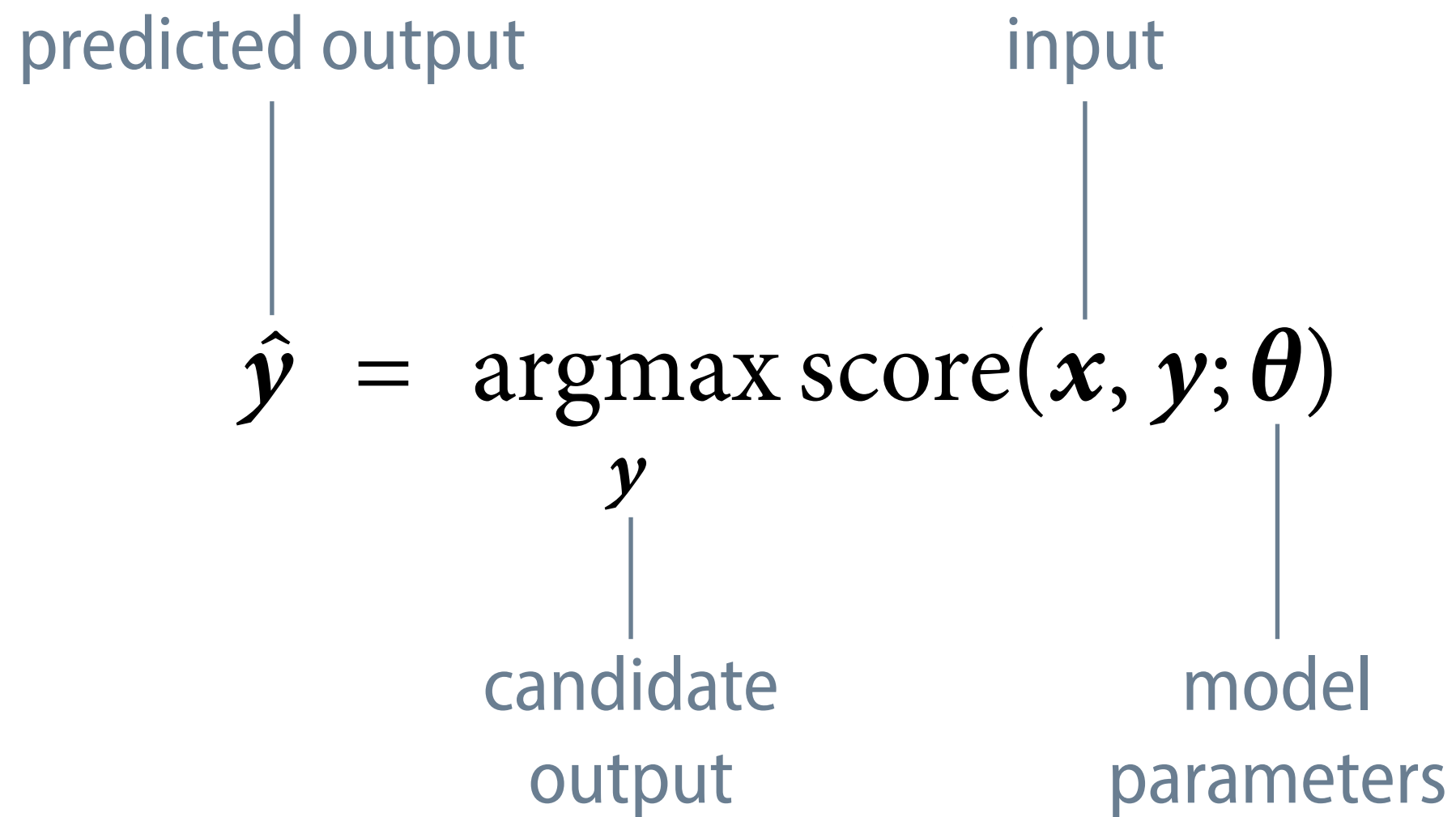


Introduction to sequence labelling

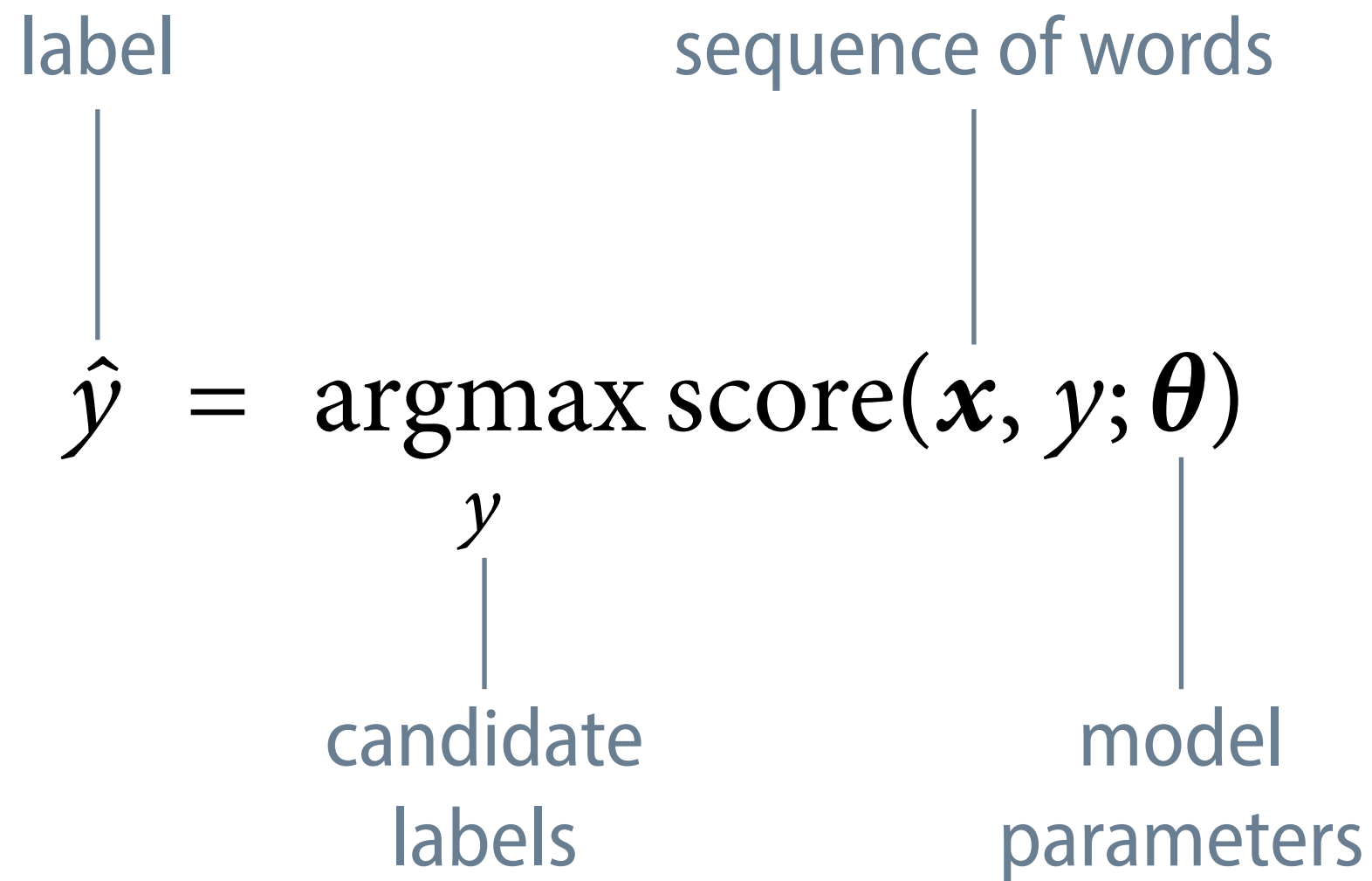
Marco Kuhlmann

Department of Computer and Information Science

Search and learning

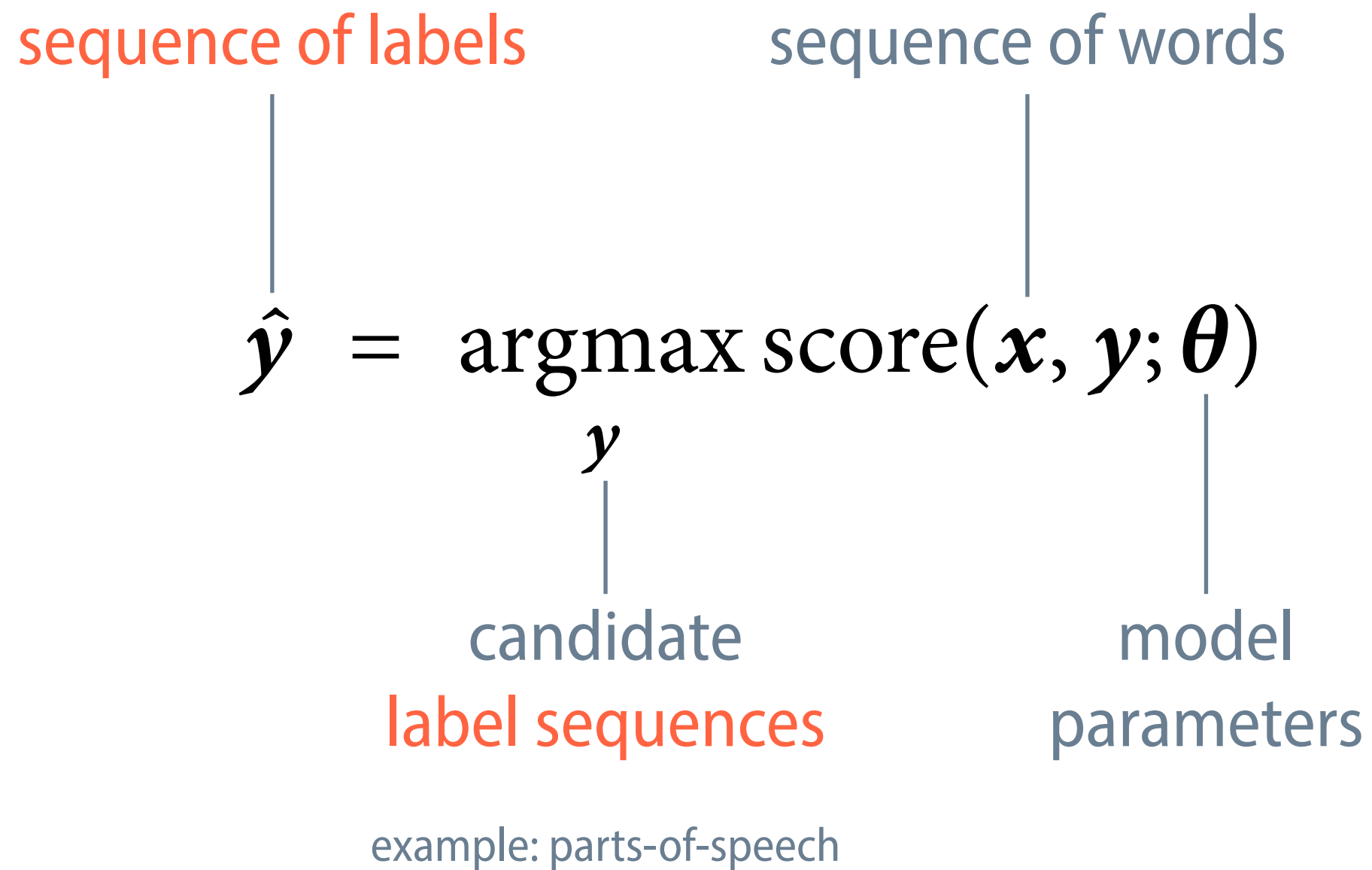


Standard labelling tasks



example: sentiment rating

Sequence labelling tasks



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

Universal part-of-speech tags

Tag	Category	Examples
ADJ	adjective	<i>big, old</i>
ADV	adverb	<i>very, well</i>
INTJ	interjection	<i>ouch!</i>
NOUN	noun	<i>girl, cat, tree</i>
VERB	verb	<i>run, eat</i>
PROPN	proper noun	<i>Mary, John</i>

Tag	Category	Examples
ADP	adposition	<i>in, to, during</i>
AUX	auxiliary verb	<i>has, was</i>
CCONJ	conjunction	<i>and, or, but</i>
DET	determiner	<i>a, my, this</i>
NUM	cardinal numbers	<i>o, one</i>
PRON	pronoun	<i>I, myself, this</i>

Missing: PART, SCONJ, PUNCT, SYM, X

Source: [Universal Dependencies Project](#)

Chinese word segmentation

我 有 一 台 计 算 机 。

I have a computer .

Named entity recognition (NER)

ORG

This **Stanford University** alumna co-founded educational technology company **Coursera**.

