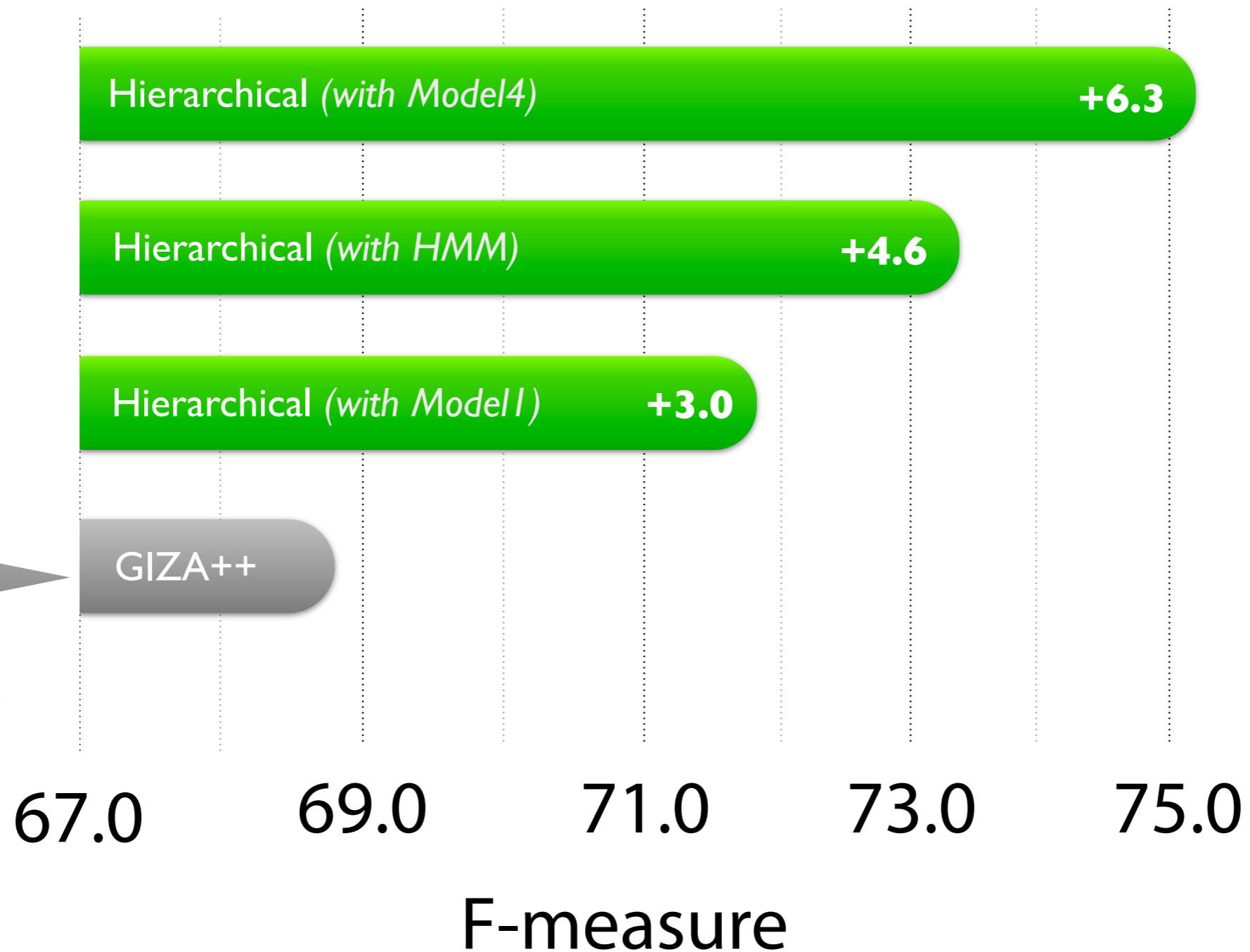
- **Evaluation:**

- ▶ Balanced F-measure
- ▶ Held-out test set of 100 sentence pairs

Experimental Results



Experimental Results



Model 4,
grow-diag-final

Translation Experiments

Translation Experiments

