人工智慧文本分析
(Artificial Intelligence for Text Analytics)
語意分析和命名實體識別
(Semantic Analysis and Named Entity Recognition; NER)

Tamkang University
淡江大學

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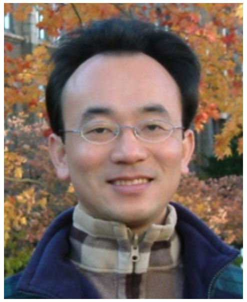

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2020-05-13

課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
1	2020/03/04	人工智慧文本分析課程介紹 (Course Orientation on Artificial Intelligence for Text Analytics)
2	2020/03/11	文本分析的基礎：自然語言處理 (Foundations of Text Analytics: Natural Language Processing; NLP)
3	2020/03/18	Python自然語言處理 (Python for Natural Language Processing)
4	2020/03/25	處理和理解文本 (Processing and Understanding Text)
5	2020/04/01	文本表達特徵工程 (Feature Engineering for Text Representation)
6	2020/04/08	人工智慧文本分析個案研究 I (Case Study on Artificial Intelligence for Text Analytics I)

課程大綱 (Syllabus)

週次 (Week)　日期 (Date)　內容 (Subject/Topics)

7　2020/04/15　文本分類 (Text Classification)

8　2020/04/22　文本摘要和主題模型
(Text Summarization and Topic Models)

9　2020/04/29　期中報告 (Midterm Project Report)

10　2020/05/06　文本相似度和分群 (Text Similarity and Clustering)

11　2020/05/13　語意分析和命名實體識別
(Semantic Analysis and Named Entity Recognition; NER)

12　2020/05/20　情感分析 (Sentiment Analysis)

課程大綱 (Syllabus)

週次 (Week)　日期 (Date)　內容 (Subject/Topics)

13　2020/05/27　人工智慧文本分析個案研究 II
(Case Study on Artificial Intelligence for Text Analytics II)

14　2020/06/03　深度學習和通用句子嵌入模型
(Deep Learning and Universal Sentence-Embedding Models)

15　2020/06/10　問答系統與對話系統
(Question Answering and Dialogue Systems)

16　2020/06/17　期末報告 I (Final Project Presentation I)

17　2020/06/24　期末報告 II (Final Project Presentation II)

18　2020/07/01　教師彈性補充教學

Semantic Analysis and Named Entity Recognition (NER)

Outline

- Semantic Analysis
  - WordNet
  - Word sense disambiguation
- Named Entity Recognition (NER)

Semantic Analysis

- **Semantics**
  - the study of meaning
- **Linguistic semantics**
  - the study of meaning in natural language.

Semantic Analysis and NER

- WordNet and synsets
  - Analyzing lexical semantic relations
  - Word sense disambiguation
- Named entity recognition
- Analyzing semantic representations

Source: Dipanjan Sarkar (2019), Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition. APress.

WordNet
A Lexical Database for English

PRINCETON UNIVERSITY

WordNet

A Lexical Database for English

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What is WordNet?

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About WordNet

WordNet® is a large lexical database of English. Nouns, verbs, adjectives and adverbs are grouped into sets of cognitive synonyms (synsets), each expressing a distinct concept. Synsets are interlinked by means of conceptual-semantic and lexical relations. The resulting network of meaningfully related words and concepts can be navigated with the browser. WordNet is also freely and publicly available for download. WordNet's structure makes it a useful tool for computational linguistics and natural language processing.

WordNet superficially resembles a thesaurus, in that it groups words together based on their

