Homework 2

Natural Language Processing 2018/2019

Contacts

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If you write on the **Facebook group**

we will love you much more <3

What you will do

- Create your own sense embeddings

- Take a chance to win your first BabelNet t-shirt or maybe get one in another color!

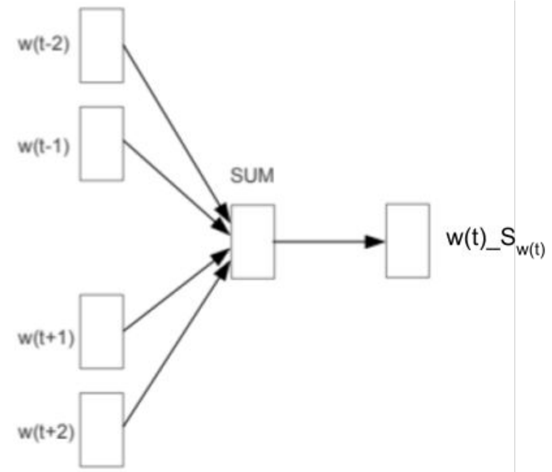
Homework outline

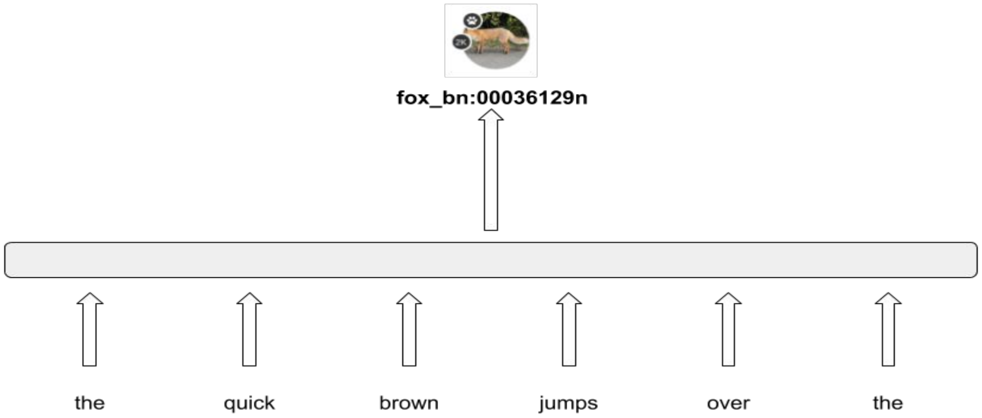
- Train your own sense embeddings
  - We will provide a reference paper, training corpora and an evaluation task
- **Parse** the corpora to extract the information needed to train the sense embeddings
- **Restrict** the sense embeddings only to senses in WordNet
- **Train** a *word2vec* model to create the sense embeddings
- **Test** the sense embeddings in the word similarity task
- Write a **report** where you describe your approach, your result analysis and any interesting features you implemented
  - Text report **max 2 page**, text after the 2nd page will not be considered
  - Images and tables **max 2 pages**
- **Submit your code, sense embeddings and report**

What we provide

- Sense tagged **training corpora**
- A reference **paper**
- An **evaluation dataset**
- A **mapping** from BabelNet synsets to WordNet offsets
- These slides as guidelines

The model





SENSEMBED: Learning Sense Embeddings for Word and Relational Similarity

Iacobacci, Pilehvar and Navigli, 2015 link to paper

It is *MANDATORY* not to use the pretrained embeddings

The model

- The model to implement can be either CBOW or Skipgram
- You can use already implemented version of word2vec models
  - Gensim
  - Word2Vec
  - Glove
  - Fasttext
  - Or implement your own!
- Given a context of words surrounding the target word, the model has to predict the correct word sense represented as <**lemma**>_<**synset**>
- Same as standard word embeddings but with word senses as outputs

EuroSense corpus

Download the *mandatory* corpus: http://lcl.uniroma1.it/eurosense/

- The corpus consists of a single large XML file (21GB uncompressed for the high precision version)
- You might not be able to load the whole file in memory (you can take a look at the **iterparse** function in the *lxml.etree* library for python to solve the issue)
- It is a multilingual corpus but you can use only the **English sentences**
- It is up to you to choose between the high precision and the high coverage version

