

# Hierarchical Recognition of Propositional Arguments with Perceptrons

**Xavier Carreras**

**Lluís Màrquez**

TALP Research Center

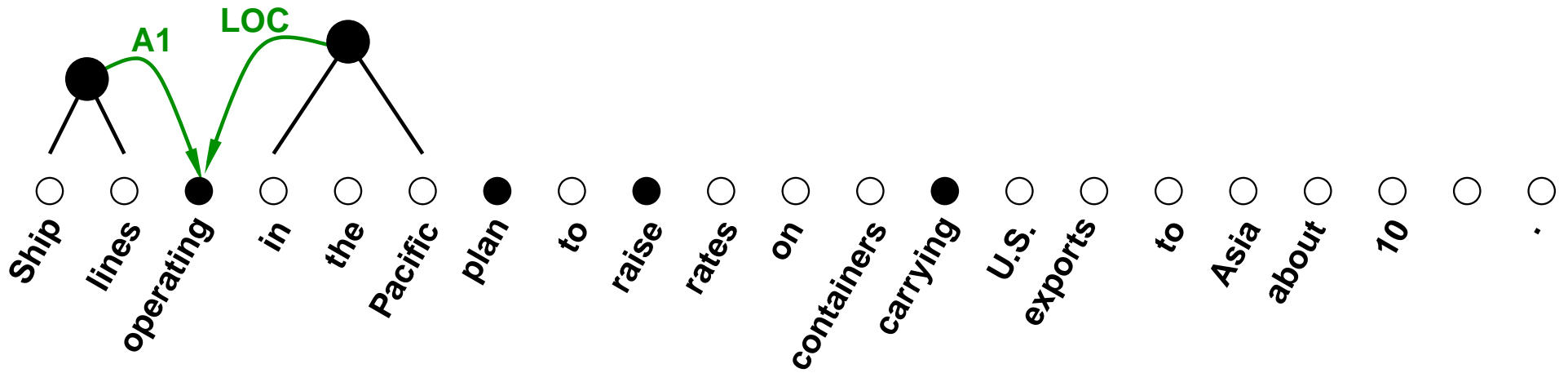
Technical University of Catalonia (UPC)

