Situation entity types:
automatic classification of clause-level aspect

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What is clause-level aspect?

aspect = how a situation is presented [Smith 1997]

[Vendler 1957, Bach 1986]:
aktionsart

state:	*The ship is in motion.*
event:	*The ship moved.*
process:	*The ship is moving.*

[Krifka et al. 1995]:
habituals / genericity

John cycles to work.

Students like coffee.

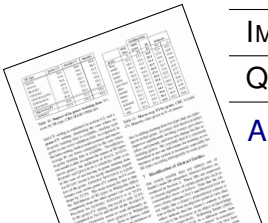
Why model these?

- understand temporal relations in discourse
- distinguish between / extract different types of knowledge

What are situation entity types?

inventory of aspectual clause types
motivated by a theory of discourse
[Smith 2003]

Situation entity types



STATE	Julie likes Cooper. Julie did **not** kill the mouse.
EVENT	Julie met Cooper two years ago.
REPORT	..., said the zookeeper.
GENERIC SENTENCE	**Owls** are nocturnal animals.
GENERALIZING SENTENCE	Julie often teases Cooper.
IMPERATIVE	Catch the mouse!
QUESTION	Why are there owls on your slides?

ABSTRACT ENTITIES → see paper

What we show in this paper

- first large reliably annotated **corpus** for situation entity types (40,000 clauses), 13 genres
- use of **distributional information** (Brown clusters) to make approach robust + scalable

  45% (informed baseline) - 76% (system) - 80% (humans)
- **sequence** labeling method (CRF) vs. local method (MaxEnt): small impact, depending on genre

Related work

- modeling of Vendler classes
  - *state, activity, accomplishment, achievement*
  - Italian [Zarcone & Lenci, 2008], German [Hermes et al., 2015]
  - stative vs. dynamic [Siegel & McKeown, 2000], [Friedrich & Palmer, 2014a]
  - completedness [Siegel & McKeown, 2000]
- modeling genericity
  - identifying genericity of NPs / reference to kinds
    [Reiter & Frank, 2010], [Friedrich & Pinkal, 2015b]
  - recognizing habituals
    [Mathew & Katz, 2009], [Friedrich & Pinkal, 2015a]
- labeling situation entities [Palmer et al. 2007]
  - maximum entropy model, features: pos tags, words, linguistic
  - data set: 20 texts / 4391 clauses, Brown corpus, $\kappa = 0.52$

Data collection: MASC / Wiki corpus

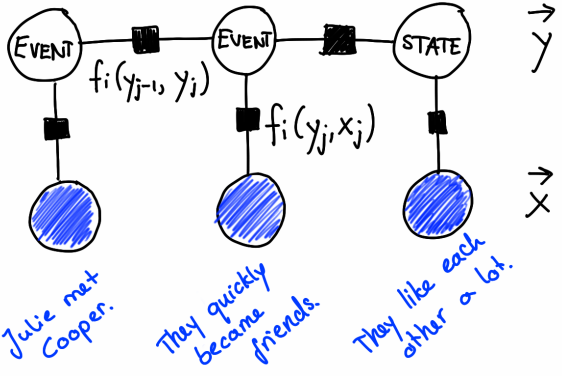
- $\approx$ 30,000 clauses from MASC [Ide et al. 2010]
  + $\approx$ 10,000 clauses from Wikipedia
- automatically segmented using SPADE [Soricut & Marcu, 2003]
- 3 annotators $\rightarrow$ majority voting $\rightarrow$ gold standard

	% in gold standard		**Fleiss' κ**
Situation entity type	**MASC**	**Wiki**	Krippendorff's diagnostics
STATE	49.8	24.3	0.67
EVENT	24.3	18.9	0.74
REPORT	4.8	0.9	0.80
GENERIC	7.3	49.7	0.68
GENERALIZING	3.8	2.5	0.43
QUESTION	3.3	0.1	0.91
IMPERATIVE	3.2	0.2	0.94
undecided	2.4	2.1	-

Conditional random field (CRF)

