北京大學
PEKING UNIVERSITY

Modeling Discourse Cohesion for Discourse Parsing via Memory Network

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Rui Yan and Dongyan Zhao

Institute of Computer Science and Technology, Peking University

Discourse Dependency Parsing

EDU means **Element Discourse Unit**

EDU_1: President Bush insists

EDU_2: it would be a great tool

EDU_3: for curbing the budget deficit

EDU_4: and slicing the lard out of government programs.

EDU_5: He wants it now .

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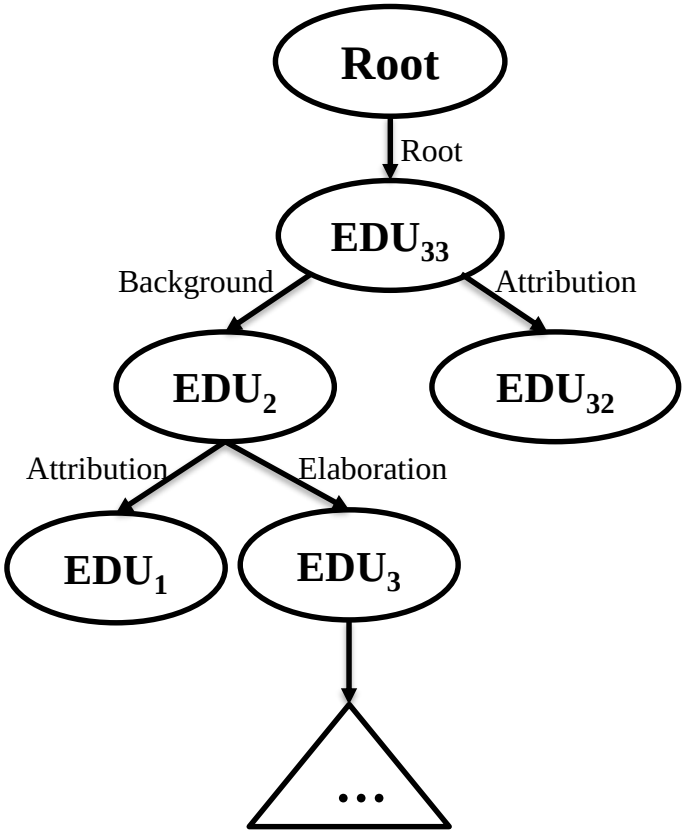

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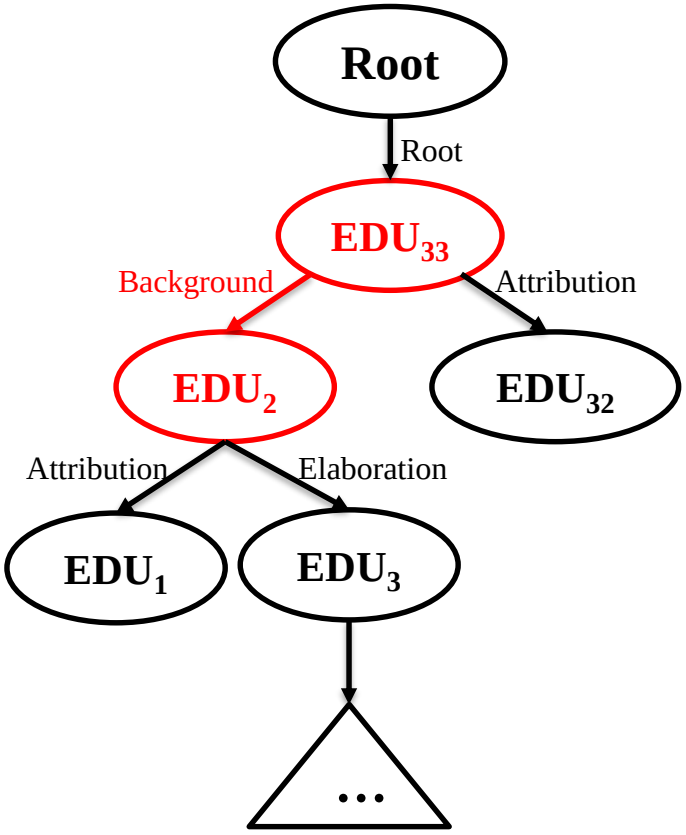

Motivation

- Identifying **long-span dependencies** between element discourse units
  - Discourse structure
    - Morris and Hirst, 1991 extracts features to characterize discourse structures
  - Discourse cohesion
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Our Work: Use Memory network to implicitly capture discourse cohesion

How Does Memory Network Work?

EDU_1: I feel hungry after wake up,
EDU_2: I rush into the kitchen and make my breakfast.
EDU_3: My breakfast is hamburger.

EDU_4: It is eight o'clock when I leave home.
EDU_5: So late!

EDU_6: I drive into the highway,
EDU_7: but meet a traffic jam.
EDU_8: Oh, I finally arrive at the company.

EDU_9: It is nine o'clock.
EDU_{10}: Thank God, I am not late for work.