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Translation Experiments

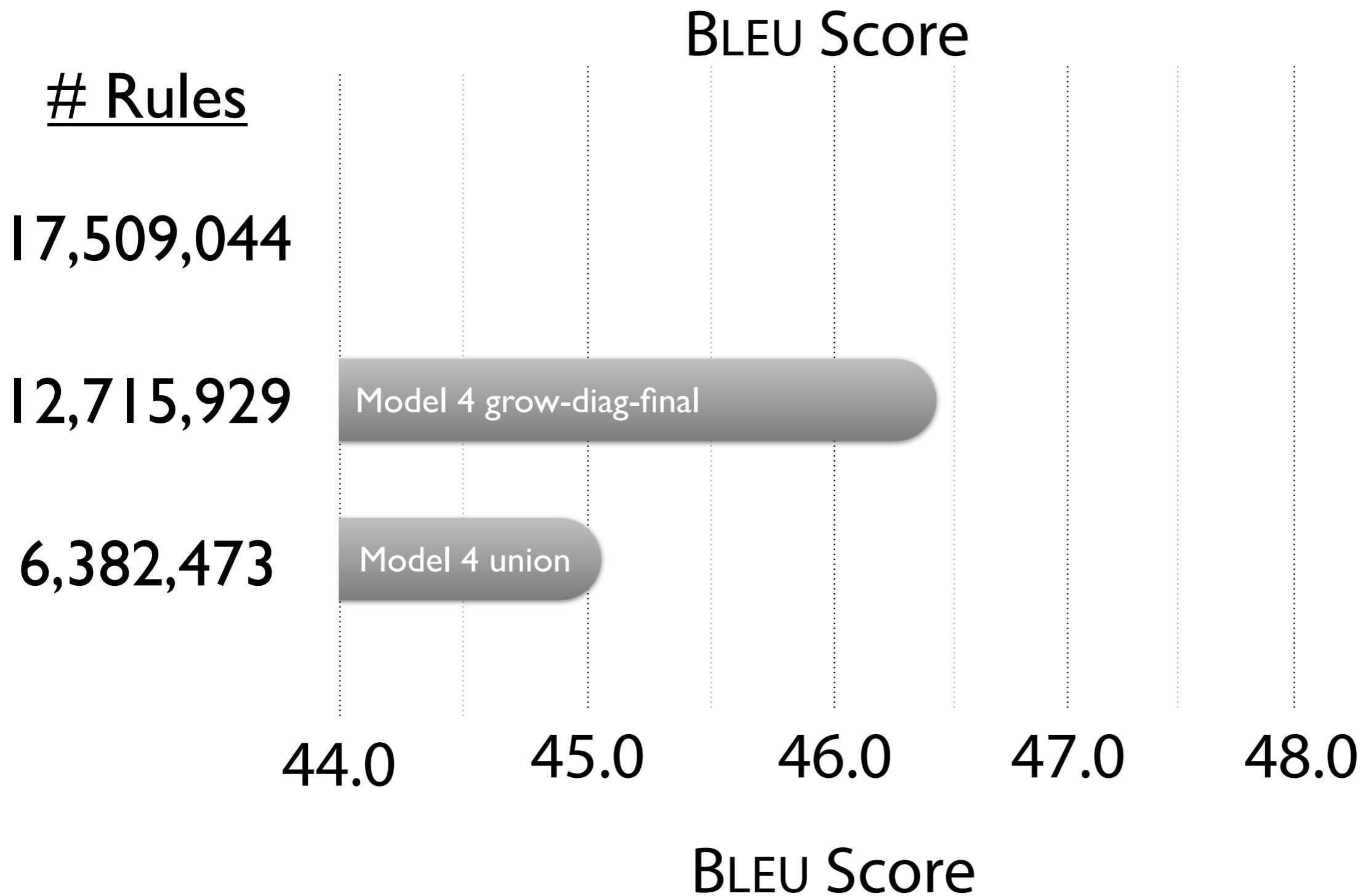
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- ▶ 5-gram randomized LM (Talbot and Brants, 08)
- ▶ Held-out test set from NIST '04, '06 test corpora

