Capitulo_3

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I. IDENTIFICANDO ENTIDADES NOMEADAS

Neste capítulo vamos treinar um identificador de Entidades (NER) nomeadas usando a biblioteca Spacy. A partir deste capítulo vamos importar também funções que já criamos anteriormente, e que encontram-se reproduzidas em dhbbmining.py

In [1]:
```
import os, glob, pickle
import spacy
from spacy import displacy
from sqlalchemy import create_engine
from dhbbmining import *
import ipywidgets as widgets
```

Para utilizar o spacy em um corpus na lingua portuguesa, vamos primeiro importar o modelo liguístico do português

In [2]:
```
nlp = spacy.load("pt_core_news_sm")
```

Em seguida podemos carregar os verbetes bográficos que salvamos no nosso banco SQLite.

In [3]:
```
eng = create_engine("sqlite:///minha_tabela.sqlite")
#dhbb = pd.read_sql_table('resultados')
biograficos = pd.read_sql_query('select * from resultados', con=eng)
biograficos.head()
```

[3]:

	index	arquivo	title	natureza	sexo	cargos	corpo
0	0	1.text	COELHO, Machado	biográfico	m	\n - dep. fed. DF 1927-1929 \n - dep. fed. DF ...	\n\nńJosé Machado Coelho de Castroż nasceu em ...
1	1	10.text	ABÍLIO, Armando	biográfico	m	\n - dep. fed. PB 1995-1999\n - dep. fed. PB ...	
2	2	100.text	ALEIXO, Pedro	biográfico	m	\n - const. 1934\n - dep. fed. MG 1935-1937\n ...	
3	3	1000.text	CAMPOS, Eduardo	biográfico	m	\n - dep. fed. PE 1995\n - dep. fed. PE 1998-...	
4	4	1001.text	CAMPOS, Eleazar Soares	biográfico	m	\n - magistrado\n - interv. MA 1945-1946\n	

```
1  \n\nńArmando Abílio Vieiraż nasceu em Itaporan...
2  \n\nńPedro Aleixoż nasceu em São Caetano, dist...
3  \n\nńEduardo Henrique Accioly Camposż nasceu e...
4  \n\nńEleazar Soares Camposż nasceu em São Luís...
```

Para começar a utilizar o Spacy, precisamos primeiro precisamos processar o texto. Nesta passagem várias análises linguísticas são realizadas.

```
In [4]: doc = nlp(biograficos.corpo[0].strip())
        type(doc)
```

```
[4]: spacy.tokens.doc.Doc
```

```
In [ ]:
```

```
In [5]: for i, token in enumerate(doc):
            print(token.text, token.lemma_, token.pos_, token.tag_, token.dep_,
                  token.shape_, token.is_alpha, token.is_stop)
            if i>5:
                break
```

```
ń ń PUNCT PU|@PU punct ń False False
José José PROPN PROPN nsubj Xxxx True False
Machado Machado PROPN PROPN flat:name Xxxxx True False
Coelho Coelho PROPN PROPN flat:name Xxxxx True False
de de ADP PRP|@N< case xx True True
Castro Castro PROPN PROP|@P< nmod Xxxxx True False
ż ż PUNCT PU|@PU punct ż False False
```

I.1. Testando o NER do Spacy

Como o Spacy já inclui algum suporte à lingua portuguesa, antes de pensar em treinar nosso próprio NER, podemos avaliar a performance do existente.

Abaixo vamos construir uma visualização interativa da marcação de entidades nos verbetes do DHBB.

```
In [6]: from IPython.display import display,clear_output
        from ipywidgets import interact
```

```
In [7]: @interact(e=(0, len(biograficos)))
        def mostra_ner(e=0):
            text = biograficos.iloc[e].corpo.strip()
            doc = nlp(text)
            displacy.render(doc, style="ent", jupyter=True)
            clear_output(wait=True)
```

```
interactive(children=(IntSlider(value=0, description='e', max=7687), Output()), _dom_classes=('widget-in
```