EDU_{11}: But the hamburger is cold,
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Traffic

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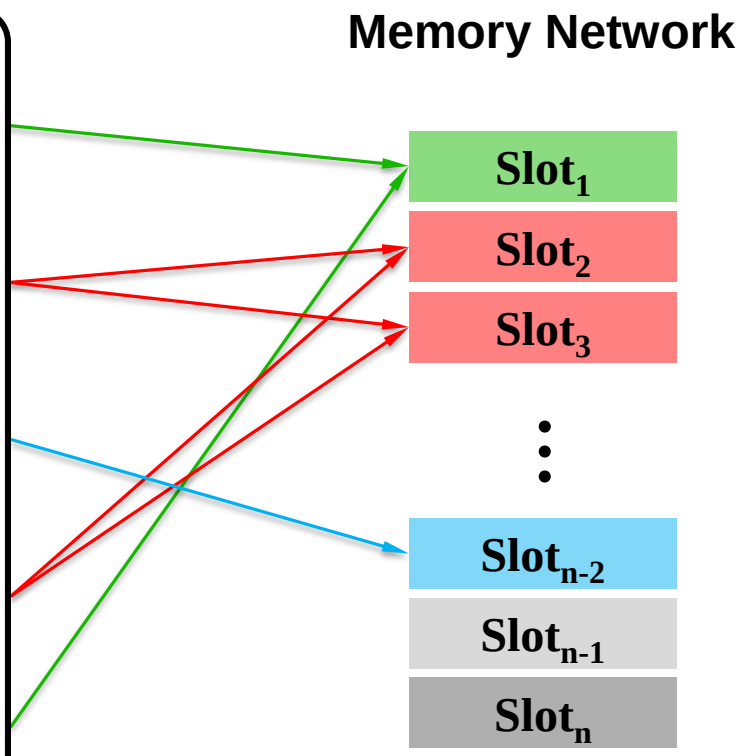

Framework

Transition-based dependency parsing

Arc-eager algorithm (Nivre):

Stack, Buffer, Arcs set

Left-Arc(LA)	$\langle e\|S, e'\|B, Arcs\rangle \rightarrow \langle S, e'\|B, Arcs \cup \{(e', e)\}\rangle$
Right-Arc(RA)	$\langle e\|S, e'\|B, Arcs\rangle \rightarrow \langle e'\|e\|S, B, Arcs \cup \{(e, e')\}\rangle$
Shift	$\langle S, e\|B, Arcs\rangle \rightarrow \langle e\|S, B, Arcs\rangle$
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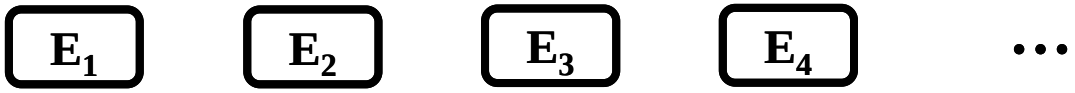

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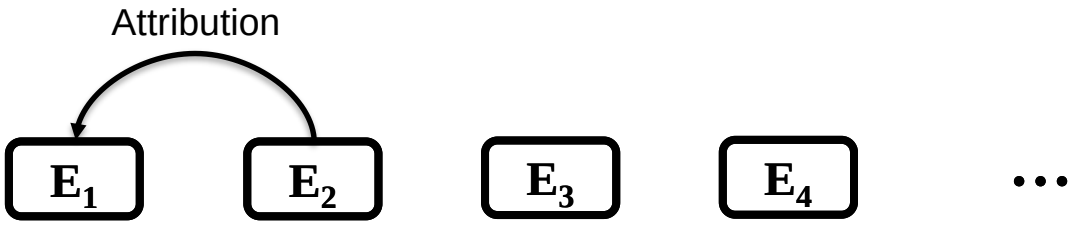

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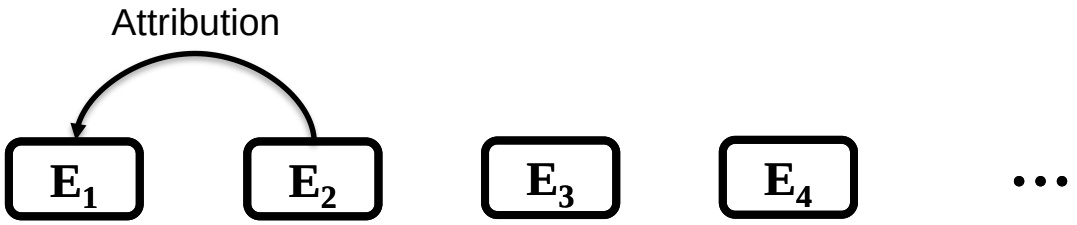

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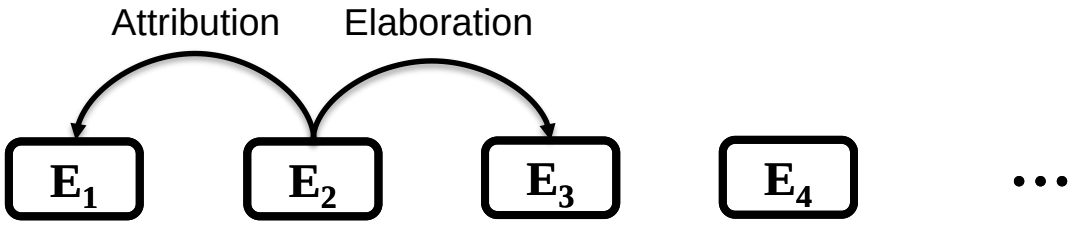

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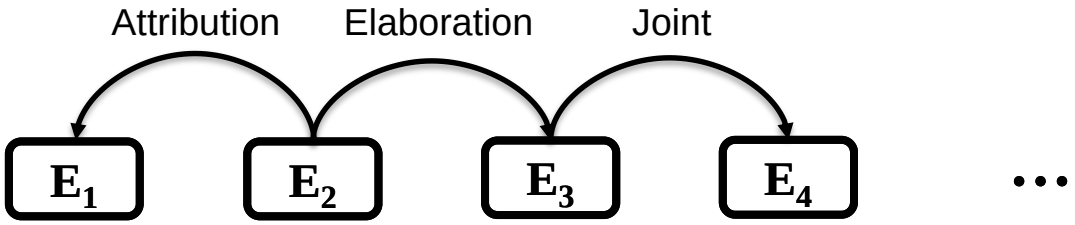

