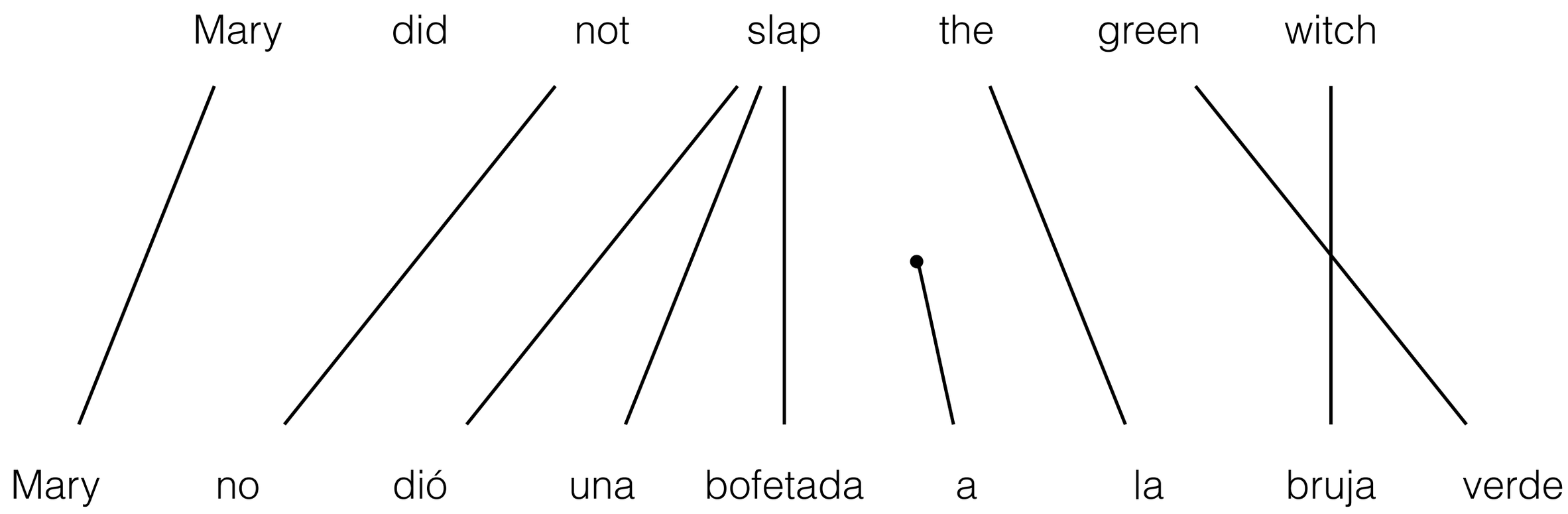
Word-Based Translation

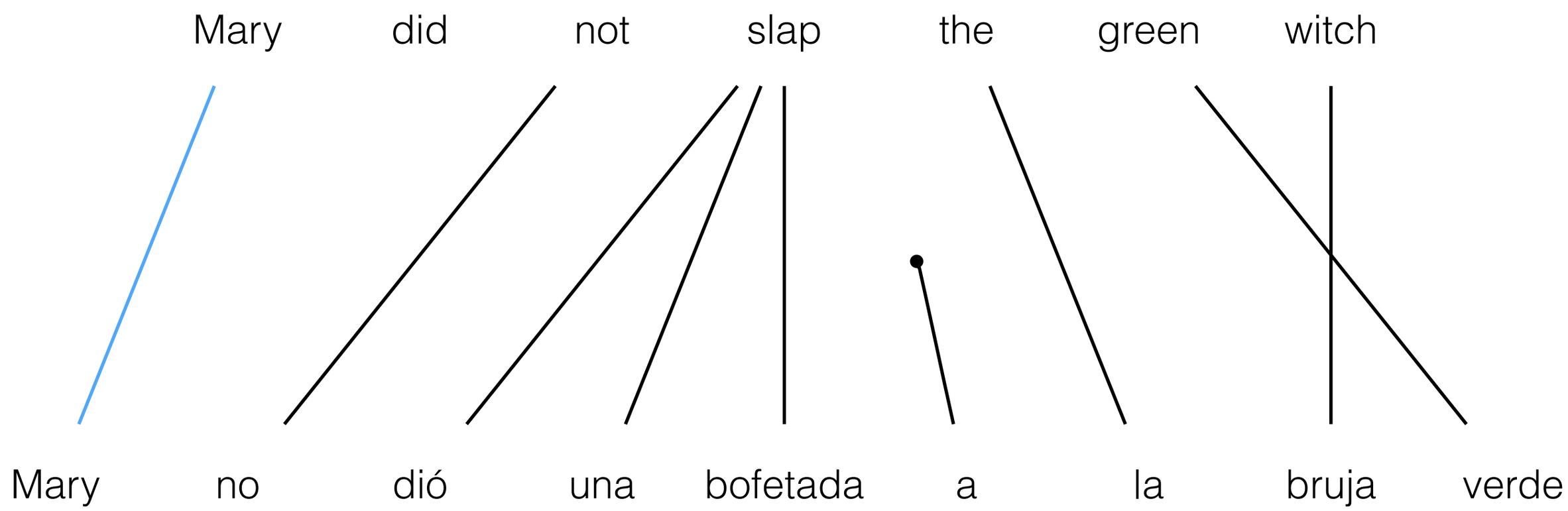
Wilker Aziz
5/4/16

Word-based Translation



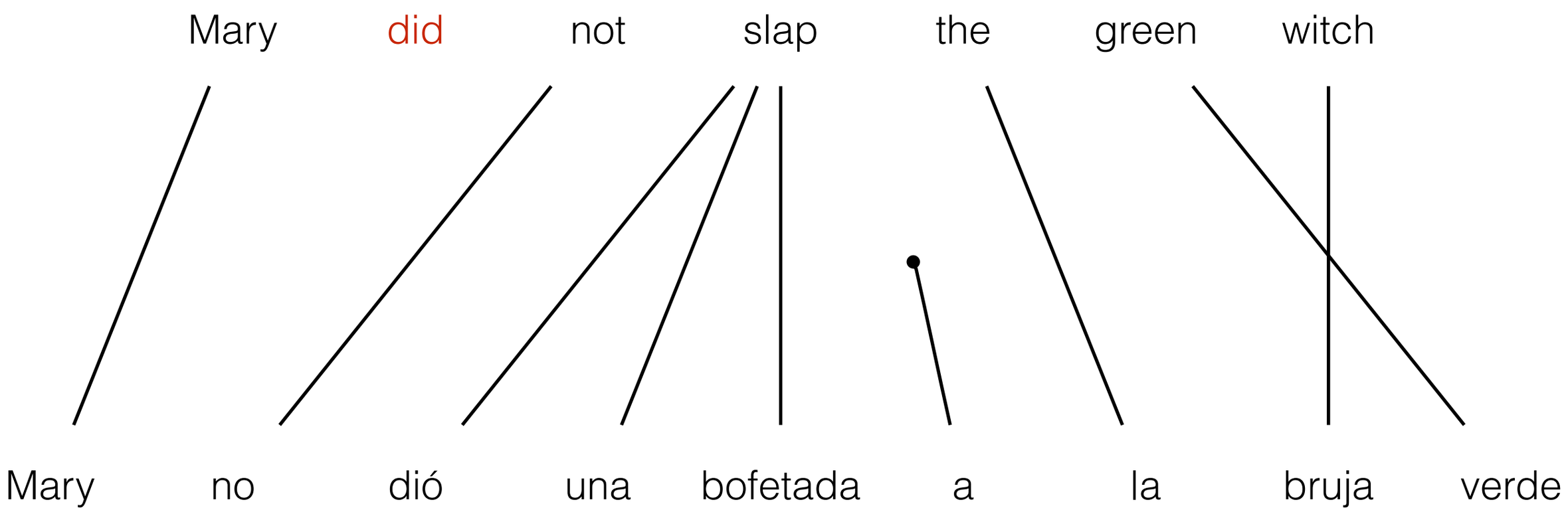
Every French word is generated by an English word (or null)

Word-based Translation



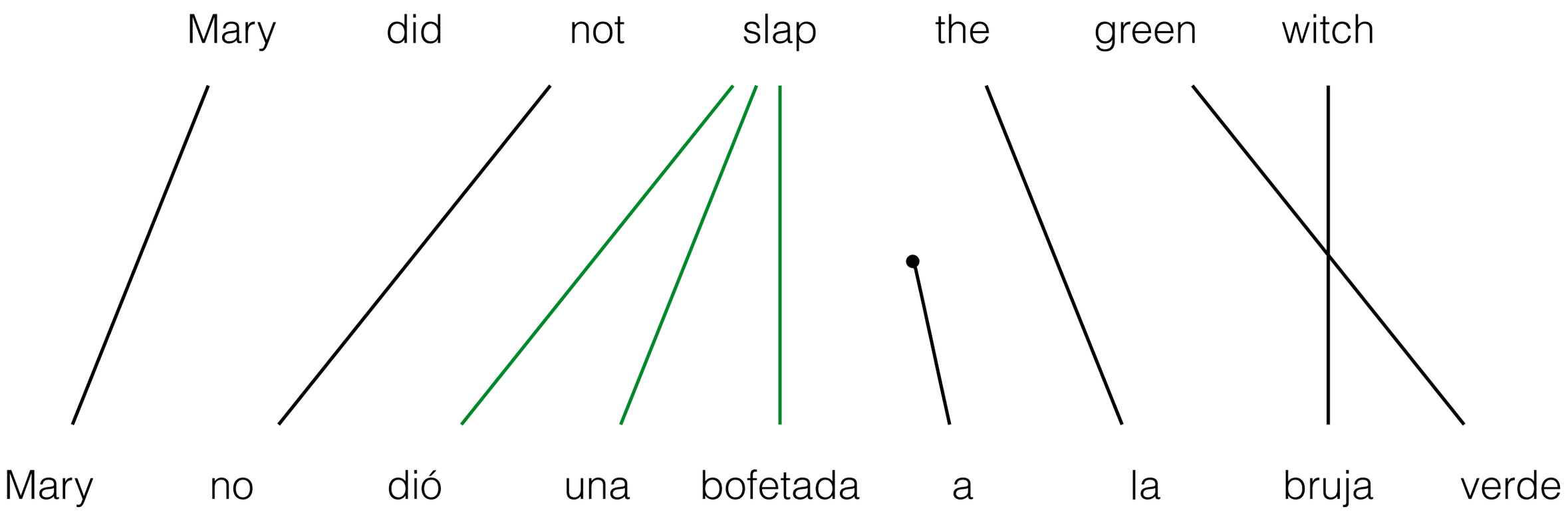
Some English words align once

Word-based Translation



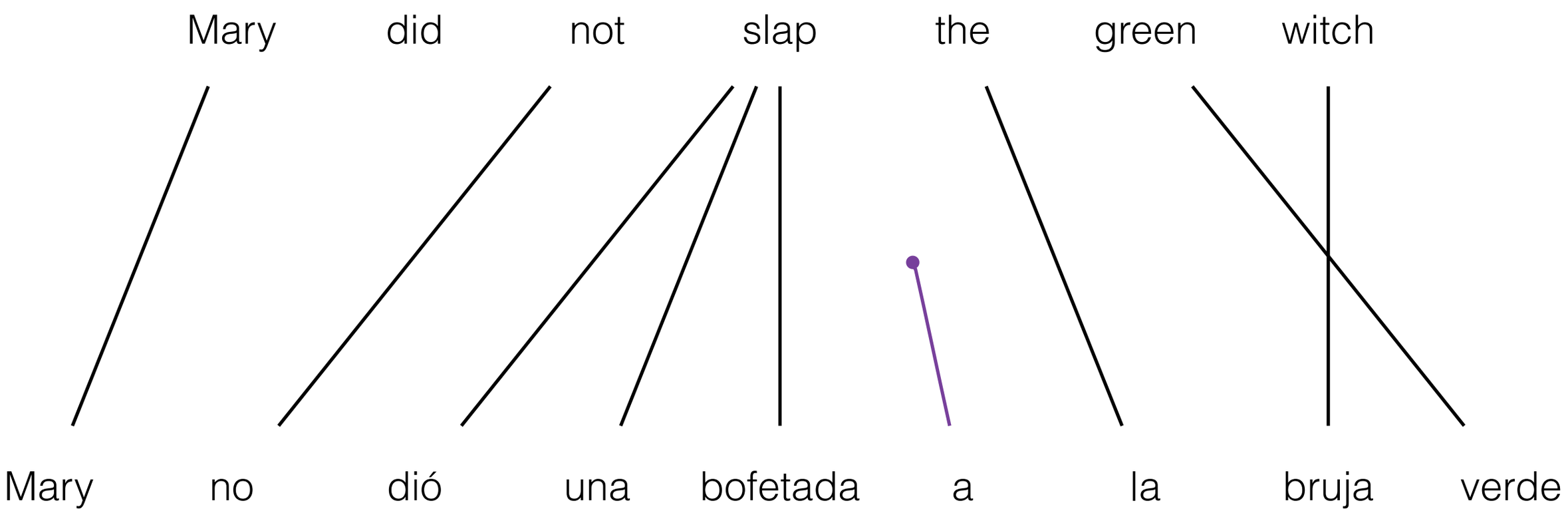
Some English words disappear

Word-based Translation



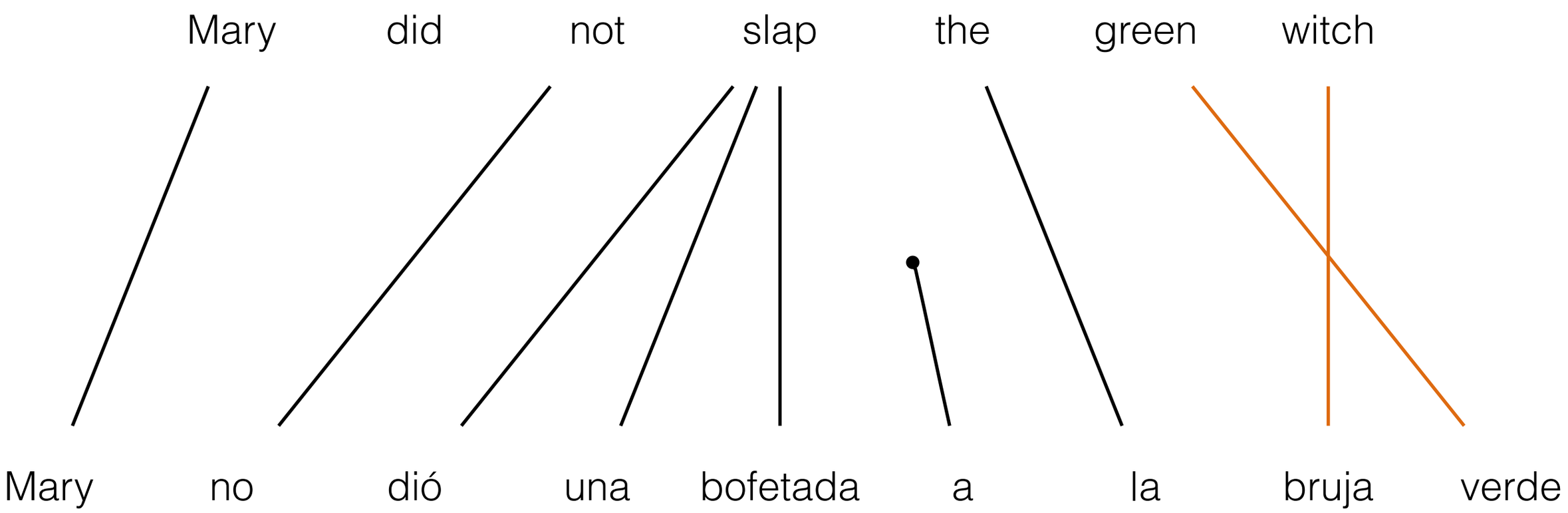
Some English words align multiple times

Word-based Translation



Some French words are null-aligned

Word-based Translation



Some French words are translated out of order

IBM models 1 and 2

Generative story

1. given an English sentence E whose length is *l*, choose length *m* of French sentence F

2. choose how to connect each position in F to a position in E

3. for each position in F, choose which word to place there

IBM1: uniform distribution over connections

IBM2: probability of a connection depends on the positions it connects and the lengths

Inference (IBM 1 and 2)

- Infer assignments for latent variables (alignment)
  - Tractable
    alignments are independent of one another
- Typical use
  - Estimation: expected alignments
  - Prediction: Viterbi alignments

Generation

When do we ever need to generate from our model?

