Paris and Stanford at EPE 2017: Downstream Evaluation of Graph-based Dependency Representations

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Motivation

We developed **graph-based representations** that can be derived from Universal Dependency trees

Not clear whether these graph-based representations improve downstream task performance

Research questions

1. Do the enhancements improve downstream results?

2. How do the representations compare to other graph-based representations?

3. What is the best way of parsing to these representations?

Research questions

4. Is UD as good a representation for downstream tasks as SD?

5. Does higher parsing accuracy translate to better downstream performance?

Our setup

8 different representations

2 parsers and parsing strategies

2 data sets

➡ 23 runs

The representations

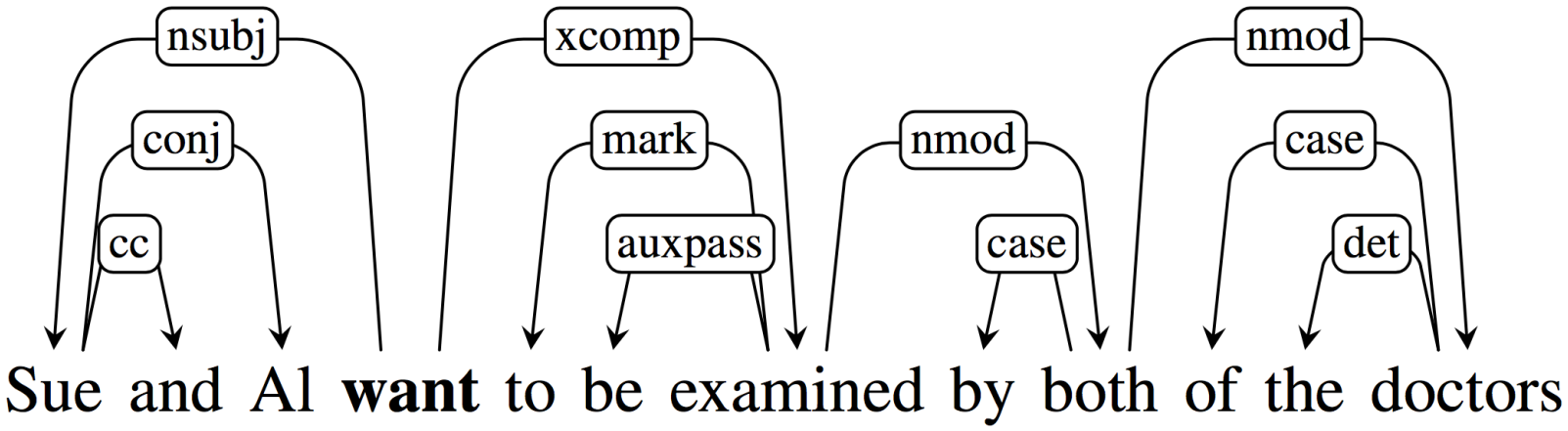
- 5 representations derived from Universal Dependencies:
  - UD basic
  - UD enhanced
  - UD enhanced++ (w/o empty nodes)
  - UD enhanced++diathesis
  - UD enhanced++diathesis --

The representations

- Stanford Dependencies basic
- DM
- Predicate Argument Structure (PAS)

