SVMTool: A general POS tagger generator based on Support Vector Machines

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ON LANGUAGE RESOURCES AND EVALUATION

Jesús Giménez and Lluís Màrquez

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TALP Research Center, Universitat Politècnica de Catalunya

Outline

- **Introduction**
  - **Part-of-speech Tagging**
  - **Idea and Motivation**
  - **Learning Framework**
- SVMT tool
- Evaluation
- Conclusions

Introduction

- Part-of-Speech Tagging

> The_DT SVMTool_NNP is_VBZ now_RB being_VBG presented_VBN to_TO NLP_NNP researchers_NNS in_IN Lisbon_NNP ._.

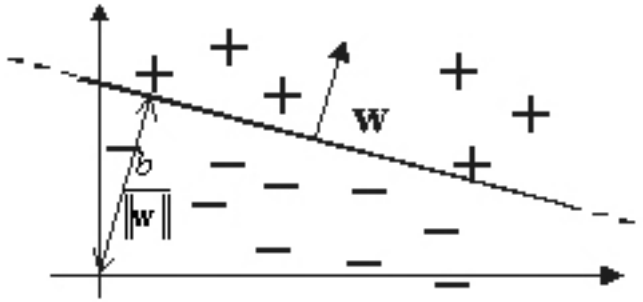
- Brill [Brill, 1995]
- TnT [Brants, 2000]

Idea and Motivation

- Accuracy [in the state-of-the-art]
- Efficiency [both learning and tagging]
- Flexibility [highly customizable]
- Portability [language independent]
- Robustness [against overfitting and on-line mistakes]
- Simplicity [easy to use]