> we do not use our translation models to predict French given English, but rather as a component of a system designed to **predict English given French** (Brown et al., 1993)

Translation

$$P(E|F) \propto P(E)P(F|E)$$

Generation

Do you see a problem in generating from IBM1 or 2?

Generation

Do you see a problem in generating from IBM1 or 2?

- given a French sentence, there are too many English candidates (perhaps infinitely many)

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  - how many deletions?

Generation

Do you see a problem in generating from IBM1 or 2?

- given a French sentence, there are too many English candidates (perhaps infinitely many)
- the generative story does not account for all English words
- we model very little about English words
  - how many deletions?
  - how many insertions?

Generative Story $IBM_{\geq 3}$: Given E

Generative Story IBM$_{\geq 3}$: Fertility

Mary	did	not	slap				the	green	witch
Mary	~~did~~	not	slap	slap	slap		the	green	witch

Generative Story IBM$_{\geq 3}$: NULL insertion

Mary	did	not	slap				the	green	witch
Mary	~~did~~	not	slap	slap	slap		the	green	witch
						NULL			

Generative Story IBM$_{\geq 3}$: Translation

Mary	did	not	slap				the	green	witch
Mary	~~did~~	not	slap	slap	slap		the	green	witch
						NULL			
Mary		no	dió	una	bofetada	a	la	verde	bruja

Generative Story IBM$_{\geq 3}$: Distortion

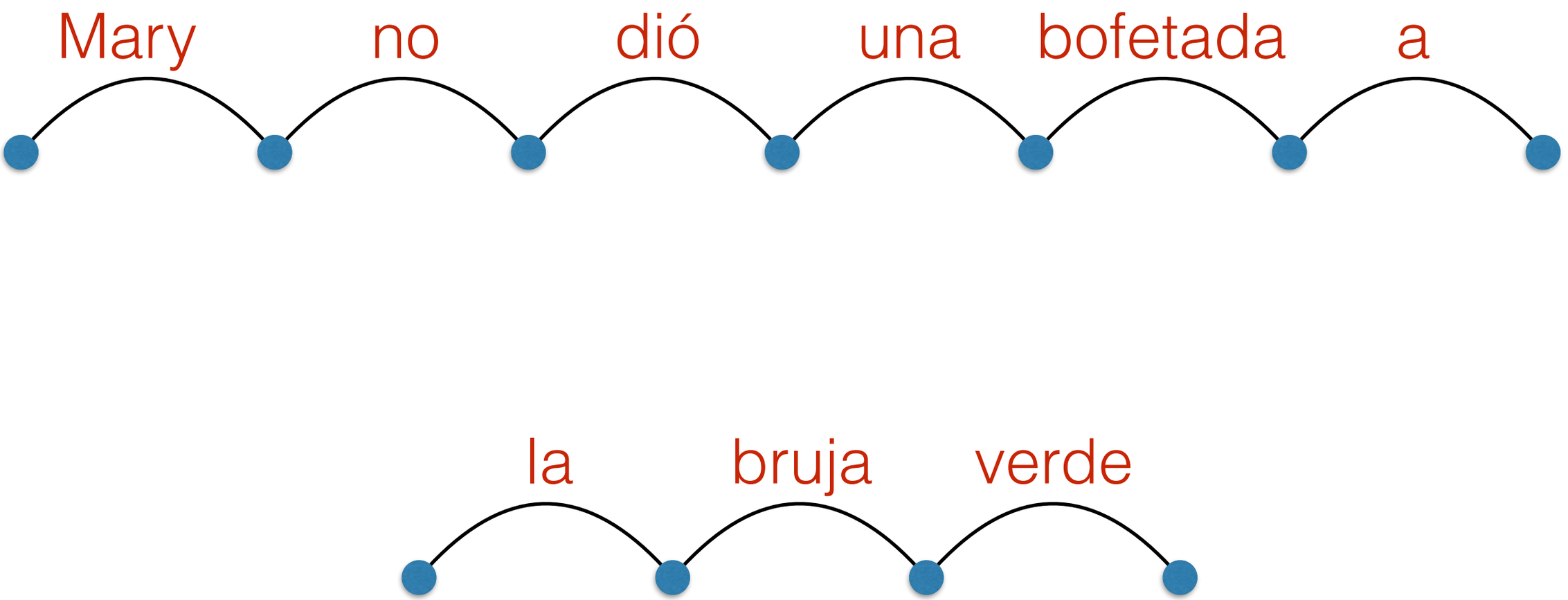
Mary	did	not	slap				the	green	witch
Mary	~~did~~	not	slap	slap	slap		the	green	witch
						NULL			
Mary		no	dió	una	bofetada	a	la	verde	bruja
Mary		no	dió	una	bofetada	a	la	bruja	verde

"Reverse" Generation Example

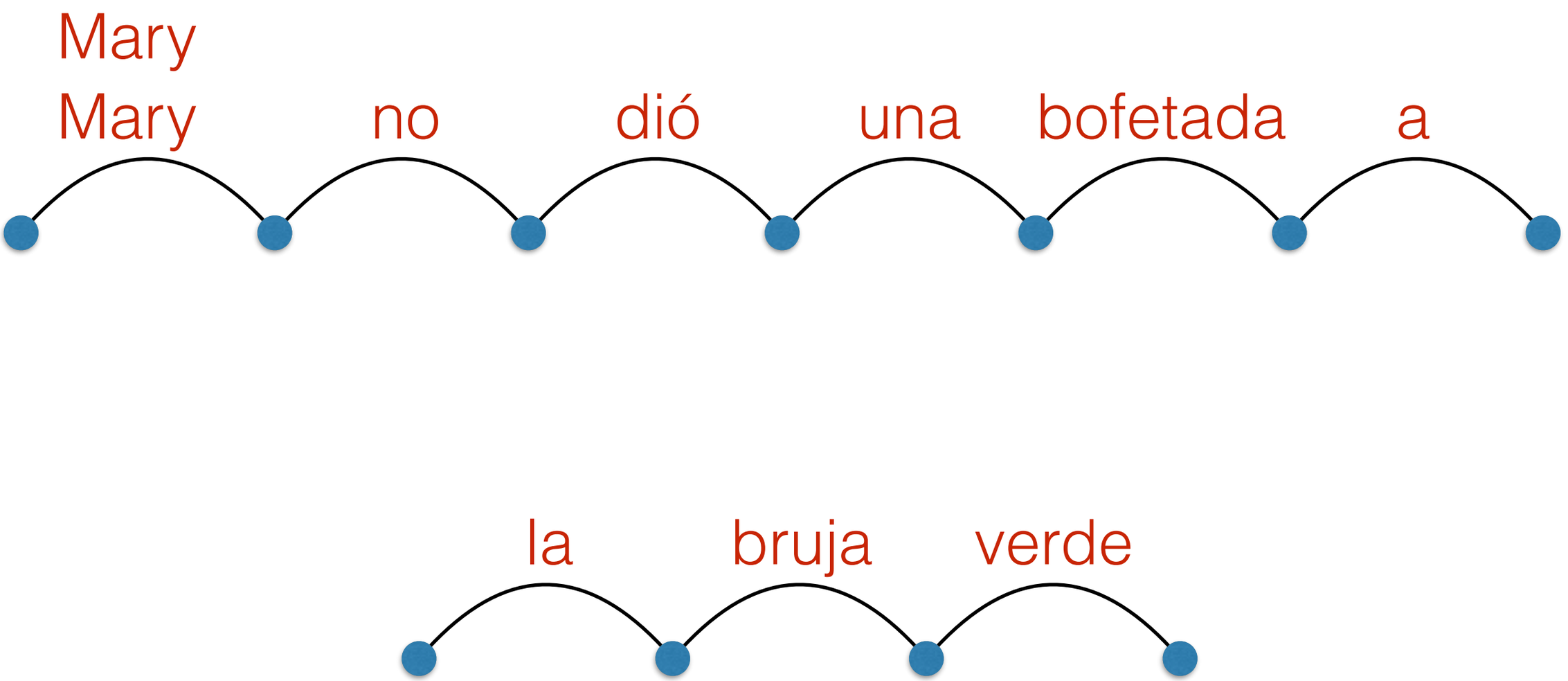
Mary no dió una bofetada a la bruja verde

Example and figures from
(Knight and Al-Onaizan, 1998) and (Knight and May, 2009).

"Reverse" Distortion



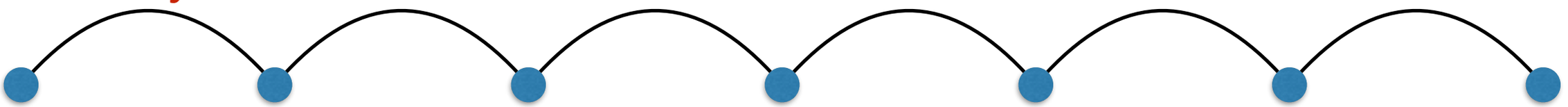
"Reverse" Distortion



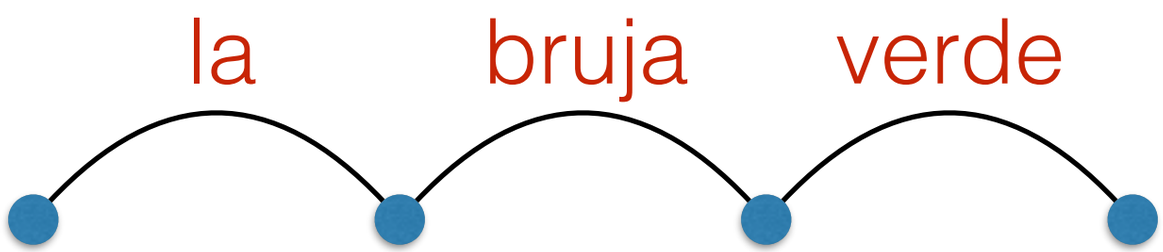
"Reverse" Distortion

Mary no

Mary no dió una bofetada a



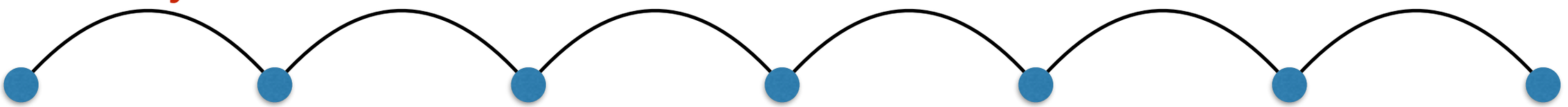
la bruja verde



"Reverse" Distortion

Mary no dió

Mary no dió una bofetada a



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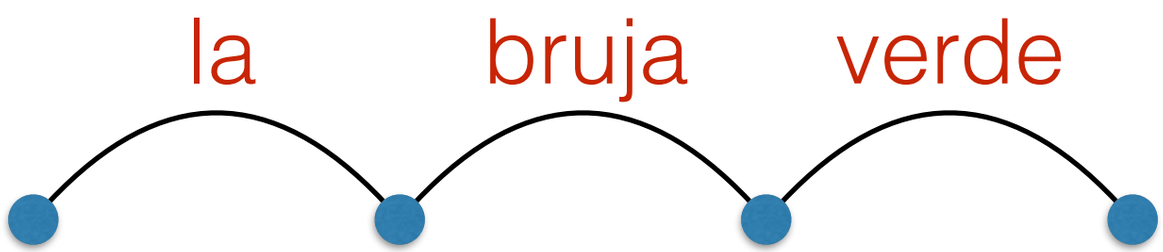

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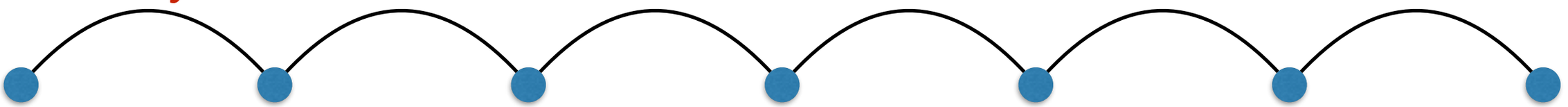

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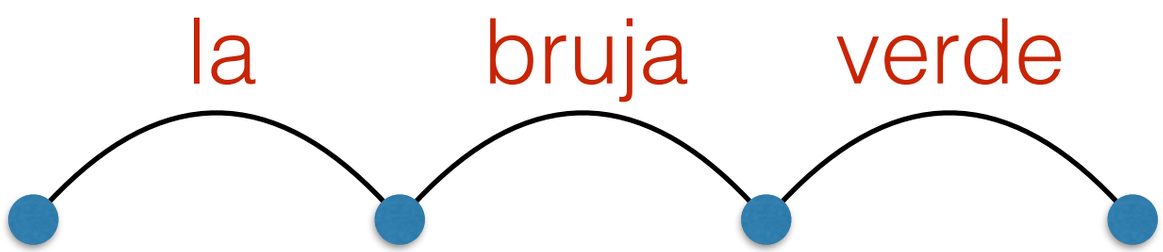

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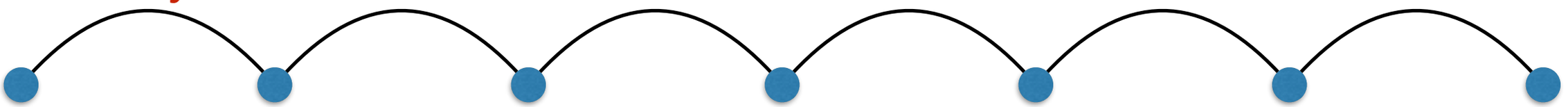

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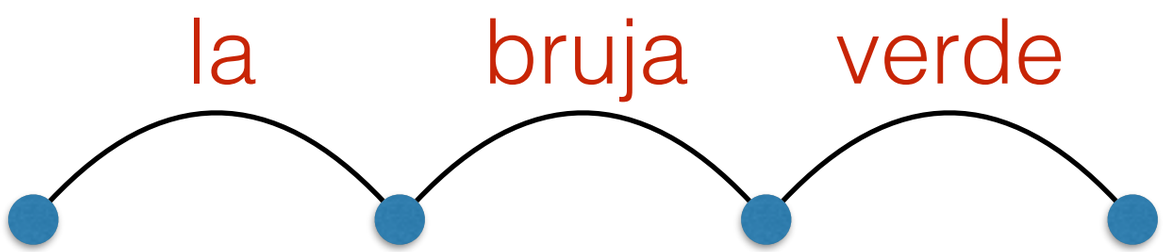

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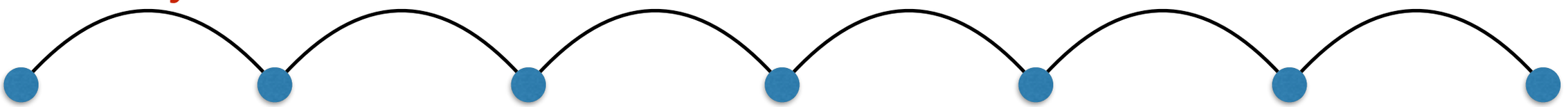

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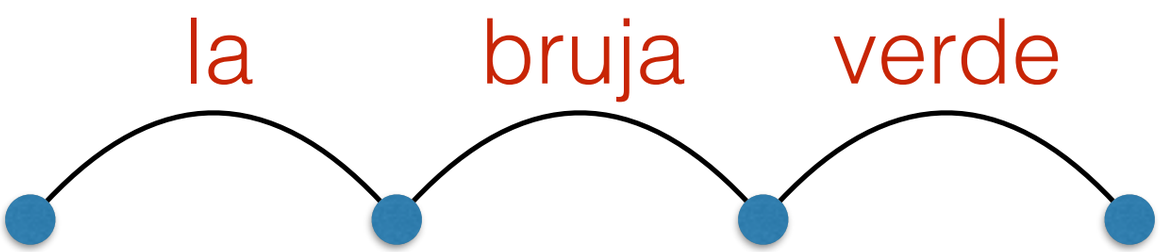

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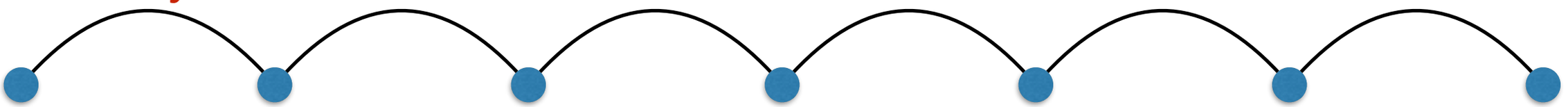

