Incremental Semantic Role Labeling with Tree Adjoining Grammar

Ioannis Konstas*, Frank Keller*, Vera Demberg† and Mirella Lapata*

*: Institute for Language, Cognition and Computation
University of Edinburgh

†: Cluster of Excellence Multimodal Computing and Interaction,
Saarland University

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Human Language Processing

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Incrementality leads to local ambiguity, which we can observe in *garden path sentences:*

(1) a. The old man the boat.
b. I convinced her children are noisy.

Human Language Processing

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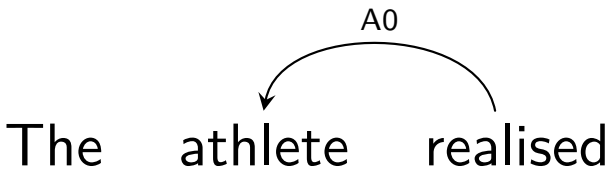
Let's look at this example in more detail.

Human Language Processing - Example



Semantic Triples: <[role labels], arg, pred>

⟨A0,athlete,realised⟩

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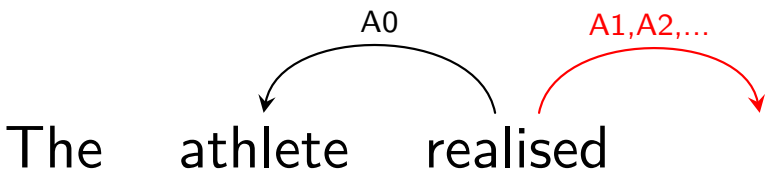

Semantic Triples: <[role labels], arg, pred>

⟨A0,athlete,realised⟩
⟨[A1,A2],nil,realised⟩

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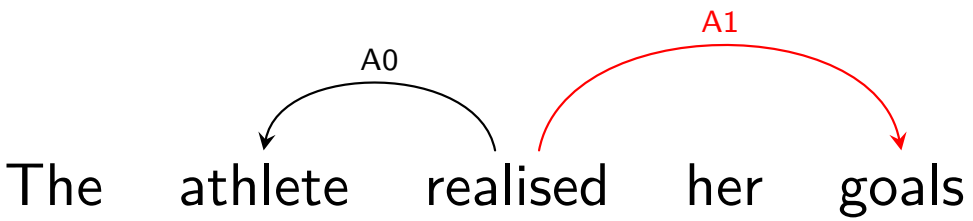

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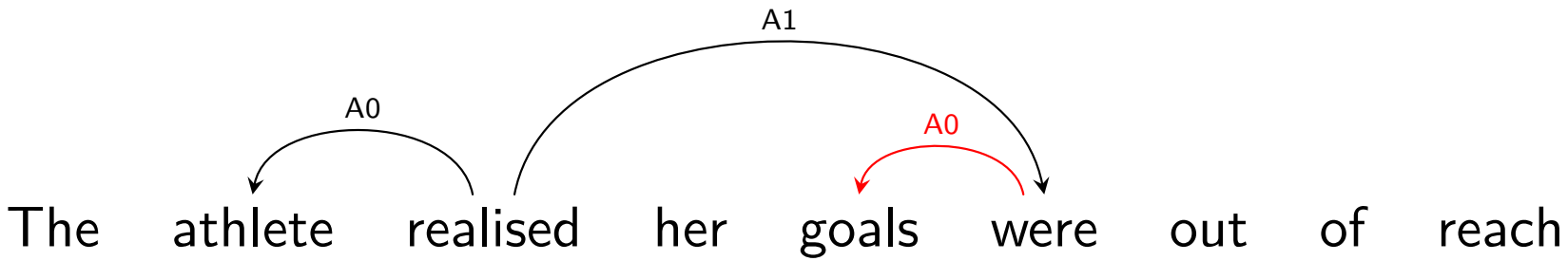

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⟨A1,were,realised⟩
⟨A0,goals,were⟩

Incremental Semantic Role Labeling

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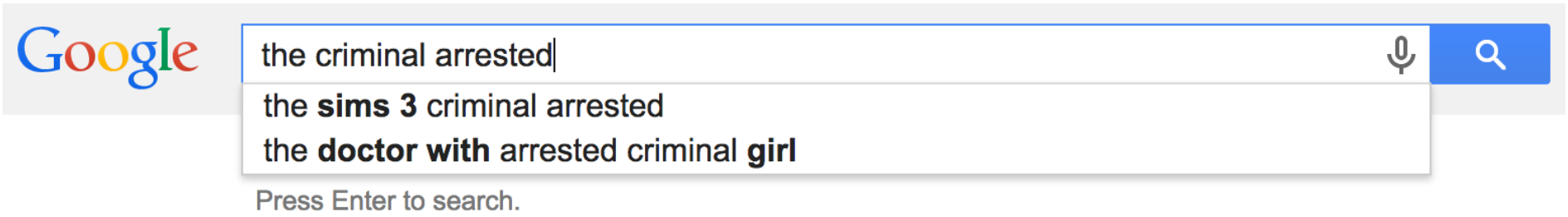
  2. Assign correct role labels
- Assign incomplete semantic roles

Sentence Auto-completion



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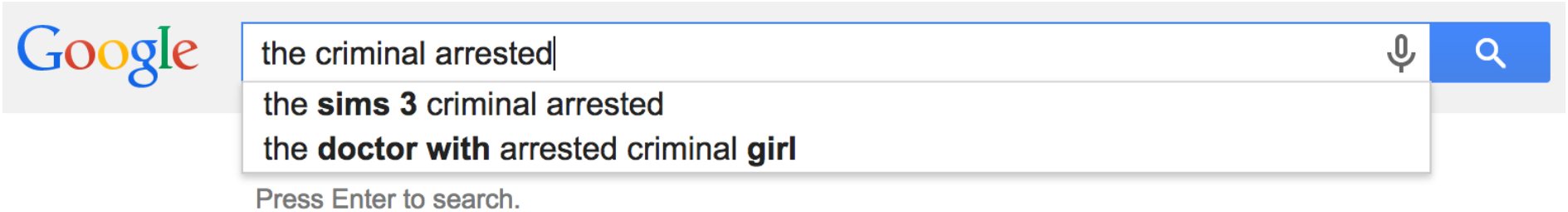

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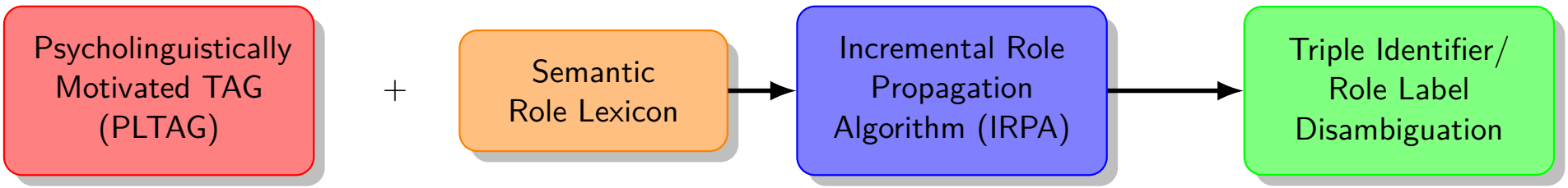
Non-incremental SRL

Pipeline approach

- Liu and Sarkar (2007)
- Màrquez et al. (2008)
- Björkelund et al. (2009) (MATE)

Model


Psycholinguistically Motivated TAG (PLTAG)
+
Semantic Role Lexicon
Incremental Role Propagation Algorithm (IRPA)
Triple Identifier/ Role Label Disambiguation

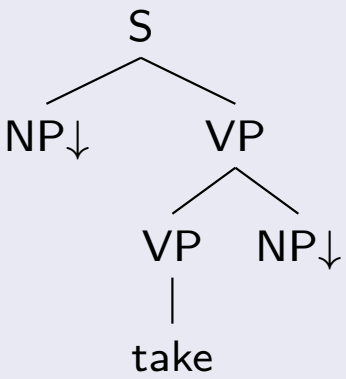
Psycholinguistically Motivated TAG (PLTAG)

Psycholinguistically Motivated TAG (PLTAG), is a variant of tree-adjoining grammar (Demberg et al., 2014) that supports parsing with incremental, fully connected structures.

