Introduction to spaCy

ADVANCED NLP WITH SPACY

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The nlp object

```
# Import the English language class
from spacy.lang.en import English

# Create the nlp object
nlp = English()
```

- contains the processing pipeline
- includes language-specific rules for tokenization etc.

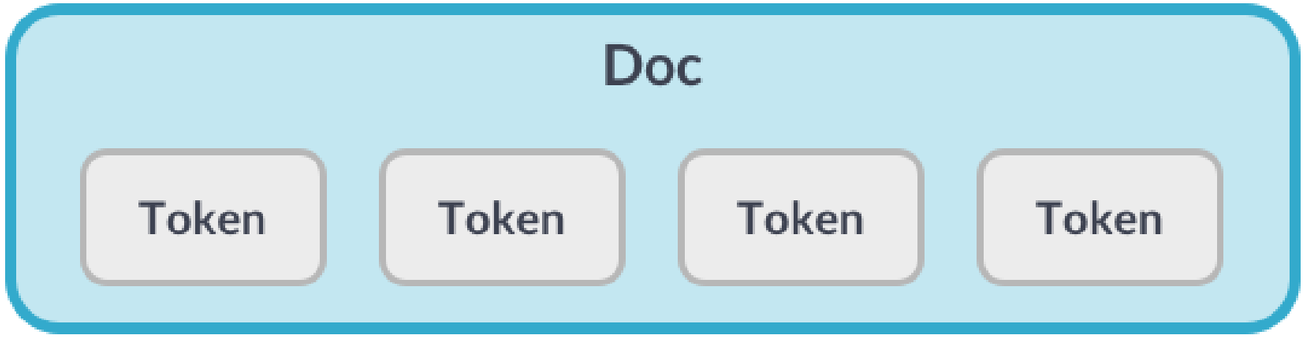
The Doc object

```
# Created by processing a string of text with the nlp object
doc = nlp("Hello world!")

# Iterate over tokens in a Doc
for token in doc:
    print(token.text)
```

```
Hello
world
!
```

The Token object

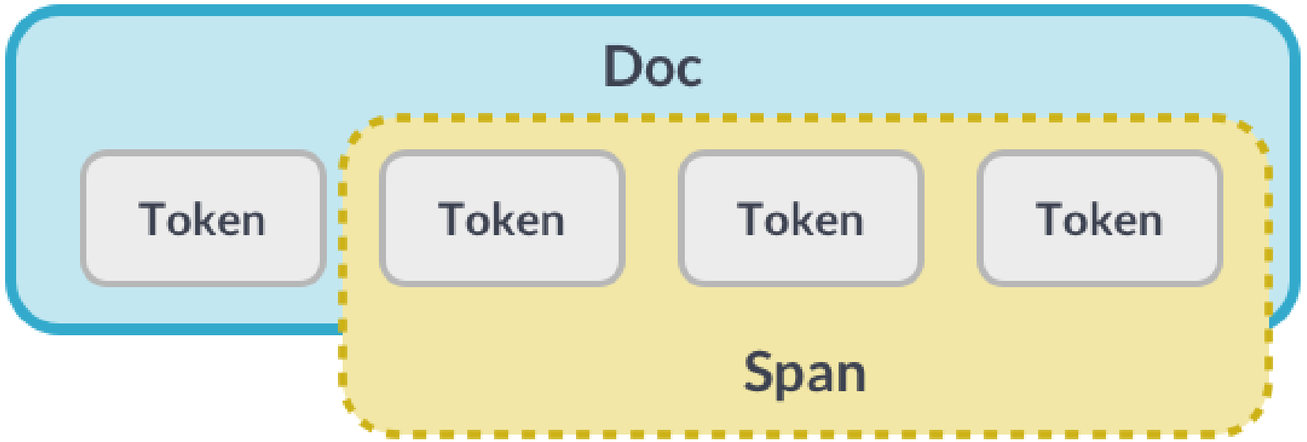



```
doc = nlp("Hello world!")

# Index into the Doc to get a single Token
token = doc[1]
# Get the token text via the .text attribute
print(token.text)
```

```
world
```