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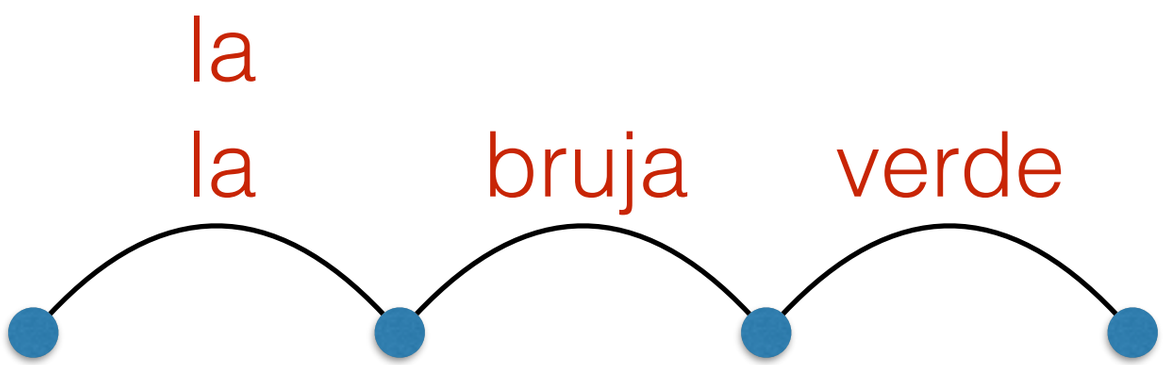

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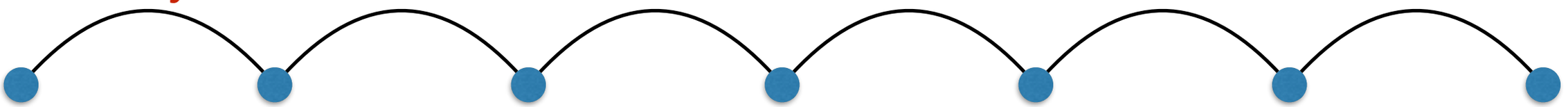
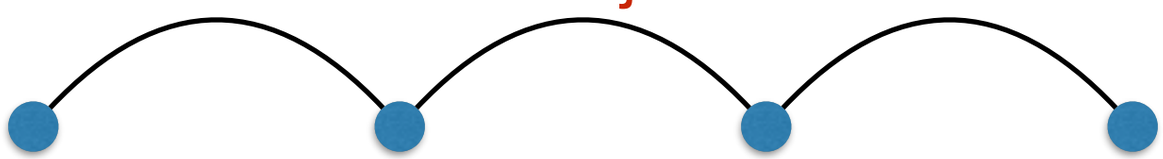


Mary no dió una bofetada a

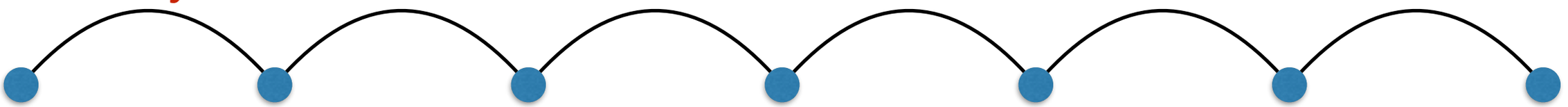
la verde



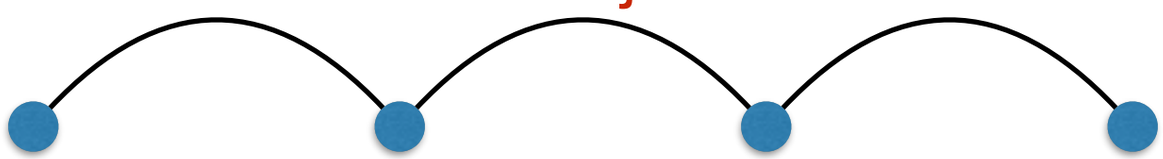
la bruja verde

"Reverse" Distortion

Mary	no	dió	una	bofetada	a
Mary	no	dió	una	bofetada	a



la	verde	bruja
la	bruja	verde



"Reverse" Translation

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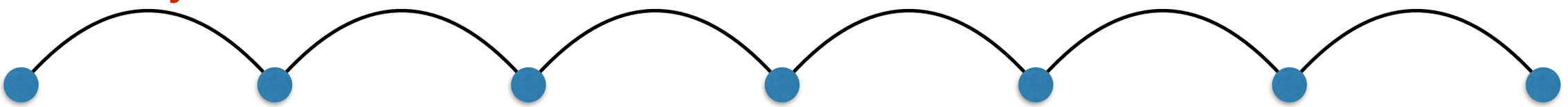
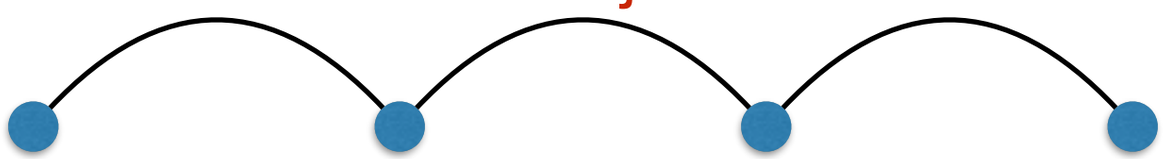


la	verde	bruja
la	bruja	verde



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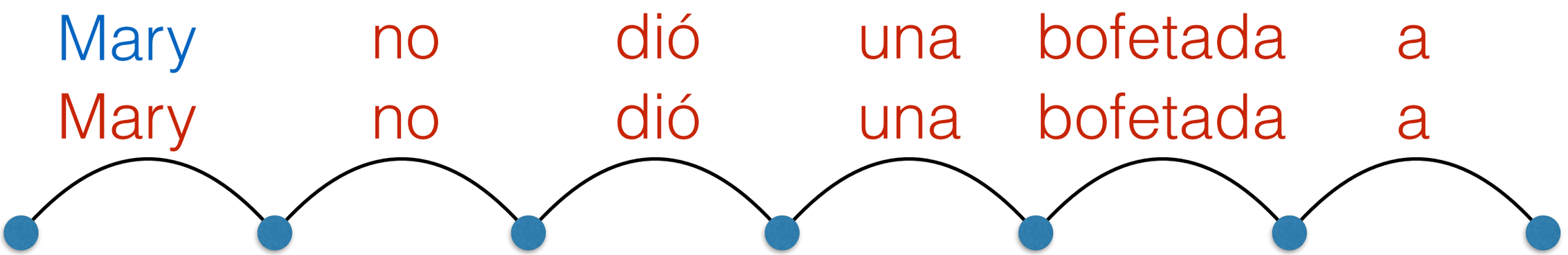
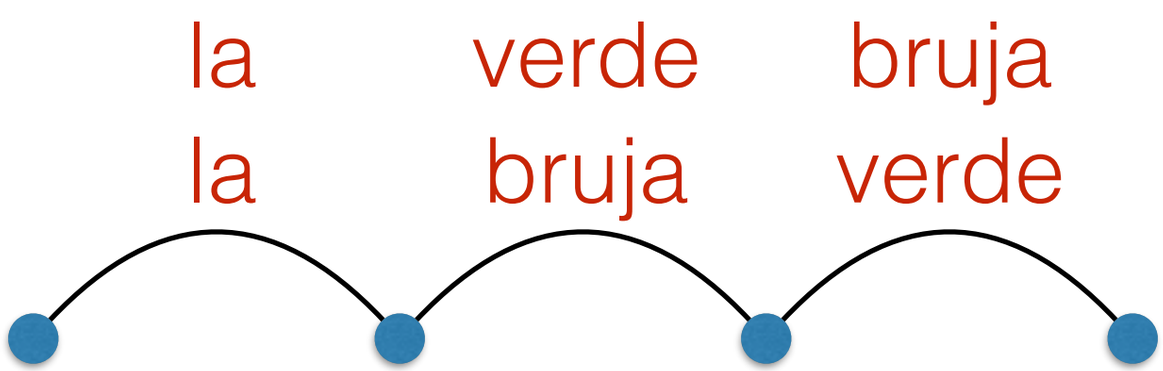
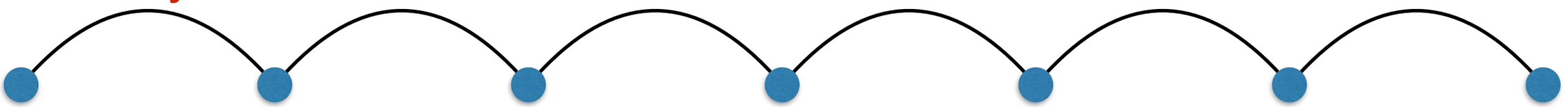


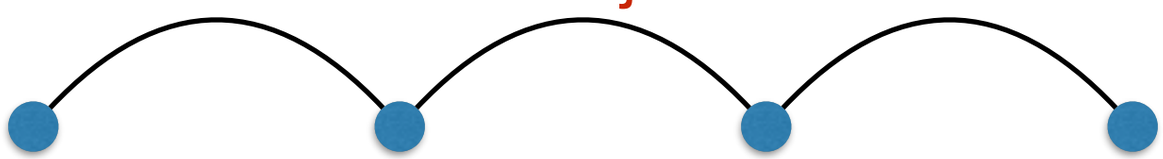


"Reverse" Translation

Mary	not	dió	una	bofetada	a
Mary	no	dió	una	bofetada	a

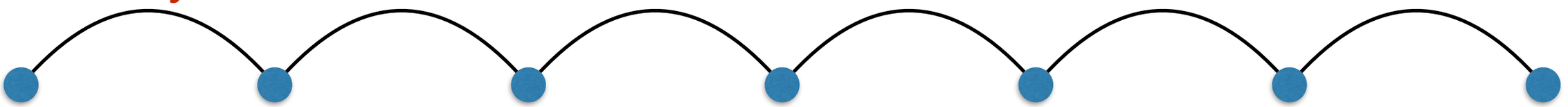


la	verde	bruja
la	bruja	verde

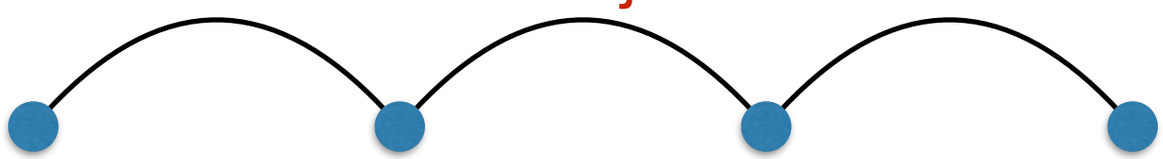


"Reverse" Translation

Mary	not	slap	una	bofetada	a
Mary	no	dió	una	bofetada	a



la	verde	bruja
la	bruja	verde



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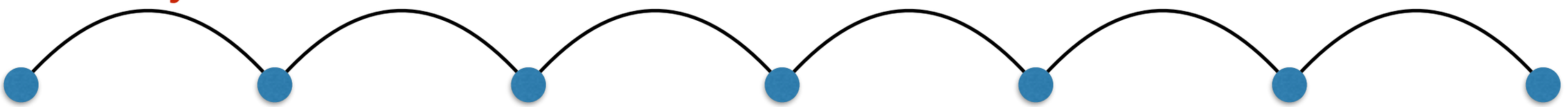
Mary	not	slap	slap	bofetada	a
Mary	no	dió	una	bofetada	a



la	verde	bruja
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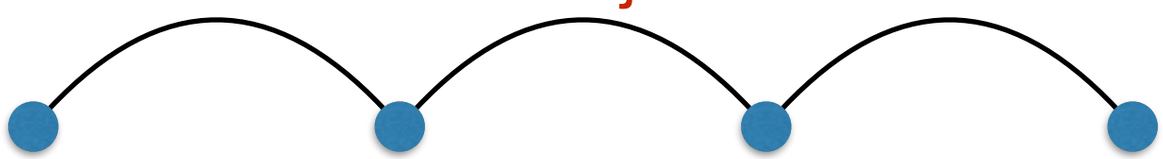

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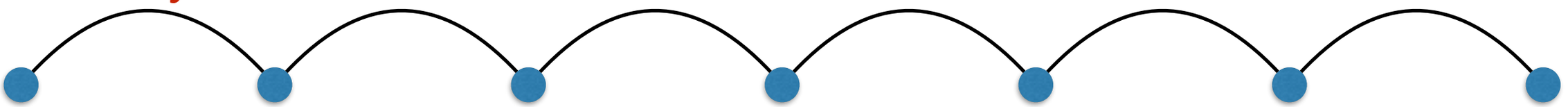
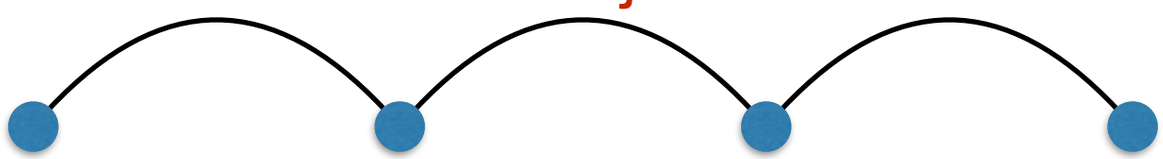
Mary	no	dió	una	bofetada	a



la	verde	bruja
la	bruja	verde



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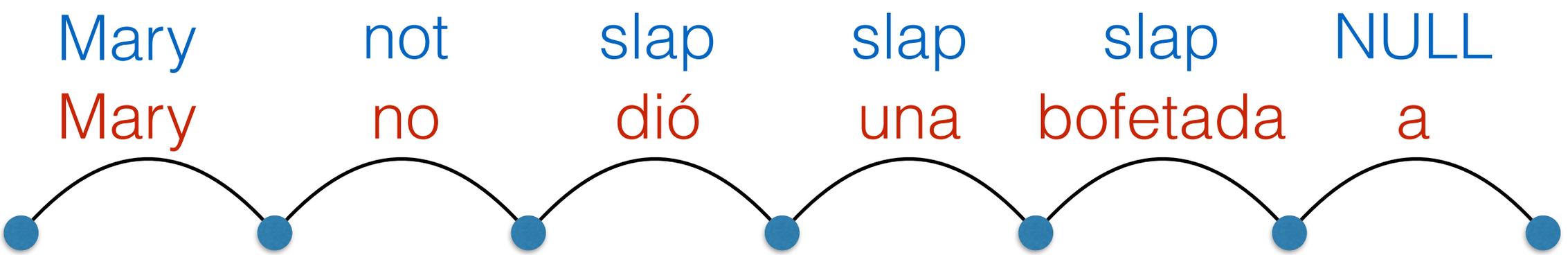

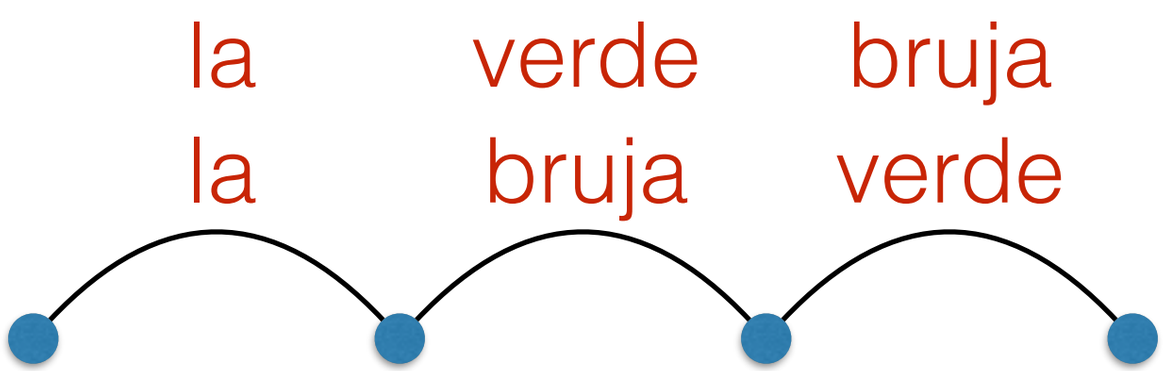

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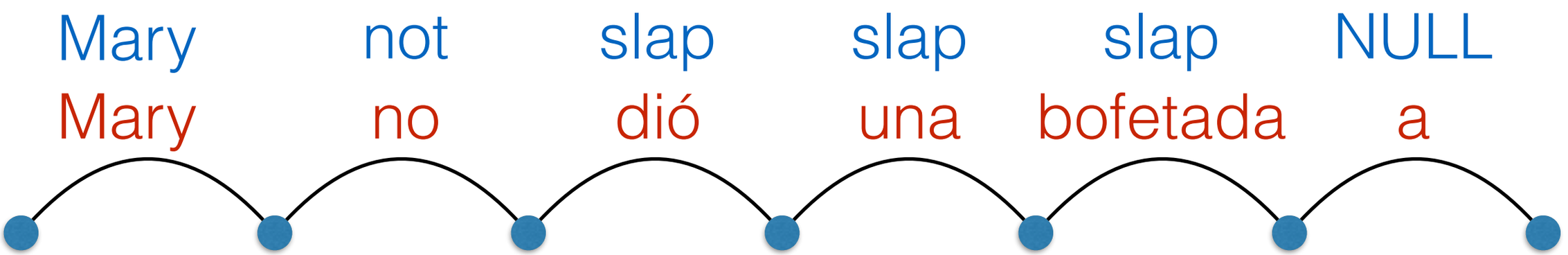