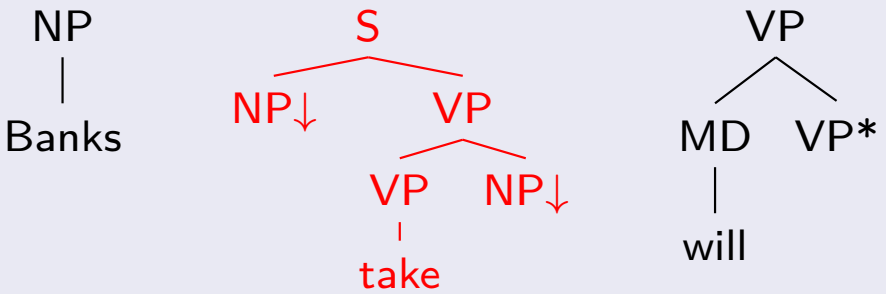
Comparison with TAG

TAG derivations are not always incremental.

Example



Lexicon



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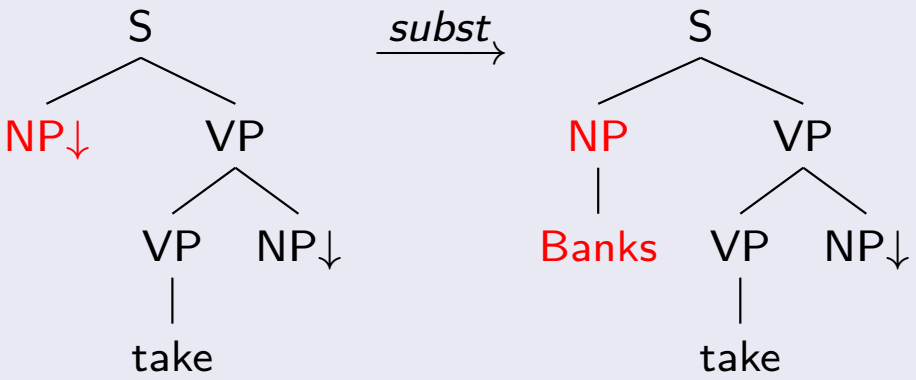

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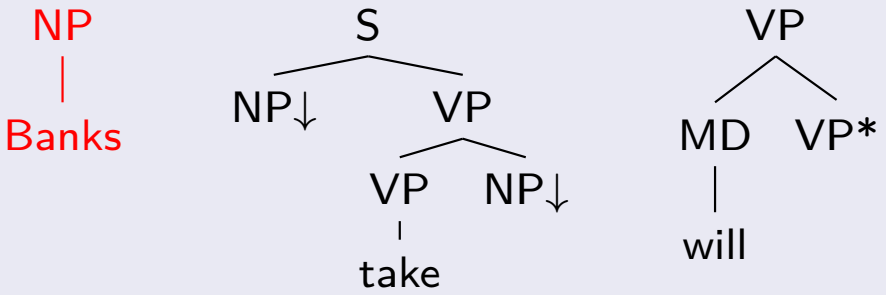

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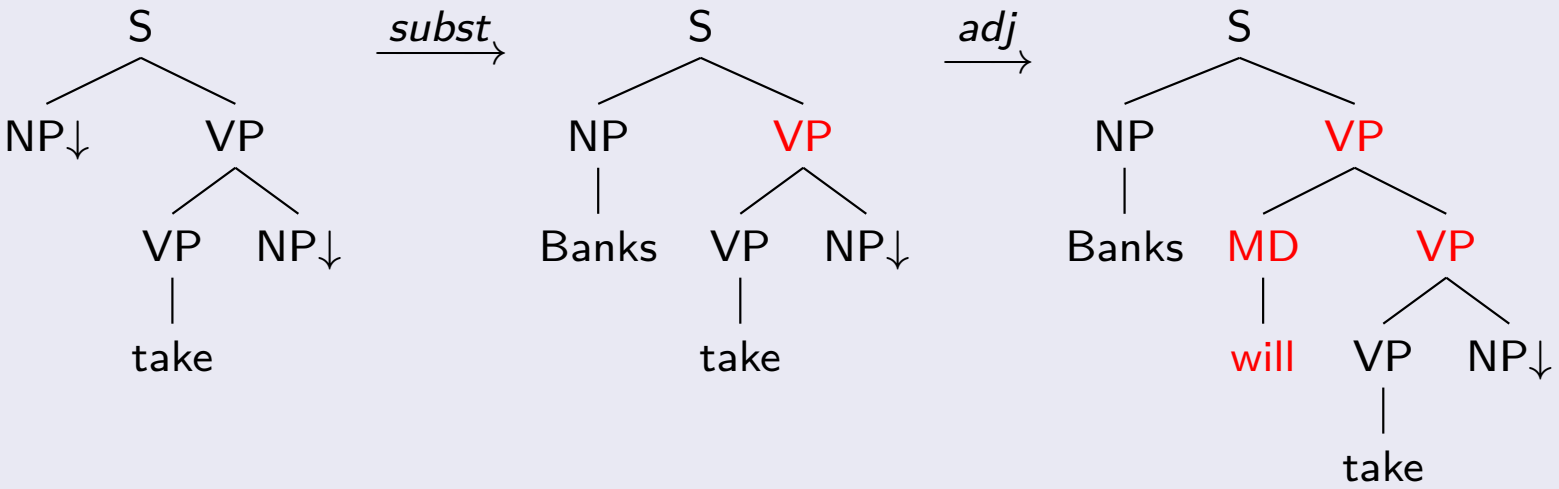

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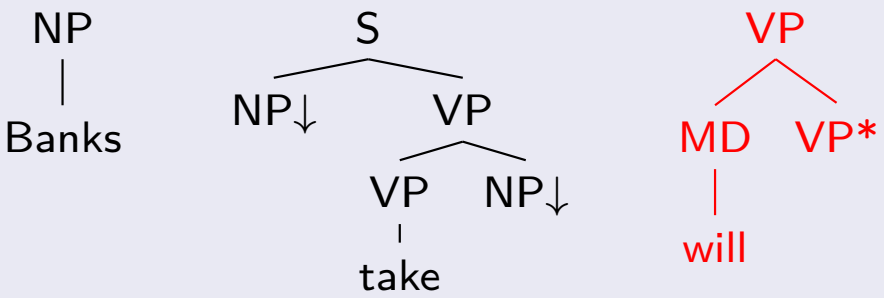

Comparison with TAG

PLTAG derivation are always incremental and fully connected.