- text document
  = sequence of clauses
- $\vec{y}$ = sequence of situation entity type labels
- $\vec{x}$ = features representing the clauses
- λ_i = weight for feature x_i
- $f_i(y_j, x_j)$ = clause / type
  $\rightarrow$ MaxEnt
- $f_i(y_{j-1}, y_j)$ = type / type
  $\rightarrow$ CRF

$$P(\vec{y}|\vec{x}) = \frac{1}{Z(\vec{x})} exp(\sum_{j=1}^{n} \sum_{i=1}^{m} \lambda_i f_i(y_{j-1}, y_j, \vec{x}, j))$$



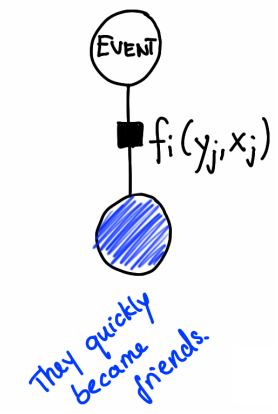
Situation entity types

Which parts of the clause are most important to distinguish the types?

[Friedrich & Palmer 2014b], [Friedrich et al. 2015], [Smith 2003]

Main verb	→ verb that heads the clause	
	Julie **likes** Cooper.	STATE
	Julie **met** Cooper.	EVENT
	Julie **teases** Cooper.	GENERALIZING SENTENCE
Main referent	→ subject of main verb	
	Julie is an owl.	STATE
	Owls are nocturnal animals.	GENERIC SENTENCE

Features for clauses



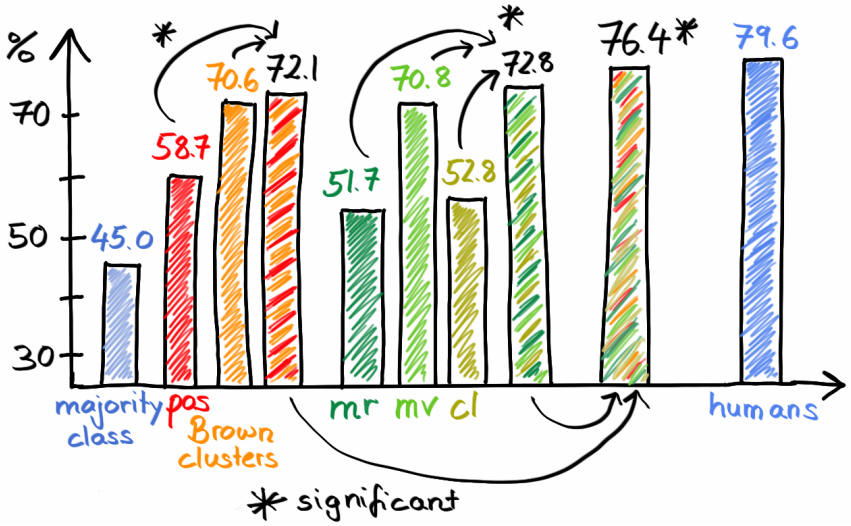
- **pos**: part of speech tags
- **bc**: Brown word clusters
  pretrained Turian et al. 2010

- **mv**: main verb
  - tense, voice, progressive, perfect, lemma, WordNet hypernyms ...
- **mr**: main referent
  - lemma, determiner type, noun type, number, person, countability, WordNet, dependency relations ...
- **cl**: clause
  - adverbs, conditional, modal, negated, ...

How well does it work?

Results: impact of different feature sets

Accuracy. Wiki+MASC dev set (80% of data), CRF, 10-fold CV.

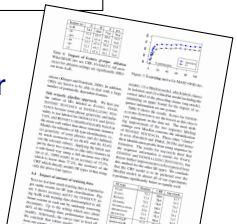


Results on heldout test set (20% of data)

Training on entire MASC+Wiki dev set.