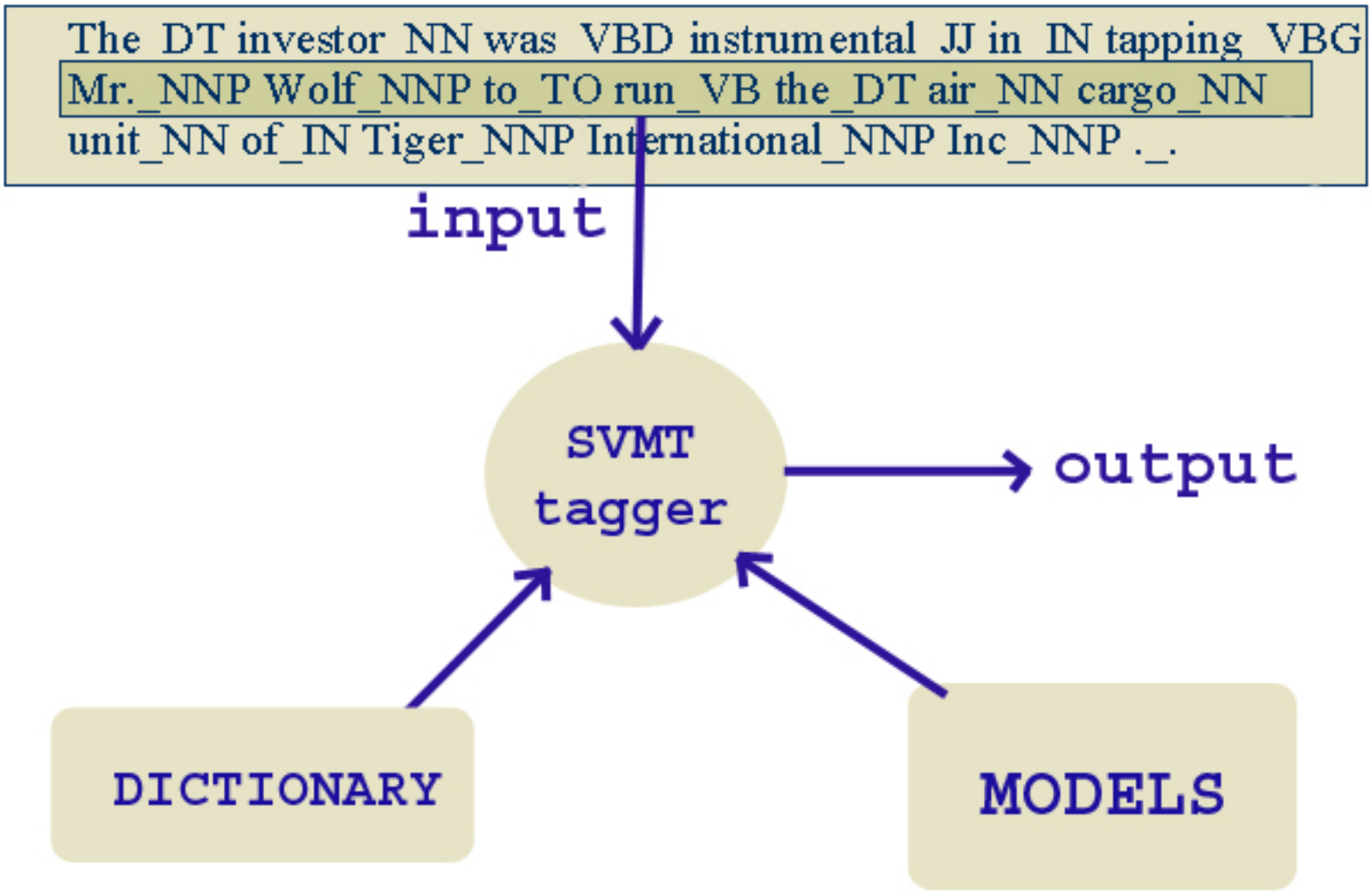
Learning FrameWork

- Support Vector Machines



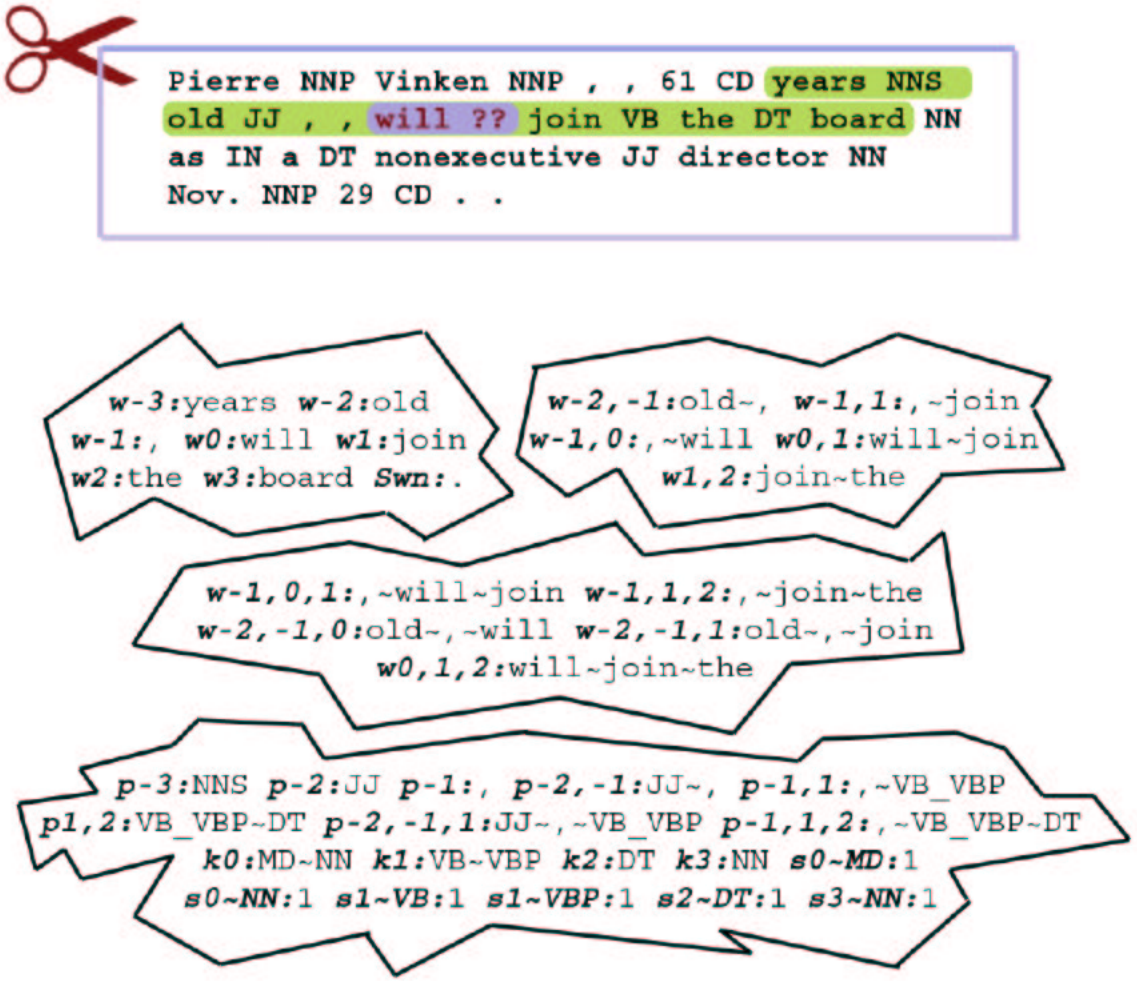
$$h(\mathbf{x}) = \text{sign}\left(\langle \mathbf{w} \cdot \mathbf{x} \rangle + b\right) = \begin{cases} +1 & \text{if } \langle \mathbf{w} \cdot \mathbf{x} \rangle + b > 0 \\ -1 & \text{otherwise} \end{cases}$$