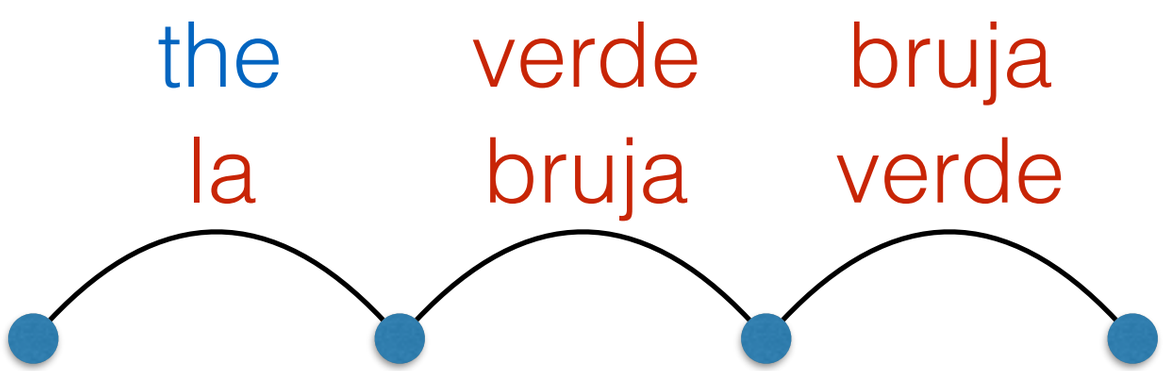

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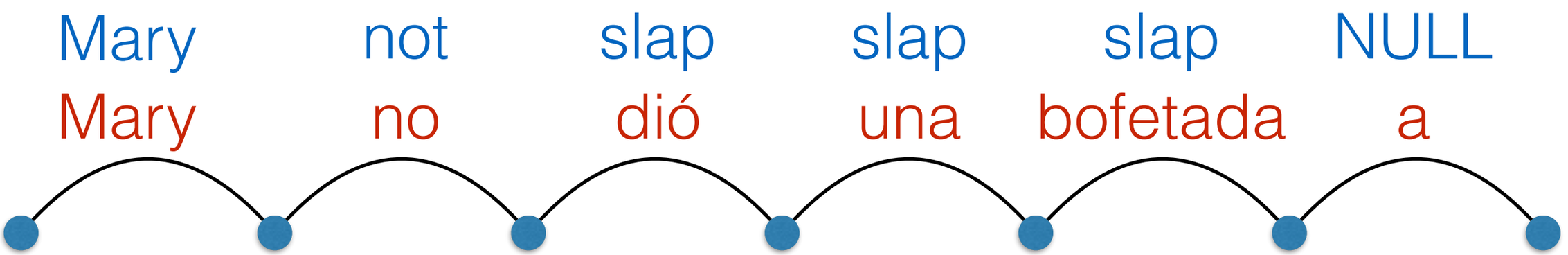

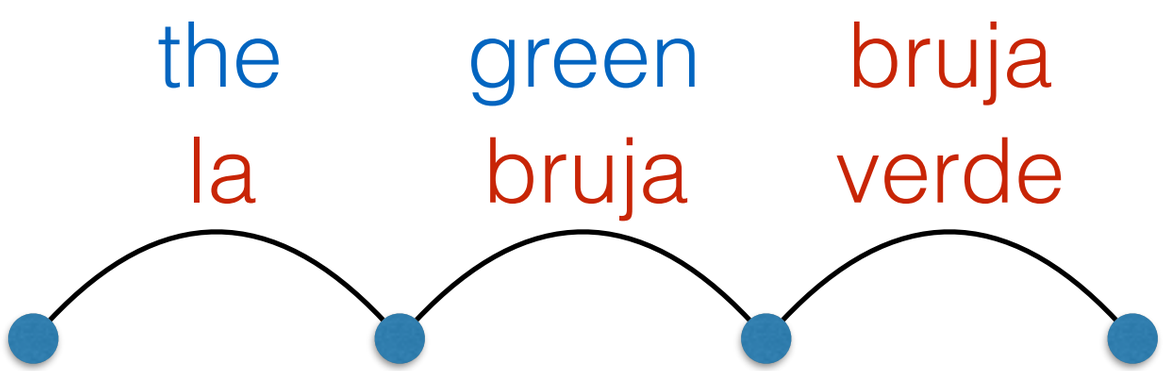

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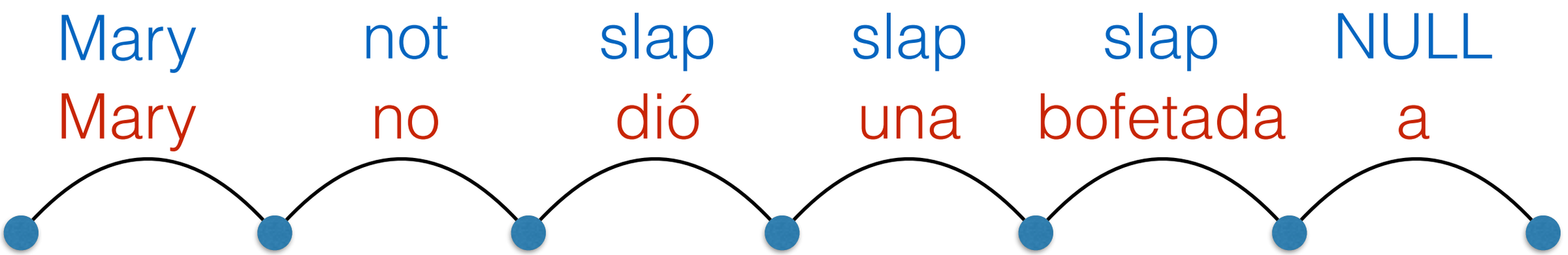
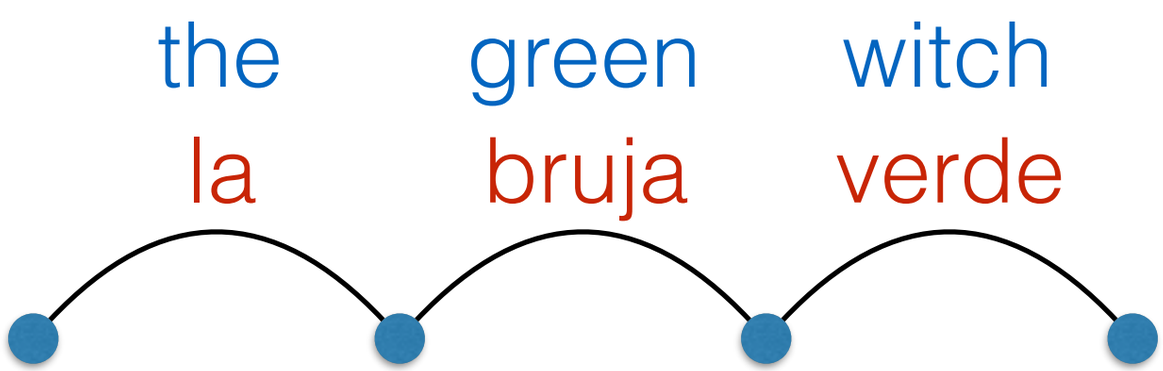
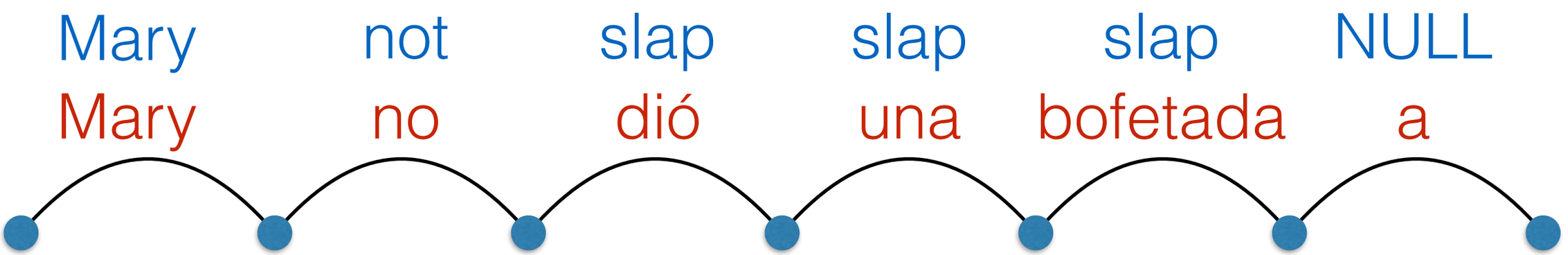
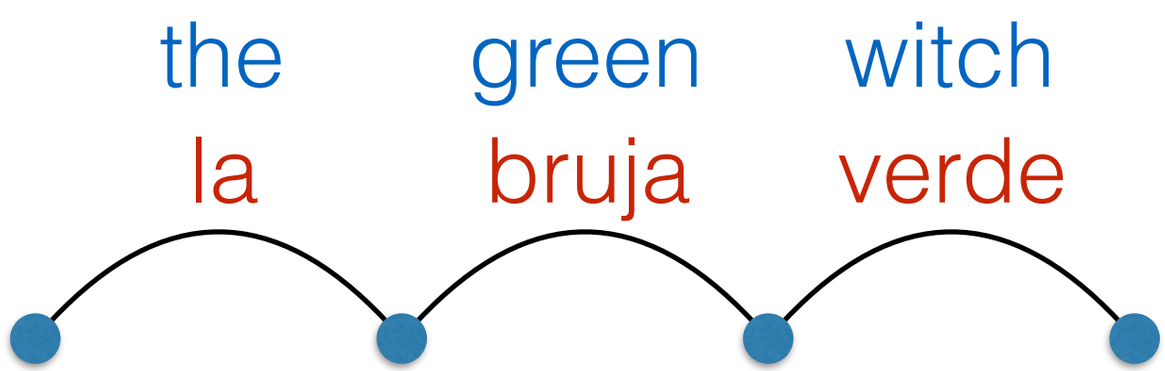


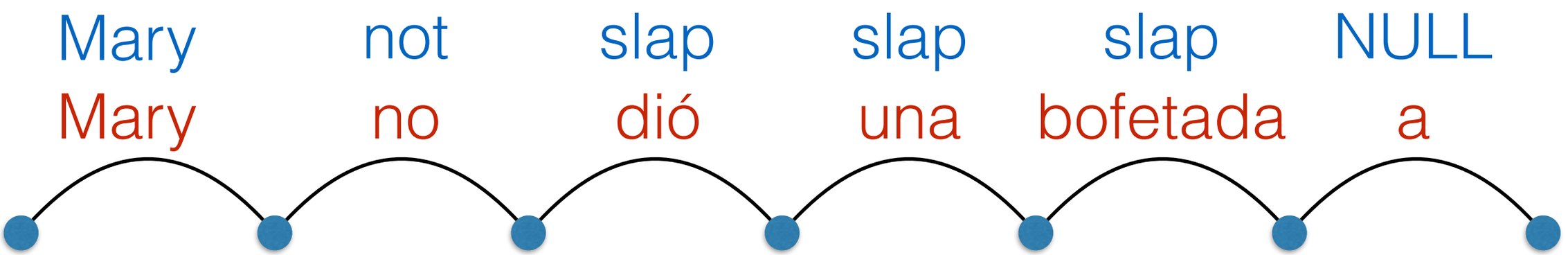


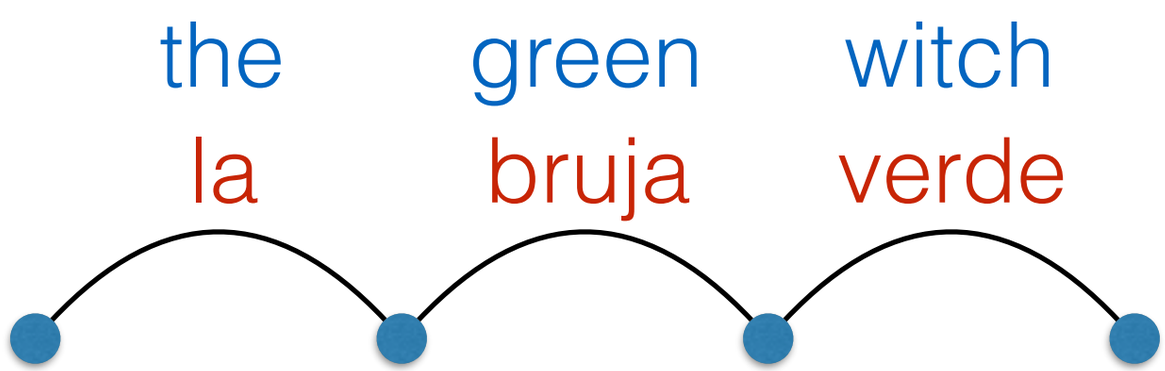
"Reverse" NULL insertion





"Reverse" NULL insertion





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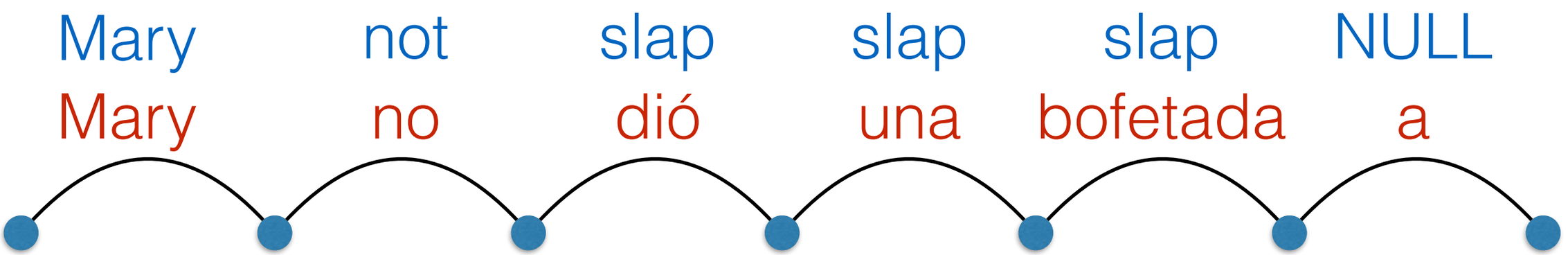

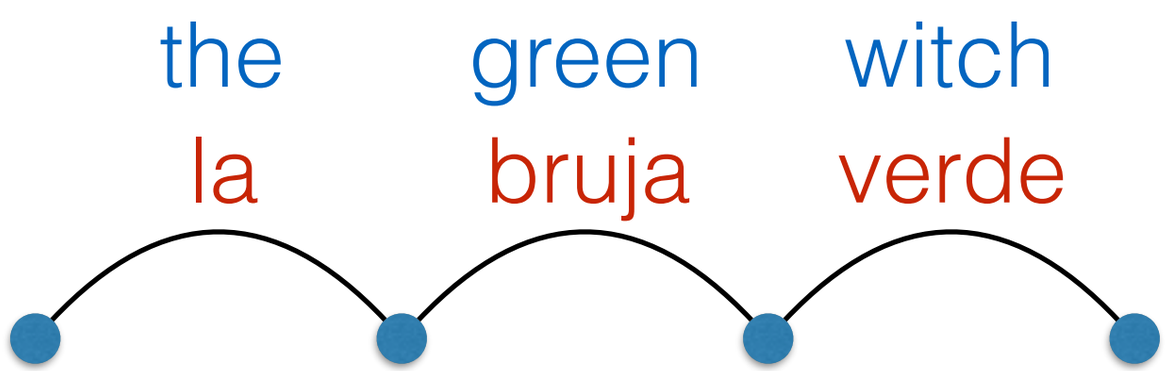

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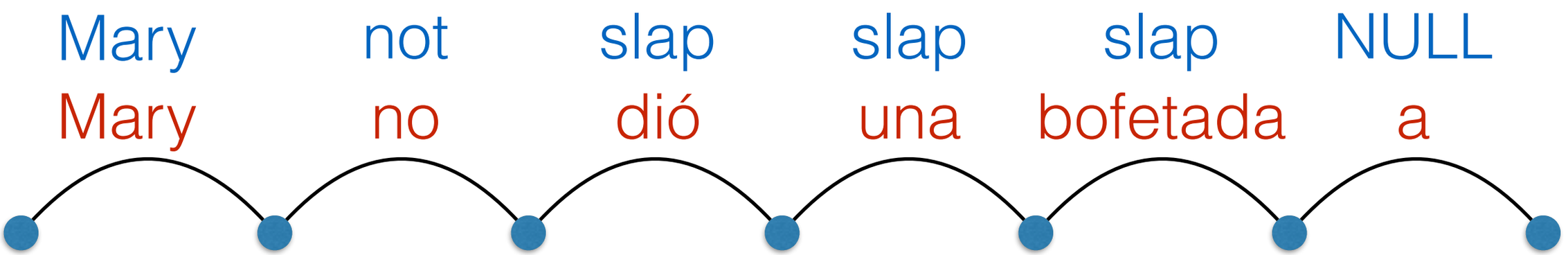