**Grzegorz Chrupała**

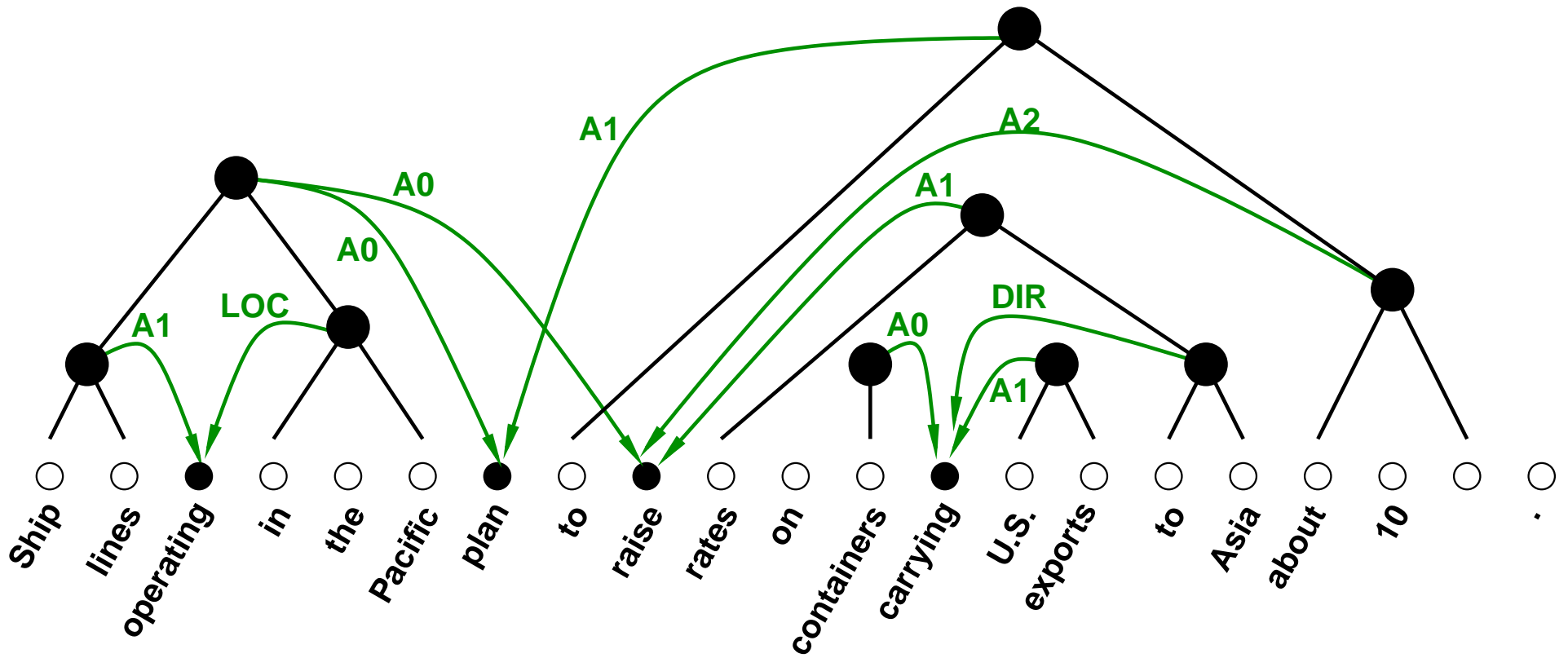
GRIAL Research Group

University of Barcelona (UB)

# Argument Hierarchies



# Argument Hierarchies





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## SRL Strategy

- Learning functions for each role  $r$ :  $\text{start}_r$ ,  $\text{end}_r$ ,  $\text{score}_r$
- Given a sentence  $x$ , our SRL model looks for:

$$SRL(x) = \arg \max_A \sum_{a \in A} \sum_{[v,r] \in a} \text{score}_r(a, v, x)$$

where :

- ★ Solutions  $A$  are sets of arguments  $a$  organized in hierarchy.
- ★ Arguments  $a$  play a number of roles with verbs,  $[v, r]$ .
- ★ Two arguments playing a role with the same verb are never nested.

and . . .

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## SRL Strategy

- Arguments have passed the filter, independent of verbs:
  - ★ Each argument  $a$  spans from word  $s$  to word  $e$ , with  $s \leq e$ .
  - ★ Word  $s$  has been predicted positively with  $\text{start}_r(x, s)$ .
  - ★ Word  $e$  has been predicted positively with  $\text{end}_r(x, e)$ .
- Inference in cubic-time dynamic programming search.

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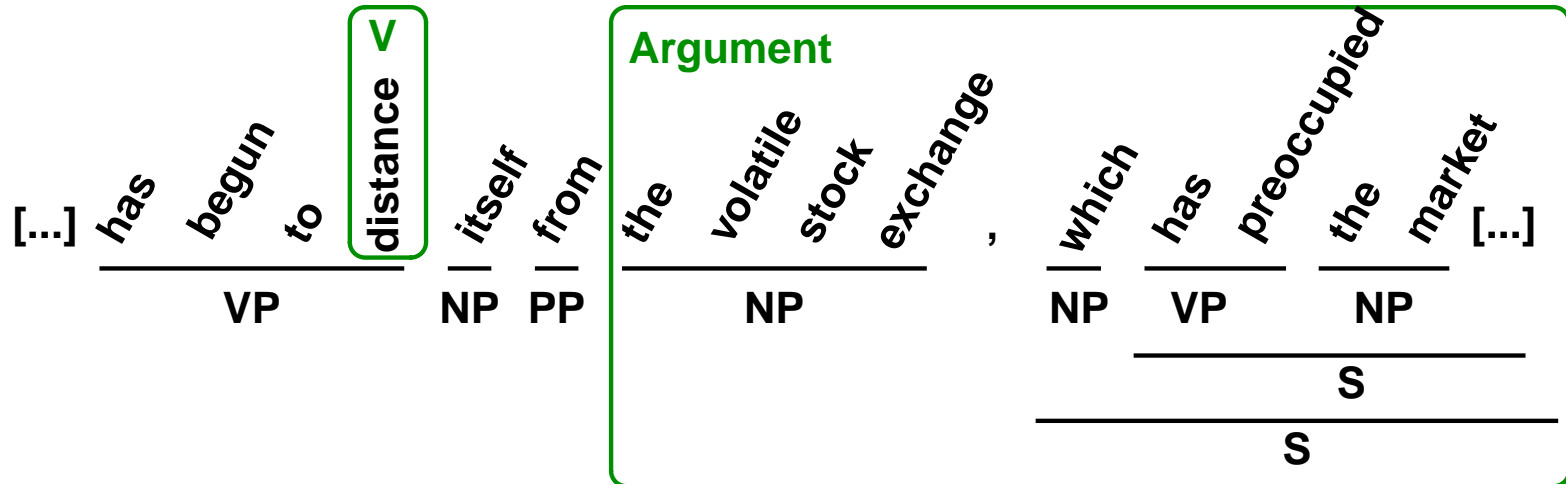
# Global Learning with Voted Perceptron