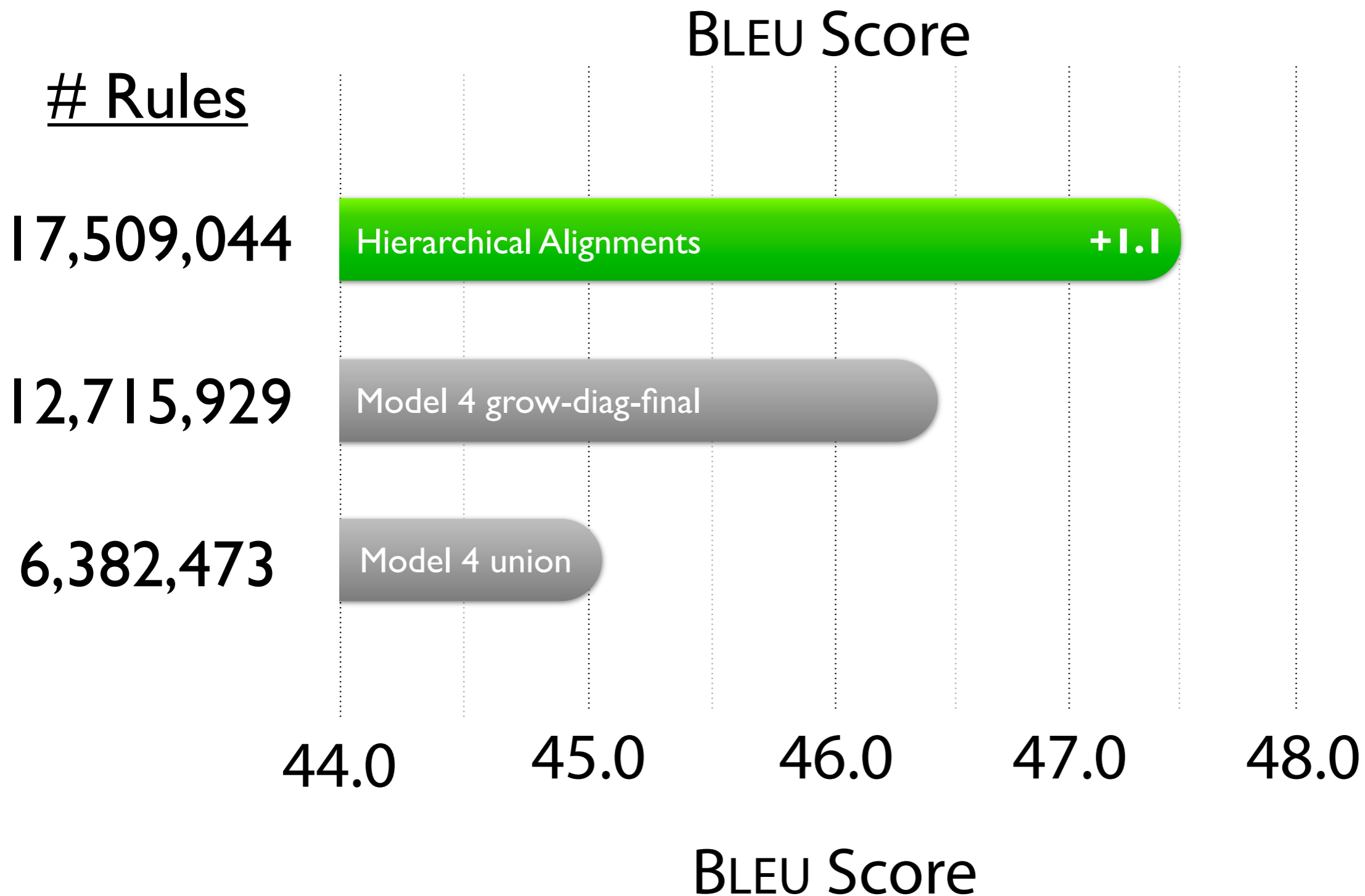
- **Baseline Alignments:**

- ▶ GIZA++, Model 4, *grow-diag-final* symmetrization
- ▶ GIZA++, Model 4, *union* symmetrization
- ▶ 50 million words