The Span object




```
doc = nlp("Hello world!")

# A slice from the Doc is a Span object
span = doc[1:4]
# Get the span text via the .text attribute
print(span.text)
```

```
world!
```

Lexical attributes

```
doc = nlp("It costs $5.")

print('Index:    ', [token.i for token in doc])

print('Text:     ', [token.text for token in doc])

print('is_alpha:', [token.is_alpha for token in doc])
print('is_punct:', [token.is_punct for token in doc])
print('like_num:', [token.like_num for token in doc])
```

```
Index:    [0, 1, 2, 3, 4]
Text:     ['It', 'costs', '$', '5', '.']
is_alpha: [True, True, False, False, False]
is_punct: [False, False, False, False, True]
like_num: [False, False, False, True, False]
```

Let's practice!

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Statistical Models

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What are statistical models?

- Enable spaCy to predict linguistic attributes *in context*
  - Part-of-speech tags
  - Syntactic dependencies
  - Named entities
- Trained on labeled example texts
- Can be updated with more examples to fine-tune predictions

Model Packages


```
import spacy

nlp = spacy.load('en_core_web_sm')
```

- Binary weights
- Vocabulary
- Meta information (language, pipeline)

Predicting Part-of-speech Tags

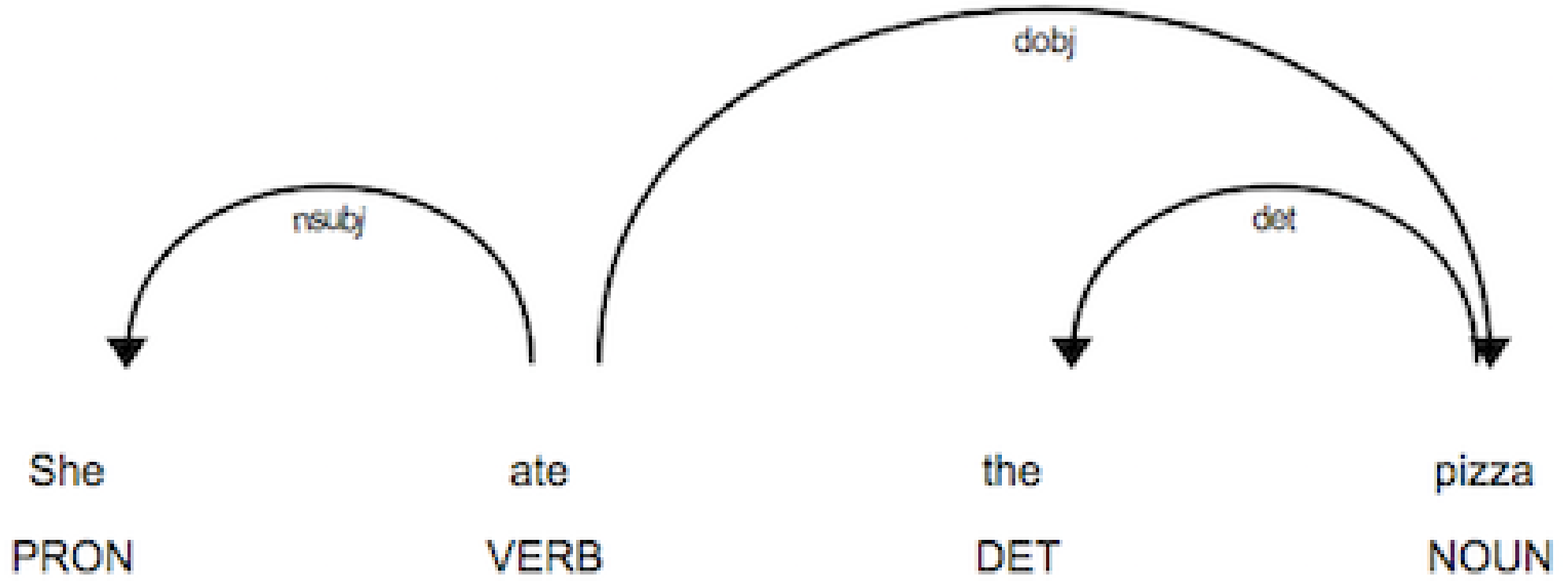
```
import spacy

# Load the small English model
nlp = spacy.load('en_core_web_sm')

# Process a text
doc = nlp("She ate the pizza")

# Iterate over the tokens
for token in doc:

    # Print the text and the predicted part-of-speech tag
    print(token.text, token.pos_)
```

```
She PRON
ate VERB
the DET
pizza NOUN
```