Example

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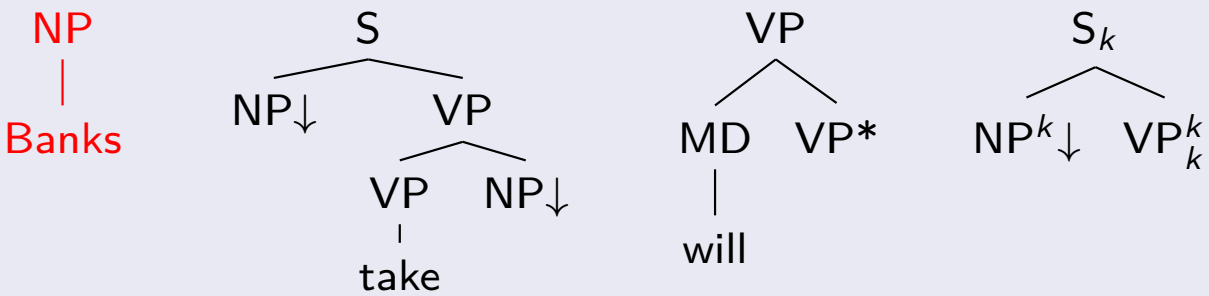

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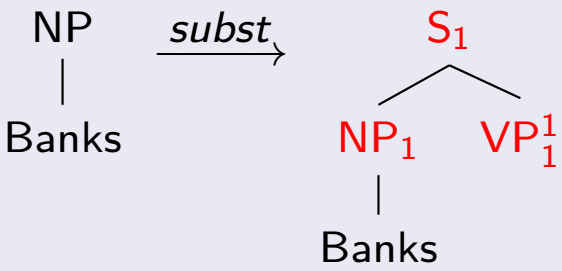

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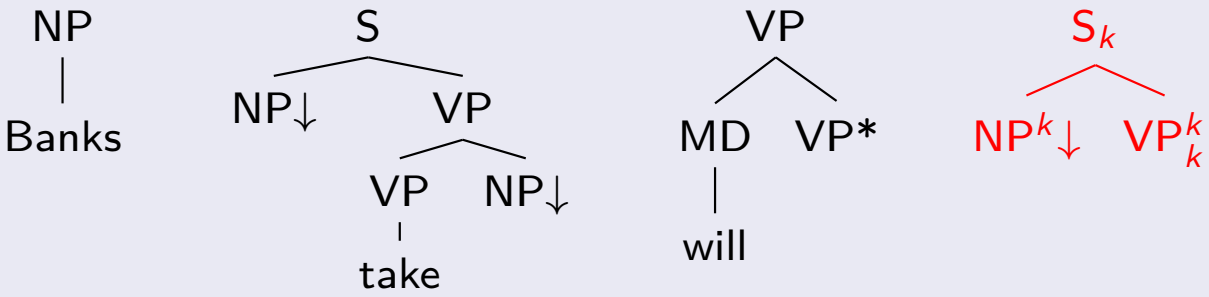

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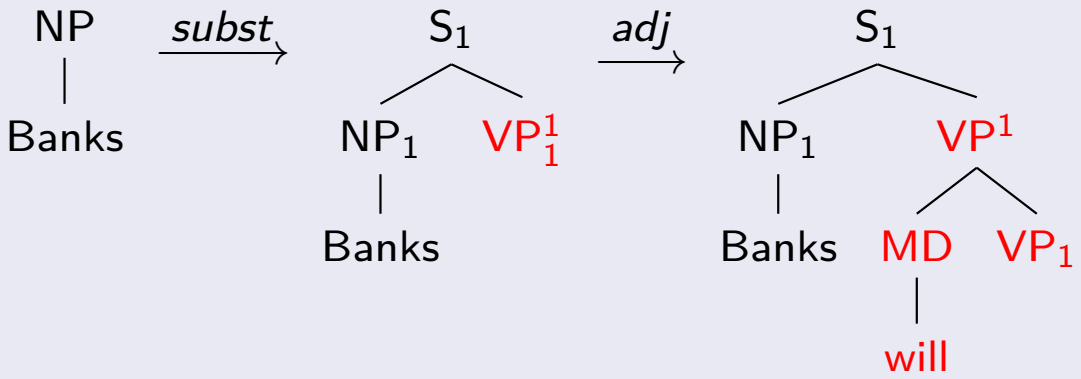

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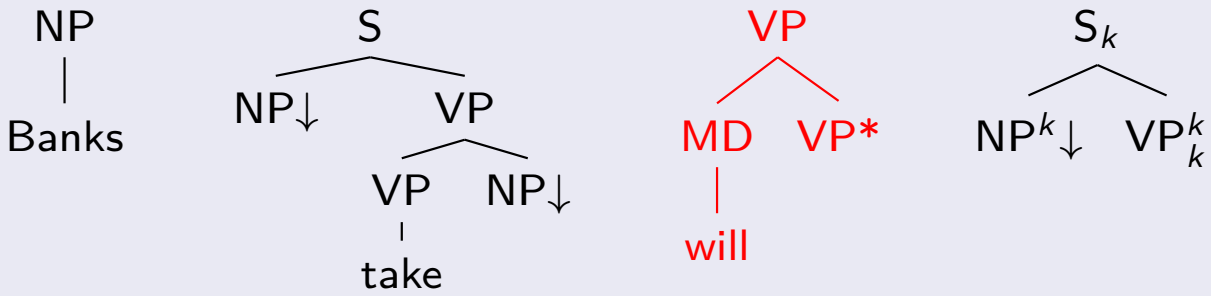

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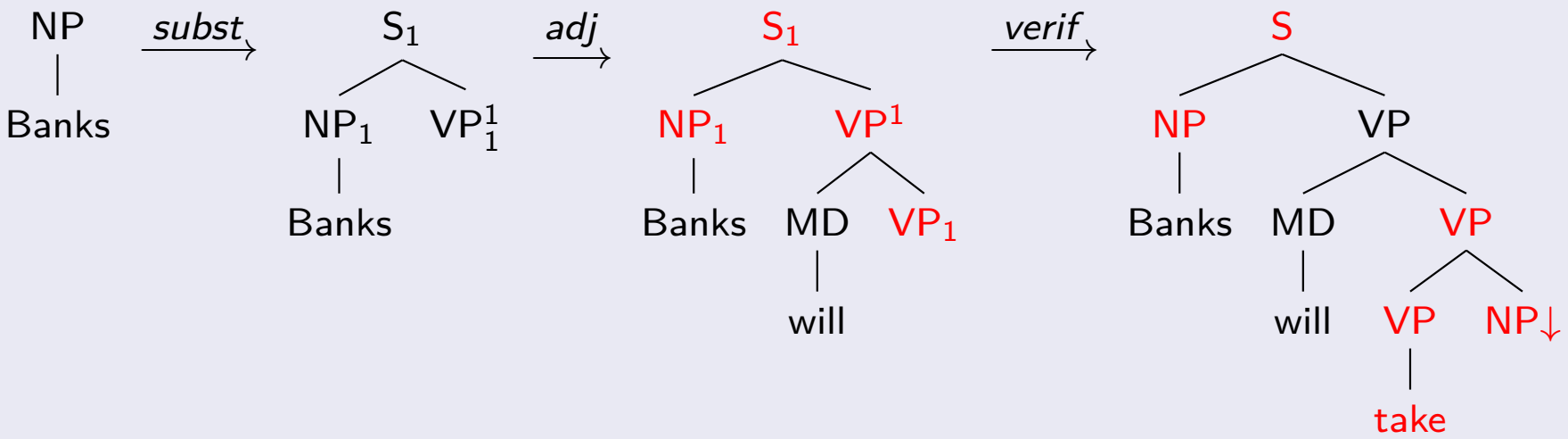

