Natural Language Processing

Introduction to sequence labelling

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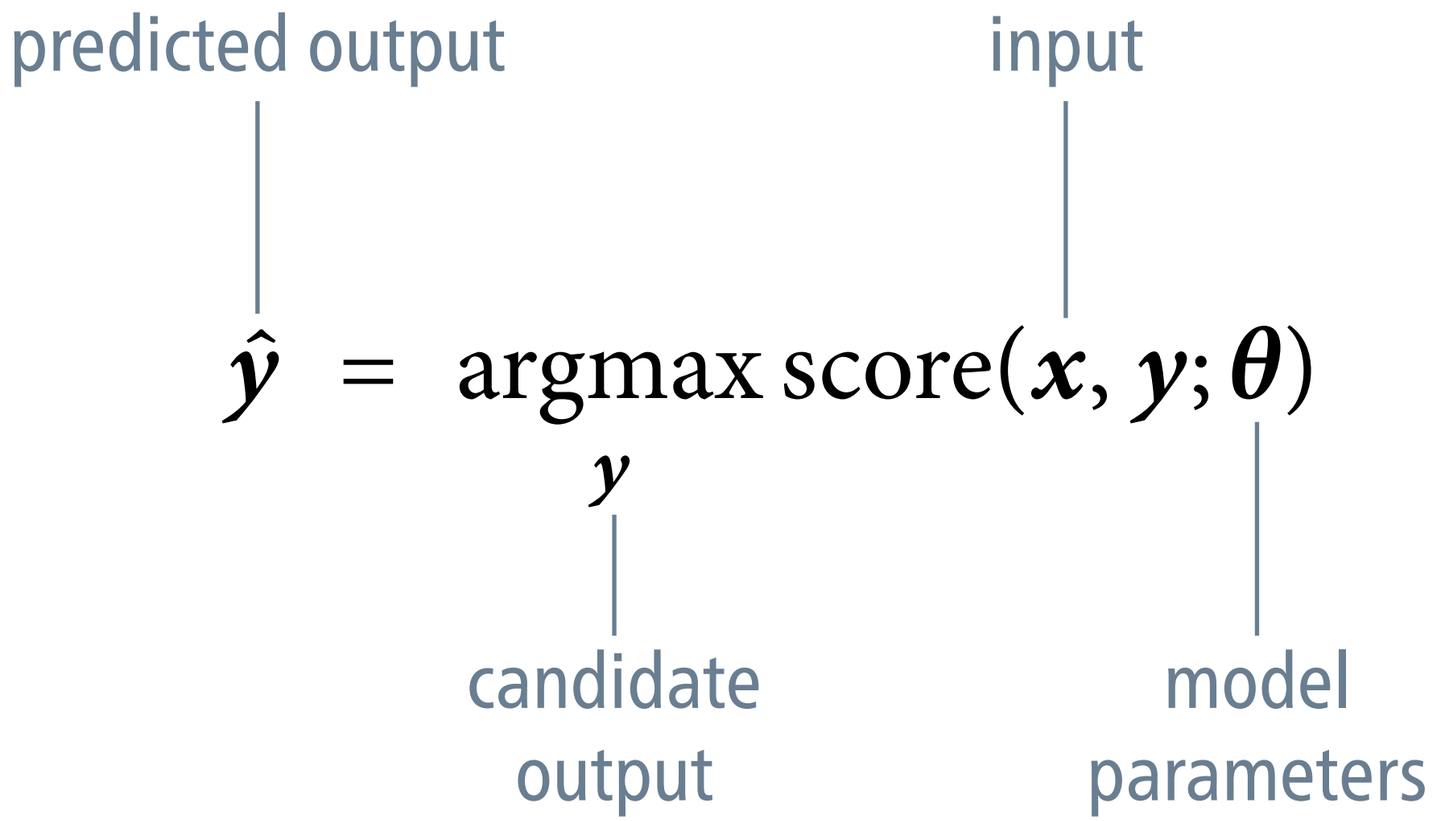
Search and learning



Eisenstein (2019), § 1.2.2

Standard labelling tasks

label

sequence of words

$$\hat{y} = \underset{y}{\operatorname{argmax}}\ \operatorname{score}(\boldsymbol{x}, y; \boldsymbol{\theta})$$

candidate labels

model parameters

example: sentiment rating

Sequence labelling tasks

sequence of labels

sequence of words

$$\hat{\boldsymbol{y}} = \underset{\boldsymbol{y}}{\operatorname{argmax}}\ \operatorname{score}(\boldsymbol{x}, \boldsymbol{y}; \boldsymbol{\theta})$$

candidate label sequences

model parameters

example: tagged sentence

Part-of-speech tagging

I	want	to	live	in	peace
PRON	VERB	PART	VERB	ADP	NOUN
NOUN	NOUN	ADP	ADJ	ADV	VERB
		ADV	ADV	ADJ	
				NOUN	

"I only want to live in peace, plant potatoes, and dream!" – Moomin

Chinese word segmentation

我	有	一 台	计 算 机	。
I	have	a	computer	.

Wang and Xu (2017)

Named entity recognition (NER)

ORG

Which Stanford University alumna co-founded the educational technology company Coursera?

