

Sequence Tagging

- **Today**
 - Part-of-speech tagging
 - Examples
 - Some fun examples
 - A sequence-tagging approach

Penn Treebank Tagset

Tag	Description	Example	Tag	Description	Example
CC	Coordin. Conjunction	<i>and, but, or</i>	SYM	Symbol	<i>+, %, &</i>
CD	Cardinal number	<i>one, two, three</i>	TO	“to”	<i>to</i>
DT	Determiner	<i>a, the</i>	UH	Interjection	<i>ah, oops</i>
EX	Existential ‘there’	<i>there</i>	VB	Verb, base form	<i>eat</i>
FW	Foreign word	<i>mea culpa</i>	VBD	Verb, past tense	<i>ate</i>
IN	Preposition/sub-conj	<i>of, in, by</i>	VBG	Verb, gerund	<i>eating</i>
JJ	Adjective	<i>yellow</i>	VBN	Verb, past participle	<i>eaten</i>
JJR	Adj., comparative	<i>bigger</i>	VBP	Verb, non-3sg pres	<i>eat</i>
JJS	Adj., superlative	<i>wildest</i>	VBZ	Verb, 3sg pres	<i>eats</i>
LS	List item marker	<i>1, 2, One</i>	WDT	Wh-determiner	<i>which, that</i>
MD	Modal	<i>can, should</i>	WP	Wh-pronoun	<i>what, who</i>
NN	Noun, sing. or mass	<i>llama</i>	WP\$	Possessive wh-	<i>whose</i>
NNS	Noun, plural	<i>llamas</i>	WRB	Wh-adverb	<i>how, where</i>
NNP	Proper noun, singular	<i>IBM</i>	\$	Dollar sign	<i>\$</i>
NNPS	Proper noun, plural	<i>Carolinas</i>	#	Pound sign	<i>#</i>
PDT	Predeterminer	<i>all, both</i>	“	Left quote	<i>(‘ or “)</i>
POS	Possessive ending	<i>’s</i>	”	Right quote	<i>(‘ or ”)</i>
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PP\$	Possessive pronoun	<i>your, one’s</i>)	Right parenthesis	<i>(],), }, >)</i>
RB	Adverb	<i>quickly, never</i>	,	Comma	<i>,</i>
RBR	Adverb, comparative	<i>faster</i>	.	Sentence-final punc	<i>(. ! ?)</i>
RBS	Adverb, superlative	<i>fastest</i>	:	Mid-sentence punc	<i>(: ; ... - -)</i>
RP	Particle	<i>up, off</i>			

Better Examples Perhaps?

- **particle vs. preposition**
 - John walked *up* the stairs.
 - Clean *up* your room!
 - Please speak *up* when answering in class.
- **past tense vs. past participle**
 - The policeman *killed* the wrong guy.
 - The man *killed* in the car accident was Jim's brother.

P-o-s tagging exercise

1. It is a nice night.

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Clickers...

1. **It** is a nice night.

- A. EX
- B. PP
- C. PP\$
- D. NN
- E. none

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1. It is a nice night.

- A. VB
- B. VBP
- C. VBZ
- D. MD
- E. other

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1. It is **a** nice night.

a/DT

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1. It is a **nice** night.

nice/JJ

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1. It is a nice **night**.

night/NN

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It/PP
is/VBZ
a/DT
nice/JJ
night/NN
./.

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5. . . . I am sitting in Mindy's restaurant putting on the gefillte fish, which is a dish I am very fond of, . . .

. . . I/PP am/VBP
sitting/VBG in/IN
Mindy/NNP 's/POS
restaurant/NN
putting/VBG on/RP
the/DT gefillte/NN
fish/NN ,/
which/WDT
is/VBZ a/DT
dish/NN I/PP
am/VBP
very/RB fond/JJ
of/RP ,/, . . .

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Think buffalo

Buffalo buffalo buffalo buffalo buffalo buffalo buffalo
buffalo.

Buffalo buffalo Buffalo buffalo buffalo buffalo Buffalo
buffalo.

Buffalo buffalo, Buffalo buffalo buffalo, buffalo Buffalo
buffalo.



Think buffalo

n1. the city of Buffalo, NY

n2. an animal...the American bison

v. to bully, confuse, deceive, or intimidate

Buffaloⁿ¹ buffaloⁿ² Buffaloⁿ¹ buffaloⁿ² buffalo^v buffalo^v Buffaloⁿ¹ buffaloⁿ².

[Those] (Buffalo buffalo) [whom] (Buffalo buffalo) buffalo, buffalo (Buffalo buffalo).

[Those] buffalo(es) from Buffalo [that are intimidated by] buffalo(es) from Buffalo intimidate buffalo(es) from Buffalo.

Bison from Buffalo, New York, who are intimidated by other bison in their community, also happen to intimidate other bison in their community.

THE buffalo FROM Buffalo WHO ARE buffaloed BY buffalo FROM Buffalo, buffalo (verb) OTHER buffalo FROM Buffalo.

a ship shipping ship shipping ships



Among easiest of NLP problems

- **State-of-the-art methods achieve ~97% accuracy.**
- **Simple heuristics can go a long way.**
 - ~90% accuracy just by choosing the most frequent tag for a word (MLE)
 - To improve reliability: *need to use some of the local context.*
- **But defining the rules for special cases can be time-consuming, difficult, and prone to errors and omissions**

Possible Approaches?

Approaches

1. **rule-based**: involve a large database of hand-written disambiguation rules, e.g. that specify that an ambiguous word is a noun rather than a verb if it follows a determiner.
2. **learning-based**: resolve tagging ambiguities by using a training corpus to compute the probability of a given word having a given tag in a given context.
 - HMM tagger
3. **hybrid ML-/rule-based**: E.g. transformation-based tagger (Brill tagger); learns symbolic rules based on a corpus.
4. **ensemble methods**: combine the results of multiple taggers.