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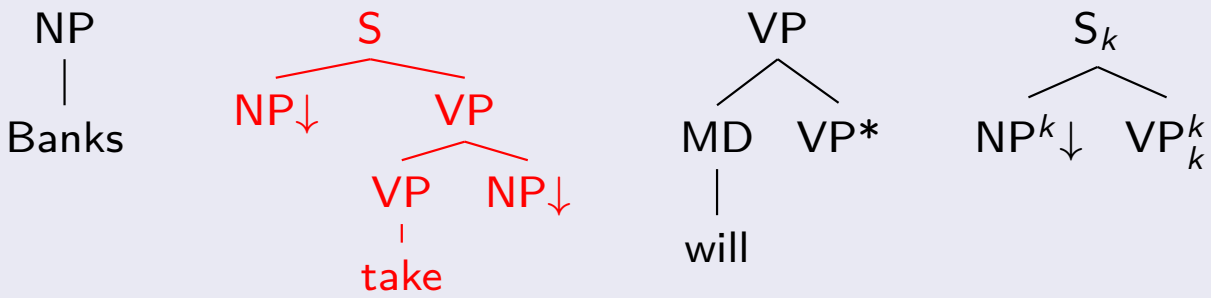
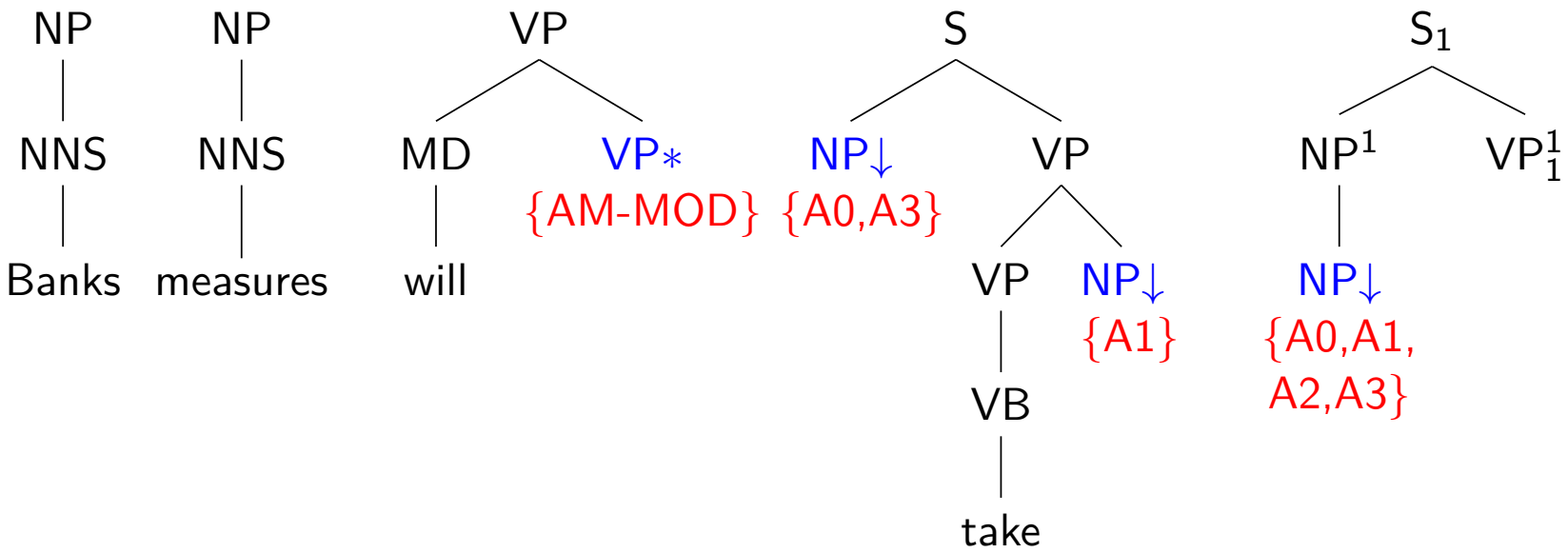
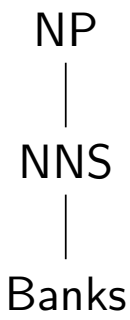


Semantic Roles in Lexicon

Used information for verb predicates *only*, derived from PropBank (Palmer, 2005).



Incremental Role Propagation Algorithm



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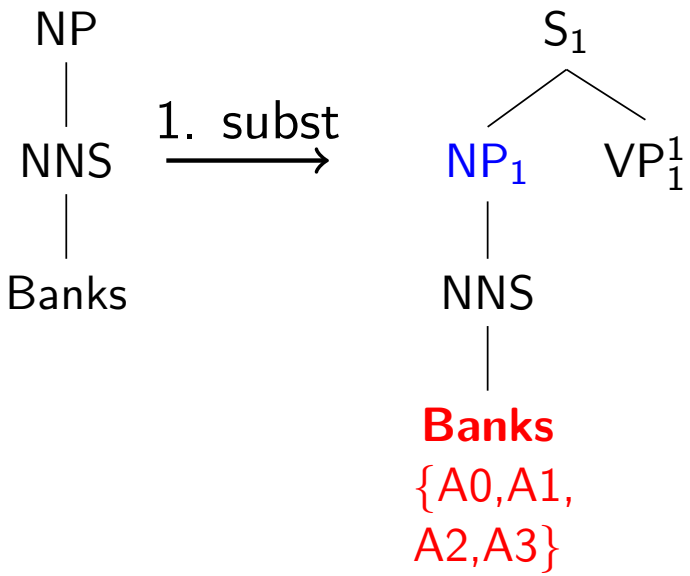

1. NP $\rightarrow \langle$\{A0,A1,A2,A3\},Banks,nil$\rangle$

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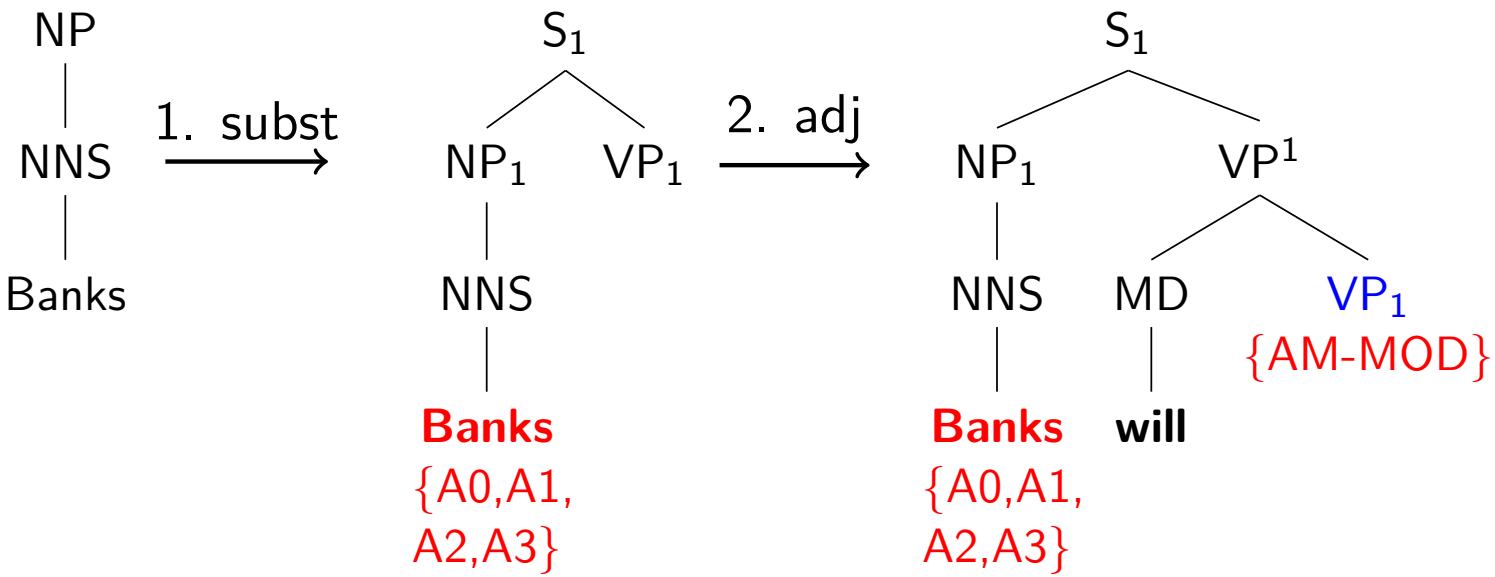