- Global, Mistake-driven Learning, with Perceptron:
  - ★ All functions learned together, dependently.
  - ★ Learning at sentence-level.
  - ★ We correct only predictions which produce error in the global argument structure for the sentence.
- As a result, Start-End behave as Filters, and Scorers as Ranking functions.

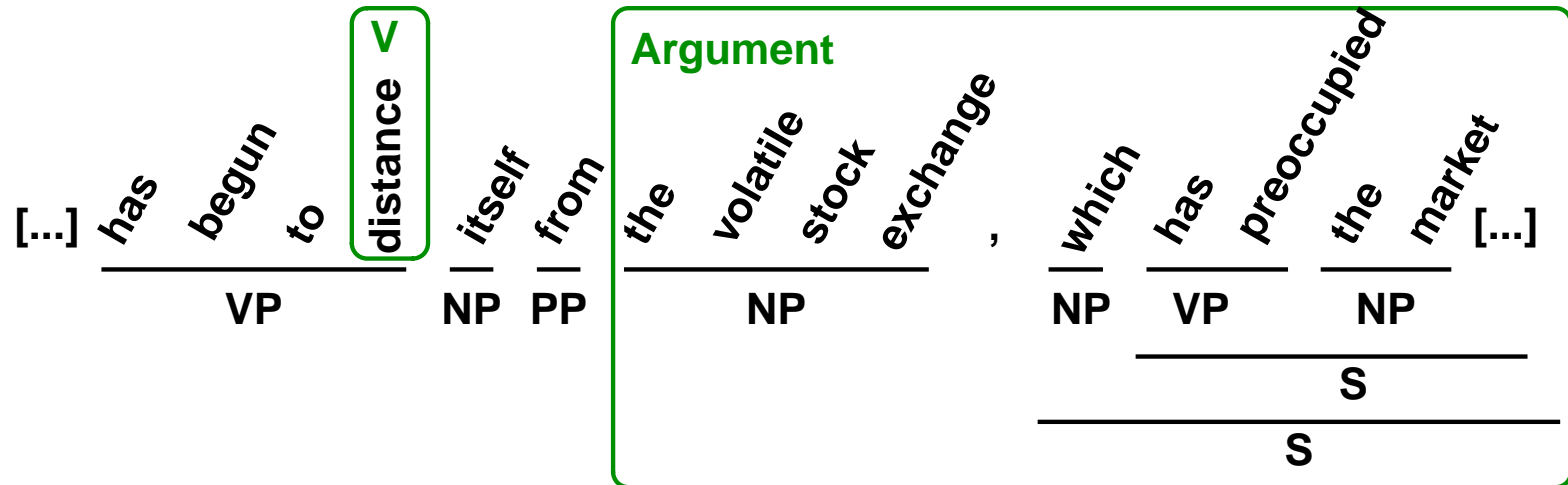
[Collins, EMNLP'02] [Carreras & Màrquez, NIPS'03]
- Tricks: averaged predictions, polynomial kernels  $d = 2$ .