Além da visualização, podemos extrair as entidades presentes em um verbete:

```
In [8]: for ent in doc.ents:
            print(ent.text, ent.start_char, ent.end_char, ent.label_)
```

```
José Machado Coelho de Castroż 1 31 PER
Lorena 42 48 LOC
SP 50 52 LOC
Ginásio Diocesano de São Paulo 67 97 LOC
Faculdade de Ciências Jurídicas 127 158 ORG
Sociais 161 168 LOC
Cunha 220 225 LOC
SP 227 229 LOC
Rio de
Janeiro 263 277 LOC
Distrito Federal 285 301 LOC
Distrito Federal 357 373 LOC
Câmara 488 494 LOC
Getúlio Vargas 575 589 PER
Ligado 591 597 LOC
Washington Luís 654 669 PER
Guanabara 682 691 LOC
Alcântara 951 960 LOC
Lisboa 965 971 LOC
Getúlio 1050 1057 PER
Vargas 1058 1064 PER
São 1125 1128 LOC
Paulo 1129 1134 LOC
São 1206 1209 LOC
Paulo 1210 1215 LOC
Partido Social Democrático 1231 1257 ORG
PSD 1259 1262 ORG
Assembléia Nacional Constituinte 1284 1316 ORG
ANC 1318 1321 ORG
Carta
 1484 1490 PER
Constituinte 1523 1535 MISC
Congresso 1539 1548 LOC
Comissão Permanente de Obras Públicas da Câmara Federal 1571 1626 ORG
Câmara 1732 1738 ORG
Companhia de Cimento Vale do Paraíba 1784 1820 ORG
Rio de Janeiro 1834 1848 LOC
```

```
In [9]: type(doc.ents[0])
```

```
[9]: spacy.tokens.span.Span
```

I.2. Treinando Um identificador de Entidades a partir do DHBB

Identificadores de entidades são algoritmos treinados em corpora manualmente anotados. Como cada corpora possui um conjunto particular de entidades, para uma performance ótima o ideal é treinarmos o modelo no Próprio DHBB. Para este fim utilizaremos os dicionários já disponíveis no DHBB, juntamente com o índice construído no capítulo 2 para recuperar o contexto de cada entrada dos dicionários.

```
In [10]: from whoosh import index
         import os
         from whoosh.qparser import QueryParser
         from whoosh import qparser
```

O primeiro passo é abrirmos o nosso indice.

```
In [11]: if os.path.exists('indexdir'):
             indice = index.open_dir('indexdir')

In [12]: indice.doc_count()
```

[12]: 6724

```
In [13]: def busca(consulta):
             qp = QueryParser("corpo", indice.schema)
             qp.add_plugin(qparser.EveryPlugin())
             query = qp.parse(consulta)

             with indice.searcher() as searcher:
                 results = [(dict(hit),hit.highlights("corpo")) for hit in searcher.
 ↪search(query,
         limit=None)]
             return results

In [14]: resultados = busca('"filho de"')[0]
```

Agora já temos os ingredientes necessários para treinar um modelo de entidades usando a biblioteca spacy.

```
In [15]: import random, os
         from tqdm import tqdm
         from pathlib import Path
         import spacy
         from spacy.util import minibatch, compounding

In [16]: for verb in biograficos.itertuples():
             print(verb.title)
             break
```

```
COELHO, Machado
```

Primeiro precisamos criar o conjunto de treinamento do modelo. e deve ter a forma de uma lista como a descrita abaixo.

```
TRAIN_DATA = [
    ("nasceu em Itaporanga ( PB ) no dia 29 de dezembro de 1944 , filho de Argemiro Abílio de Sousa
     {"entities": [(10, 20, "LOC"), (69, 93, "PERSON")]}
    ),
]
```