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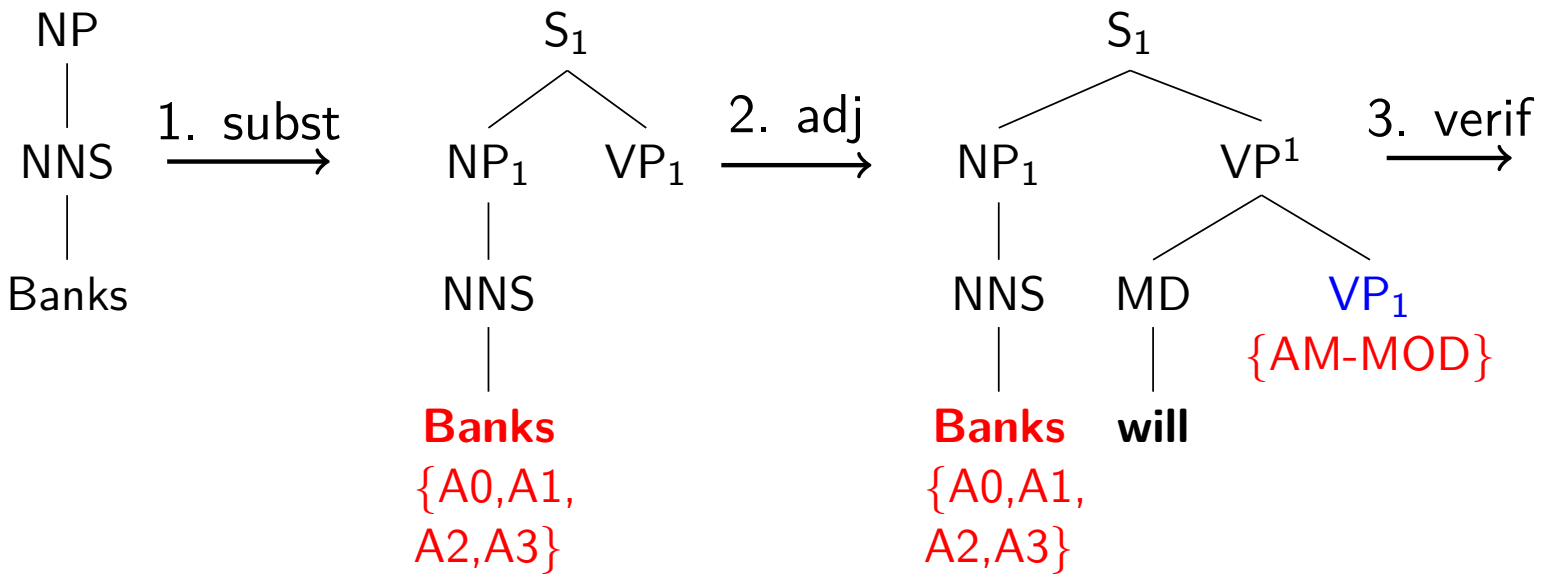

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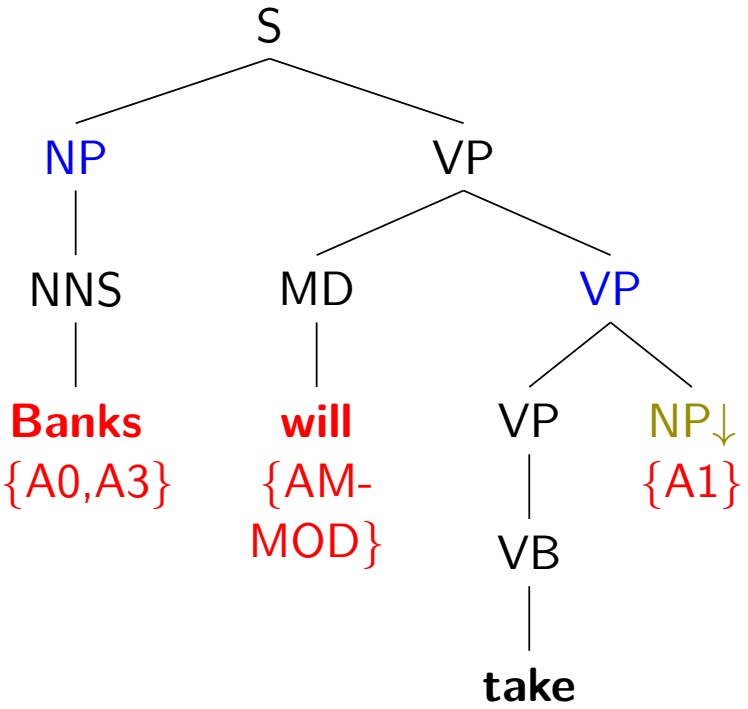

3. NP $\rightarrow$ $\langle$\{A0, ~~A1~~ , ~~A2~~ ,A3\},Banks,take$\rangle$
   VP $\rightarrow$ $\langle$AM-MOD,will,take$\rangle$
   NP $\rightarrow$ $\rightarrow$ $\langle$A1,nil,take$\rangle$

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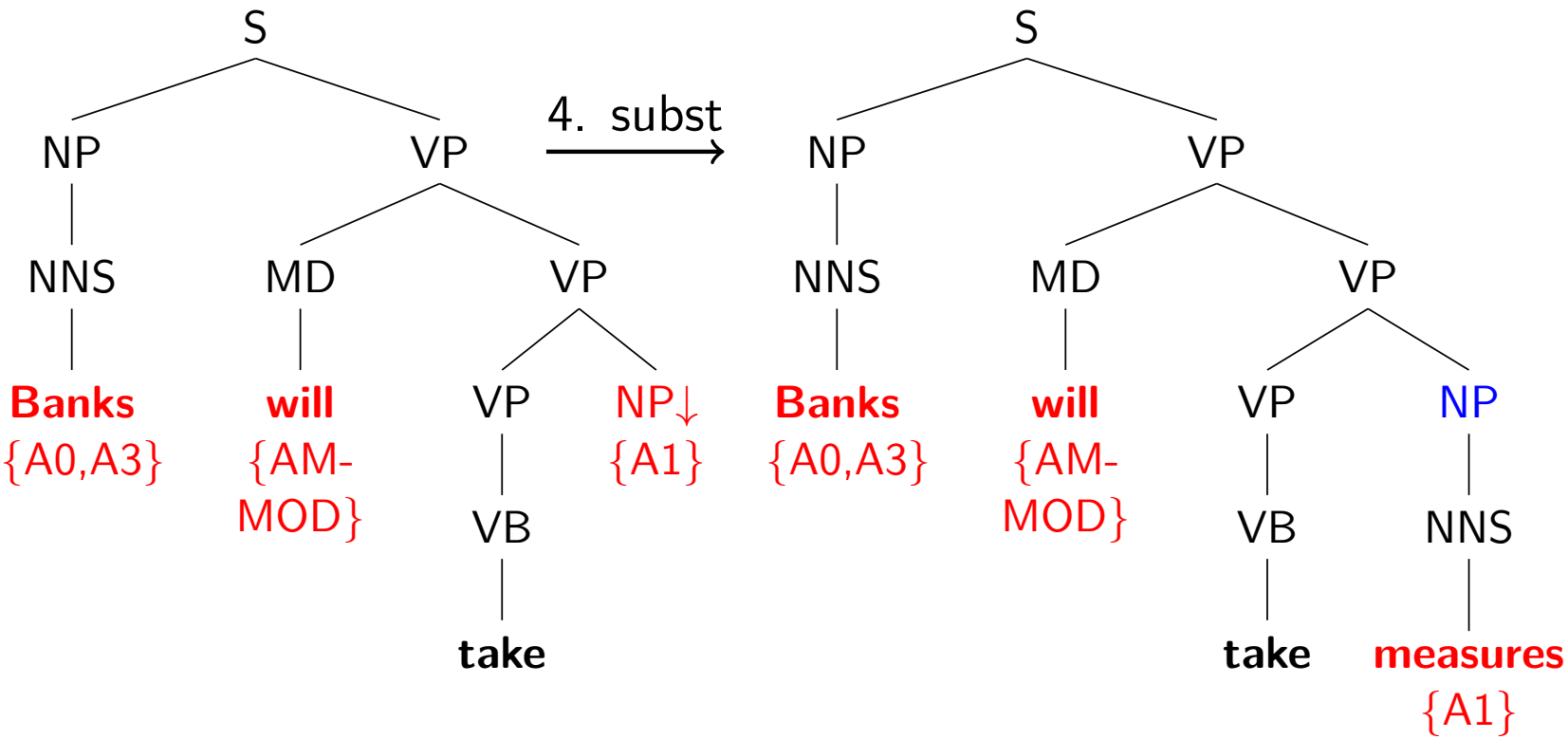