[Freund & Schapire, Machine Learning 1998]

# Some Features on Arguments



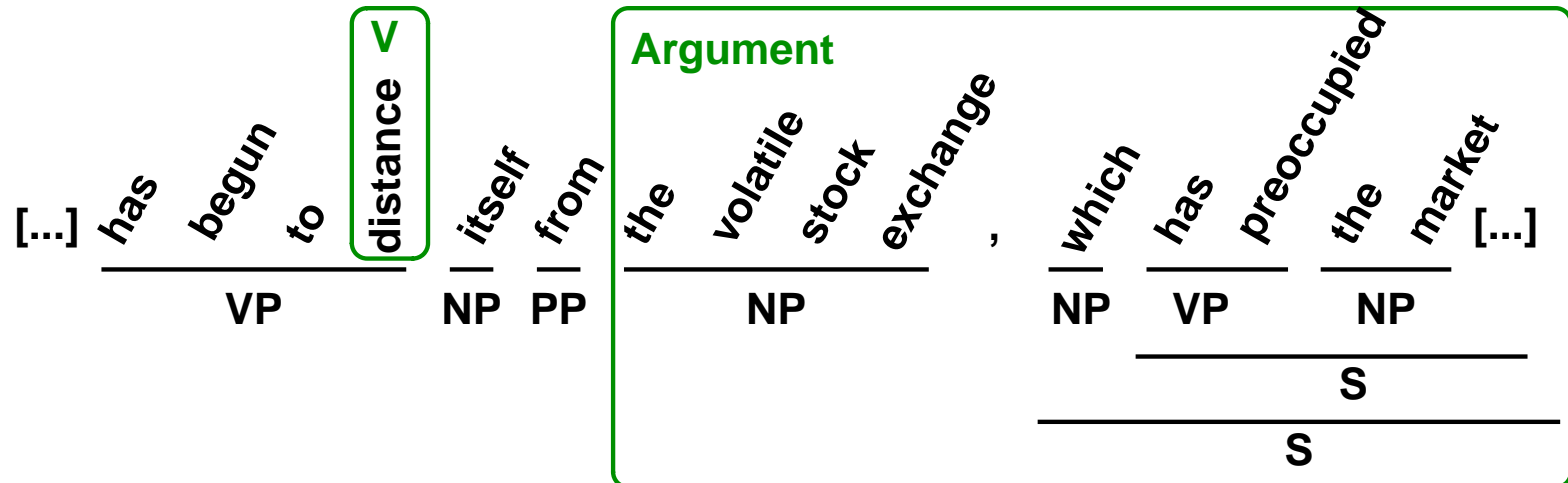
# Some Features on Arguments



Structural Features:

PoS sequence : DT + JJ + NN + NN + , + WDT + ...