ORG

SPARQL query against DBpedia

```
SELECT DISTINCT ?x WHERE {  
  ?x dbo:almaMater dbr:Stanford_University.  
  dbr:Coursera dbo:foundedBy ?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].

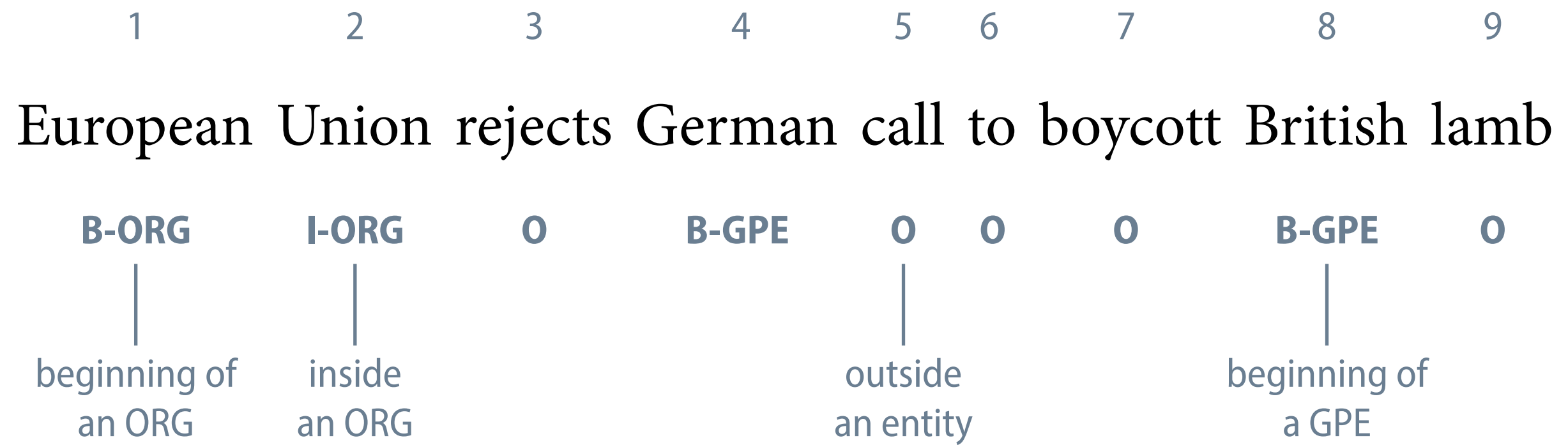
Example from Jurafsky and Martin (2017)

Aspect-based sentiment analysis

NEGATIVE **ASPECT**
I hated their fajitas,
but their salads were great!
ASPECT **POSITIVE**

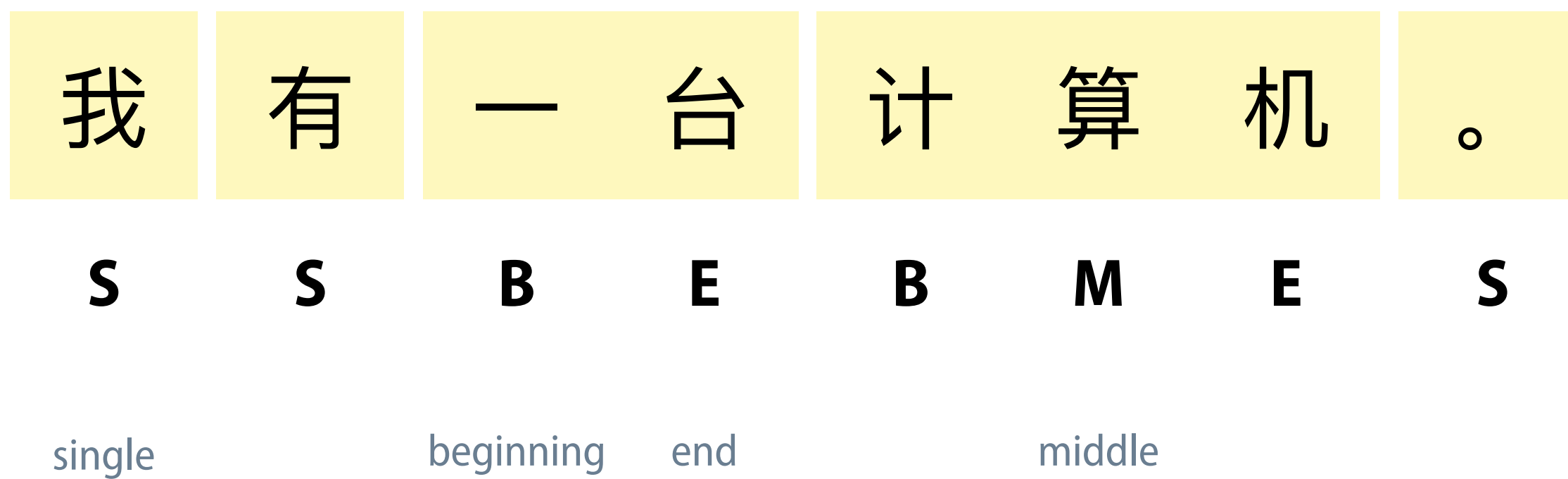
{fajitas: negative, salads: positive}

Reducing NER to tagging



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