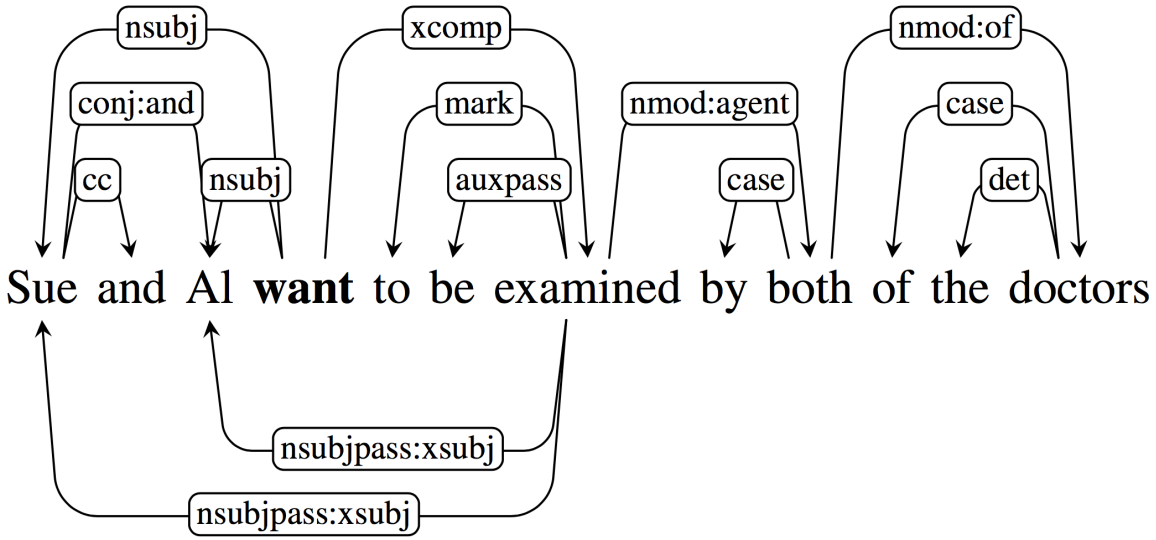
UD basic

- A dependency tree representation that
  - aims to allow **cross-linguistically consistent treebank** annotations
  - contains dependencies between **content words**



UD enhanced

- A graph-based dependency representation that
  - contains **additional edges** for phenomena such as control, raising, and coordination
  - **augments relation labels** with function words

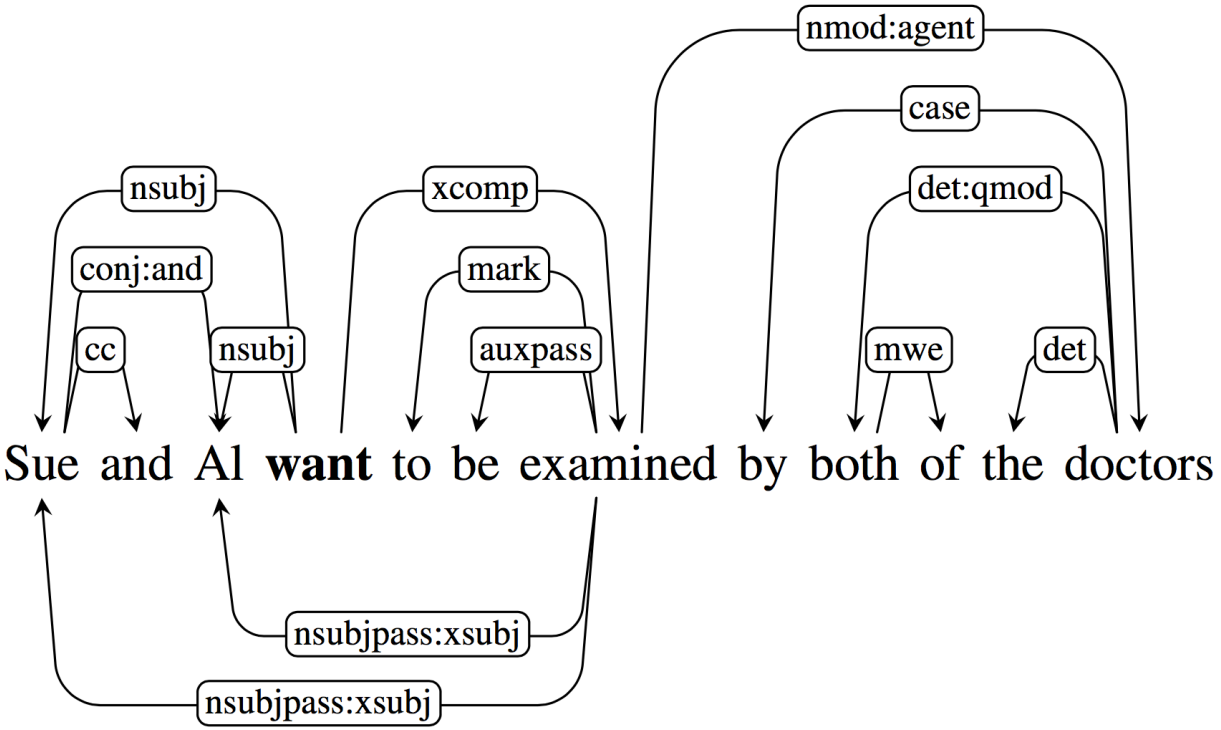


UD enhanced++

- A graph-based dependency representation that
  - is based on UD enhanced
  - **modifies the structure** such that there are more relations between content words