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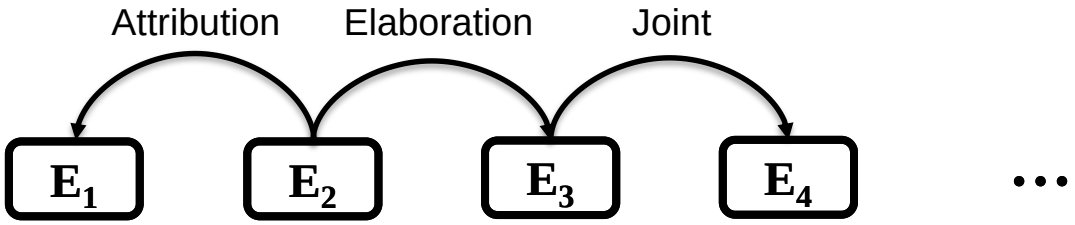

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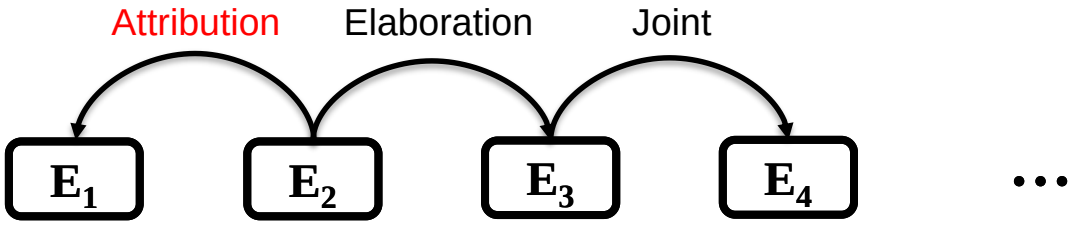
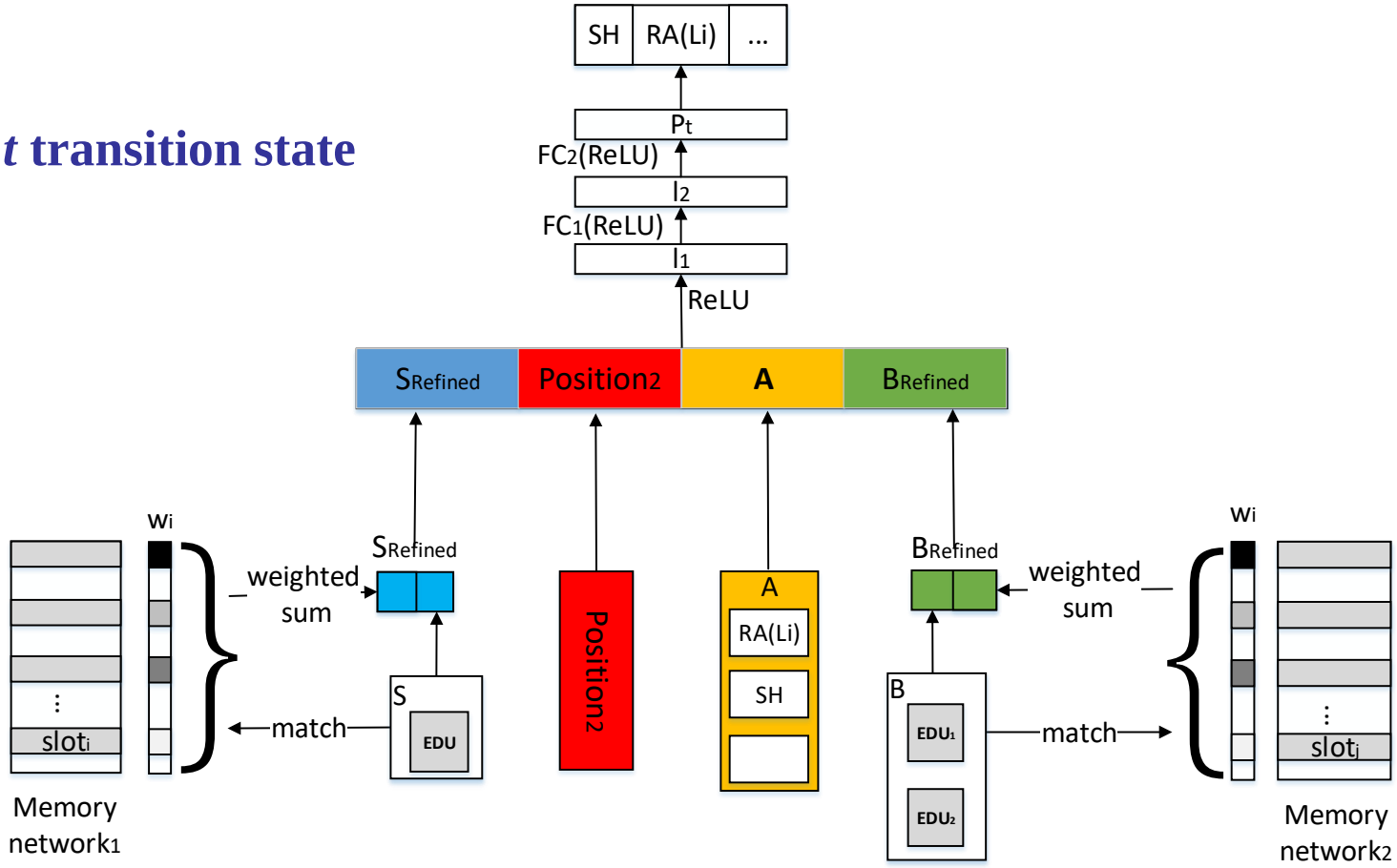