SVMT tool


The_DT investor_NN was_VBD instrumental_JJ in_IN tapping_VBG
Mr._NNP Wolf_NNP to_TO run_VB the_DT air_NN cargo_NN
unit_NN of_IN Tiger_NNP International_NNP Inc_NNP ._.
input
SVMT
tagger
output
DICTIONARY
MODELS

Feature Patterns

word unigrams **word bigrams** **word trigrams**	$w_{-3}, w_{-2}, w_{-1}, w_0, w_{+1}, w_{+2}, w_{+3}$ $(w_{-2}, w_{-1}), (w_{-1}, w_{+1}), (w_{-1}, w_0), (w_0, w_{+1}), (w_{+1}, w_{+2})$ $(w_{-3}, w_{-2}, w_{-1}), (w_{-2}, w_{-1}, w_0), (w_{-2}, w_{-1}, w_{+1}),$ $(w_{-1}, w_0, w_{+1}), (w_{-1}, w_{+1}, w_{+2}), (w_0, w_{+1}, w_{+2})$
POS unigrams **POS bigrams** **POS trigrams**	p_{-3}, p_{-2}, p_{-1} $(p_{-2}, p_{-1}), (p_{-1}, a_{+1}), (a_{+1}, a_{+2})$ $(p_{-3}, p_{-2}, p_{-1}), (p_{-2}, p_{-1}, a_{+1}), (p_{-1}, a_{+1}, a_{+2})$
ambiguity classes	a_0, a_1, a_2, a_3
maybe's	m_0, m_1, m_2, m_3
prefixes	s_1, $s_1 s_2$, $s_1 s_2 s_3$, $s_1 s_2 s_3 s_4$
suffixes	s_n, $s_{n-1} s_n$, $s_{n-2} s_{n-1} s_n$ $s_{n-3} s_{n-2} s_{n-1} s_n$
binary word-form features	intial_Upper_Case, all_Upper_Case, no-initial_Capital_Letter(s), all_Lower_Case, contains_(period/number/hyphen ...)
word length	integer
Sentence info	last_word ('.', '?', '!')