UD enhanced++

- A graph-based dependency representation that
  - is based on UD enhanced

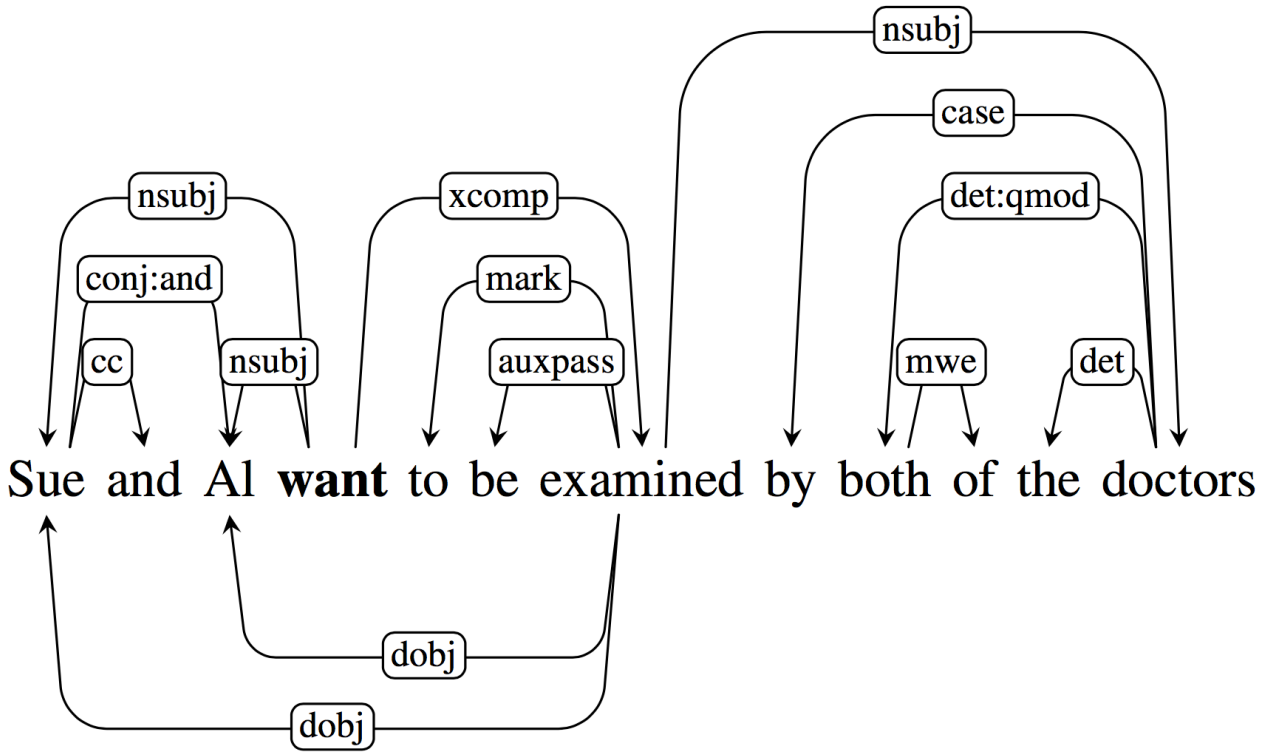


UD enhanced++ diathesis

- A graph-based dependency representation that
  - is based on UD enhanced++
  - **Neutralizes** some syntactic **alternations**
  - Introduces dependencies for **other forms of control**