Como primeira abordagem de treinamento, vamos atualizar o modelo que vem com o spacy adicionando mais um tipo de entidade: “eventos”. Posteriormente, o modelo pode continuar a ser incrementado adicionando-se outros tipos de entidade. Vamos também aproveitar as entidades reconhecidas pelo modelo base no corpus do DHBB para reforçar o treinamento do modelo no contexto linguístico do DHBB.

```
In [17]: path = "F:/dhbb-master/dic/evento.txt"
         path = "../../dhbb/dic/evento.txt"
         with open(path, 'r', encoding='utf-8') as f:
             dicio = f.readlines()
         #ent.text, ent.start_char, ent.end_char, ent.label_
         def gera_dados_treinamento(dicionário, tag):
```

```
            data = []
            for verb in tqdm(biograficos.itertuples()):
                texto = verb.corpo
                doc = nlp(texto)
                entdict = {"entities":[(ent.start_char, ent.end_char, ent.label_) for␣
↪ent in
        doc.ents]}
                for evento in dicionário:
                    try:
                        posini =texto.index(evento)
                    except ValueError:
                        continue
                    posfim = posini + len(evento)
                    entdict['entities'].append((posini,posfim, tag))
                data.append((texto, entdict))
            return data
```

```
In [18]: if os.path.exists('ner_training.pickle'):
            dados = pickle.load(open('ner_training.pickle','rb'))
        else:
            dados = gera_dados_treinamento(dicio, "EVT")
```

```
7687it [35:17,  3.43it/s]
```

```
In [19]: pickle.dump(dados,open('ner_training.pickle','wb'))
```

```
In [20]: for d in dados[:10]:
            print(d[1])
```

```
{'entities': [(3, 33, 'PER'), (44, 50, 'LOC'), (52, 54, 'LOC'), (69, 99, 'LOC'), (129,
160, 'ORG'), (163, 170, 'LOC'), (222, 227, 'LOC'), (229, 231, 'LOC'), (265, 279,
'LOC'), (287, 303, 'LOC'), (359, 375, 'LOC'), (490, 496, 'LOC'), (577, 591, 'PER'),
(593, 599, 'LOC'), (656, 671, 'PER'), (684, 693, 'LOC'), (953, 962, 'LOC'), (967, 973,
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'ORG'), (1836, 1850, 'LOC')]}
{'entities': [(3, 25, 'PER'), (36, 46, 'LOC'), (48, 50, 'LOC'), (92, 116, 'PER'),
(122, 144, 'PER'), (169, 175, 'LOC'), (180, 212, 'LOC'), (213, 247, 'LOC'), (337, 358,
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```

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'PER'), (15264, 15269, 'LOC'), (15340, 15350, 'LOC'), (15426, 15434, 'LOC'), (15437,
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```

In [21]:
```
TEST_DATA = dados[-1000:]
TRAIN_DATA = dados[:-1000]
```

In [22]:
```
def main(model="pt_core_news_sm", output_dir="dhbb_nlp", n_iter=100):
    """Load the model, set up the pipeline and train the entity recognizer."""
    if model is not None:
        nlp = spacy.load(model)  # load existing spaCy model
        print("Loaded model '%s'" % model)
    else:
        nlp = spacy.blank("pt")  # create blank Language class
        print("Created blank 'pt' model")

    # create the built-in pipeline components and add them to the pipeline
    # nlp.create_pipe works for built-ins that are registered with spaCy
    if "ner" not in nlp.pipe_names:
        ner = nlp.create_pipe("ner")
        nlp.add_pipe(ner, last=True)
    # otherwise, get it so we can add labels
    else:
        ner = nlp.get_pipe("ner")

    # add labels
    for _, annotations in TRAIN_DATA:
        for ent in annotations.get("entities"):
            ner.add_label(ent[2])

    # get names of other pipes to disable them during training
    other_pipes = [pipe for pipe in nlp.pipe_names if pipe != "ner"]
    with nlp.disable_pipes(*other_pipes):  # only train NER
        # reset and initialize the weights randomly  but only if we're
        # training a new model
        if model is None:
            nlp.begin_training()
        for itn in range(n_iter):
            random.shuffle(TRAIN_DATA)
            losses = {}
            # batch up the examples using spaCy's minibatch
            batches = minibatch(TRAIN_DATA, size=compounding(4.0, 32.0, 1.001))
            for batch in batches:
                texts, annotations = zip(*batch)
                nlp.update(
                    texts,  # batch of texts
```

```
                            annotations,  # batch of annotations
                            drop=0.5,  # dropout - make it harder to memorise data
                            losses=losses,
                        )
                    print("Losses", losses)

            # test the trained model
            for text, _ in TRAIN_DATA:
                doc = nlp(text)
                print("Entities", [(ent.text, ent.label_) for ent in doc.ents])
                print("Tokens", [(t.text, t.ent_type_, t.ent_iob) for t in doc])