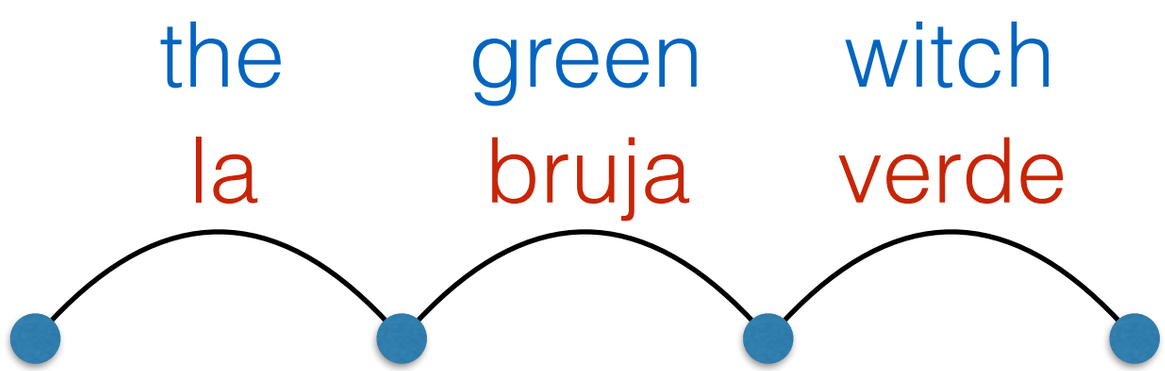

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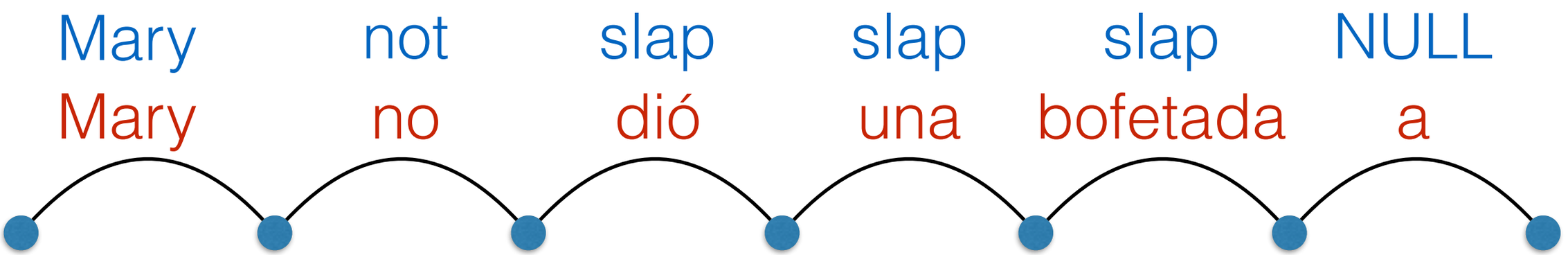

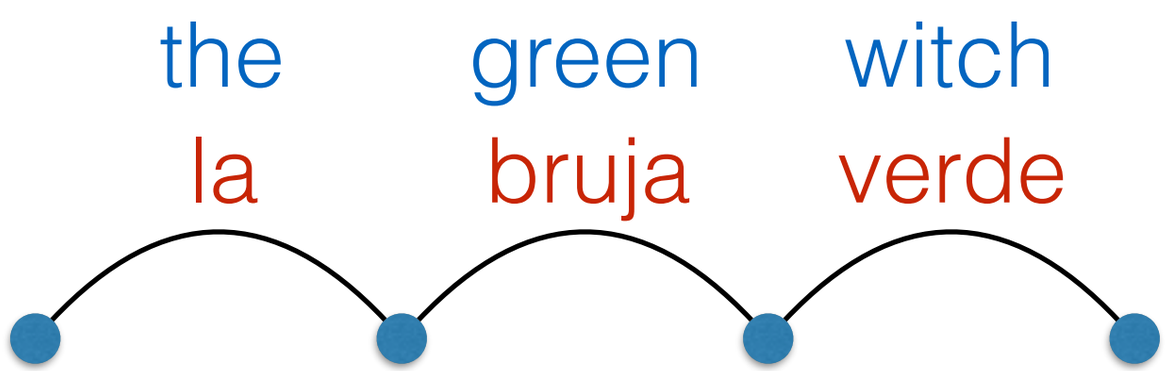

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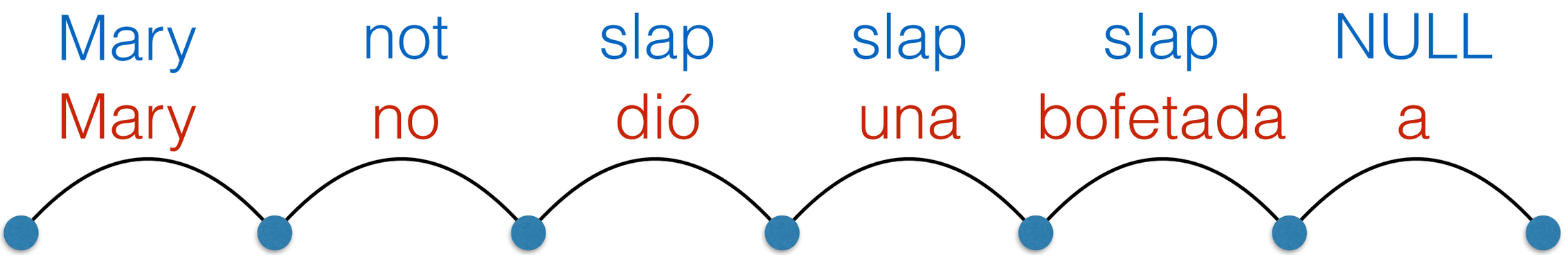

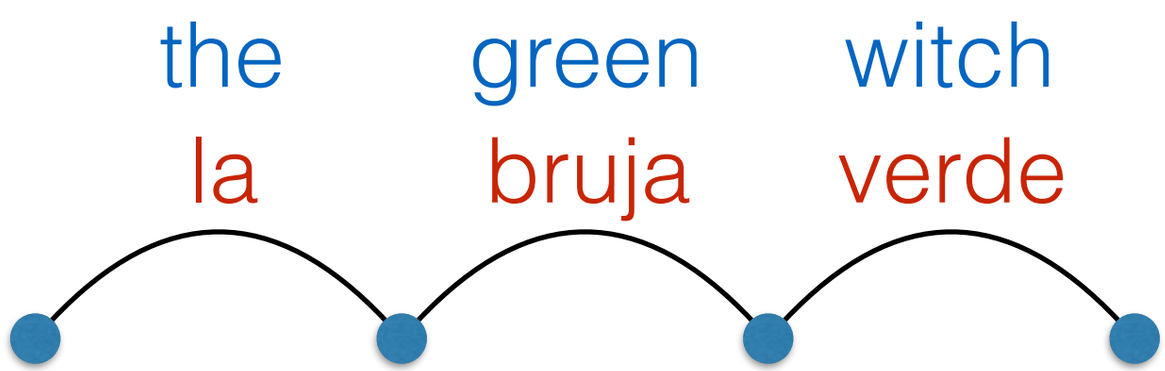

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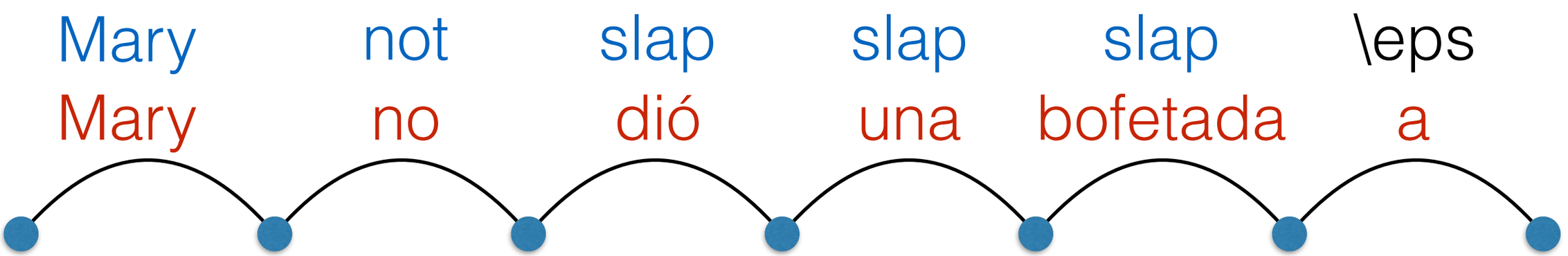

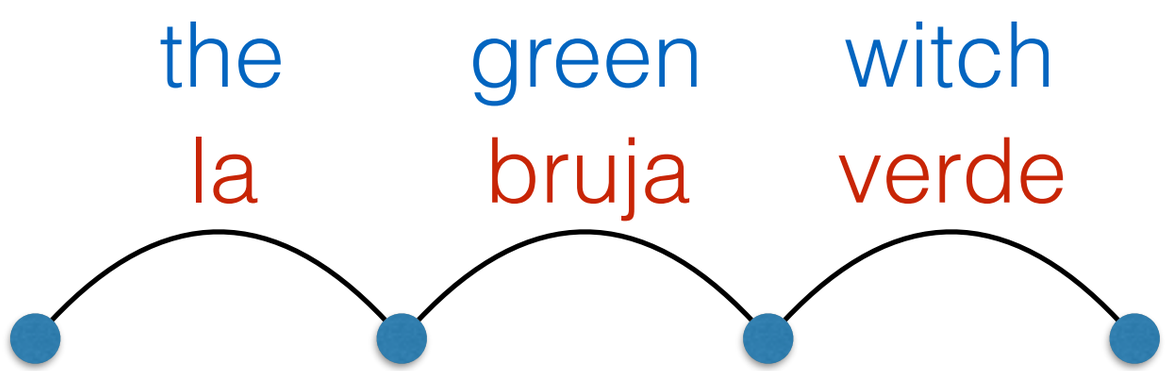

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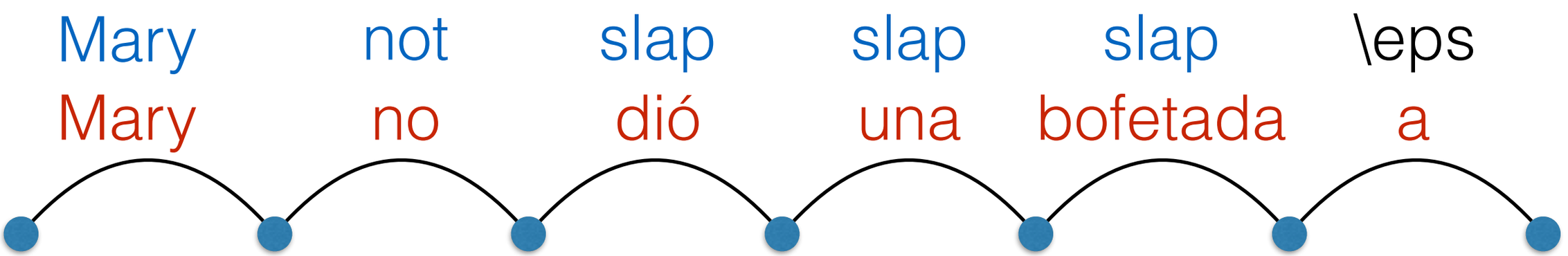

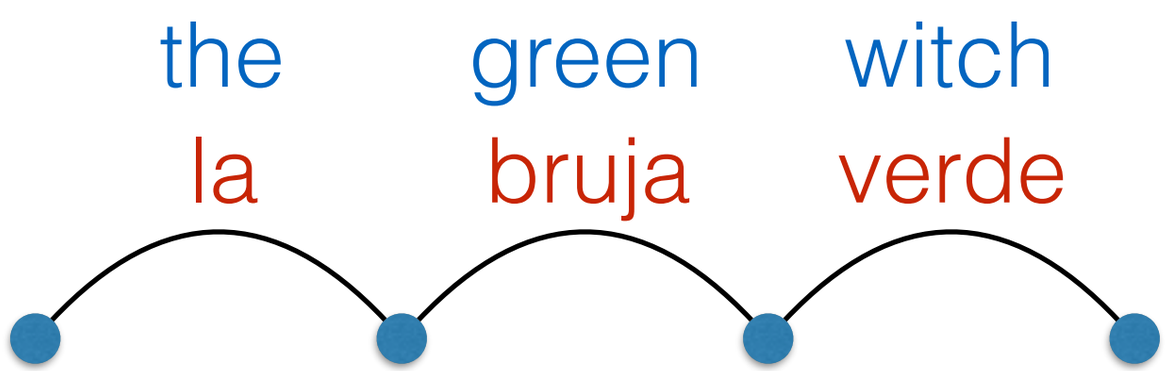

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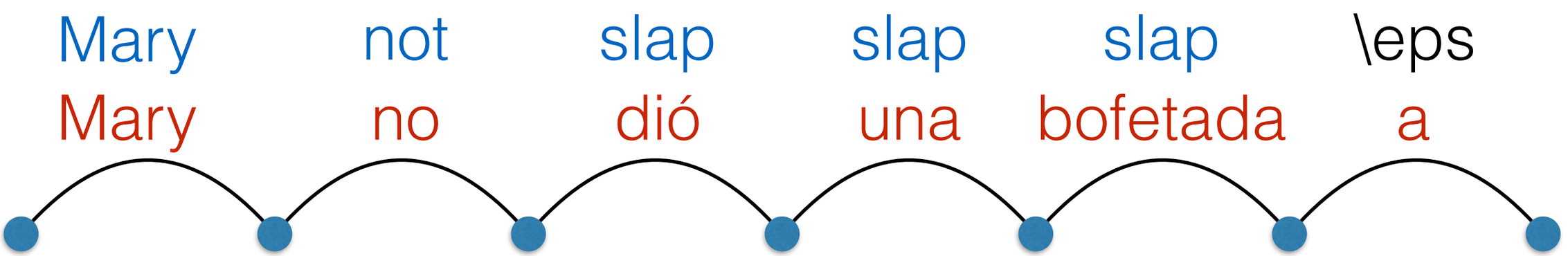