Note

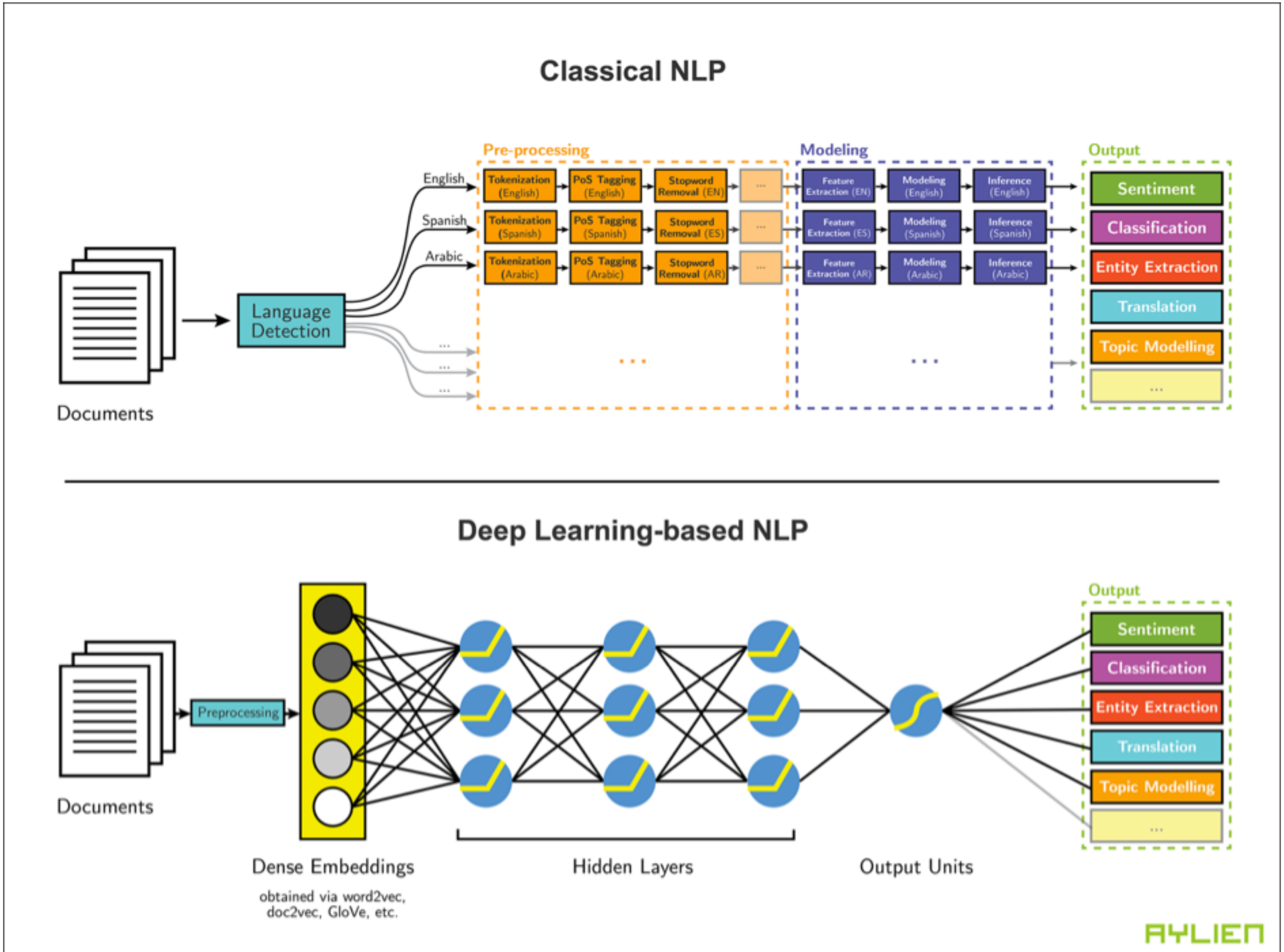
Due to funding and staffing issues, we are no longer able to accept comment and suggestions.

We get numerous questions regarding topics that are addressed on our FAQ page. If you have a problem or question regarding something you downloaded from the "Related projects" page, you must contact the developer directly.