Reducing segmentation to tagging



Approaches to sequence labelling

- **Local search**

Cast sequence labelling as a sequence of classification problems: predict the label for each position in the input sequence.

Lectures 3.2–3.4

- **Global search**

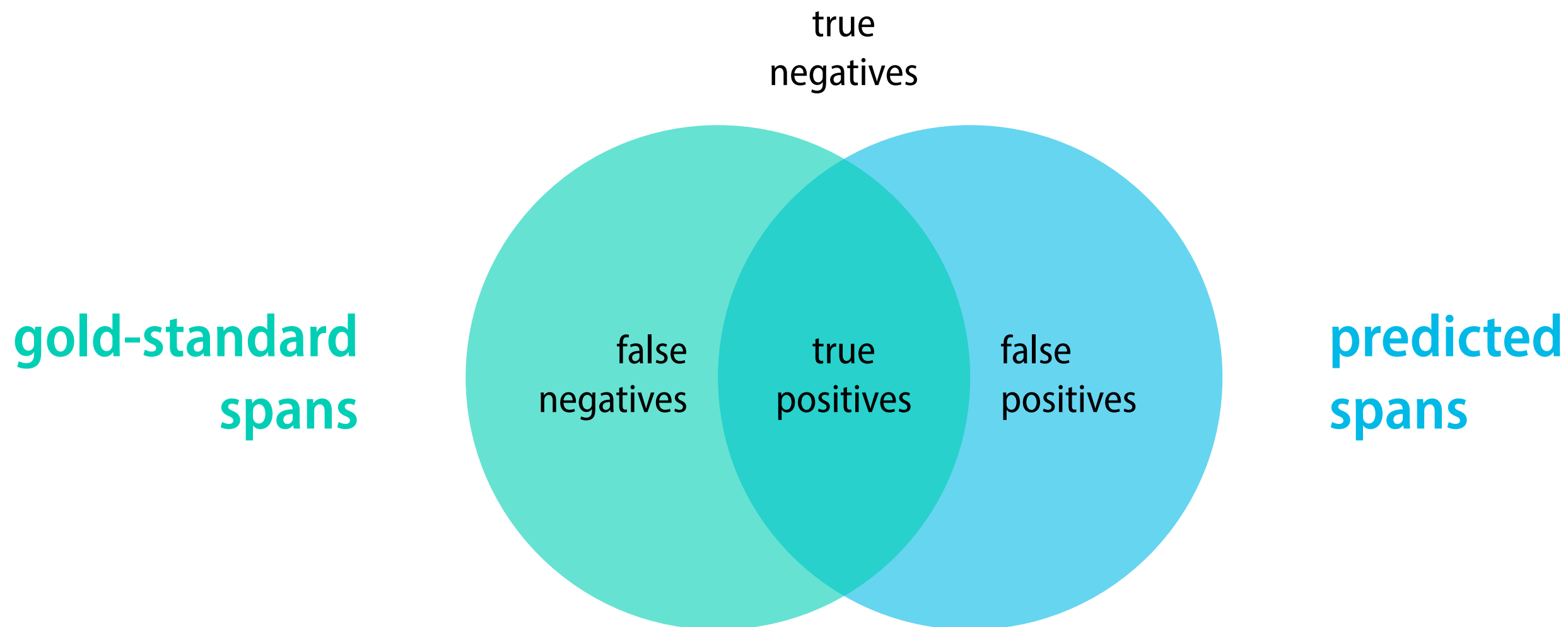
Cast sequence labelling as a combinatorial optimisation problem over the full set of candidate sequences.

Lectures 3.5–3.6

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



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

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