Experimental Results



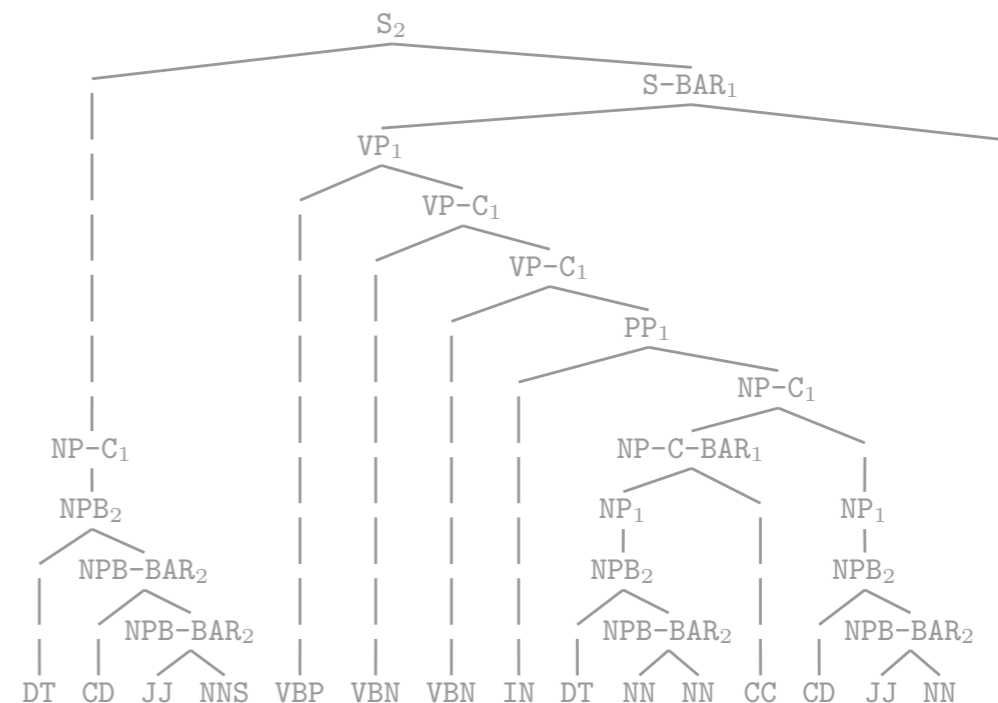
Experimental Results



Hierarchical Alignment

- **FEATURES**

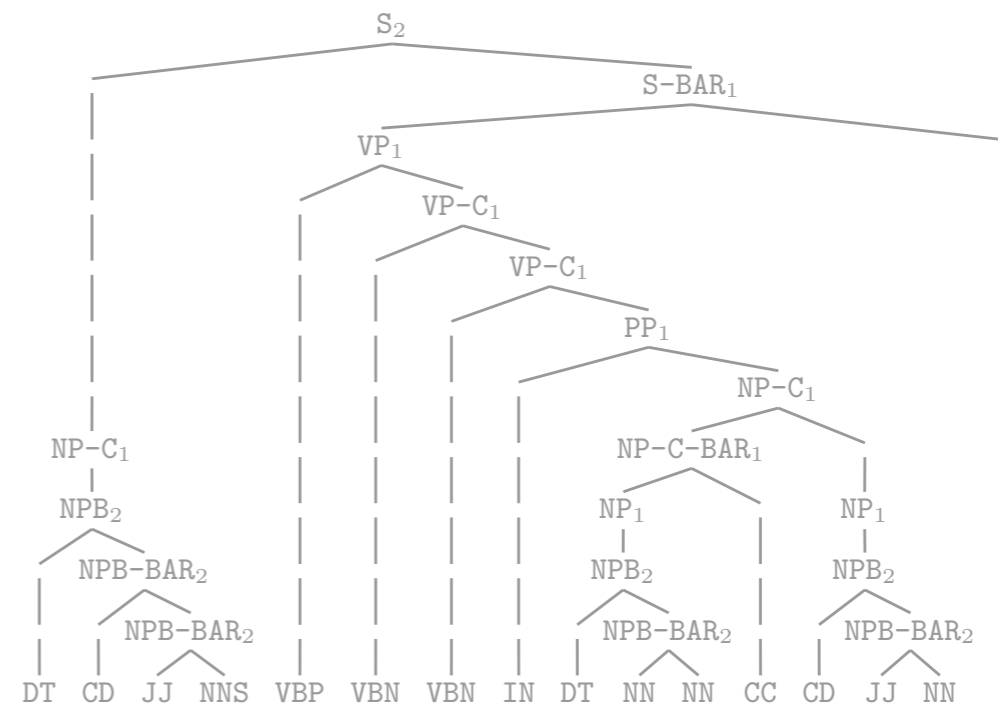
✓ Lexical, syntactic and structural features