            # save model to output directory
            if output_dir is not None:
                output_dir = Path(output_dir)
                if not output_dir.exists():
                    output_dir.mkdir()
                nlp.to_disk(output_dir)
                print("Saved model to", output_dir)

                # test the saved model
                print("Loading from", output_dir)
                nlp2 = spacy.load(output_dir)
                for text, _ in TRAIN_DATA:
                    doc = nlp2(text)
                    print("Entities", [(ent.text, ent.label_) for ent in doc.ents])
                    print("Tokens", [(t.text, t.ent_type_, t.ent_iob) for t in doc])
```

```
In [ ]: main()
```

```
Loaded model 'pt_core_news_sm'
Losses {'ner': 6148187.004867554}
```

I.3. Similaridade semantica

```
In [10]: import numpy as np
         import networkx as nx
         %pylab inline
```

```
Populating the interactive namespace from numpy and matplotlib
```

```
In [24]: G = nx.Graph()

         for i,verb1 in tqdm(enumerate(biograficos.itertuples())):
             for j,verb2 in enumerate(biograficos.itertuples()):
                 if j>=i:
                     continue
                 doc1 = nlp(verb1.corpo)
                 doc2 = nlp(verb2.corpo)
                 sim = doc1.similarity(doc2)
                 print(sim)
                 if sim > 0.9:
                     G.add_edge(verb1.title, verb2.title, weight=sim)
             if len(G.nodes)>20:
                 break
```

```
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2it [00:00,  4.01it/s]

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0.9887844127611848



3it [00:04,  1.37s/it]

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0.9877588312193162
0.988704284126218



4it [00:08,  2.15s/it]

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0.8972676949479885



5it [00:11,  2.44s/it]

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6it [00:15,  2.88s/it]

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7it [00:19,  3.23s/it]
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8it [00:23,  3.43s/it]

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9it [00:59, 13.15s/it]

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10it [01:08, 12.08s/it]

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11it [01:17, 11.20s/it]
```

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12it [01:28, 11.05s/it]

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13it [01:39, 10.87s/it]

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14it [01:50, 11.13s/it]

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0.9848907434531723
0.9821222880320676
0.978869223936925
0.9814983394217695



16it [02:17, 12.22s/it]

0.9656398823983473
0.969678042772926
0.970864767294153
0.9774371578737523
0.9080779275061355
0.9580085885467087
0.9731642283364211
0.9004763446067745
0.9572270317214112
0.9767716452428961
0.9403238456020123
0.9706329435270021
```

KeyboardInterrupt Traceback (most recent call last)