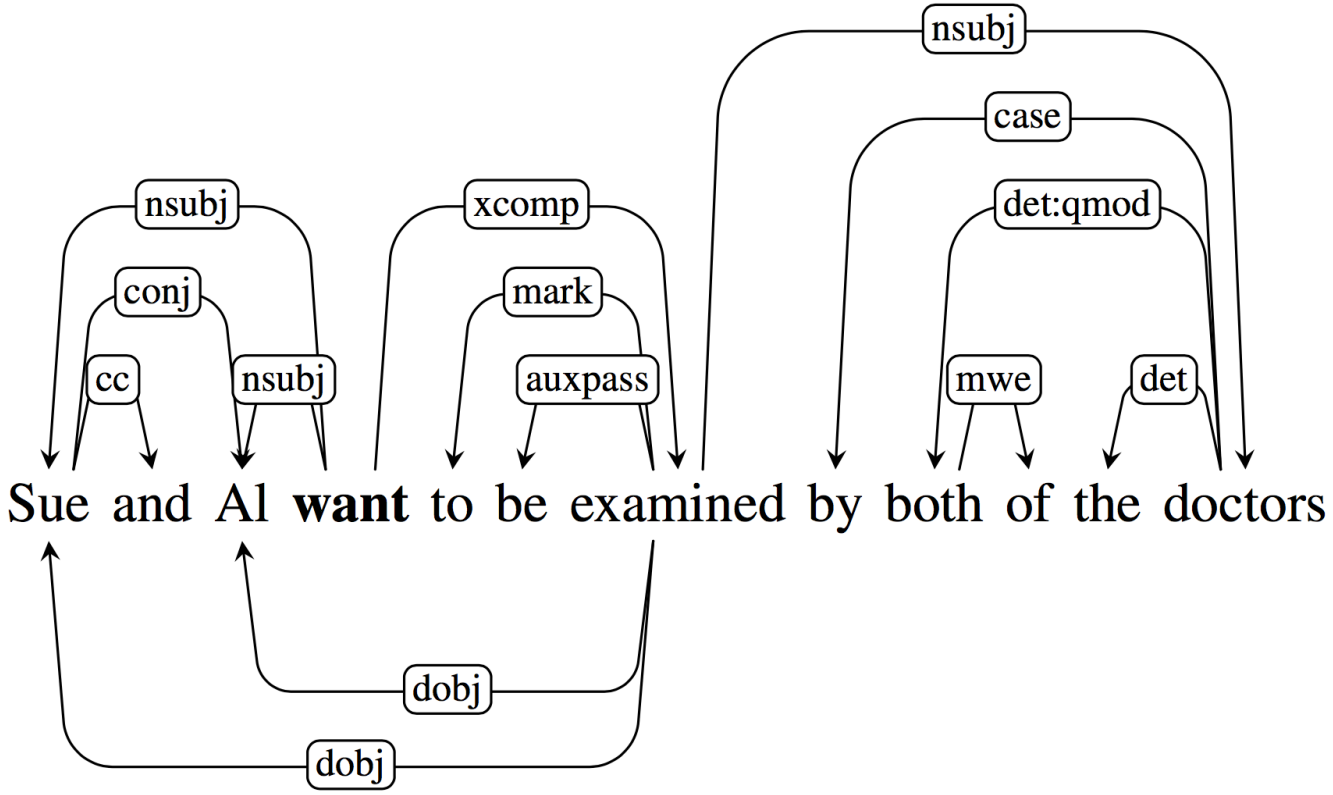
UD enhanced++ diathesis

- A graph-based dependency representation that
  - is based on UD enhanced++



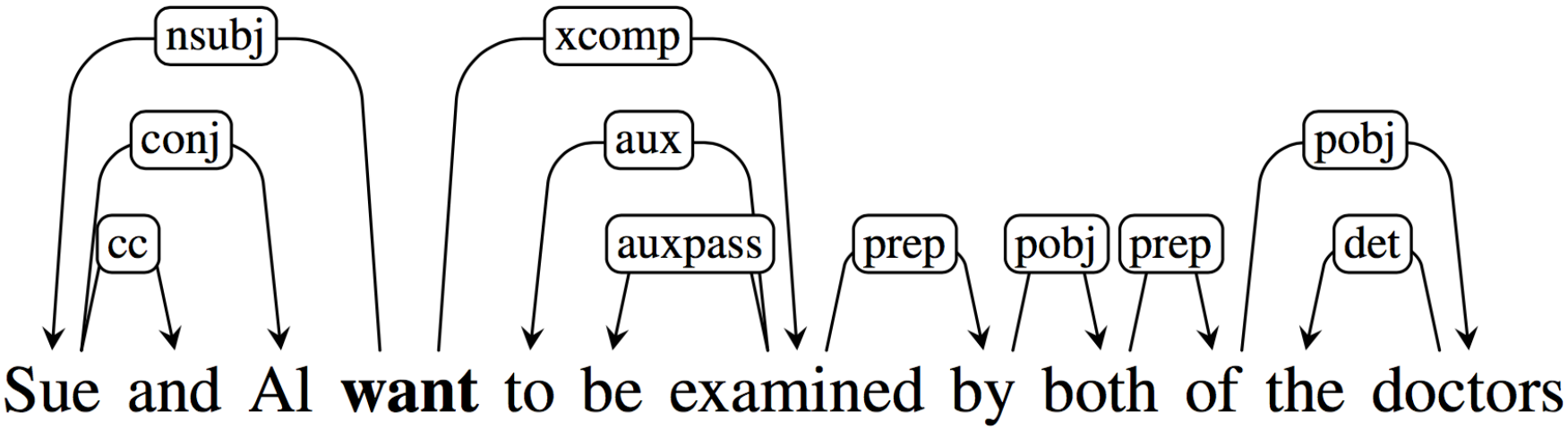
UD enhanced++ diathesis --