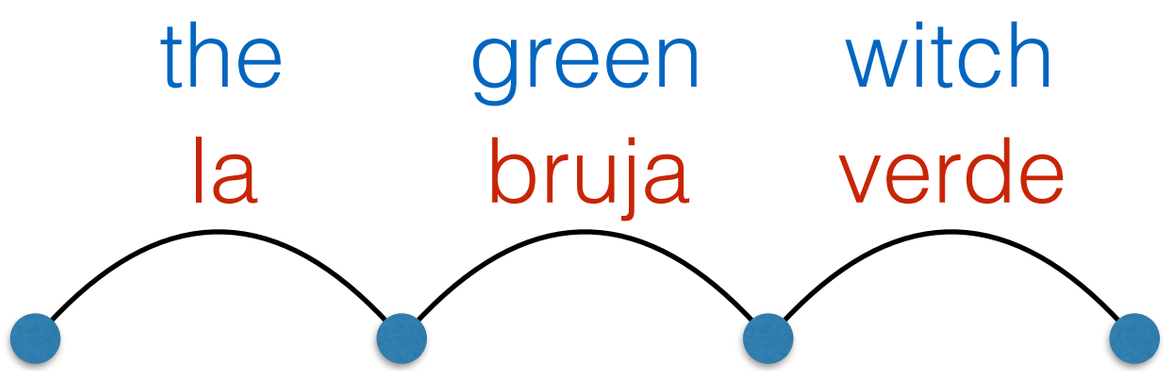

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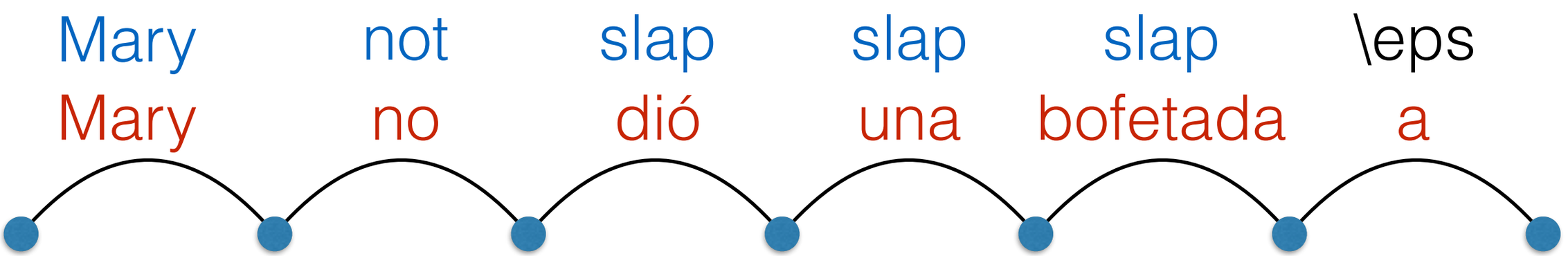

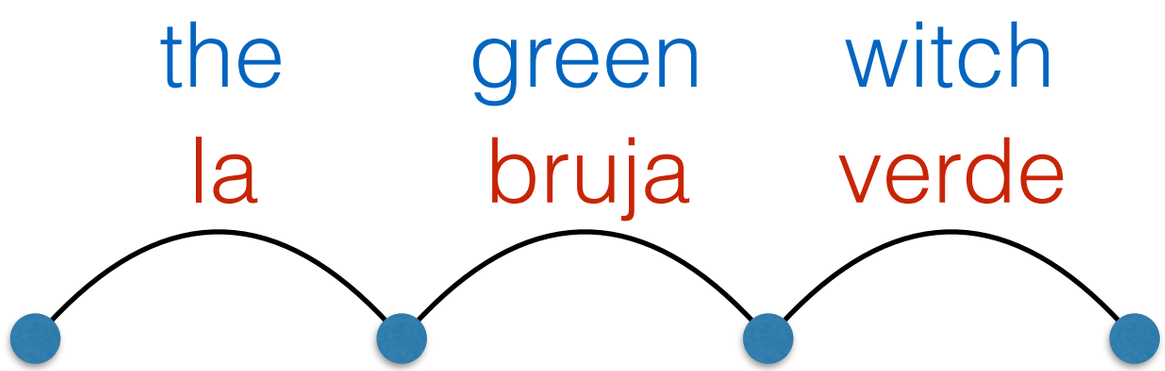

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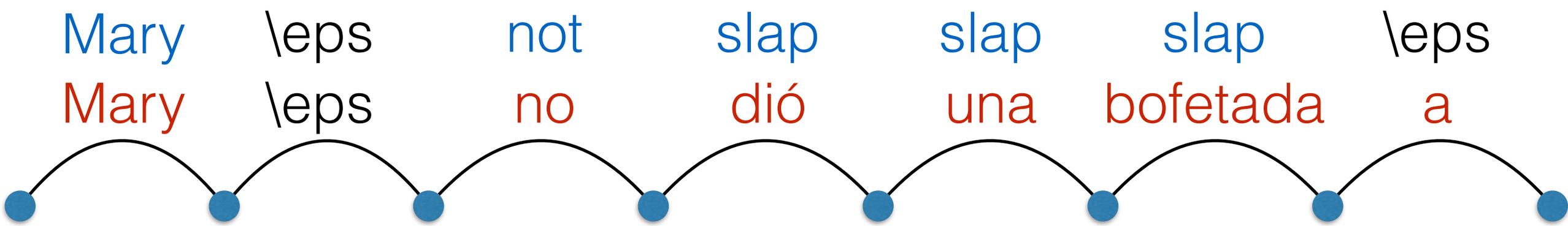

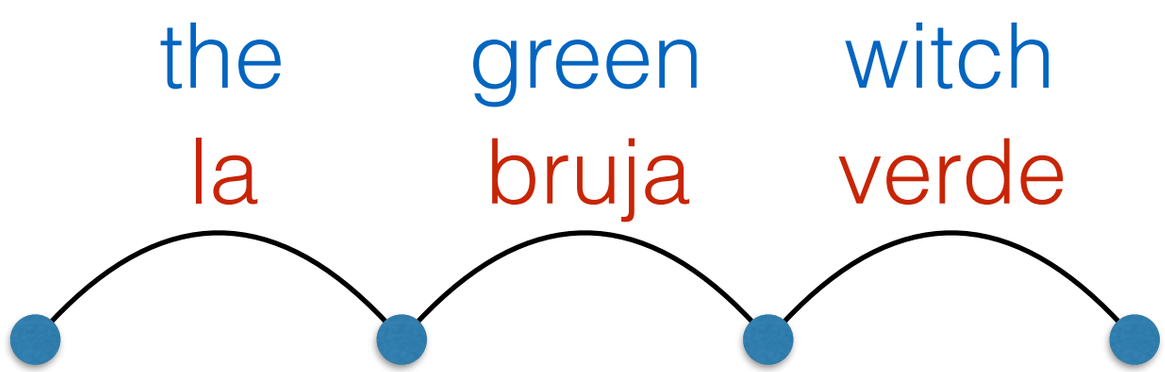

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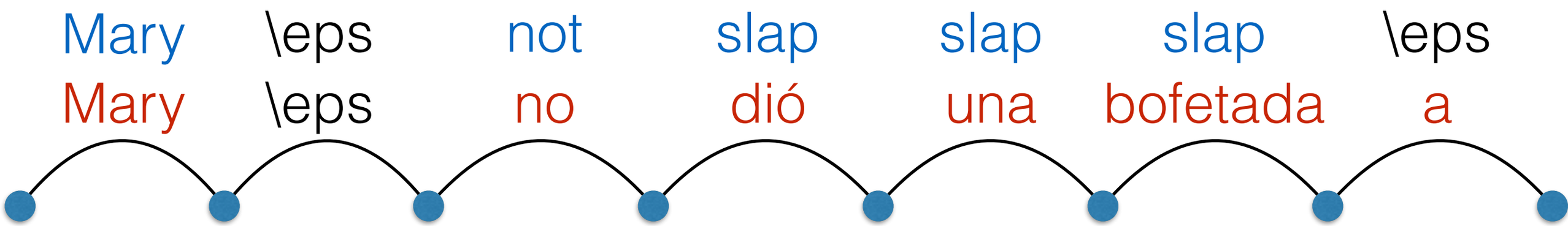

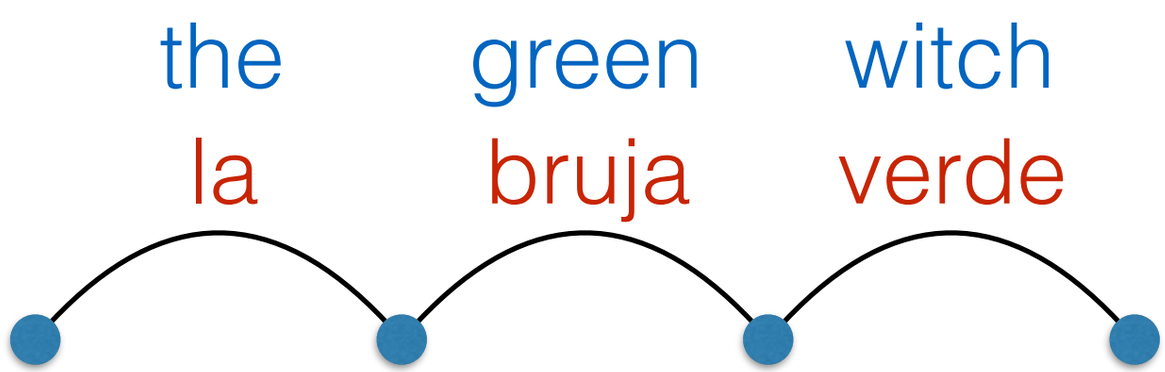

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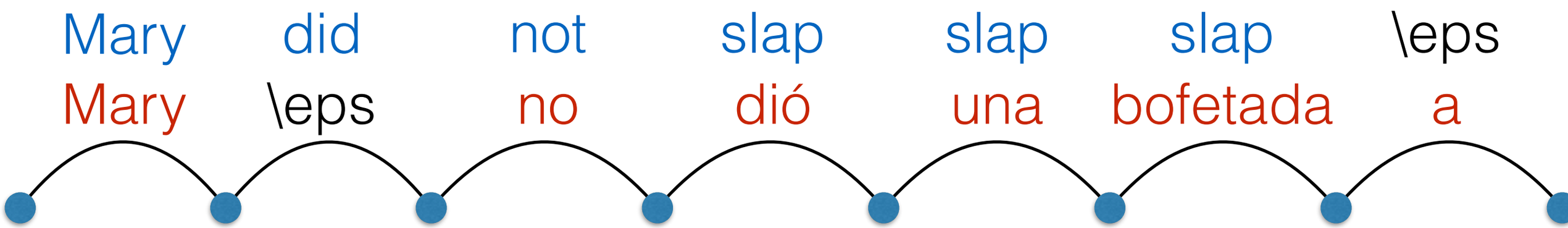

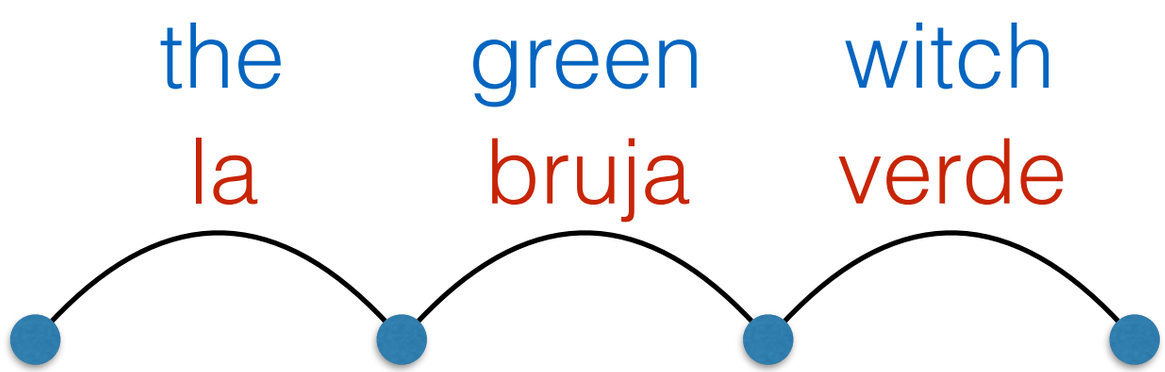

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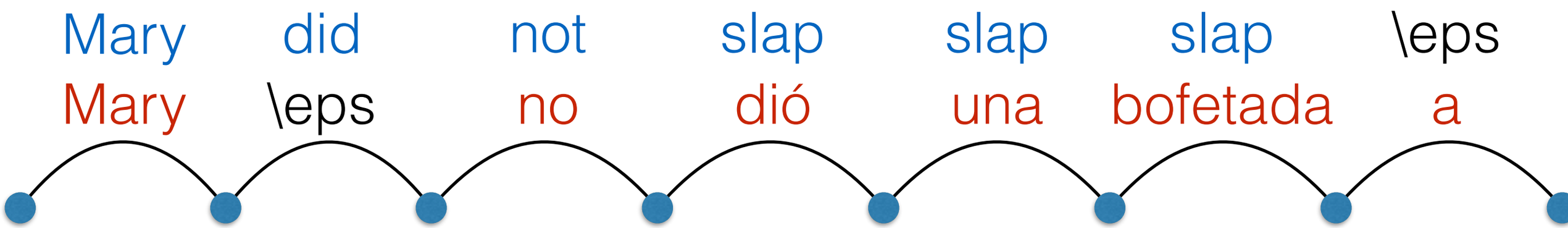

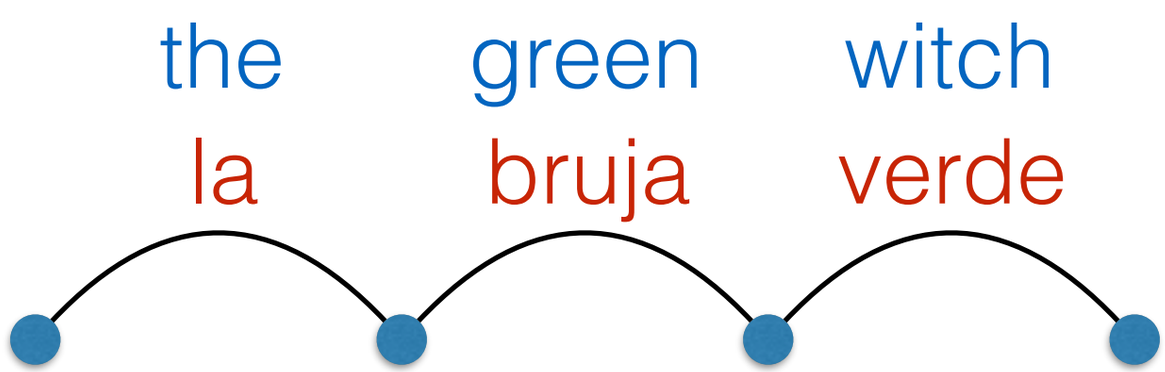

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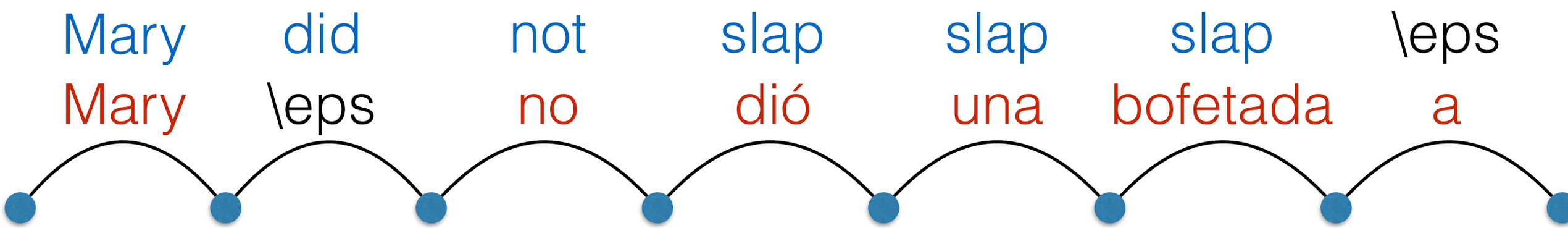

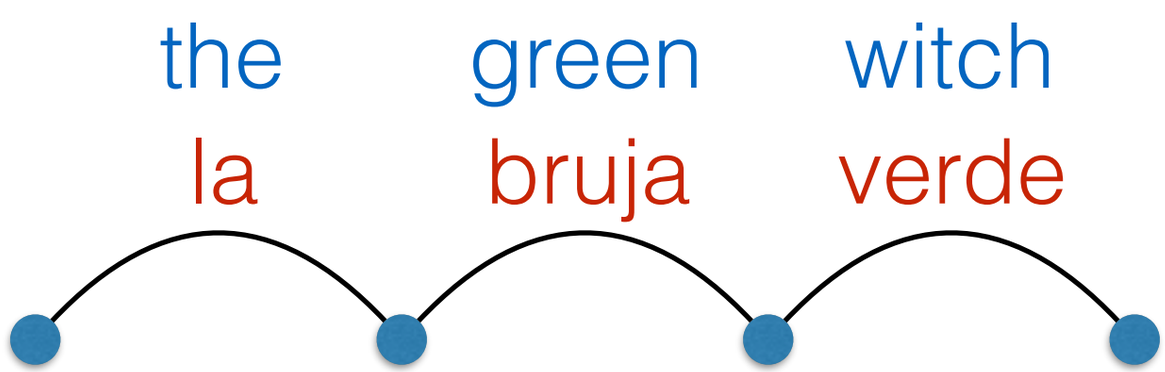

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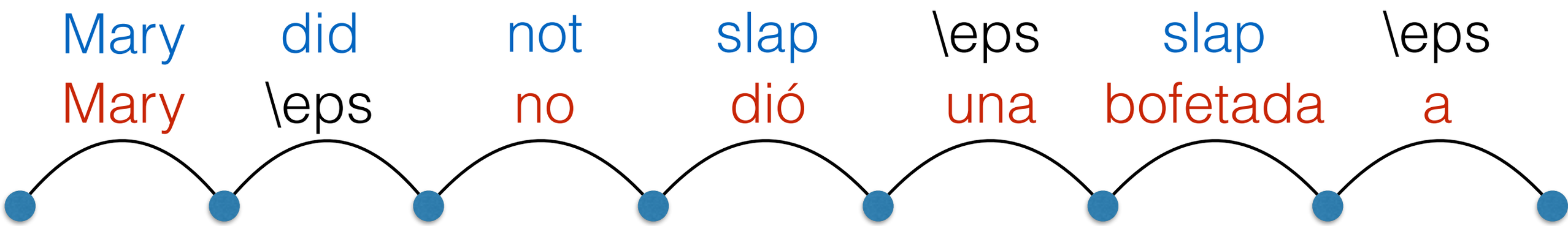