Model Overview

time *t* transition state



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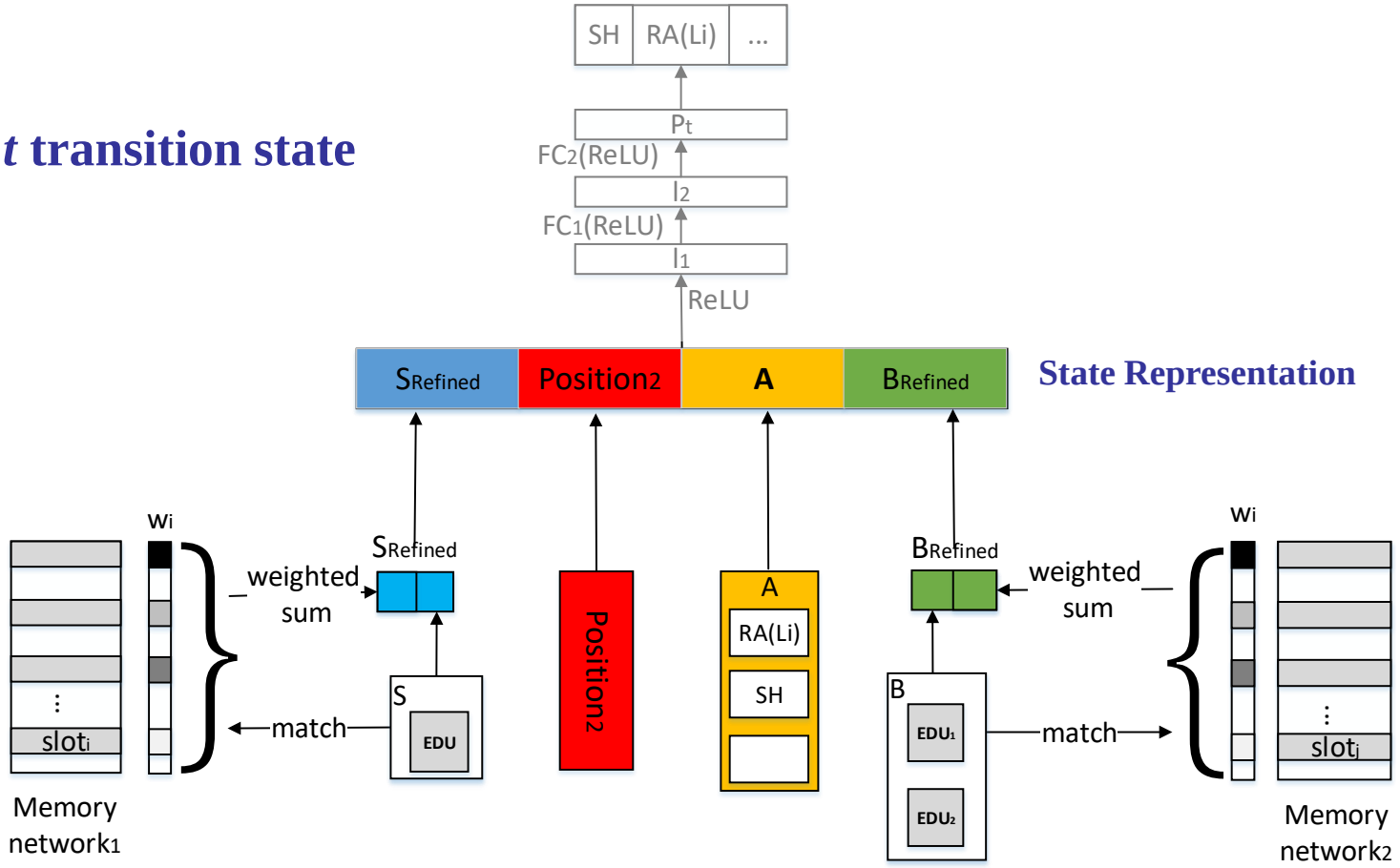