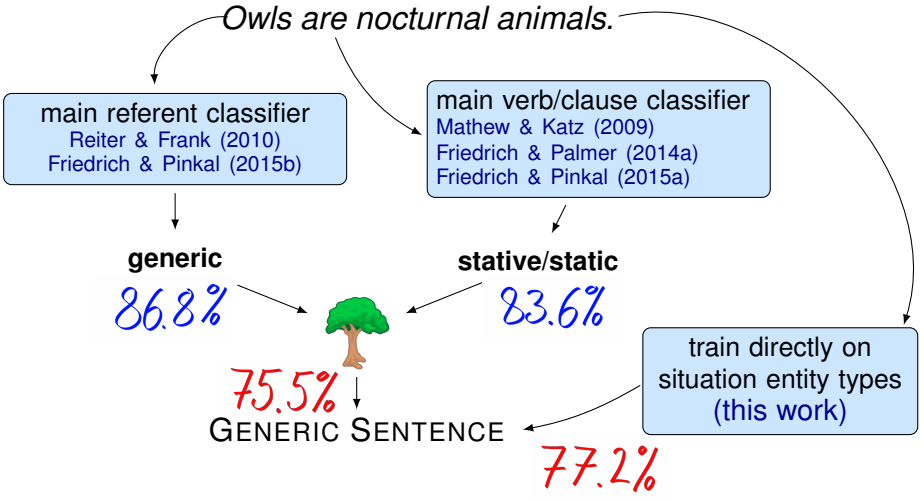
	macro-average			
feature set	**P**	**R**	**F**	**accuracy**
maj. class (STATE)	6.4	14.3	8.8	44.7
pos+Brown	67.6	60.6	63.9	69.8
mr+mv+cl	69.9	61.7	65.5	71.4
all	**73.4**	**65.5**	**69.3**	**74.7**

Ablation tests tell same story → see paper



Pipelined model?

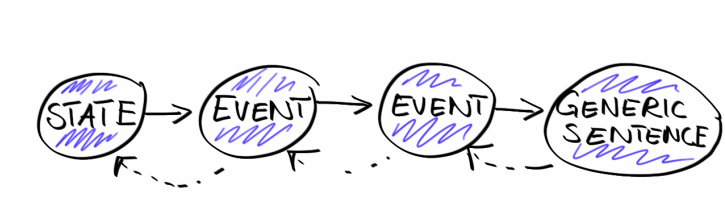
STATE, EVENT, GENERIC SENTENCE, GENERALIZING SENTENCE



Is sequential information important?

As claimed by Palmer et. al [2007]

... and if yes, when?



Maximum entropy model vs. conditional random field

SE type	MaxEnt	CRF
STATE	79.1	**80.6**
EVENT	77.5	**78.6**
REPORT	78.2	**78.9**
GENERIC	61.3	**68.3**
GENERALIZING	25.0	**29.4**
IMPERATIVE	72.3	**75.3**
QUESTION	84.4	**84.4**
macro-avg F1	68.7	**71.2**
accuracy	$*$74.1	$*$**76.4**

$*$ statistically significant

How genre-dependent is this task?

- How important is it to have in-genre training data?
  helpful, $\approx$ +5% accuracy/F_1
- Is it a good idea to add out-of-genre / domain training data?
  YES! 49.0 $\rightarrow$ 64.0 (macro-average F_1)
  system gets better at identifying infrequent types
- Statistics per type / genre $\rightarrow$ see paper

Lessons learned

- situation entity type classification task is difficult even for humans
- system performs well when comparing to human upper bound (76% vs. 80%)
- our system performs well across genres
- some types are infrequent in particular genres
  $\rightarrow$ adding out-of-domain training data helps to identify them
- a wide range of syntactic-semantic features are useful for this task
- sequential information useful for identifying 'generic contexts'

What next?

- integration of aspectual information into applications
  - temporal relation processing, argumentation mining, information extraction, translation
  - distinguishing different 'modes' of discourse (NARRATIVE, INFORMATION, REPORT, DESCRIPTION, ARGUMENTATIVE [Smith 2003])
- modification of situation entity types inventory
  - set of types by Smith [2003] possibly too coarse-grained

Thanks!

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`http://coli.uni-saarland.de/projects/sitent`

Questions?

"Burrowing owl" by kuhnmi / CC BY 2.0

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