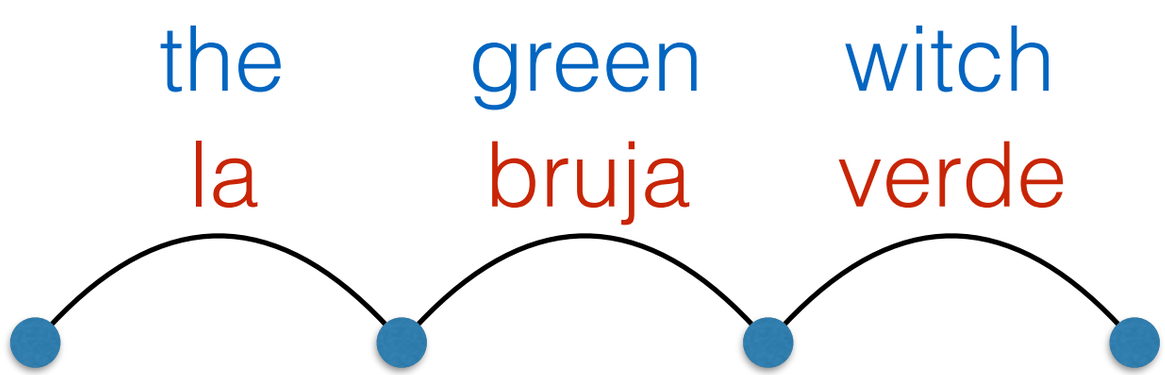

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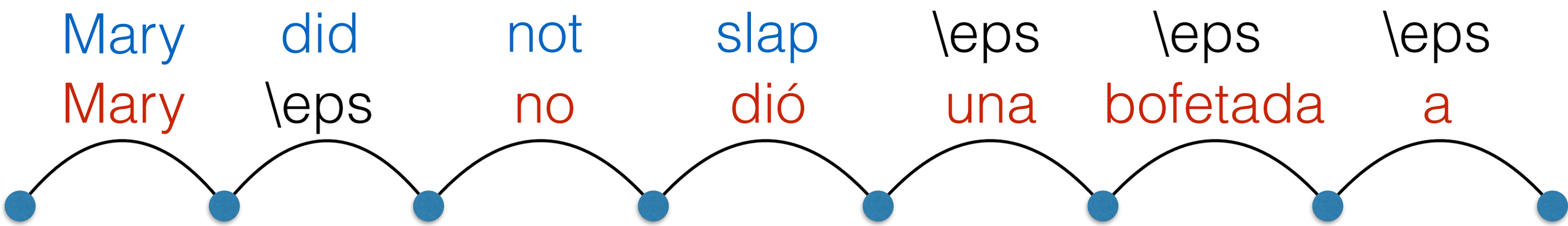

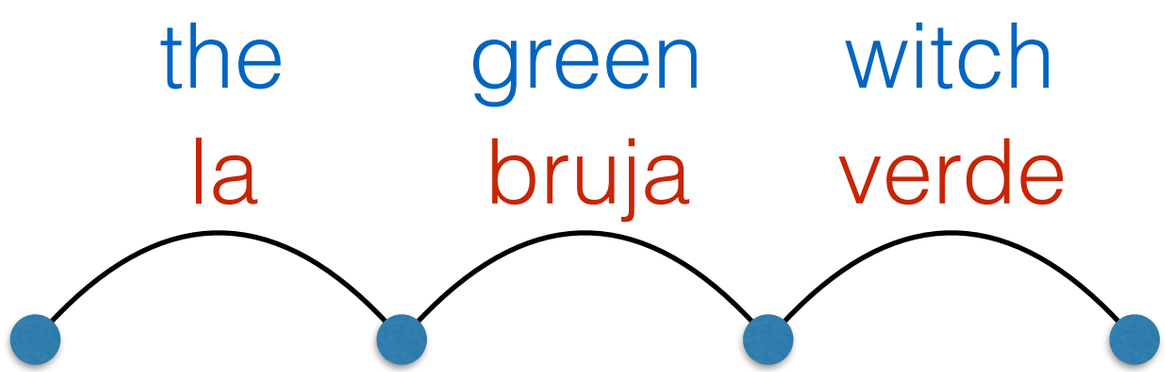

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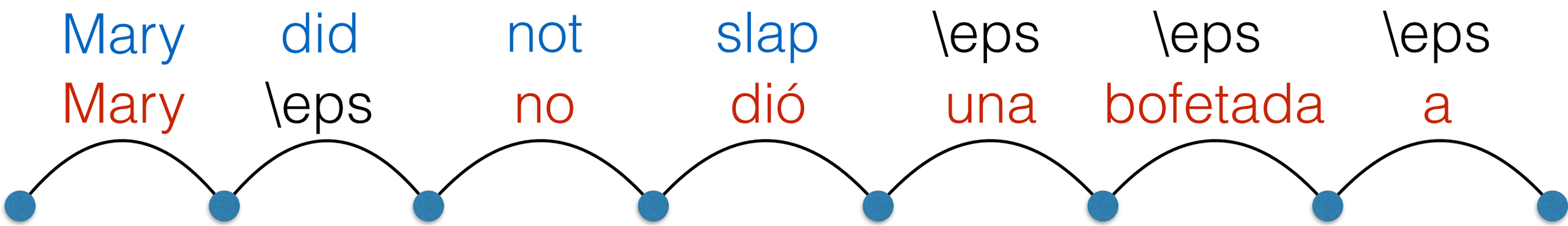

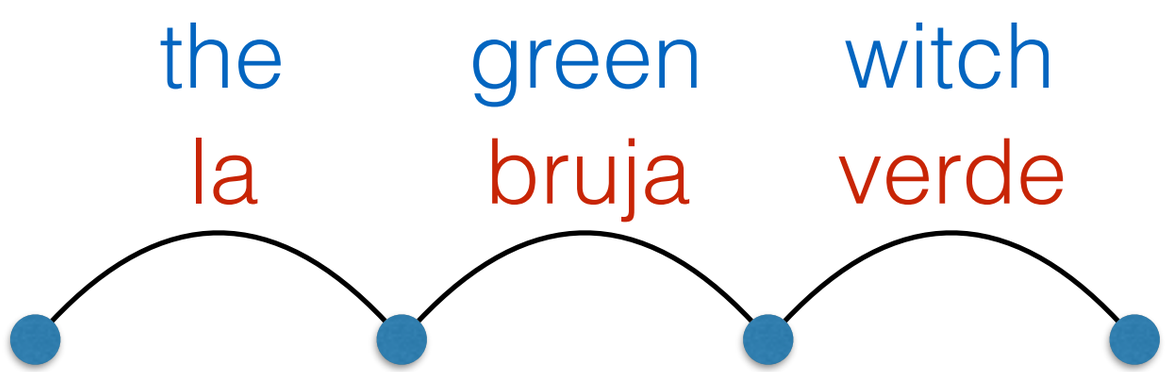

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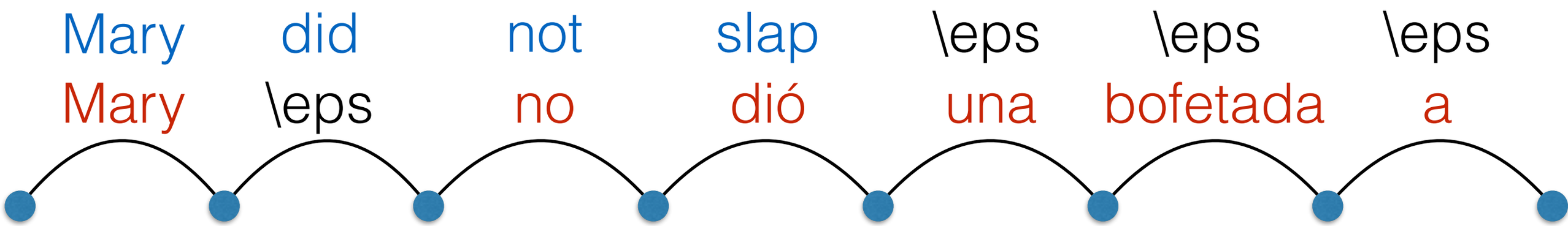

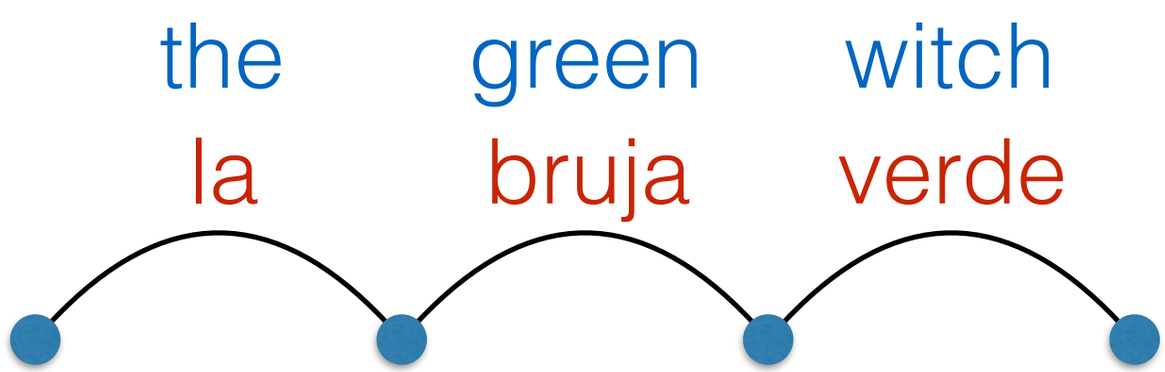

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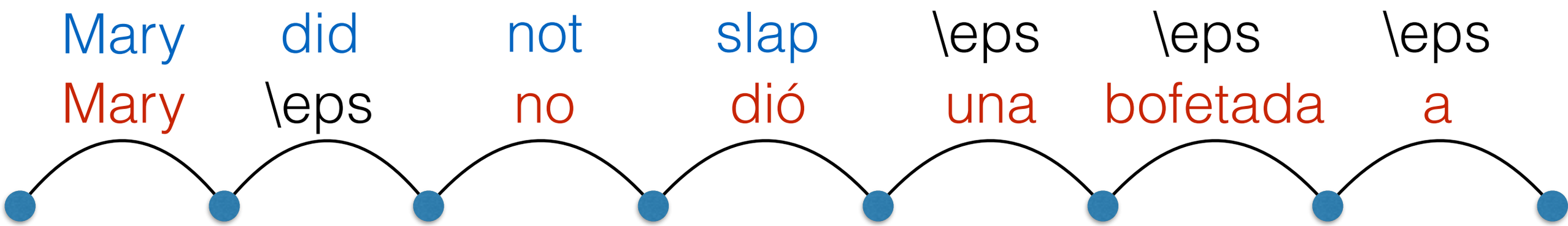

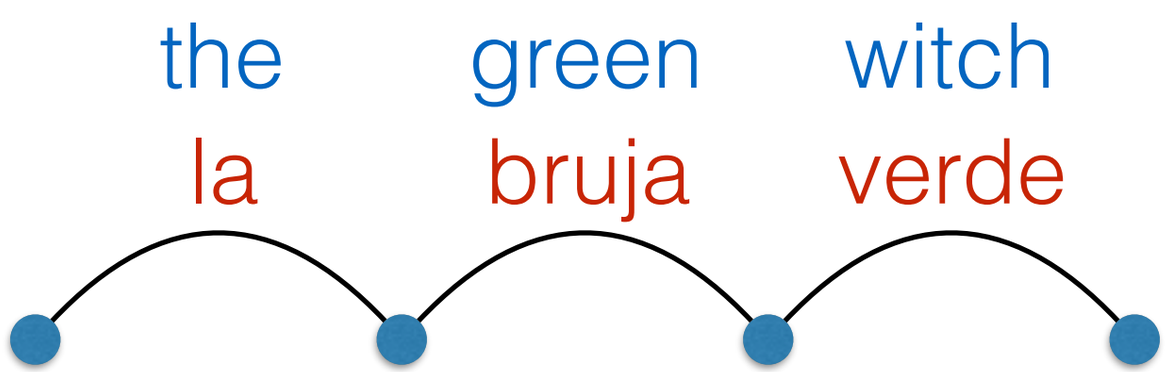

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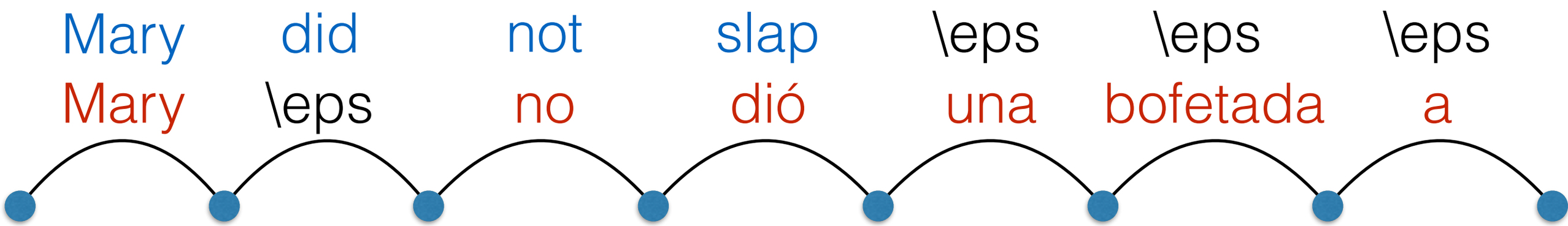
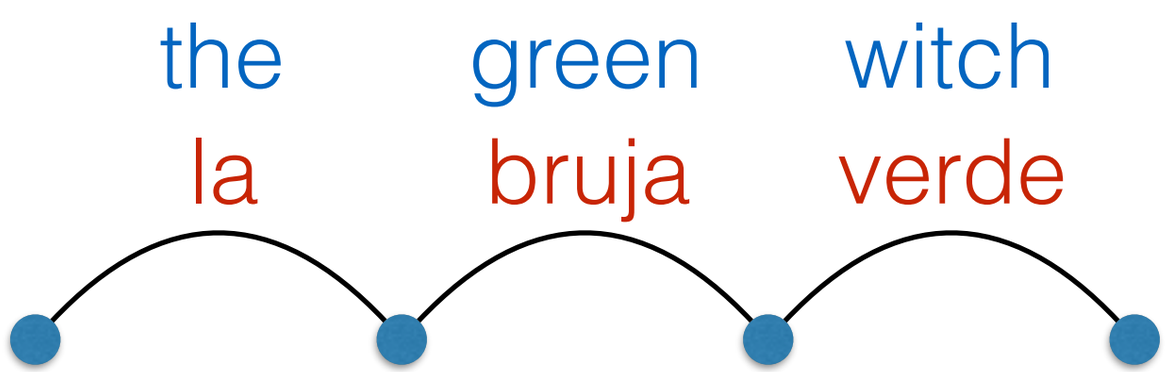