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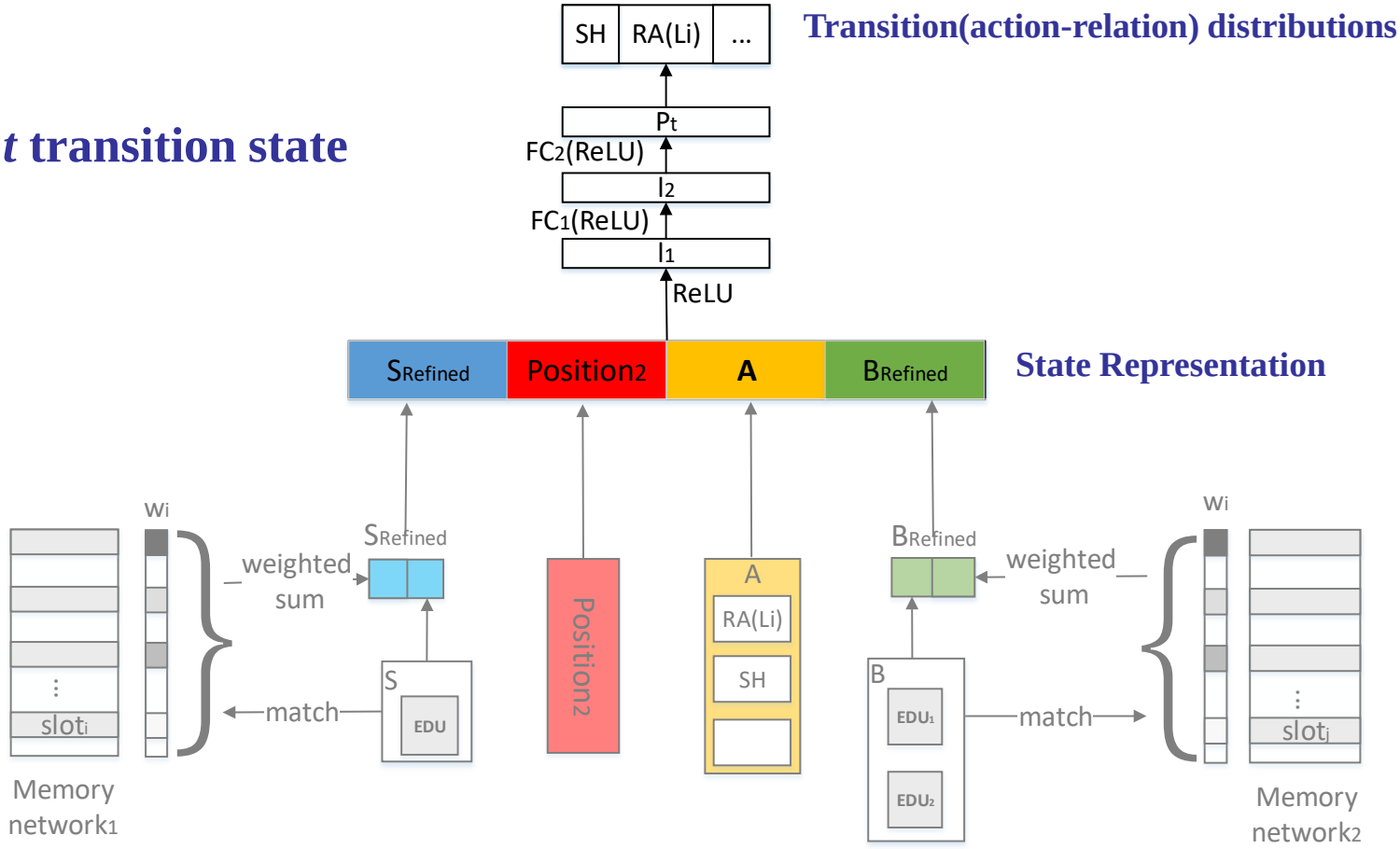