# Some Features on Arguments

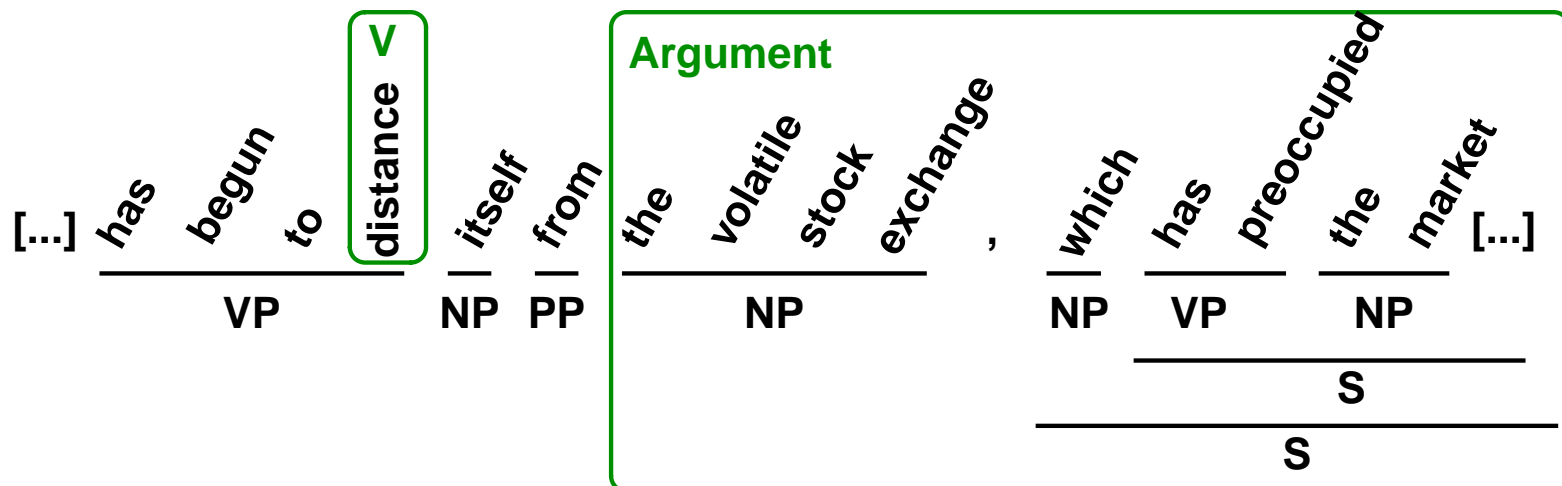


Structural Features:

PoS sequence : DT + JJ + NN + NN + , + WDT + ...

Top-most elements : NP + , + S-which

## Some Features on Arguments



### Structural Features:

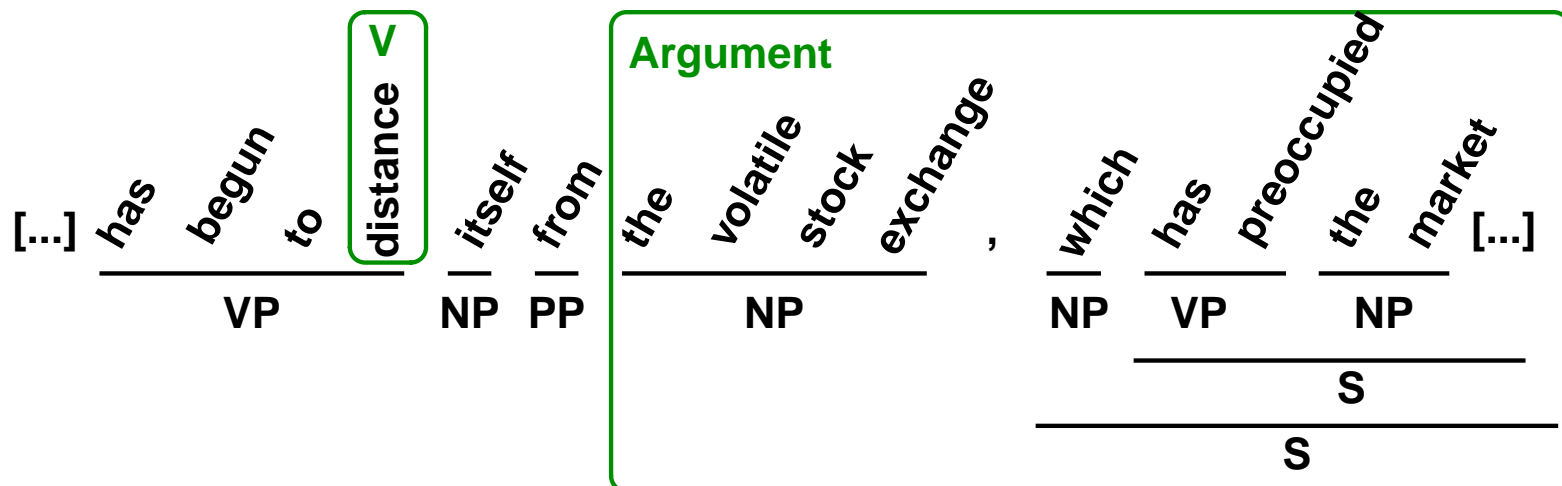
PoS sequence : DT + JJ + NN + NN + , + WDT + ...