EuroSense corpus

- Each `sentence` is translated into several languages identified by the **`lang`** attribute in the `<text>` tag. They are already tokenized so you just need to split by space

```
<sentence id="0">
     <text lang="de">Ich halte es für äußerst wichtig , die Grauzonen [...]</text>
     <text lang="en">I do believe that it is vital to minimise the grey areas [...]</text>
     … // more languages

     <annotations>
          <annotation lang="en" type="NASARI" anchor="areas" lemma="area"
               coherenceScore="0.2247" nasariScore="0.9829"> bn:00005513n</annotation>

          … //more annotations
     </annotations>
</sentence>
```

EuroSense corpus

- Each `sentence` has its own annotations depending on the **`lang`**
- Each `annotation` marks the sense for a word in `text` identified by the **`anchor`** attribute

```
<sentence id="0">
      <text lang="de">Ich halte es für äußerst wichtig , die Grauzonen [...]</text>
      <text lang="en">I do believe that it is vital to minimise the grey  areas [...]</text>
      … // more languages

      <annotations>
            <annotation lang=" en" type="NASARI" anchor=" areas" lemma="area"
                  coherenceScore="0.2247" nasariScore="0.9829"> bn:00005513n</annotation>

            … //more annotations
      </annotations>
</sentence>
```

EuroSense corpus

- Remind that your sense embedding must be represented as ***lemma_synset***
- Each `annotation` provides you with the **`lemma`** of the word it is tagging and the synset id

```
<sentence id="0">
     <text lang="de">Ich halte es für äußerst wichtig , die Grauzonen [...]</text>
     <text lang="en">I do believe that it is vital to minimise the grey  areas [...]</text>
     … // more languages

     <annotations>
          <annotation lang="en" type="NASARI" anchor="areas"  lemma="area"
               coherenceScore="0.2247" nasariScore="0.9829"> bn:00005513n</annotation>

          … //more annotations
     </annotations>
</sentence>
```

Additional Corpora (optional)

- You can use additional corpora to improve your sense embeddings
  - SEW (Semantically Enriched Wikipedia)
  - TOM (Train-O-Matic)
  - Anything you can come up with
- Make sure you write how you use them in your report

Remind that the use of ***EuroSense*** is still **mandatory**

Sense Inventory

- You **MUST** create sense embeddings only for the BabelNet synset that are in WordNet
  - All WordNet synsets have a matching BabelNet synset
- We provide you with a file **bn2wn_mapping.txt** which contains the **mapping** from BabelNet synset ids to WordNet offset ids
- For example, each `annotation` of EuroSense refers to a **BabelNet synset**, so you have to consider a synset only if it is in the mapping

BabelNet WordNet mapping

- In order to access the synset in WordNet you can use the nltk API

```
from nltk.corpus import wordnet as wn

offset = “14512817n”
synset = wn.synset_from_pos_and_offset( offset[-1], offset[:-1] )
```

Word Similarity Task

- You have to **test** your sense embeddings on the WordSimilarity-353 dataset (use the *combined.tab* version)

- The task consists of measuring the **similarity** or **relatedness** of pairs of words

- Word similarity datasets consists of a list of pairs of words. For each pair you get a **score** of similarity established by human annotators

Word1	Word2	Gold
tiger	cat	7.35
book	paper	7.46
computer	keyboard	7.62

Word Similarity Task

- In order to perform this task with sense embeddings you have to:
    - For each pair $\boldsymbol{w_1}$, $\boldsymbol{w_2}$
        - $\mathbf{S_1}$ = all sense embeddings associated with word w_1
        - $\mathbf{S_2}$ = all sense embeddings associated with word w_2
        - score = - 1.0
        - For each pair $\mathbf{s_1}$ in S_1 and $\mathbf{s_2}$ in S_2 do
            - *score* = max(score, **cos**(s_1, s_2))

(**cos** == cosine similarity of two vectors)