- Does not use augmented relation labels



Stanford Dependencies

- A dependency tree representation that
  - is less content-word centric than UD



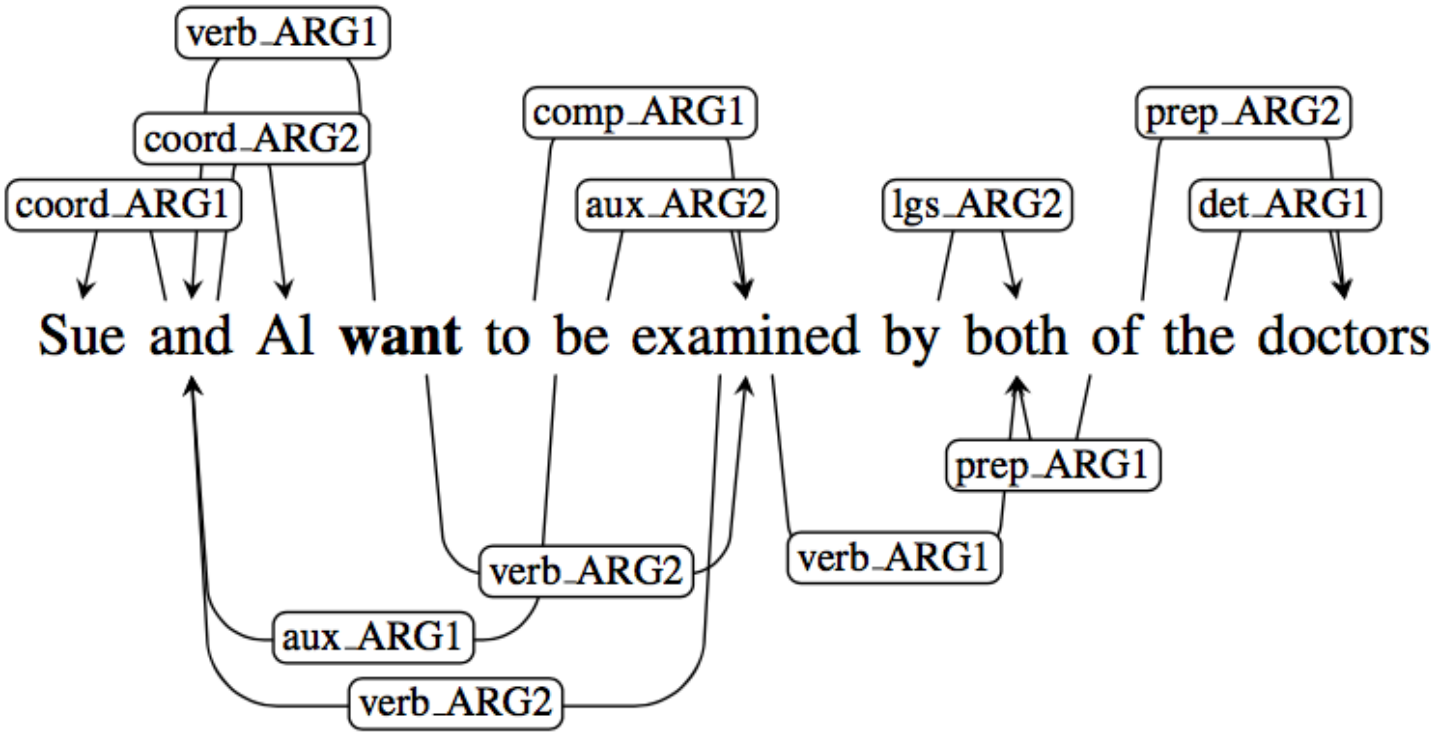
Predicate Argument Structure (PAS)