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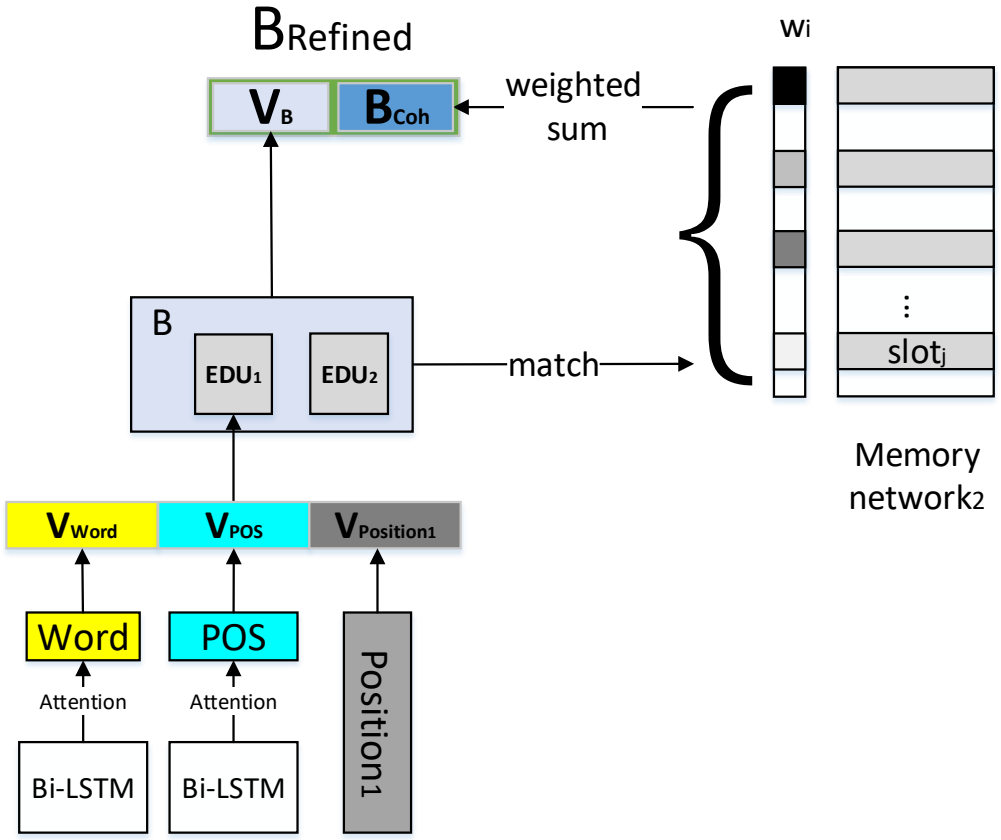
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weighted sum
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EDU2
match
slotj
Memory network2
VWord
VPOS
VPosition1
Word
POS
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Attention
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Bi-LSTM
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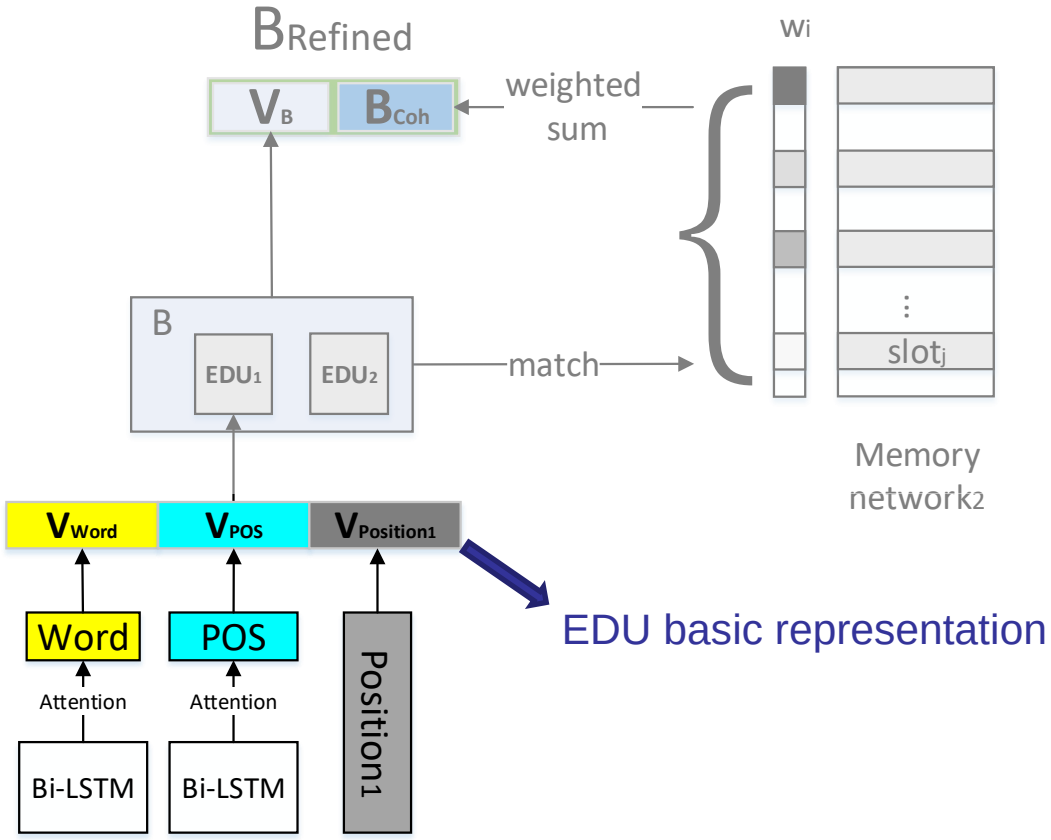
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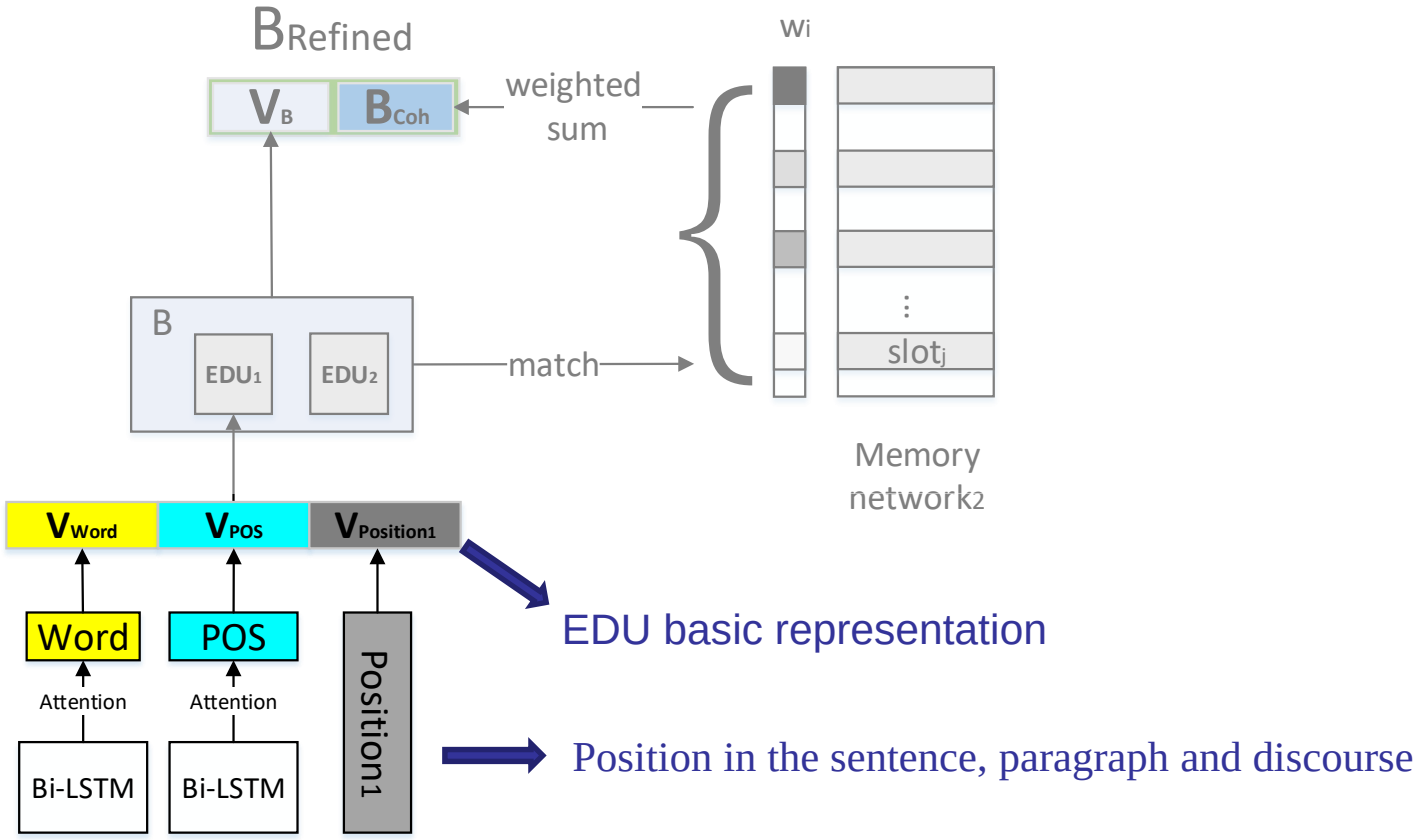
$B_{Refined}$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EDU basic representation
Position in the sentence, paragraph and discourse