Please note that any changes

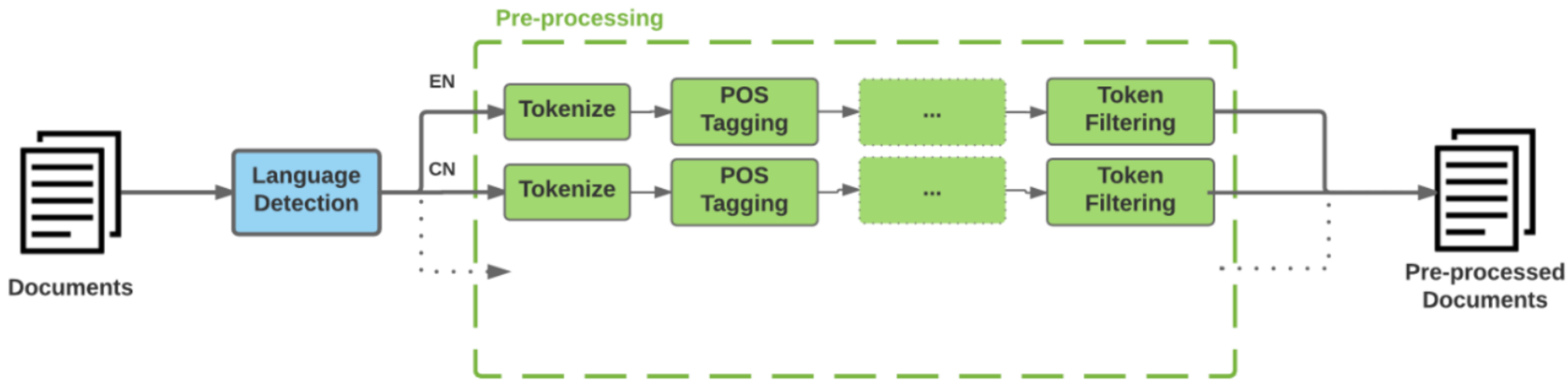
https://wordnet.princeton.edu/

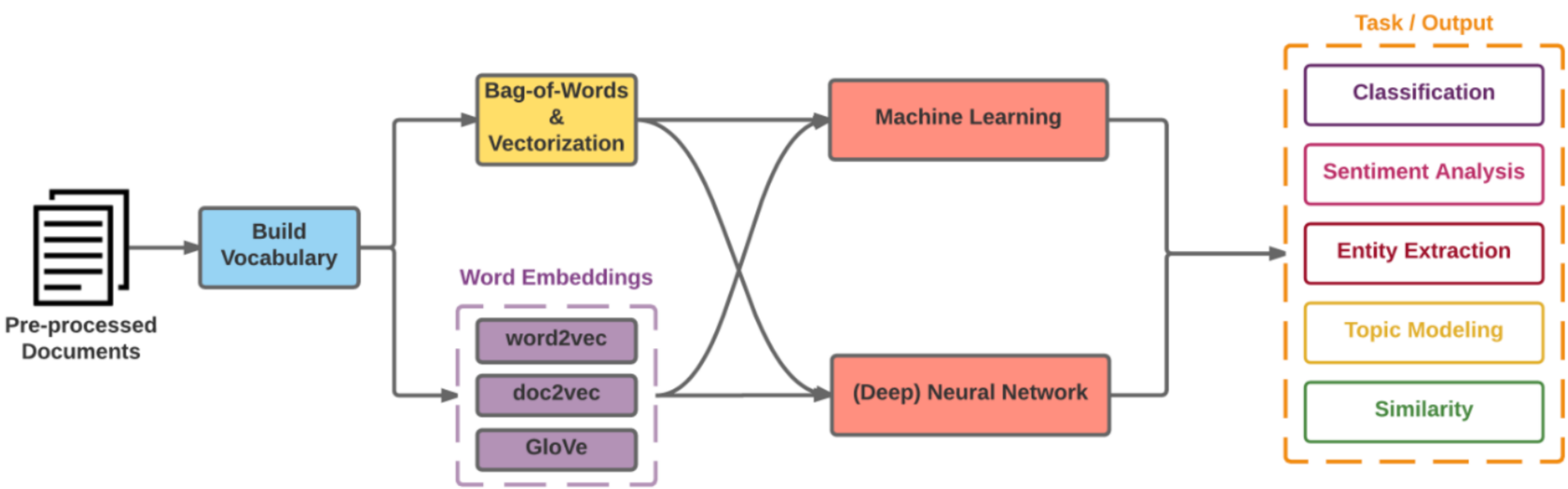
NLP



Source: http://blog.aylien.com/leveraging-deep-learning-for-multilingual/

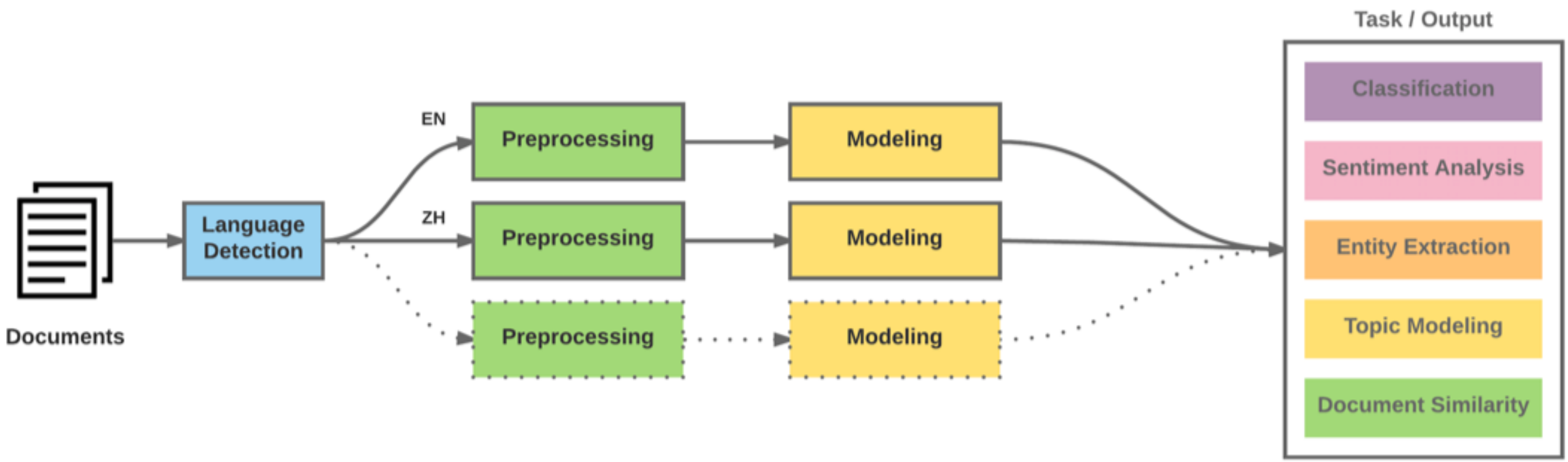
Modern NLP Pipeline





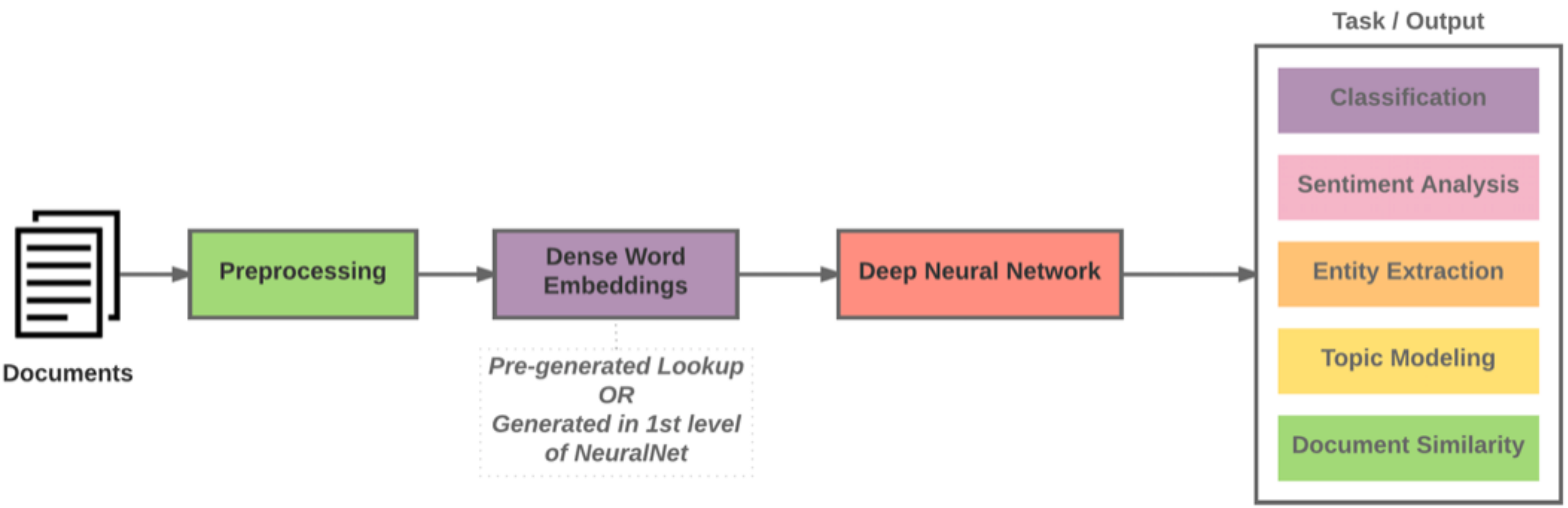
Source: https://github.com/fortiema/talks/blob/master/opendata2016sh/pragmatic-nlp-opendata2016sh.pdf