- A graph-based representation derived from an **automatic HPSG-style** re-annotation of the **Penn Treebank**

- Relation names encode the **index of the arguments** and the **POS tag of the head**

Predicate Argument Structure (PAS)

- A graph-based representation derived from an **automatic HPSG-style** re-annotation of the **Penn Treebank**

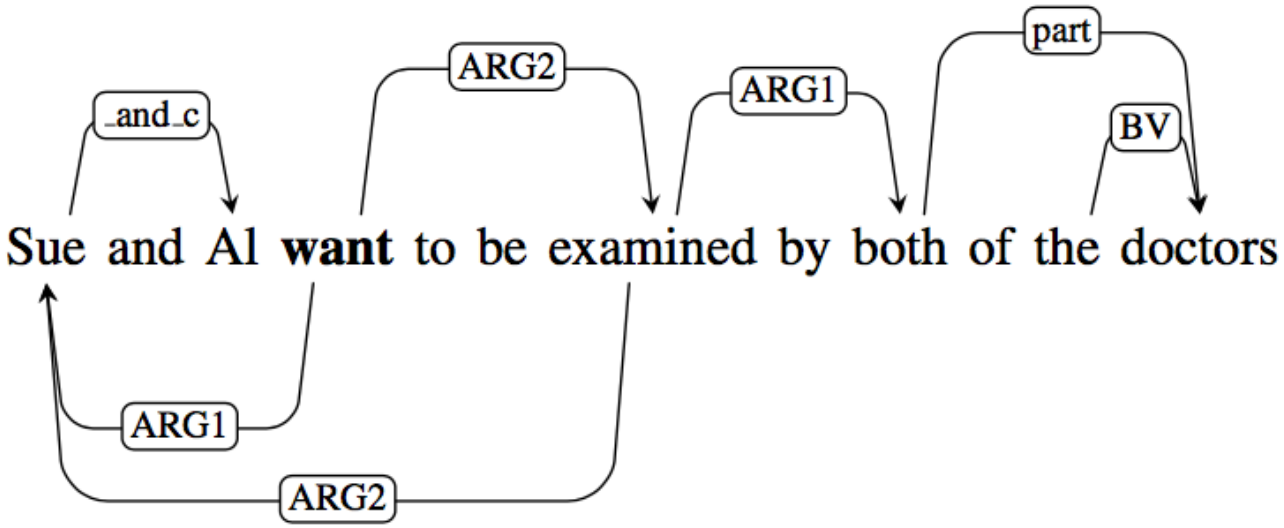


DM

- A graph-based representation derived from the **DeepBank** HPSG annotations
- Most dependency labels **encode the index** of the argument
- Special relations for some phenomena such as **bound variables**, **coordination**, and **partitives**

DM

- A graph-based representation derived from the **DeepBank** HPSG annotations
- Most dependency labels **encode the index** of the argument



Parsing strategies

- **Directly parsing to graphs** with the dyalog-SRNN parser (Ribeyre et al., 2013; de la Clergerie et al., 2017)

- **Parsing to dependency** trees with the Dozat and Manning (2017) parser and applying **rule-based augmentations**

Data: DM Split

- WSJ data from SemEval 2014 Semantic Dependency Parsing Shared Task
- PAS and DM data from SDP Shared Task
- UD and SD representations converted from PTB constituency trees

Data: Full

- WSJ + Brown + GENIA
- not available for DM and PAS
- UD and SD representations converted from PTB constituency trees

Overview of our runs

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

Research questions

1. **Do the enhancements improve downstream results?**
2. How do the representations compare to other graph-based representations?
3. What is the best way of parsing to these representations?
4. Is UD as good a representation for downstream tasks as SD?
5. Does higher parsing accuracy translate to better downstream performance?

Graph > surface syntax representations?

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

Graph > surface syntax representations?

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	2	1	4	3	5	no	yes	yes
	FULL	3	1	2	5	4	no	no	no
Dep parser + conv.	DM	4	2	1	3	5	no	no	no
	FULL	5	1	3	2	4	yes	no	no

Graph > surface syntax representations?