Word-based translation and FSTs

Language model

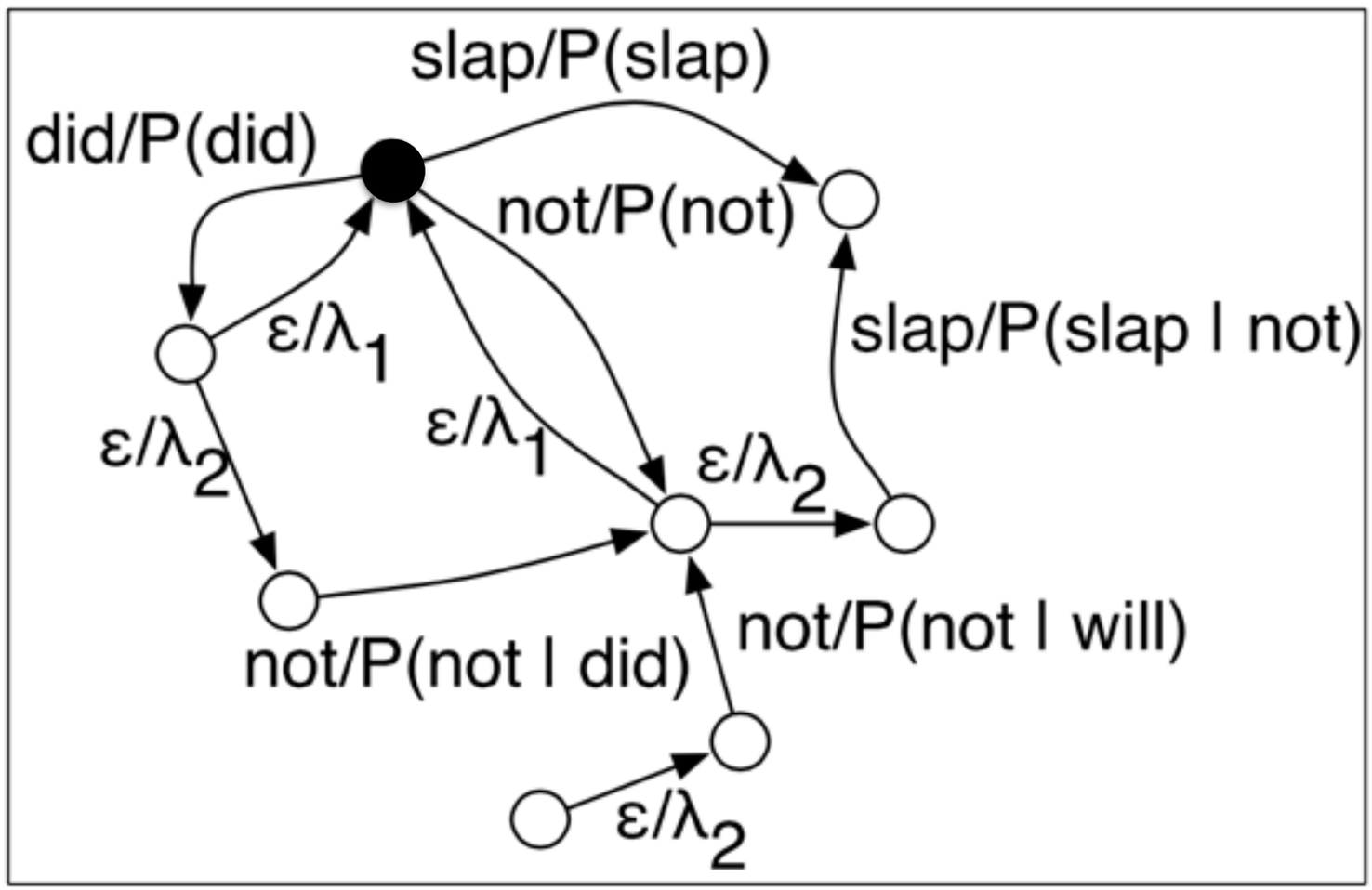
Fertility

Null insertion

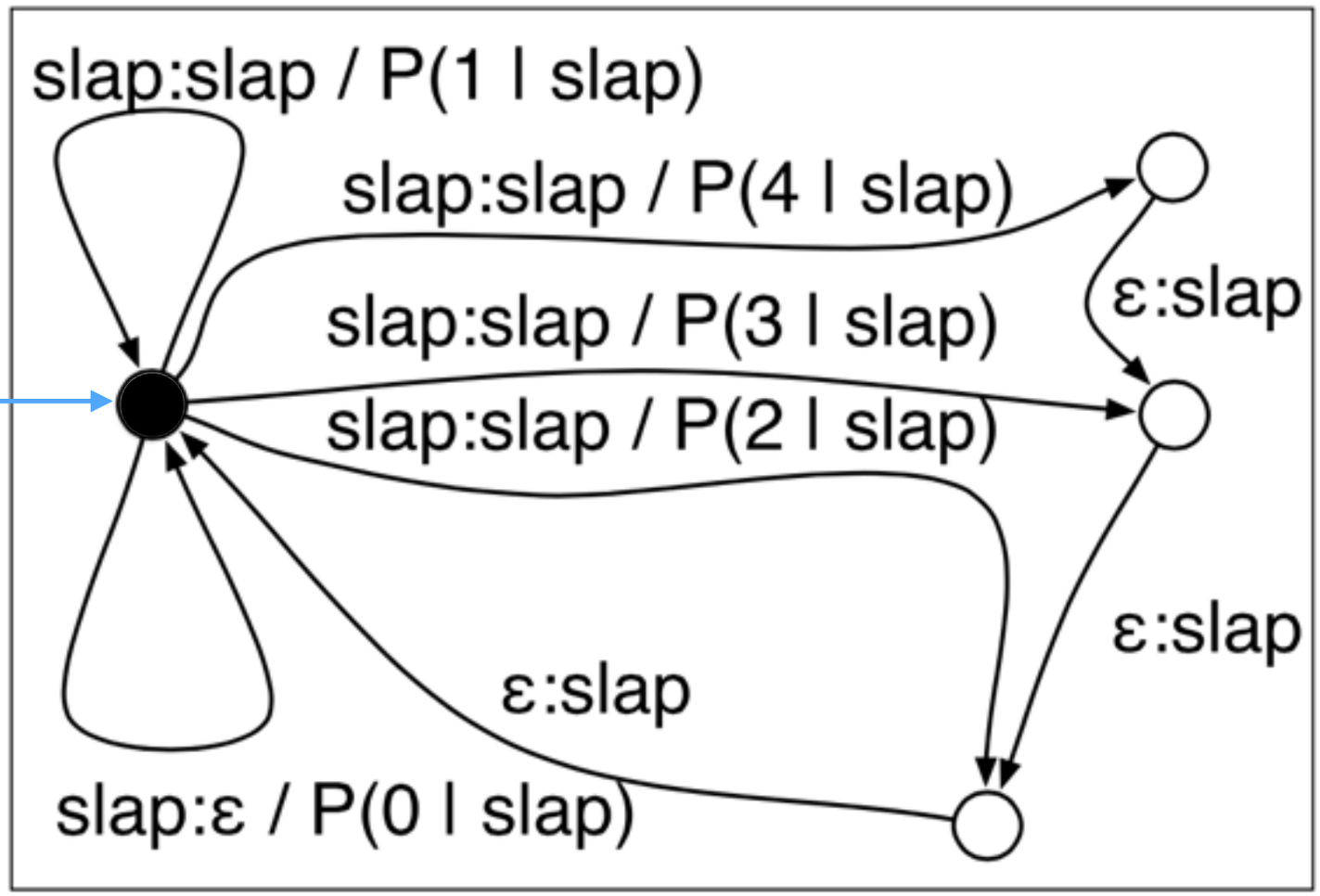
Translation

Distortion

Language Model



Fertility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slap:slap / P(4 | slap)
slap:slap / P(3 | slap)
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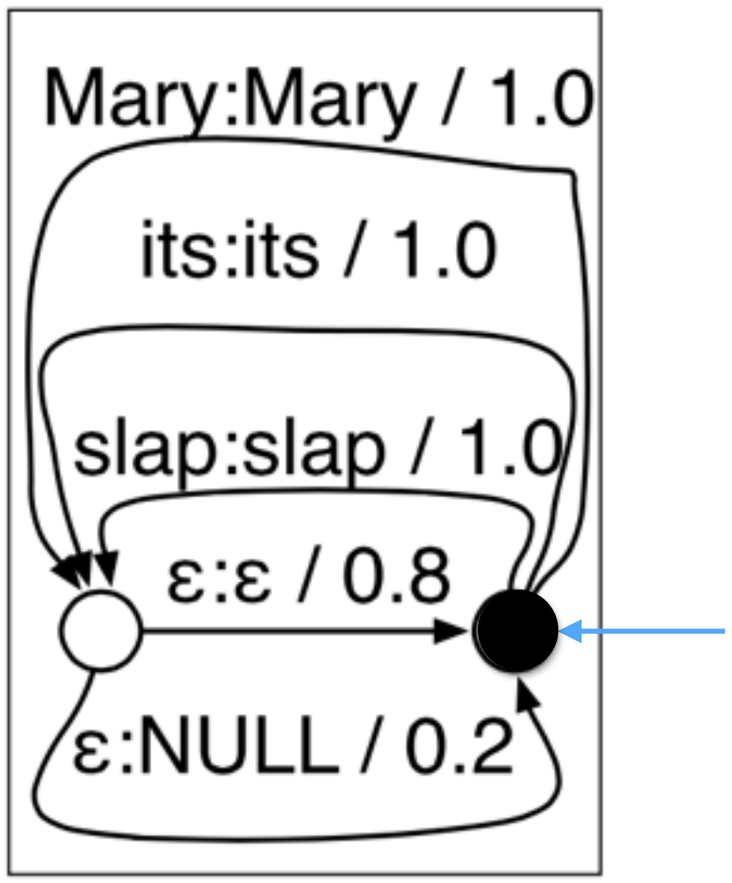
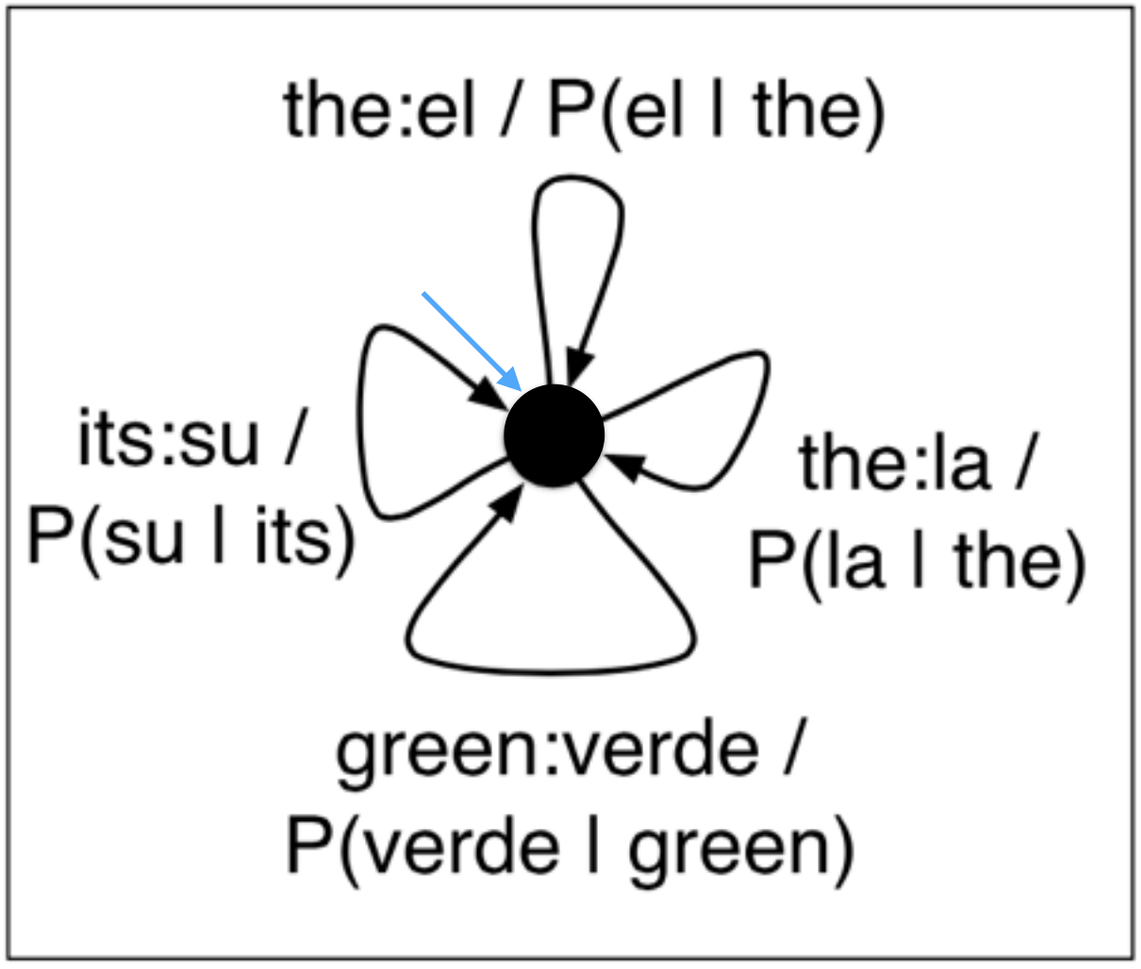
ε:slap
ε:slap
ε:slap
slap:ε / P(0 | slap)

Null Insertion



Translation



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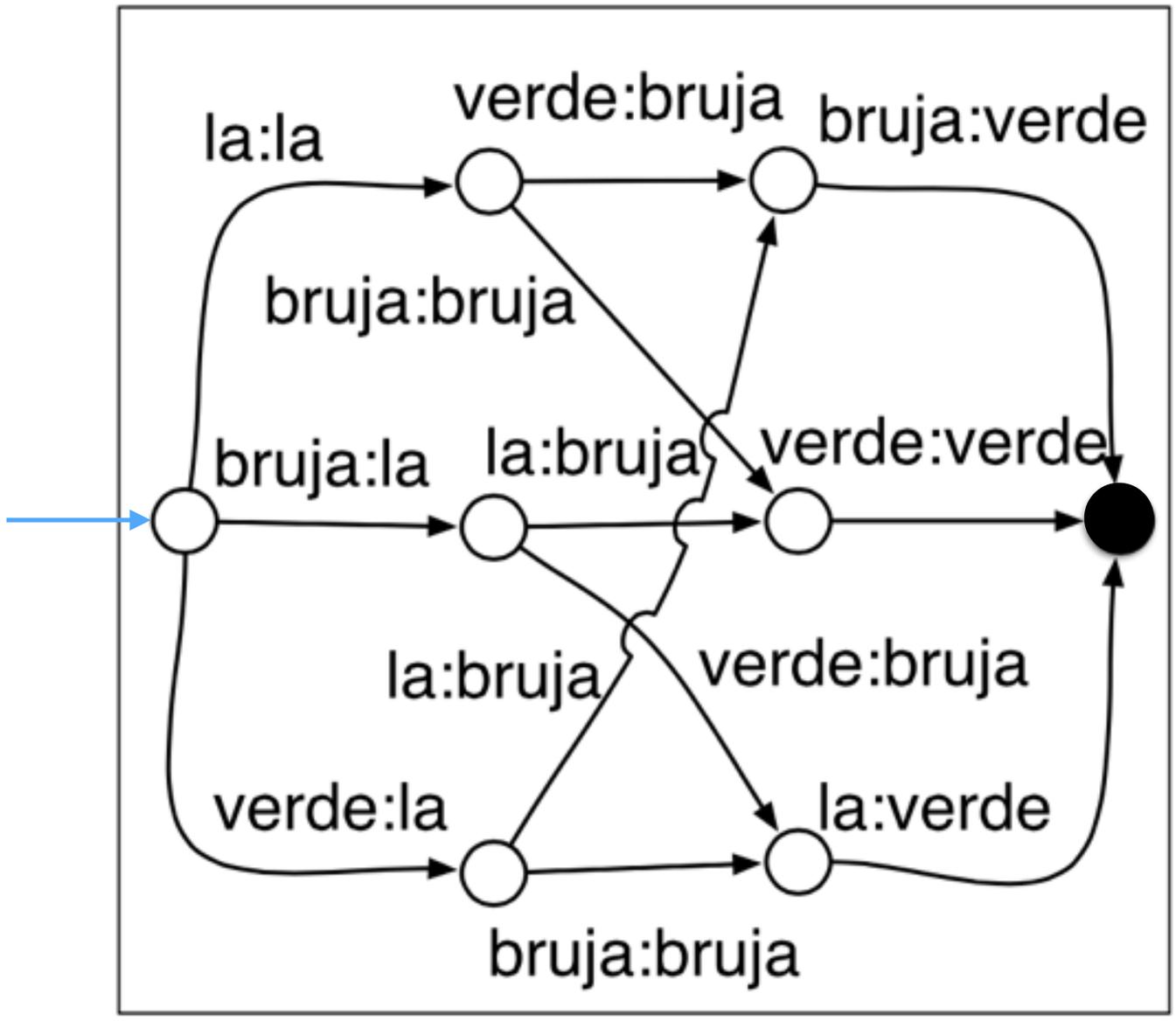
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