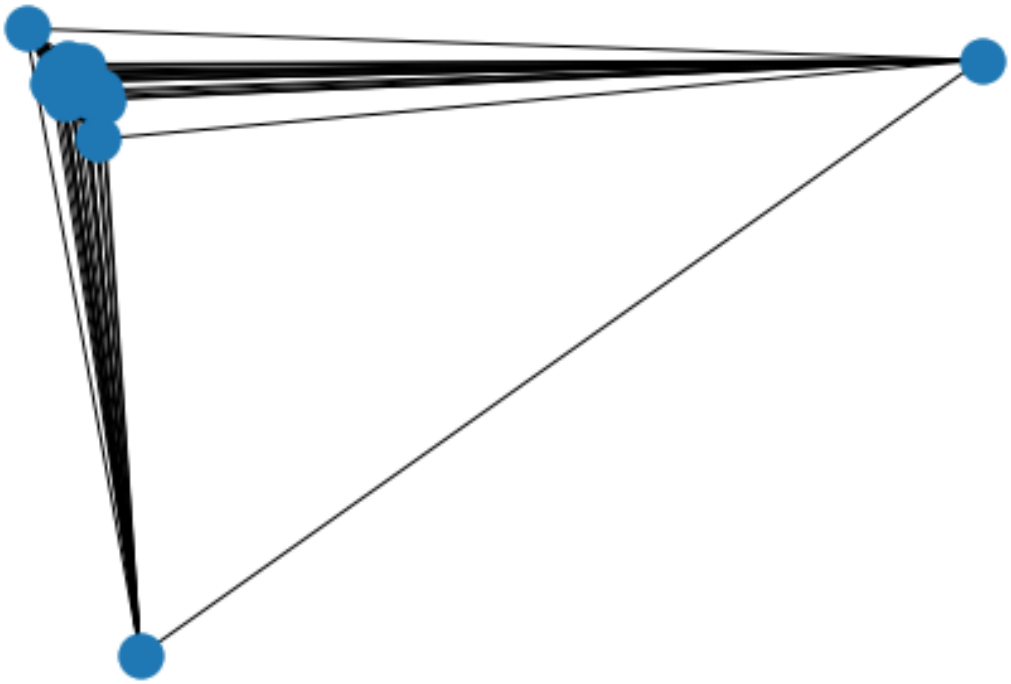
<ipython-input-24-f913f04d0c79> in <module>

```
         6             continue
         7         doc1 = nlp(verb1.corpo)
   ----> 8         doc2 = nlp(verb2.corpo)
         9         sim = doc1.similarity(doc2)
        10         print(sim)


       ~\.conda\envs\curso\lib\site-packages\spacy\language.py in __call__(self, text,␣
↪disable)
       344             if not hasattr(proc, '__call__'):
       345                 raise ValueError(Errors.E003.format(component=type(proc),␣
↪name=name))
   --> 346             doc = proc(doc)
       347             if doc is None:
       348                 raise ValueError(Errors.E005.format(name=name))


       pipeline.pyx in spacy.pipeline.Tagger.__call__()


       pipeline.pyx in spacy.pipeline.Tagger.predict()


       ~\.conda\envs\curso\lib\site-packages\thinc\neural\_classes\model.py in␣
↪__call__(self, x)
       159             Must match expected shape
       160         '''
   --> 161         return self.predict(x)
       162
       163     def pipe(self, stream, batch_size=128):


       ~\.conda\envs\curso\lib\site-packages\thinc\api.py in predict(seqs_in)
       291     def predict(seqs_in):
       292         lengths = layer.ops.asarray([len(seq) for seq in seqs_in])
   --> 293         X = layer(layer.ops.flatten(seqs_in, pad=pad))
       294         return layer.ops.unflatten(X, lengths, pad=pad)
       295


       ~\.conda\envs\curso\lib\site-packages\thinc\neural\_classes\model.py in␣
↪__call__(self, x)
       159             Must match expected shape
       160         '''
   --> 161         return self.predict(x)
       162
       163     def pipe(self, stream, batch_size=128):


       ~\.conda\envs\curso\lib\site-packages\thinc\check.py in␣
↪checked_function(wrapped, instance, args, kwargs)
       144                     raise ExpectedTypeError(check, ['Callable'])
       145                 check(arg_id, fix_args, kwargs)
   --> 146         return wrapped(*args, **kwargs)
       147
       148     def arg_check_adder(func):
```

```
       ~\.conda\envs\curso\lib\site-packages\thinc\neural\_classes\softmax.py in␣
↪predict(self, input__BI)
        16     def predict(self, input__BI):
        17         output__BO = self.ops.affine(self.W, self.b, input__BI)
   ---> 18         output__BO = self.ops.softmax(output__BO, inplace=False)
        19         return output__BO
        20


       ops.pyx in thinc.neural.ops.Ops.softmax()


       ~\.conda\envs\curso\lib\site-packages\numpy\core\_methods.py in _sum(a, axis,␣
↪dtype, out, keepdims, initial)
        34 def _sum(a, axis=None, dtype=None, out=None, keepdims=False,
        35          initial=_NoValue):
   ---> 36     return umr_sum(a, axis, dtype, out, keepdims, initial)
        37
        38 def _prod(a, axis=None, dtype=None, out=None, keepdims=False,


       KeyboardInterrupt:
```

```
In [21]: nx.draw(G, pos=nx.spectral_layout(G, weight='similarity'));
```

```
C:\Users\flavio.codeco.coelho\.conda\envs\curso\lib\site-
packages\networkx\drawing\nx_pylab.py:579: MatplotlibDeprecationWarning:
The iterable function was deprecated in Matplotlib 3.1 and will be removed in 3.3. Use
np.iterable instead.
  if not cb.iterable(width):
```



In [23]: nx.write_gexf(G,'dhbb.gexf')

In [ ]: