Bag-of-words

SENTIMENT ANALYSIS IN PYTHON

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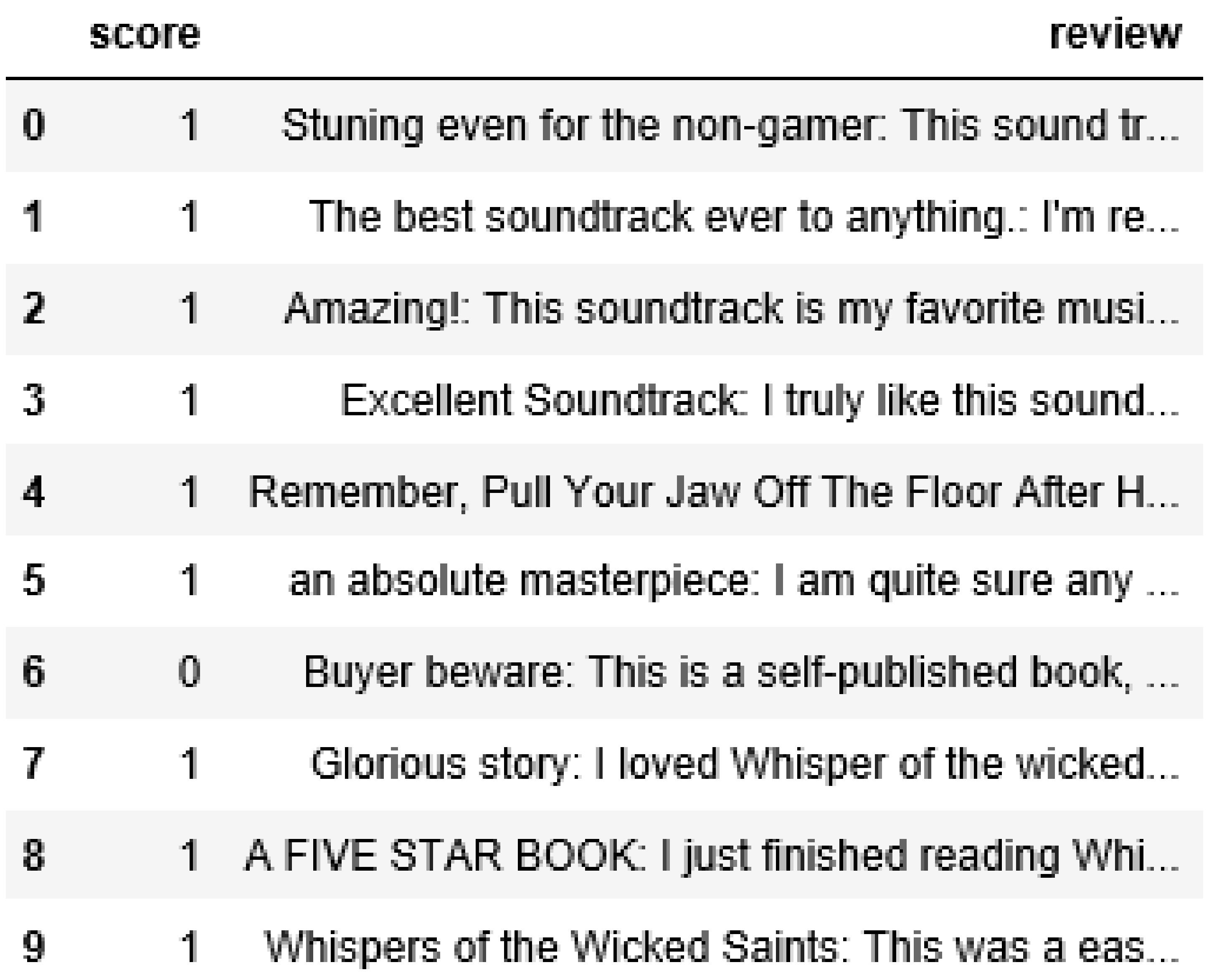
What is a bag-of-words (BOW) ?