3. NP → ⟨{A0,A3},Banks,take⟩
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4. NP → ⟨A1,measures,take⟩

Argument Identification - Role Label Disambiguation

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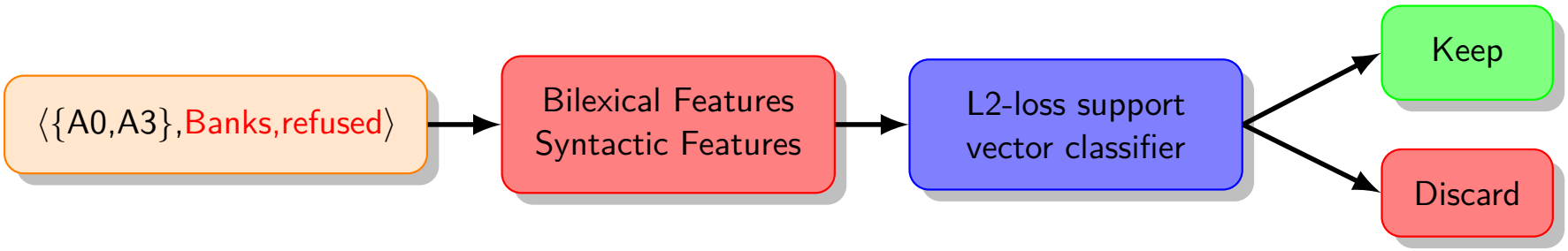

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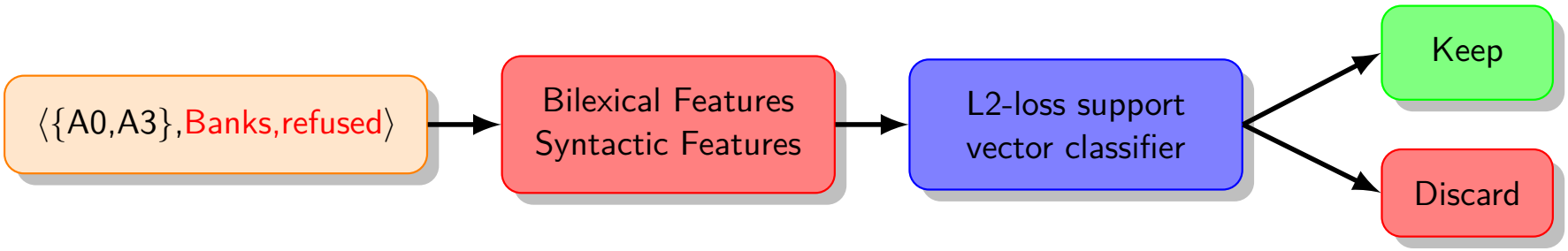

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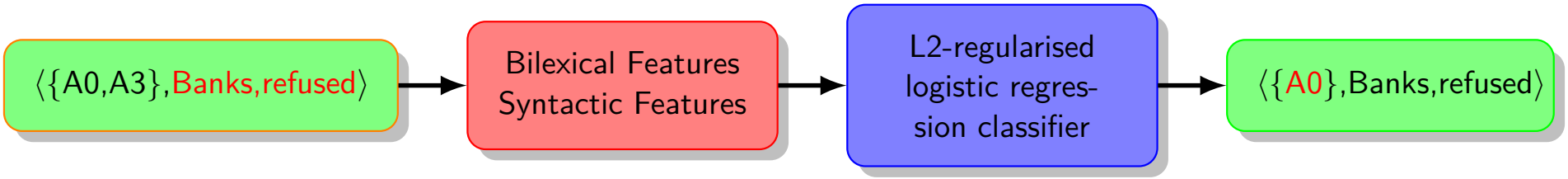

Experiments

- Propositions with verb predicates only
- Gold lexicon entries during parsing - CoNLL-SRL-only task