Top-most elements : NP + , + S-which

Bag of Nouns : stock, exchange

Bag of Adjectives : volatile

## Some Features on Arguments



### Structural Features:

PoS sequence : **DT + JJ + NN + NN + , + WDT + ...**

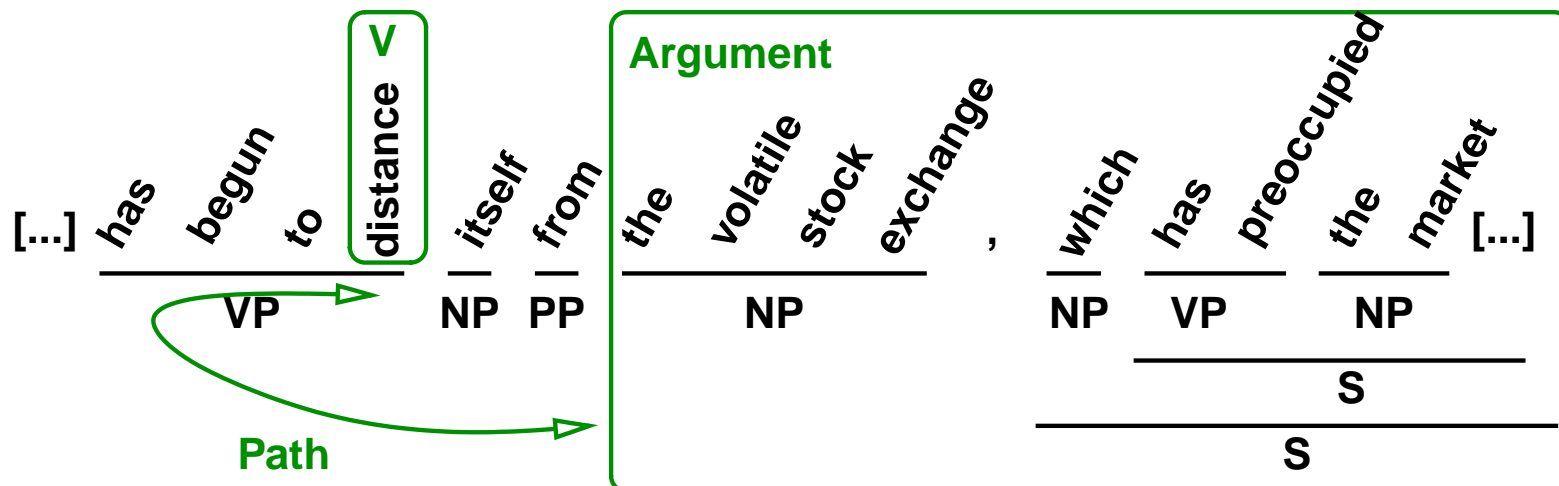
Top-most elements : **NP + , + S-which**

Bag of Nouns : **stock, exchange**

Bag of Adjectives : **volatile**

Lexical head : **exchange**

## Some Features on Arguments



### Structural Features:

PoS sequence : DT + JJ + NN + NN + , + WDT + ...

Top-most elements : NP + , + S-which

Bag of Nouns : stock, exchange

Bag of Adjectives : volatile

Lexical head : exchange

Path : -PP -NP |VP

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## Results

artificial	Precision	Recall	$F_{\beta=1}$
g-Start, g-End, g-Score	100.0%	94.73%	97.26
Start, End, g-Score	100.0%	89.44%	94.38
g-Start, g-End, Score	85.12%	67.99%	75.60

	Precision	Recall	$F_{\beta=1}$
Development	73.40%	63.70%	68.21
Test	71.81%	61.11%	66.03

Core	P	R	$F_{\beta=1}$
A0	81.83	76.46	79.05
A1	68.73	65.27	66.96
A2	59.41	34.03	43.28
A3	58.18	21.33	31.22
A4	72.97	54.00	62.07
A5	0.00	0.00	0.00
R-A0	78.85	77.36	78.10
R-A1	64.29	51.43	57.14
R-A2	100.00	22.22	36.36

<b>All</b>	<b>71.81</b>	<b>61.11</b>	<b>66.03</b>
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AM's	P	R	$F_{\beta=1}$
ADV	54.50	35.50	43.00
CAU	58.33	28.57	38.36
DIR	64.71	22.00	32.84
DIS	64.06	57.75	60.74
EXT	100.00	50.00	66.67
LOC	35.62	22.81	27.81
MNR	50.89	22.35	31.06
MOD	97.57	95.25	96.40
NEG	90.23	94.49	92.31
PNC	36.11	15.29	21.49
PRD	0.00	0.00	0.00
TMP	61.86	48.86	54.60

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**Thanks!**