Pierre NNP Vinken NNP , , 61 CD years NNS
old JJ , , will ?? join VB the DT board NN
as IN a DT nonexecutive JJ director NN
Nov. NNP 29 CD . .
w-3:years w-2:old
w-1:, w0:will w1:join
w2:the w3:board Swn:.
w-2,-1:old~, w-1,1:,~join
w-1,0:,~will w0,1:will~join
w1,2:join~the
w-1,0,1:,~will~join w-1,1,2:,~join~the
w-2,-1,0:old~,~will w-2,-1,1:old~,~join
w0,1,2:will~join~the
p-3:NNS p-2:JJ p-1:, p-2,-1:JJ~, p-1,1:,~VB_VBP
p1,2:VB_VBP~DT p-2,-1,1:JJ~,~VB_VBP p-1,1,2:,~VB_VBP~DT
k0:MD~NN k1:VB~VBP k2:DT k3:NN s0~MD:1
s0~NN:1 s1~VB:1 s1~VBP:1 s2~DT:1 s3~NN:1

Outline

- Introduction
- **SVMT tool**
  - **SVMT-learner [Training of SVM classifiers]**
  - **SVMT-tagger [POS-tagging of a given input]**
  - **SVMT-evaluator [Study of tagging results]**
  - **SVMT API [Embedded usage of SVMT-tagger]**
- Evaluation
- Conclusions

SVMT-learner

- Options
  - slinding window: length [def: 5] core position [def: 2]
  - feature set [configurable]
  - feature filtering [default: (2 / 100,000)]
  - C parameter tuning (greedy) [default: disabled]
  - SVM model compression [default: disabled]
  - ambiguous/open-class POS lists may be provided if available. [automatically created by default]

SVMT-learner

- dictionary repairing
  - heuristic [by default]
  - using a list of corrections provided

< **the** 50975 6 CD 1 DT 50959 JJ 7 NN 1 NNP 6 VBP 1 >

< **the** 50975 1 DT 50959 >

SVMT-tagger

- Options
  - tagging scheme
    - greedy [default]
    - sentence-level
  - tagging direction
    - left-to-right [default]
    - right-to-left
    - both left-to-right and right-to-left
  - number of tagging passes (1 or 2) [default: 1]
  - backup lexicon

SVMT-evaluator

gold output + SVMT output = report

- brief report
- known vs. unknown tokens
- level of ambiguity
- class of ambiguity
- part-of-speech study

SVMT API

```
my $svmt = SVMTAGGER::SVMT_load(...);
my @tokens = join(/ +/, 'The SVMTool is now being
                         presented to NLP researchers in Lisbon.');
my $input = SVMTAGGER::SVMT_prepare_input(@tokens);
my $output = SVMTAGGER::SVMT_tag($input, $svmt...);
for my $elem (@{$output}) {
    print $elem->get_word."_".$elem->get_pos;
}
```

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- Introduction
- SVMT tool
- **Evaluation**
  - **English on WSJ**
  - **Spanish on LEXESP**
- Conclusions

Evaluation

learning time	1-20 cpu hour
tagging speed	1500 words/second

- 2Ghz Pentium-IV processor; 1Gb RAM
  Perl v5.005_03 (Benchmark package for timing)

Evaluation for English

- Wall Street Journal
  [Penn Treebank III]
- 1,17 million words
  [Training (912k), Validation (132k) and Test (130k)]
- Penn Treebank tagset -> 48 tags
  35 parts-of-speech present ambiguity
  17 are open-classes

	TnT	Collins 02	SVMT	Toutanova et al.
Accuracy	96.46%	97.11%	97.16%	97.24%

Evaluation for Spanish

- LEXESP
- 106k words [Training (86k) and Test (20k)]
- Parole tagset -> 183 tags -> 61 tags (reduced tagset)

  43 parts-of-speech present ambiguity

  12 are open-classes

	TnT	SVMT
Accuracy	96.50%	96.89%

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Conclusions

- **highly accurate:** 97.0 - 97.2% [English on WSJ]
- **efficient:** linear SVMs, primal formulation
- **robust:** soft margin SVMs, two-passes, LR + RL
- **very flexible:** rich feature set, tagging strategies
- **portable:** applied to English, Spanish and Catalan
- **simple:** ease to configure, tune and use

Ongoing Steps

- C++ version coming soon
- Study of more flexible and robust tagging schemes
- Better guessing of unknown words
- Unsupervised learning

Thanks

you may download SVMTool v 1.2 at

http://www.lsi.upc.es/~nlp/SVMTool

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