Hierarchical Alignment

- **FEATURES**

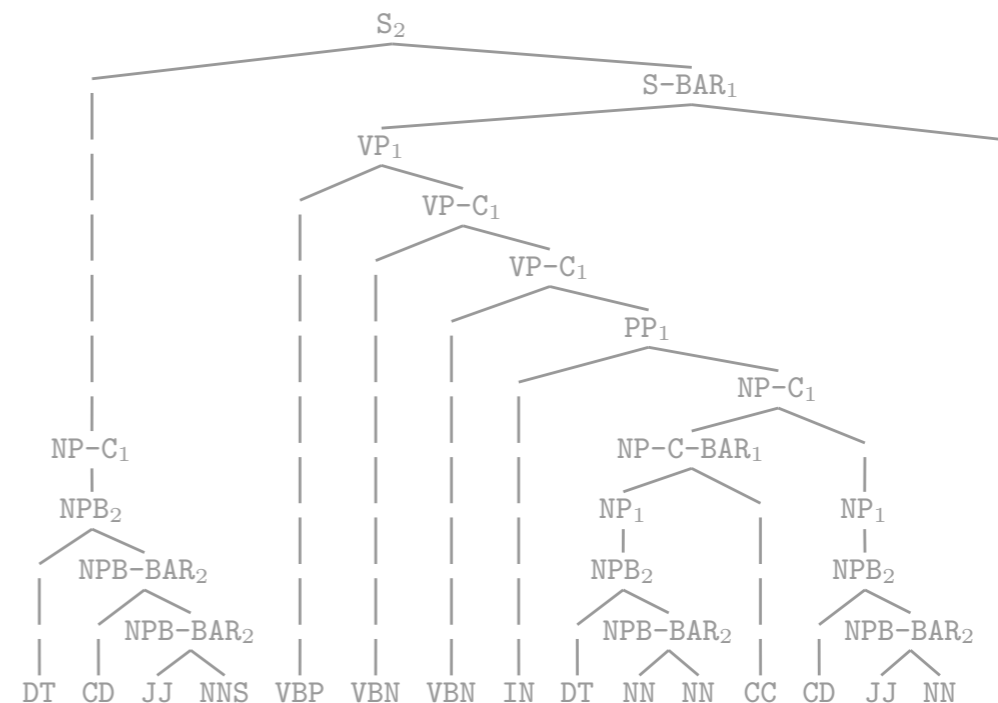
- ✓ Lexical, syntactic and structural features
- ✓ Difficult to capture in generative alignment models



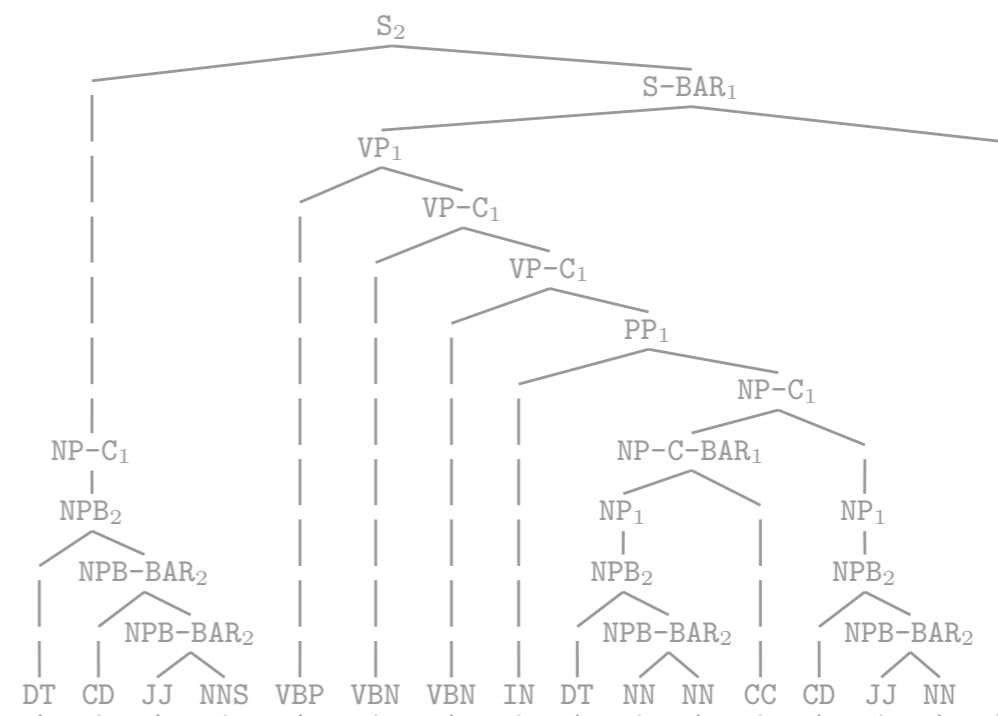
Hierarchical Alignment

- **FEATURES**

- ✓ Lexical, syntactic and structural features
- ✓ Difficult to capture in generative alignment models
- ✓ Local and nonlocal features

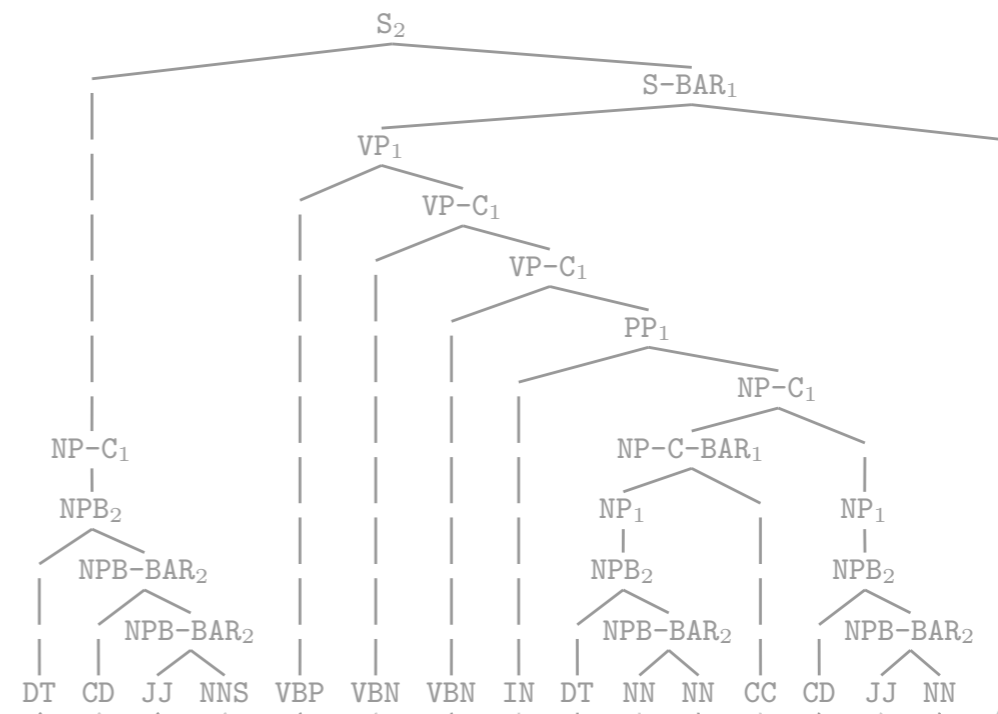


Hierarchical Alignment



Hierarchical Alignment

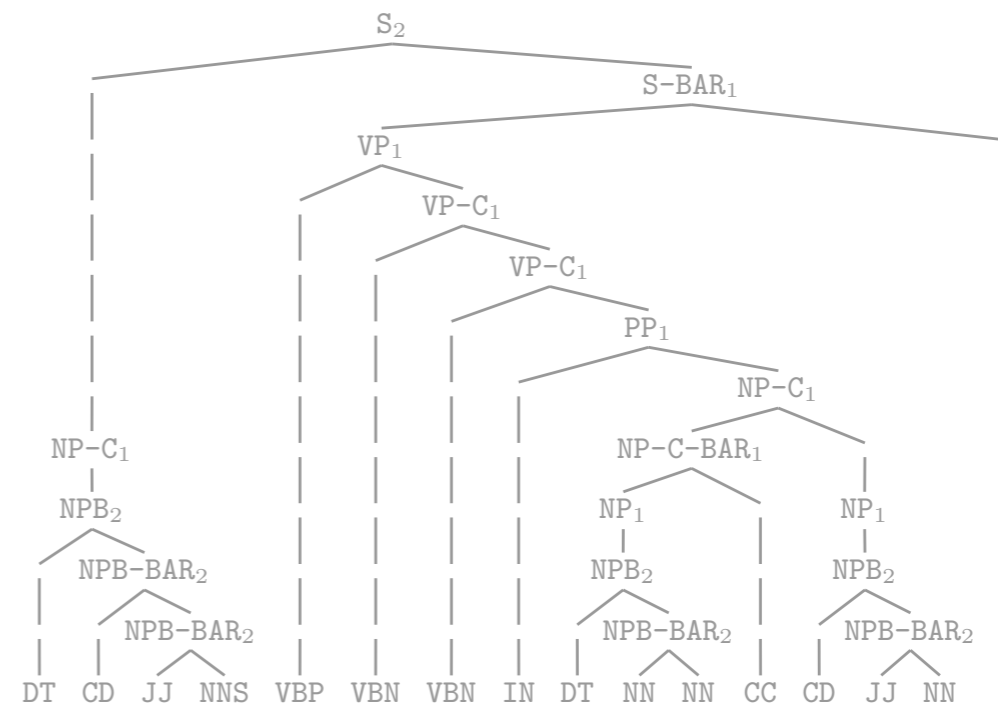
- **SEARCH**



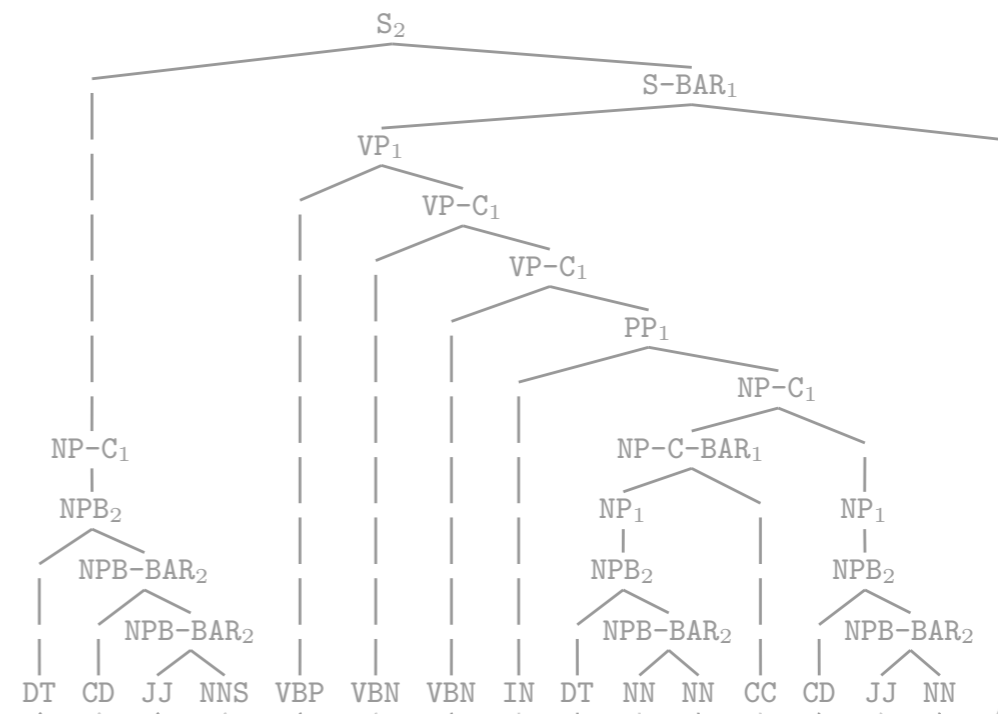
Hierarchical Alignment

- **SEARCH**