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	**-0.1**	**56.44**	**-1.06**	**-0.26**	**-1.19**	no	yes	yes
	FULL	**-0.55**	**56.81**	**-0.42**	**-1.95**	**-1.11**	no	no	no
Dep parser + conv.	DM	**-0.74**	**-0.51**	**59.08**	**-0.66**	**-1.06**	no	no	no
	FULL	**-0.97**	**60.51**	**-0.91**	**-0.64**	**-0.95**	yes	no	no

Graph > surface syntax representations?

- **UD enhanced**, on average, consistently lead to **better** downstream results than **UD basic**
- **UD enhanced++** and **enhanced++ diathesis** also good representations for downstream tasks, but higher variance

Task-specific findings: Event extraction and opinion analysis

- Representations that **worked well**:
  - UD enhanced
  - UD enhanced++
  - UD enhanced++ diathesis
- Representations that **worked less well**:
  - basic UD
  - UD diathesis --
- **Augmented relation labels** seem to be **useful** for this task!

Task-specific findings: Negation scope resolution

- Representations that **worked well**
  - enhanced UD
- Much more variance in results
- Augmented relation labels don’t seem to add anything

Research questions

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5. Does higher parsing accuracy translate to better downstream performance?

UD representations > other graph representations?

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

UD representations > other graph representations?

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	**2**	**1**	**4**	**3**	**5**	no	**6**	**7**
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

UD representations > other graph representations?

- No evidence that DM/PAS are better representations for downstream tasks than more surface-syntax aligned UD representations
- Especially true for event extraction and opinion analysis tasks
  - Suggests again that **rich label sets** are **important** for these tasks
- Gap widens much more if one uses more data, which is not available for DM and PAS!

Research questions

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5. Does higher parsing accuracy translate to better downstream performance?

Parsing method

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

Parsing method

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

Parsing method

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	**2**	**2**	**2**	**2**	**2**	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	**1**	**1**	**1**	**1**	**1**	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

Parsing method

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	2	2	2	2	2	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	1	1	1	1	1	yes	no	no

Parsing method

- **Two-step parsing consistently outperformed** direct graph parser
- In particular true for negation scope task (up 8 points difference)
- Very **small difference** for **event extraction** and small difference for **opinion analysis tasks**

Research questions

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SD vs. UD

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	yes	yes	yes	yes	yes	yes	no	no

SD vs. UD

		UD basic	UD enh.	UD enh.++	UD enh.++ diat	UD enh.++ diat --	SD basic	DM	PAS
Graph parser	DM	yes	yes	yes	yes	yes	no	yes	yes
	FULL	yes	yes	yes	yes	yes	no	no	no
Dep parser + conv.	DM	yes	yes	yes	yes	yes	no	no	no
	FULL	**59.5**	yes	yes	yes	yes	**59.7**	no	no

SD vs. UD

- Both seem on average **similarly good representations** for downstream tasks
- SD slightly better for event extraction, UD better for opinion analysis
- No evidence that striving for cross-linguistic consistency hurts downstream performance

Research questions

1. Do the enhancements improve downstream results?
2. How do the representations compare to other graph-based representations?
3. What is the best way of parsing to these representations?
4. Is UD as good a representation for downstream tasks as SD?
5. **Does higher parsing accuracy translate to better downstream performance?**

Correlation between parsing and downstream performance

	LAS	UAS	Task F1
Graph parser	88.99	90.43	56.26
Dep. parser	91.13 (+ 2.14)	93.26 (+ 2.83)	59.54 (+ 3.28)

Conclusions

- **Adding explicit dependency relations** for long distance dependencies and **augmenting relation labels** seems to be useful for downstream tasks
- No evidence that representations that explicitly encode predicate-argument structures are better than representations derived from surface syntax trees
- **Two-step parsing** (currently) seems to be the best parsing approach
- **UD as good a representation** as SD for downstream tasks

Sponsored slide

- The UD representations seem to be good representations for downstream tasks because
  - they have **expressive labels**
  - **high-performing parsers** and **accurate converters** exist
  - **lots of data** can be obtained through conversion
  - enhanced variants **recover predicate-argument** structures in many cases

Thank you!