Modern NLP Pipeline



Source: http://mattfortier.me/2017/01/31/nlp-intro-pt-1-overview/

Deep Learning NLP



Source: http://mattfortier.me/2017/01/31/nlp-intro-pt-1-overview/

Natural Language Processing (NLP) and Text Mining

- Raw text
- Sentence Segmentation
- Tokenization
- Part-of-Speech (POS)
- Stop word removal
- Stemming / Lemmatization
- Dependency Parser
- String Metrics & Matching

word's stem	word's lemma
am → am	am → be
having → hav	having → have

Source: Nitin Hardeniya (2015), NLTK Essentials, Packt Publishing; Florian Leitner (2015), Text mining - from Bayes rule to dependency parsing

Analyzing Lexical Semantic Relationships

- Entailments
- Homonyms and Homographs
- Synonyms and Antonyms
- Hyponyms and Hypernyms
- Holonyms and Meronyms
- Semantic Relationships and Similarity

Source: Dipanjan Sarkar (2019), Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition. APress.

Word Sense Disambiguation

- Lesk algorithm (Lesk, 1986)
  - leverage dictionary or vocabulary definitions for a word we want to disambiguate in a body of text and compare the words in these definitions with a section of text surrounding our word of interest.
  - The main objective is to return the synset with the maximum number of overlapping words or terms between the context sentence and the different definitions from each synset for the word we target for disambiguation.

Source: Dipanjan Sarkar (2019), Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition. APress.

Named Entity Recognition (NER)

- **Named entities**
  - represent real-world objects
  - people, places, organizations
  - proper names
- **Named entity recognition**
  - Entity chunking
  - Entity extraction

NER: OntoNotes 5 Named Entities

SID	TYPE	DESCRIPTION
1	PERSON	People, including fictional.
2	NORP	Nationalities or religious or political groups.
3	FAC	Buildings, airports, highways, bridges, etc.
4	ORG	Companies, agencies, institutions, etc.
5	GPE	Countries, cities, states.
6	LOC	Non-GPE locations, mountain ranges, bodies of water.
7	PRODUCT	Objects, vehicles, foods, etc. (Not services.)
8	EVENT	Named hurricanes, battles, wars, sports events, etc.
9	WORK_OF_ART	Titles of books, songs, etc.
10	LAW	Named documents made into laws.
11	LANGUAGE	Any named language.
12	DATE	Absolute or relative dates or periods.
13	TIME	Times smaller than a day.
14	PERCENT	Percentage, including ”%“.
15	MONEY	Monetary values, including unit.
16	QUANTITY	Measurements, as of weight or distance.
17	ORDINAL	“first”, “second”, etc.
18	CARDINAL	Numerals that do not fall under another type.

Source: https://spacy.io/api/annotation#named-entities

NER: Wikipedia Named Entities

SID	TYPE	DESCRIPTION
1	PER	Named person or family.
2	LOC	Name of politically or geographically defined location (cities, provinces, countries, international regions, bodies of water, mountains).
3	ORG	Named corporate, governmental, or other organizational entity.
4	MISC	Miscellaneous entities, e.g. events, nationalities, products or works of art.

Source: https://spacy.io/api/annotation#named-entities

NER IOB Scheme

TAG	ID	DESCRIPTION
"I"	1	Token is inside an entity.
"O"	2	Token is outside an entity.
"B"	3	Token begins an entity.
""	0	No entity tag is set (missing value).