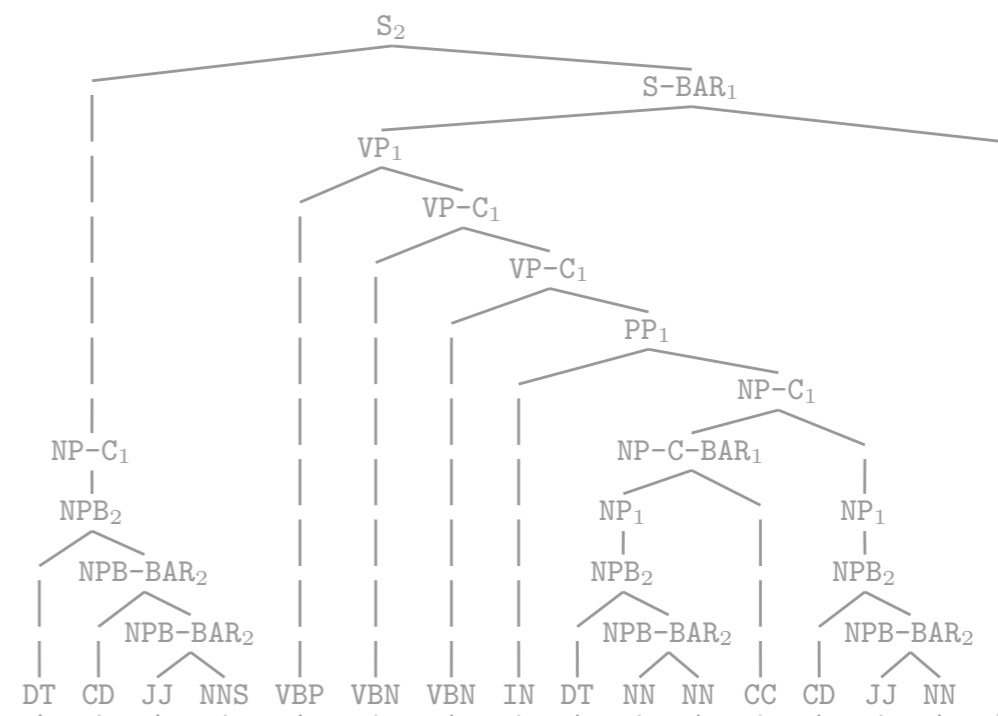
- ✓ Tree provides natural structure to guide the search
- ✓ Cube pruning natural approximation to exact search



Hierarchical Alignment



Hierarchical Alignment



Thanks

USC Viterbi
School of Engineering