- Describes the occurrence of words within a document or a collection of documents (corpus)
- Builds a vocabulary of the words and a measure of their presence

Amazon product reviews



	score	review
0	1	Stuning even for the non-gamer: This sound tr...
1	1	The best soundtrack ever to anything.: I'm re...
2	1	Amazing!: This soundtrack is my favorite musi...
3	1	Excellent Soundtrack: I truly like this sound...
4	1	Remember, Pull Your Jaw Off The Floor After H...
5	1	an absolute masterpiece: I am quite sure any ...
6	0	Buyer beware: This is a self-published book, ...
7	1	Glorious story: I loved Whisper of the wicked...
8	1	A FIVE STAR BOOK: I just finished reading Whi...
9	1	Whispers of the Wicked Saints: This was a eas...

Sentiment analysis with BOW: Example

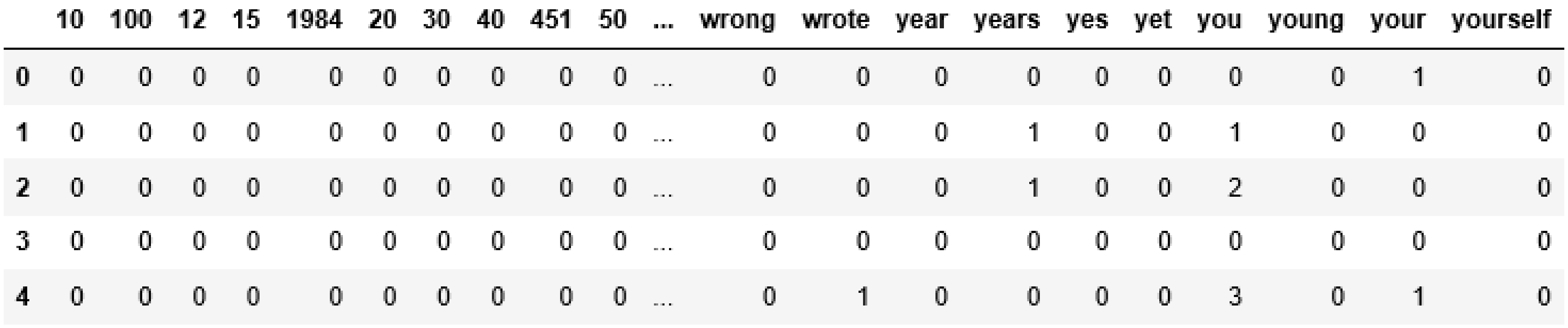
> This is the best book ever. I loved the book and highly recommend it!!!

```
{'This': 1, 'is': 1, 'the': 2 , 'best': 1 , 'book': 2,
'ever': 1, 'I':1 , 'loved':1 , 'and': 1  , 'highly': 1,
'recommend': 1 , 'it': 1 }
```

- Lose word order and grammar rules!

BOW end result

- The output will look something like this:



	10	100	12	15	1984	20	30	40	451	50	...	wrong	wrote	year	years	yes	yet	you	young	your	yourself
0	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0	0	0	...	0	0	0	1	0	0	1	0	0	0
2	0	0	0	0	0	0	0	0	0	0	...	0	0	0	1	0	0	2	0	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	1	0	0	0	0	3	0	1	0

CountVectorizer function

```python
import pandas as pd
from sklearn.feature_extraction.text import CountVectorizer
```

```python
vect = CountVectorizer(max_features=1000)
vect.fit(data.review)
X = vect.transform(data.review)
```

CountVectorizer output

```
X
```

```
<10000x1000 sparse matrix of type '<class 'numpy.int64'>'
  with 406668 stored elements in Compressed Sparse Row format>
```

Transforming the vectorizer

```
# Transform to an array
my_array = X.toarray()
```

```
# Transform back to a dataframe, assign column names
X_df = pd.DataFrame(my_array, columns=vect.get_feature_names())
```

Let's practice!

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Getting granular with n-grams

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Context matters

> I am *happy*, **not sad**.

> I am *sad*, **not happy**.

- Putting 'not' in front of a word (negation) is one example of how context matters.