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- Full sentence Accuracy (F_1)
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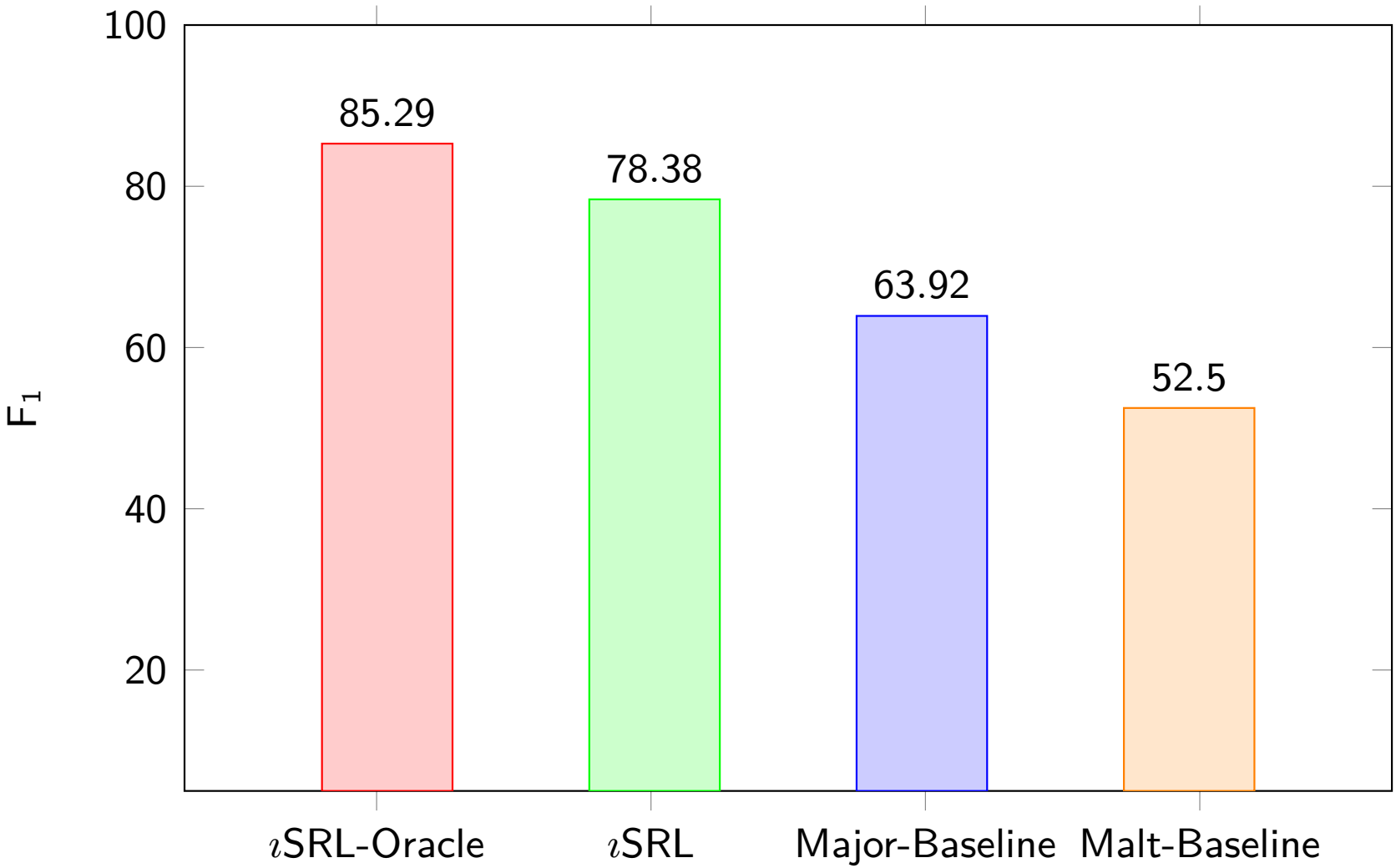
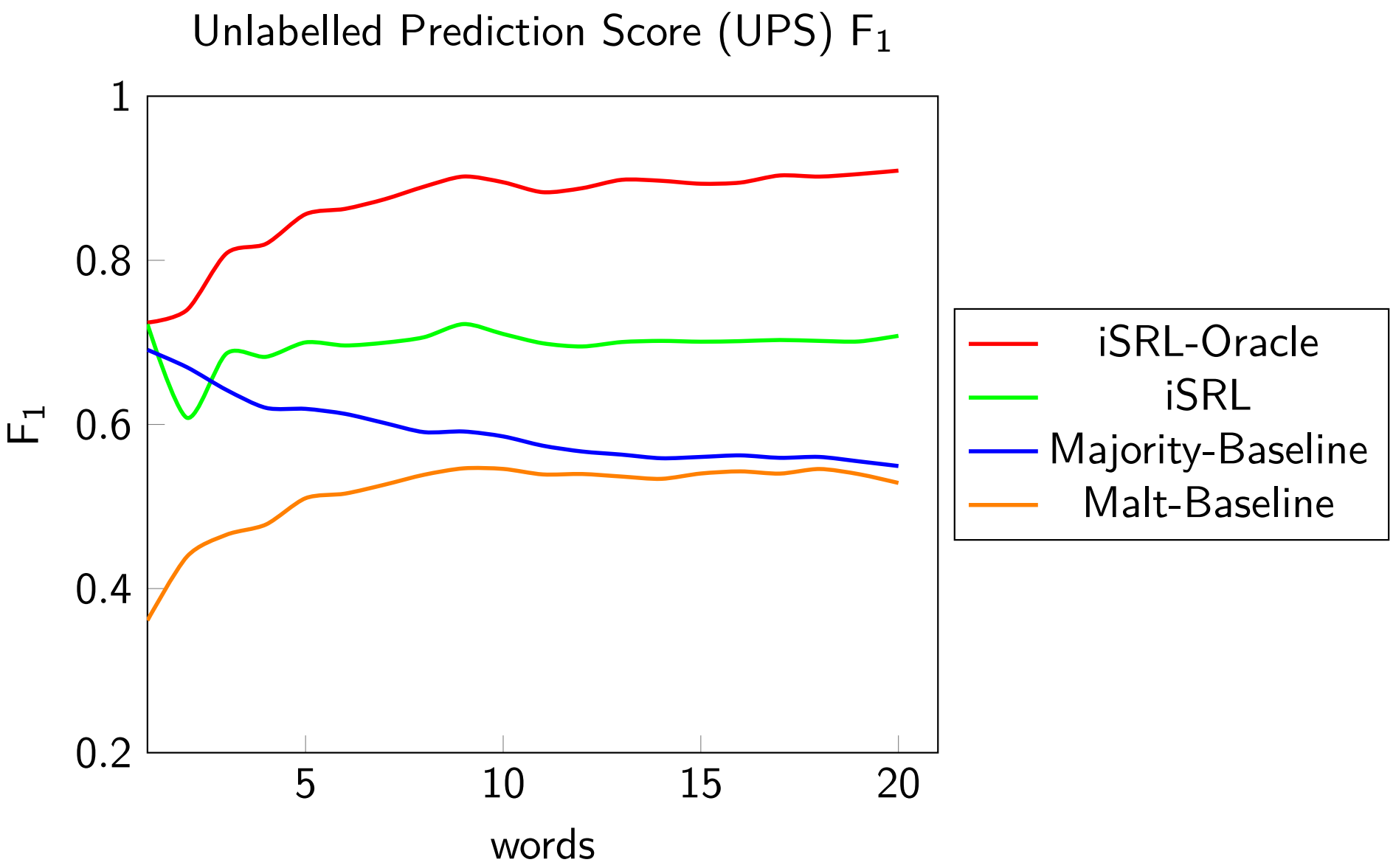
System Comparison

- $\imath$SRL-Oracle : Gold Semantic Role Labels
- $\imath$SRL: All Semantic Role Labels
- Majority-Baseline
- Malt-Baseline

Results - Full sentence



Results - Incremental



Conclusions

- New task of Incremental Semantic Role Labeling
- Our system combines:
  - Psycholinguistically Motivated TAG (PLTAG)
  - Semantic Role Lexicon
  - Incremental Role Propagation Algorithm (IRPA)
  - Argument Identification, Role Disambiguation Classifiers
- Outperforms baselines
- Performs well incrementally: predicts (in)-complete triples early in the sentence
- Download the code from `http://homepages.inf.ed.ac.uk/ikonstas/`

Thank you

Bonus Material - PLTAG

Lexicon:

- Standard TAG lexicon
- Predictive lexicon (PLTAG)

Operations:

- Substitution
- Adjunction
- Verification (PLTAG)

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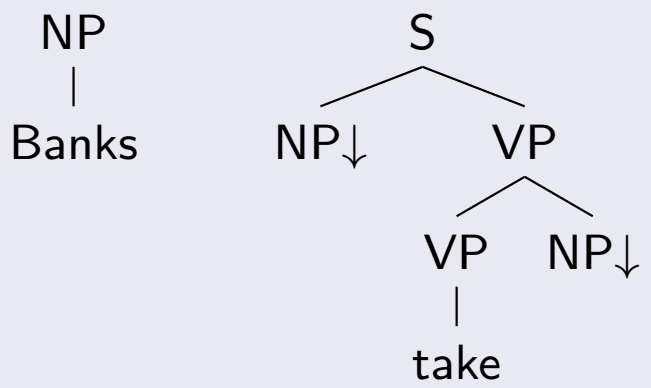
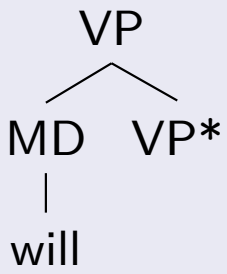
Initial Tree:



Auxiliary Tree:



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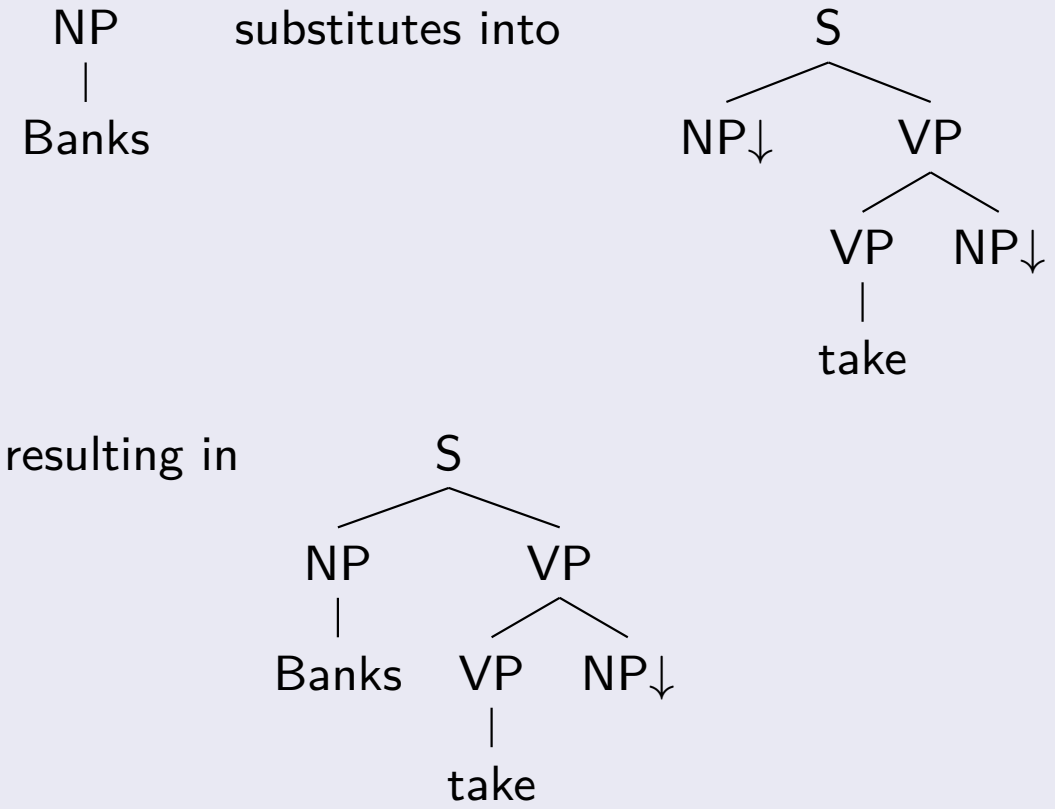