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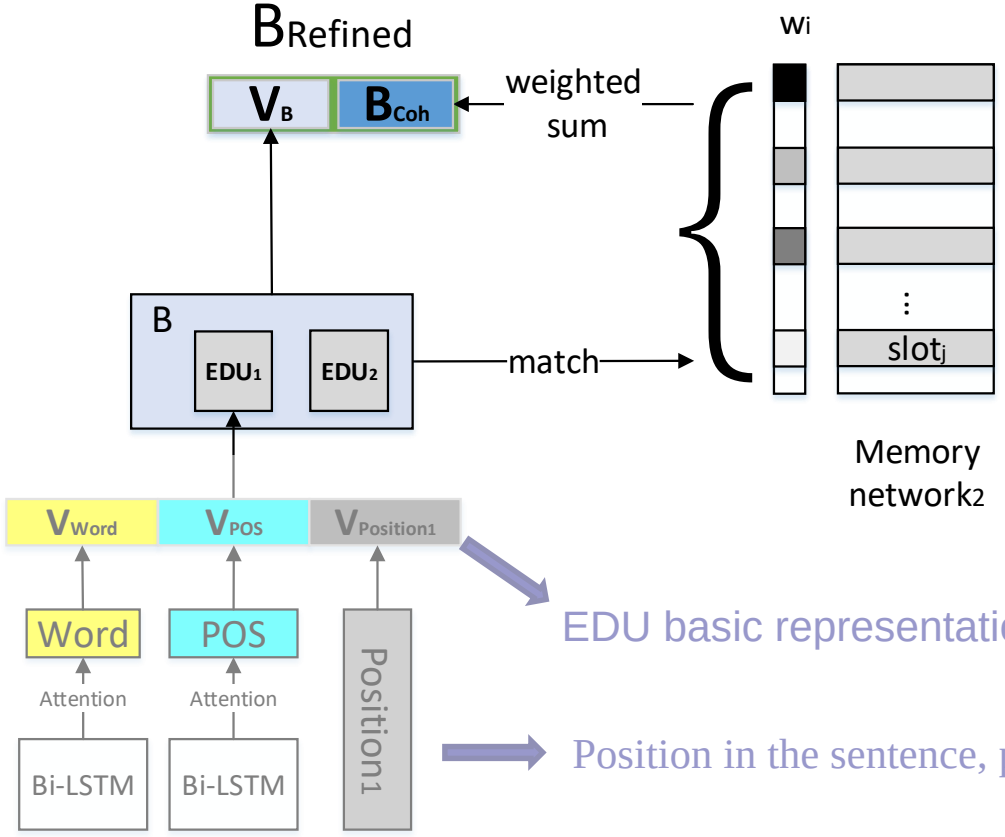

$$w_i = \frac{exp(\lambda Cos(V_B, slot_i))}{\sum_j exp(\lambda Cos(V_B, slot_j))}$$

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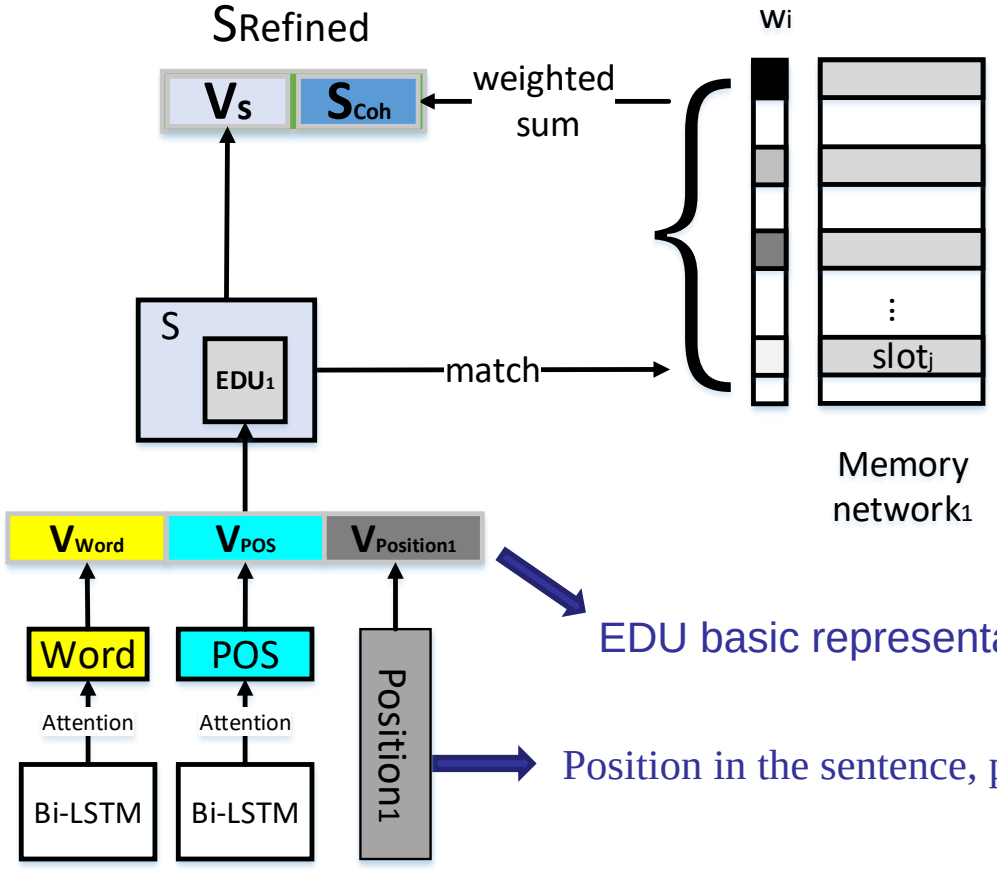
EDU basic representation