Capturing context with a BOW

- **Unigrams** : single tokens
- **Bigrams:** pairs of tokens
- **Trigrams:** triples of tokens
- **n-grams:** sequence of n-tokens

Capturing context with BOW

> The weather today is wonderful.

- **Unigrams** : { The, weather, today, is, wonderful }
- **Bigrams:** {The weather, weather today, today is, is wonderful}
- **Trigrams:** {The weather today, weather today is, today is wonderful}

n-grams with the CountVectorizer

```
from sklearn.feature_extraction.text import CountVectorizer
```

```
vect = CountVectorizer(ngram_range=(min_n, max_n))
```

```
# Only unigrams
ngram_range=(1, 1)
```

```
# Uni- and bigrams
ngram_range=(1, 2)
```

What is the best n?

Longer sequence of tokens

- Results in more features
- Higher precision of machine learning models
- Risk of overfitting

Specifying vocabulary size

```
CountVectorizer(max_features, max_df, min_df)
```

- **max_features:** if specified, it will include only the top most frequent words in the vocabulary
  - If max_features = None, all words will be included
- **max_df**: ignore terms with higher than specified frequency
  - If it is set to integer, then absolute count; if a float, then it is a proportion
  - Default is 1, which means it does not ignore any terms
- **min_df**: ignore terms with lower than specified frequency
  - If it is set to integer, then absolute count; if a float, then it is a proportion
  - Default is 1, which means it does not ignore any terms

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Build new features from text

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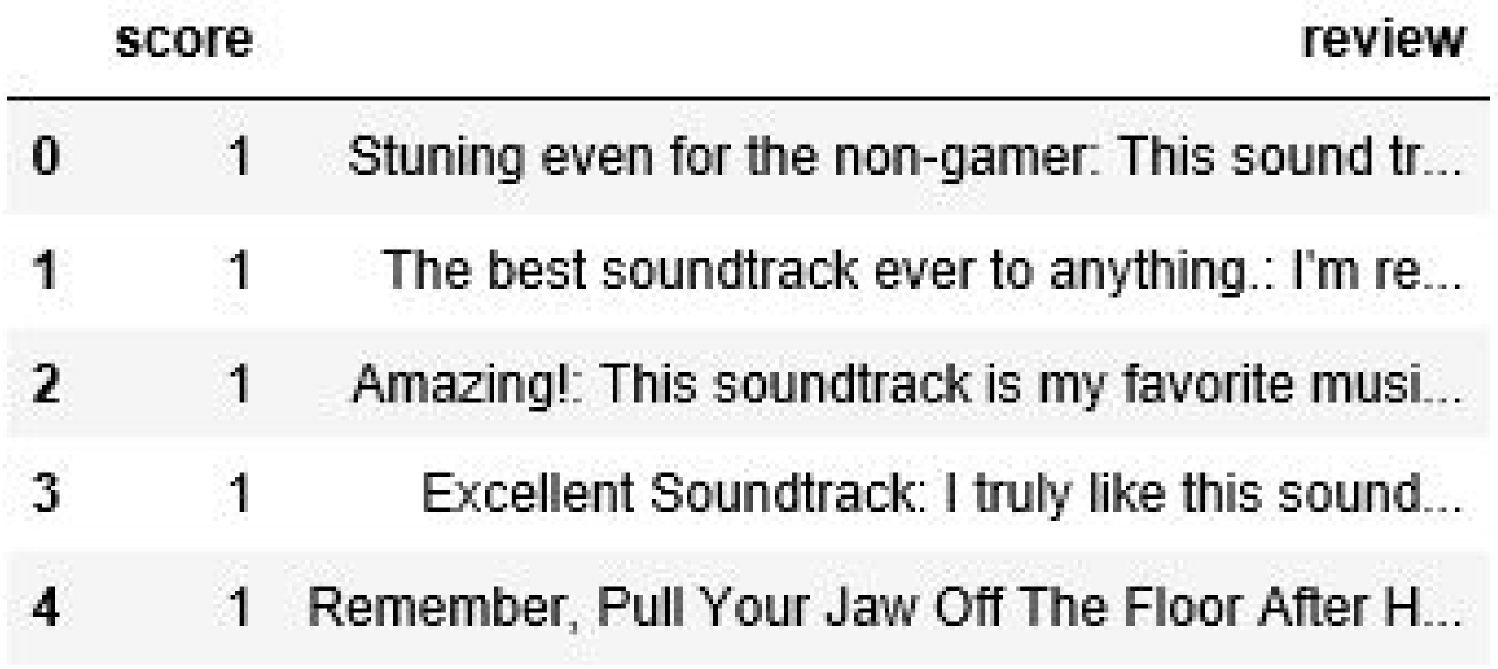
Goal of the video