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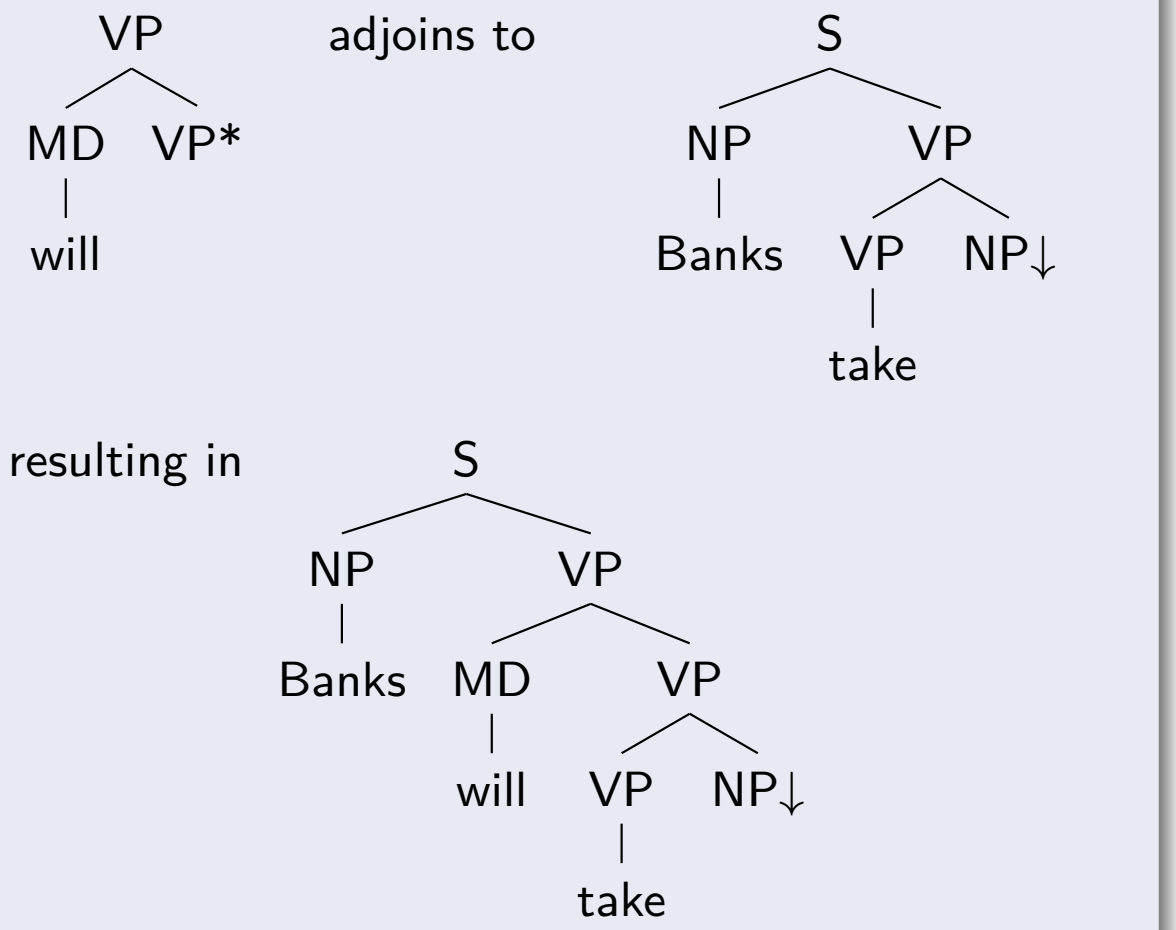

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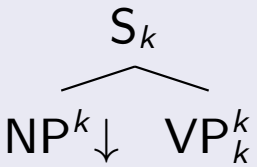
Prediction Tree:



Index k marks predicted node.

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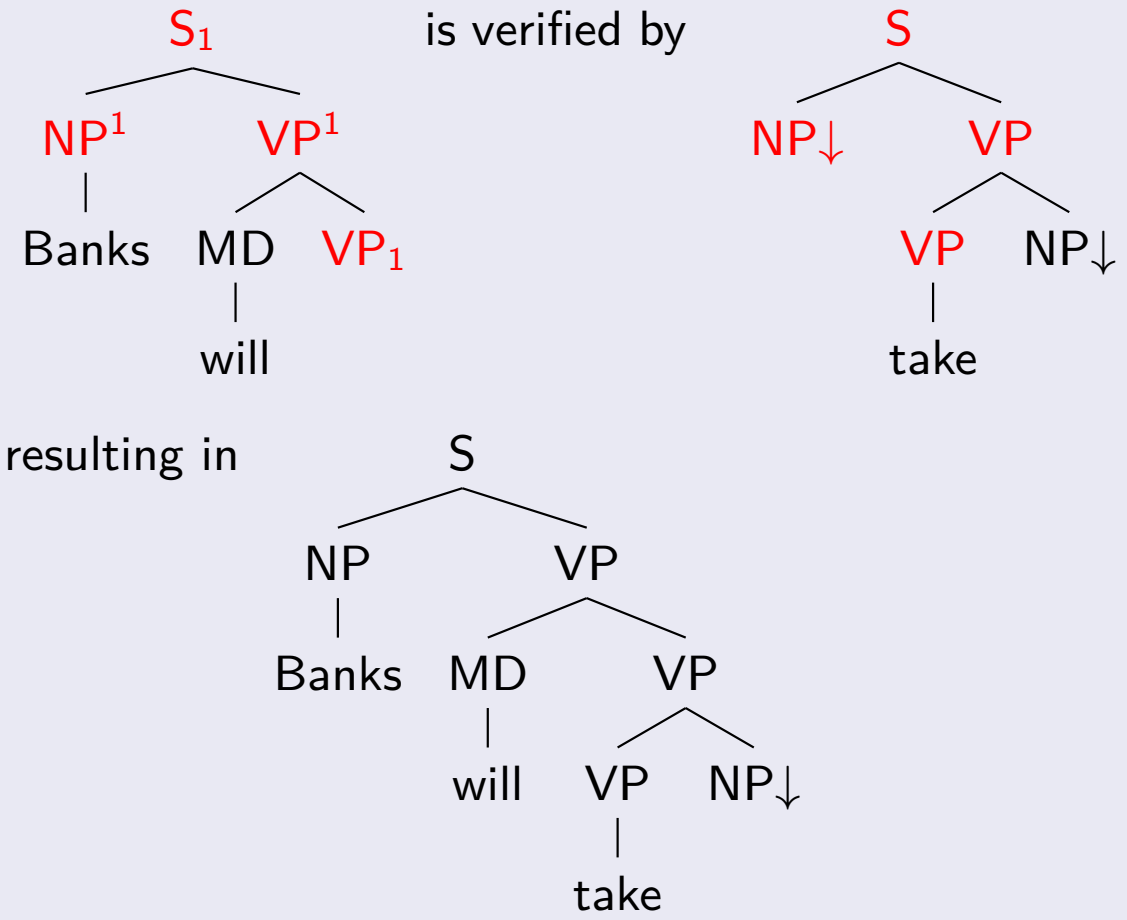

All nodes indexed with k have to be verified.