Word Similarity Task

- Once you calculate the score for each pair you need to check your scores against the gold ones in the dataset

- To do so, you have to calculate the **Spearman** correlation between gold similarity scores and cosine similarity scores

Word1	Word2	Gold	Cosine
tiger	cat	7.35	0.452
book	paper	7.46	0.784
computer	keyboard	7.62	0.643

```
Spearman([7.35, 7.46, 7.62], [0.452, 0.784, 0.643]) = 0.5
```

Word Similarity Task

- The cosine similarity might not be the best score function so feel free to experiment with other metrics (some of them are proposed in the paper)
- If you use some interesting ones make sure you write them in your **report**
- However, we will **evaluate** your embeddings by using the ***cosine*** *similarity*
- We will test your sense embeddings on a **secret** (again!) word similarity dataset

Submission

- You have to submit your sense embeddings by saving them in a single file named **embeddings.vec**
- The *embeddings.vec* file **MUST** respect the word2vec format:

number_of_senses embedding_dimension

lemma1_synset1 dim_1 dim_2 dim_3 … dim_n

lemma2_synset2 dim_1 dim_2 dim_3 … dim_n

- **`space`** (“ ”) is the separator character
- To make sure you save it correctly try to load them using

```python
from gensim.models import KeyedVectors
model = KeyedVectors.load_word2vec_format('embeddings.vec', binary=False)
```

- File formatted in other ways will be directly **discarded**

Submission

The project will have this **structure**:

- Your report in **pdf** format, **2 PAGES** for text and **2 PAGES** for images/tables/references, named **report.pdf**
- A folder with your source code named **code**
- A folder with the *embeddings.vec* file named **resources** and the your model weights
- You should submit **ONLY** one *embeddings.vec* file: if you make some improvements make sure you submit only the best embeddings

Submission

- Register to GitLab (you should have already done that :D)
- Create a new repository (**private**) with name: <**firstname**>**_**<**lastname**>**_**<**matricola**>**_nlp19hw2**
- **Share** the project with us (*MAINTAINER role)*:
  - use ALL the emails on the second slide and
  - navigli@di.uniroma1.it
- The link where you have to submit:

SUBMISSION FORM

How we will grade

The maximum grade for this homework is 34.5 (115% of 30) weighted as follows:

- Quality, comments and cleanness of code [30%]
- Report [63%]
- Overall performance of the system [7%]
    - We will evaluate you on a secret word similarity test set
- **Creativity boost:** Improvements over the model [15%]
    - You will get extra points if you add some effective features to your embeddings, model and similarity measure, in this case we will expect a comparison with the different approaches and meaningful observations on what you experimented

What we expect in the report

- **Describe** any important step you carried out in the **preprocessing** phase (we do not care about small implementation details such as “how to parse an xml”)
- Report the **model** and the parameters you used, plus any implementation choice worth mentioning
- **Describe** the features you added to improve the sense embeddings
- Report some **qualitative analysis** such as nearest neighbours evaluation for a few interesting cases
- Report some **interesting plots** such as the visualization of a sample of the embeddings with t-SNE and/or PCA

Deadlines

- We will upload everything you need to complete this homework Sunday 5 May evening the latest, on the facebook group
- Your deadline for homework 1 will be: **31/05/2019, 23:59** anywhere on Earth
- If you push anything after the deadline you will be get **1 point less** for each day of delay

Competition results

- The competition scores will be published after the homework evaluations
- The **top 5** ranked students will receive another (super!) fancy **BabelNet T-Shirt!**

We will check all your submissions for **plagiarism**!

- If we find that you plagiarised you are **OUT** of this year's course and you cannot take the exam, you will have to sign up for the course next year
- We have a **zero-tolerance** policy for plagiarism!

- **Advice**: start as early as possible to parse the corpora!
- **Parsing** such large files could take days so make sure to perform that step ASAP
- **Memory** is also an issue: you will probably not be able to load the whole corpora into memory with standard libraries, e.g. you will have to load them as suggested

Good luck!

If you have any questions, do not hesitate to post them on the Facebook group