> Goal : Enrich the existing dataset with features related to the text column (capturing the sentiment)

Product reviews data

```
reviews.head()
```



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4	1	Remember, Pull Your Jaw Off The Floor After H...

Features from the review column

- How long is each review?
- How many sentences does it contain?
- What parts of speech are involved?
- How many punctuation marks?

Tokenizing a string

```
from nltk import word_tokenize
```

```
anna_k = 'Happy families are all alike, every unhappy family is unhappy in its own way.'
```

```
word_tokenize(anna_k)
```

```
['Happy','families','are', 'all','alike',',',
 'every','unhappy', 'family', 'is','unhappy','in',
 'its','own','way','.']
```

Tokens from a column

```
# General form of list comprehension
[expression for item in iterable]
```

```
word_tokens = [word_tokenize(review) for review in reviews.review]
type(word_tokens)
```

```
list
```

```
type(word_tokens[0])
```

```
list
```

Tokens from a column

```
len_tokens = []

# Iterate over the word_tokens list
for i in range(len(word_tokens)):
     len_tokens.append(len(word_tokens[i]))
```

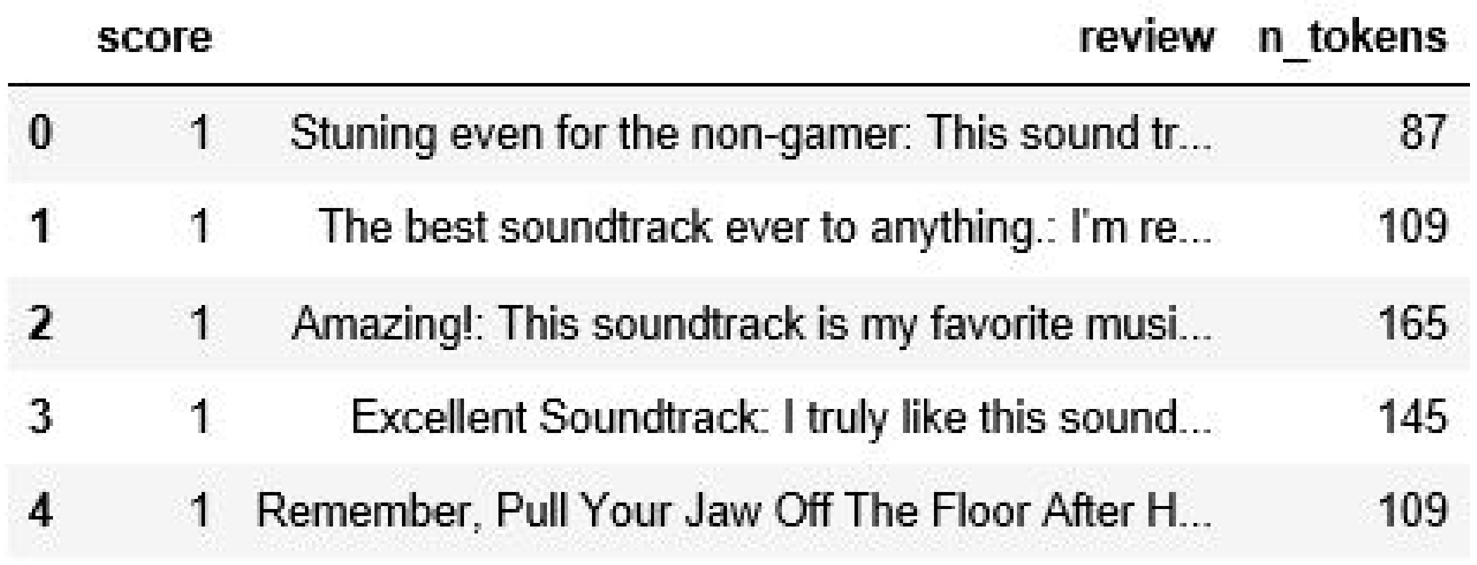
```
# Create a new feature for the length of each review
reviews['n_tokens'] = len_tokens
```