ORG

SPARQL query against DBPedia

```
SELECT DISTINCT ?x WHERE {
  ?x dbp:education dbr:Stanford_University.
  dbr:Coursera dbp:founder ?x.
}
```

Named entity recognition (NER)

Citing high fuel prices, [United Airlines ORG] said [Friday TIME] it has increased fares by [$6 MONEY] per round trip on flights to some cities also served by lower-cost carriers. [American Airlines ORG], a unit of [AMR Corp. ORG], immediately matched the move, spokesman [Tim Wagner PER] said. [United ORG], a unit of [UAL Corp. ORG], said the increase took effect [Thursday TIME] and applies to most routes where it competes against discount carriers, such as [Chicago LOC] to [Dallas LOC] and [Denver LOC] to [San Francisco LOC].

Example from Jurafsky and Martin (2017)

Aspect-based sentiment analysis

NEGATIVE ASPECT

I hated their fajitas,

but their salads were great!

ASPECT POSITIVE

{fajitas: negative, salads: positive}

Pontiki et al. (2014)

Reducing NER to tagging

1	2	3	4	5	6	7	8	9
European	Union	rejects	German	call	to	boycott	British	lamb
B-ORG	I-ORG	O	B-GPE	O	O	O	B-GPE	O
beginning of an ORG	inside an ORG			outside an entity			beginning of a GPE	

{(1, 2): ORG, (4, 4): GPE, (8, 8): GPE}

Reducing segmentation to tagging

我	有	一 台	计 算 机	。
S	S	B E	B M E	S
single		beginning end	middle	

Wang and Xu (2017)

Evaluation of sequence labelling tasks

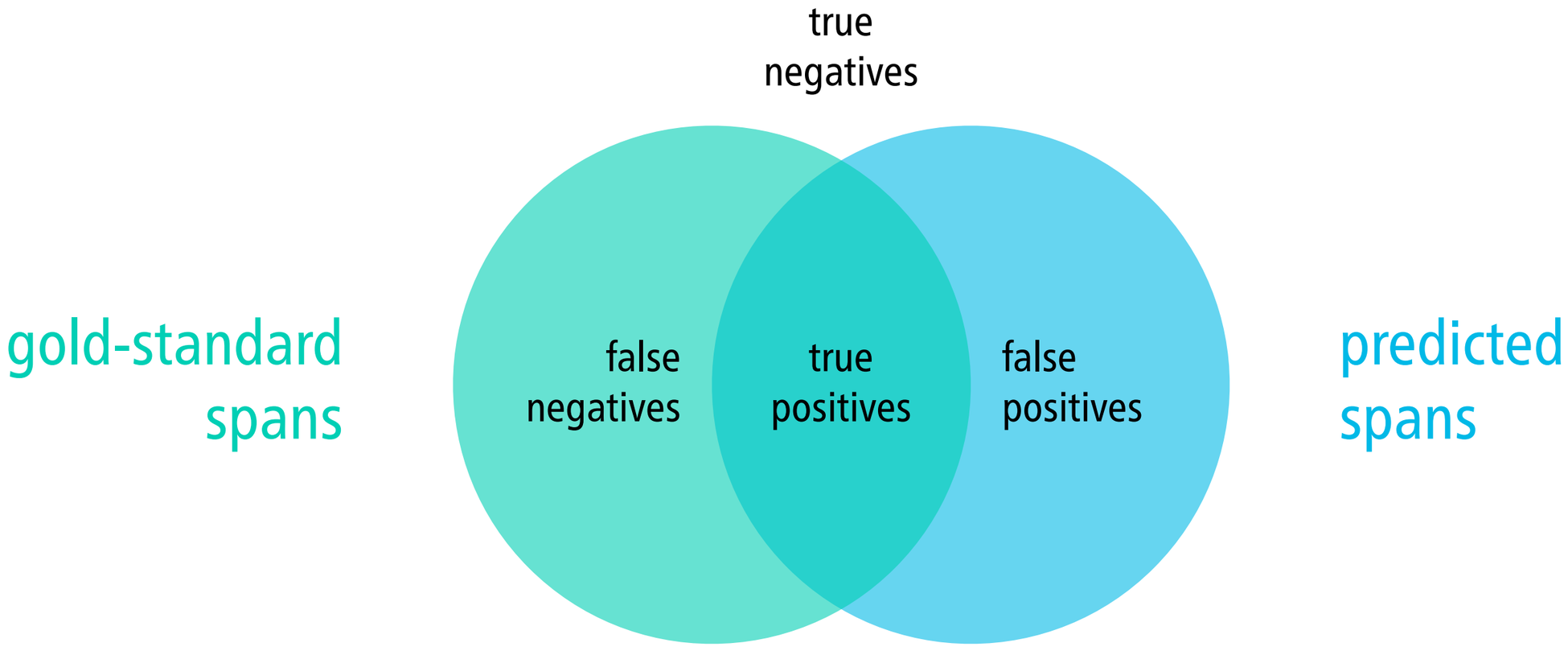
- The standard evaluation metric for part-of-speech tagging is **accuracy** at the token level.

  percentage of correctly assigned tags

- The standard evaluation metrics for segmentation and bracketing are **precision** and **recall**.

  percentage of correctly assigned predicted spans/reference spans

Precision and recall for bracketing tasks



$$P = \frac{|\text{gold} \cap \text{predicted}|}{|\text{predicted}|} \qquad R = \frac{|\text{gold} \cap \text{predicted}|}{|\text{gold}|}$$