Predicting Syntactic Dependencies

```
for token in doc:
    print(token.text, token.pos_, token.dep_, token.head.text)
```

```
She PRON nsubj ate
ate VERB ROOT ate
the DET det pizza
pizza NOUN dobj ate
```



Label	Description	Example
nsubj	nominal subject	She
dobj	direct object	pizza
det	determiner (article)	the

Predicting Named Entities


```
# Process a text
doc = nlp(u"Apple is looking at buying U.K. startup for $1 billion")

# Iterate over the predicted entities
for ent in doc.ents:

    # Print the entity text and its label
    print(ent.text, ent.label_)
```

```
Apple ORG
U.K. GPE
$1 billion MONEY
```

Tip: the explain method

Get quick definitions of the most common tags and labels.

```
spacy.explain('GPE')
```

```
Countries, cities, states'
```

```
spacy.explain('NNP')
```

```
'noun, proper singular'
```

```
spacy.explain('dobj')
```

```
'direct object'
```

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Rule-based Matching

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Why not just regular expressions?

- Match on `Doc` objects, not just strings
- Match on tokens and token attributes
- Use the model's predictions
- Example: "duck" (verb) vs. "duck" (noun)

Match patterns

- Lists of dictionaries, one per token
- Match exact token texts

```
[{'ORTH': 'iPhone'}, {'ORTH': 'X'}]
```

- Match lexical attributes

```
[{'LOWER': 'iphone'}, {'LOWER': 'x'}]
```

- Match any token attributes

```
[{'LEMMA': 'buy'}, {'POS': 'NOUN'}]
```

Using the Matcher (1)

```
import spacy

# Import the Matcher
from spacy.matcher import Matcher

# Load a model and create the nlp object
nlp = spacy.load('en_core_web_sm')

# Initialize the matcher with the shared vocab
matcher = Matcher(nlp.vocab)

# Add the pattern to the matcher
pattern = [{'ORTH': 'iPhone'}, {'ORTH': 'X'}]
matcher.add('IPHONE_PATTERN', None, pattern)

# Process some text
doc = nlp("New iPhone X release date leaked")

# Call the matcher on the doc
matches = matcher(doc)
```

Using the Matcher (2)

```
# Call the matcher on the doc
doc = nlp("New iPhone X release date leaked")
matches = matcher(doc)
# Iterate over the matches
for match_id, start, end in matches:
    # Get the matched span
    matched_span = doc[start:end]
    print(matched_span.text)
```

```
iPhone X
```

- `match_id` : hash value of the pattern name
- `start` : start index of matched span
- `end` : end index of matched span

Matching lexical attributes

```
pattern = [
    {'IS_DIGIT': True},
    {'LOWER': 'fifa'},
    {'LOWER': 'world'},
    {'LOWER': 'cup'},
    {'IS_PUNCT': True}
]
```

```
doc = nlp("2018 FIFA World Cup: France won!")
```

```
2018 FIFA World Cup:
```

Matching other token attributes

```
pattern = [
    {'LEMMA': 'love', 'POS': 'VERB'},
    {'POS': 'NOUN'}
]
```

```
doc = nlp("I loved dogs but now I love cats more.")
```

```
loved dogs
love cats
```

Using operators and quantifiers (1)

```
pattern = [
    {'LEMMA': 'buy'},
    {'POS': 'DET', 'OP': '?'},  # optional: match 0 or 1 times
    {'POS': 'NOUN'}
]
```

```
doc = nlp("I bought a smartphone. Now I'm buying apps.")
```

```
bought a smartphone
buying apps
```

Using operators and quantifiers (2)

	Description
`{'OP': '!'}`	Negation: match 0 times
`{'OP': '?'}`	Optional: match 0 or 1 times
`{'OP': '+'}`	Match 1 or more times
`{'OP': '*'}`	Match 0 or more times

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