Dealing with punctuation

- We did not address it but you can exclude it
- A feature that measures the number of punctuation signs
  - A review with many punctuation signs could signal a very emotionally charged opinion

Reviews with a feature for the length

```
reviews.head()
```



	score	review	n_tokens
0	1	Stuning even for the non-gamer: This sound tr...	87
1	1	The best soundtrack ever to anything.: I'm re...	109
2	1	Amazing!: This soundtrack is my favorite musi...	165
3	1	Excellent Soundtrack: I truly like this sound...	145
4	1	Remember, Pull Your Jaw Off The Floor After H...	109

Let's practice!

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Can you guess the language?

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Language of a string in Python

```
from langdetect import detect_langs
foreign = 'Este libro ha sido uno de los mejores libros que he leido.'
```

```
detect_langs(foreign)
```

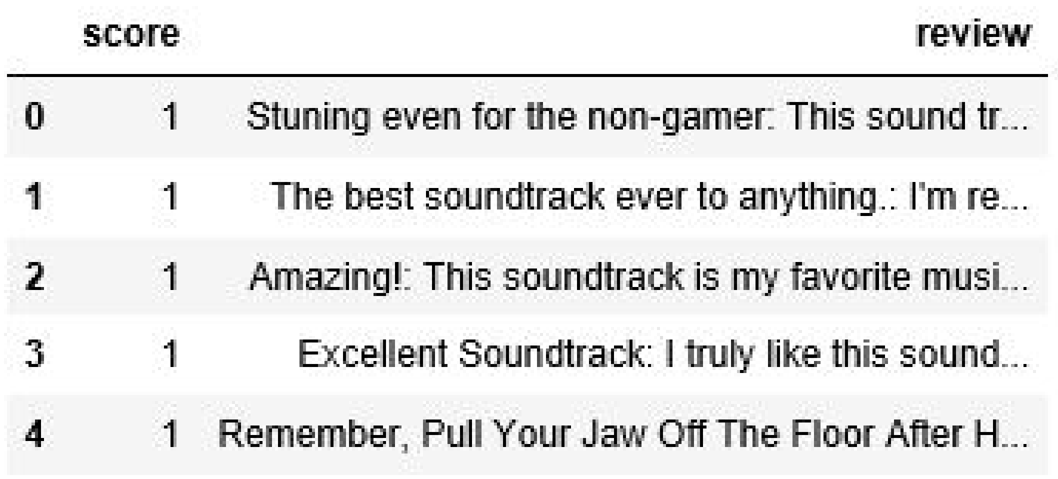
```
[es:0.9999945352697024]
```

Language of a column

- Problem: Detect the language of each of the strings and capture the most likely language in a new column

```python
from langdetect import detect_langs
reviews = pd.read_csv('product_reviews.csv')
```

```python
reviews.head()
```



	score	review
0	1	Stuning even for the non-gamer: This sound tr...
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Building a feature for the language

```
languages = []
```

```
for row in range(len(reviews)):
    languages.append(detect_langs(reviews.iloc[row, 1]))
```

```
languages
[it:0.9999982541301151],
[es:0.9999954153640488],
[es:0.7142833997345875, en:0.2857160465706441],
[es:0.9999942365605781],
[es:0.999997956049055] ...
```

Building a feature for the language

```
# Transform the first list to a string and split on a colon
str(languages[0]).split(':')
['[es', '0.9999954153640488]']
```

```
str(languages[0]).split(':')[0]
'[es'
```

```
str(languages[0]).split(':')[0][1:]
'es'
```

Building a feature for the language

```
languages = [str(lang).split(':')[0][1:] for lang in languages]
```

```
reviews['language'] = languages
```

Let's practice!

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