Position in the sentence, paragraph and discourse

SRefined



$$w_i = \frac{exp(\lambda Cos(V_S, slot_i))}{\sum_j exp(\lambda Cos(V_S, slot_j))}$$

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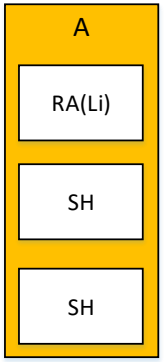
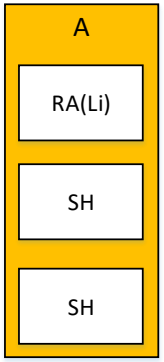
A and Position2



Top three transition information

Concatenate every transition's embedding

A and Position2



Top three transition information

Concatenate every transition's embedding

Position2

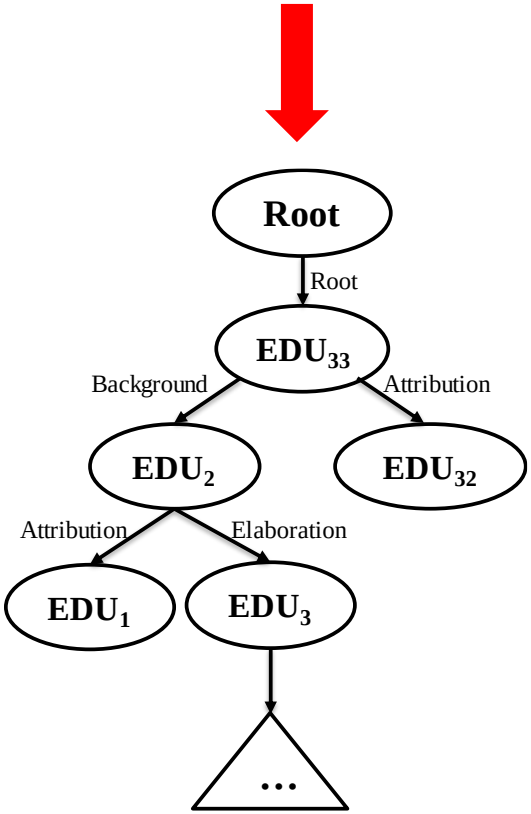
The spatial relationship between the top EDUs of S and B

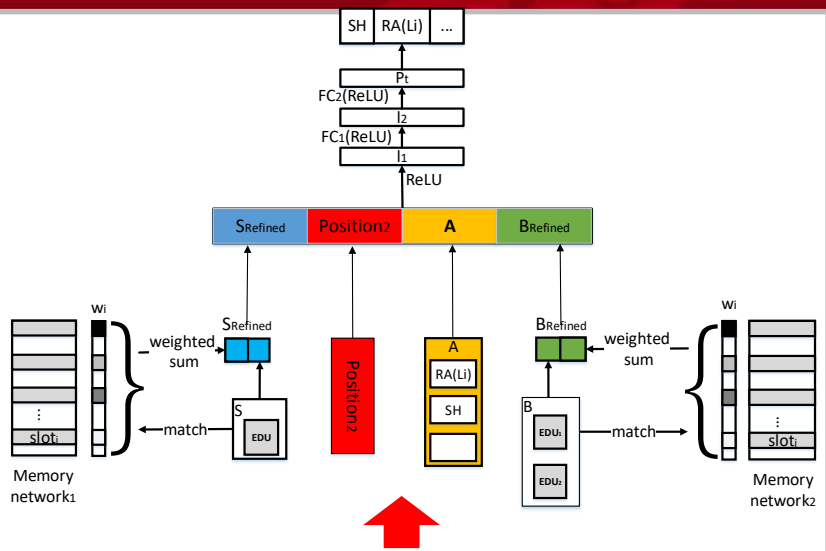
- Same sentence
- Same paragraph
- Distance in paragraph

Overall Process

Transitions Sequence:

Shift, LA-attribution, SH, RA-elaboration , RA-joint, …





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Experiment

Dataset:

RST Discourse Treebank

- 380 discourses
  - **312 training, 30 validation, 38 testing**
- 111 relation types for fine-grained
- 19 relation types for coarse-grained

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Evaluation metrics:

- UAS, LAS

Experiment(Cont.)

Method	UAS	LAS(Fine)	LAS(Coarse)
Perceptron	0.5422	0.3231	0.3777
Basic(word+POS)	0.5588	0.367	0.3985
Basic(word+POS+position)	**0.5933**	**0.3832**	**0.4305**
Main-full	0.6197	0.3947	0.4445
MST-full	0.7331	0.4309	0.4851

Position features provide useful **structural clues** to our parser

Experiment(Cont.)

Method	UAS	LAS(Fine)	LAS(Coarse)
Perceptron	0.5422	0.3231	0.3777
Basic(word+POS)	0.5588	0.367	0.3985
Basic(word+POS+position)	0.5933	0.3832	0.4305
Main-full	**0.6197**	**0.3947**	**0.4445**
MST-full	0.7331	0.4309	0.4851

Memory Network could **model the discourse cohesion info** such as lexical chains, topical infos so as to provide clues to our parser.

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MST-full (graph-based) can directly analyze the relationship between **any EDU pairs**

Conclusions & Future work

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We propose to utilize **memory networks** to model **discourse cohesion** automatically.

- Capture the **topic change** or **lexical chains** within a discourse

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Future work:

Apply our method on the **graph-based** parsing system

Optimize memory network structure

Thanks