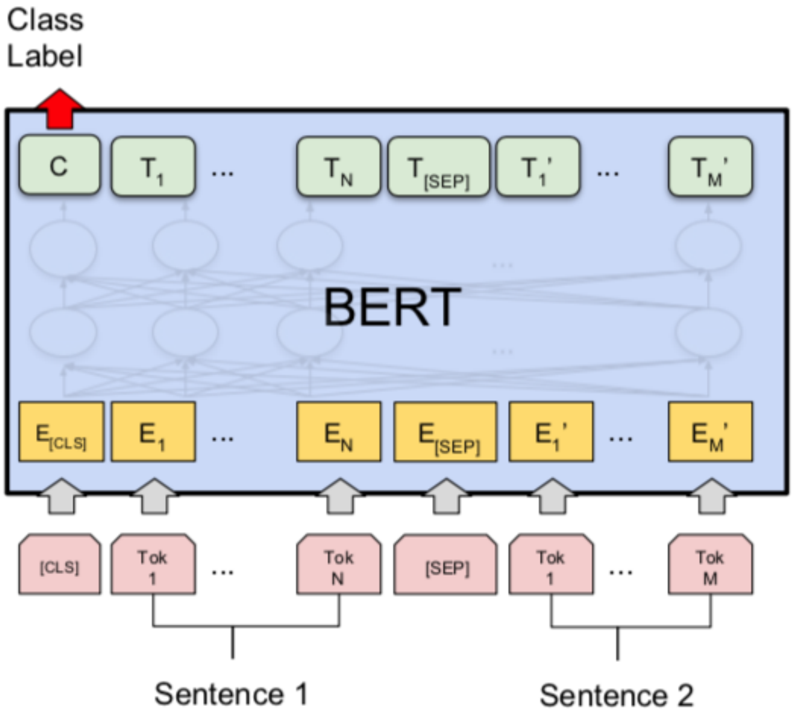
Source: https://spacy.io/api/annotation#named-entities

NER **BILUO** Scheme

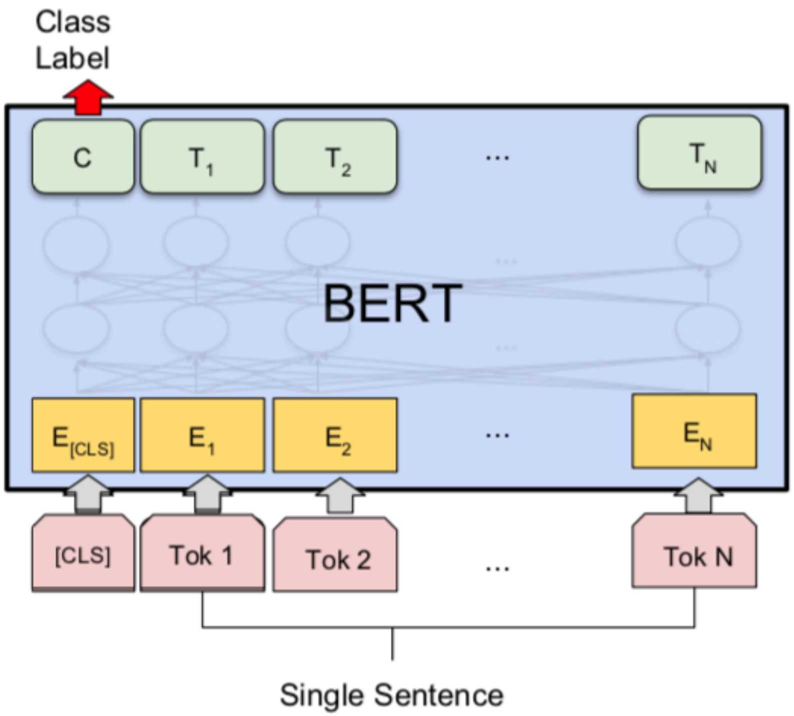
TAG	DESCRIPTION
BEGIN	The first token of a multi-token entity.
IN	An inner token of a multi-token entity.
LAST	The final token of a multi-token entity.
UNIT	A single-token entity.
OUT	A non-entity token.

Source: https://spacy.io/api/annotation#named-entities

BERT Sequence-level tasks



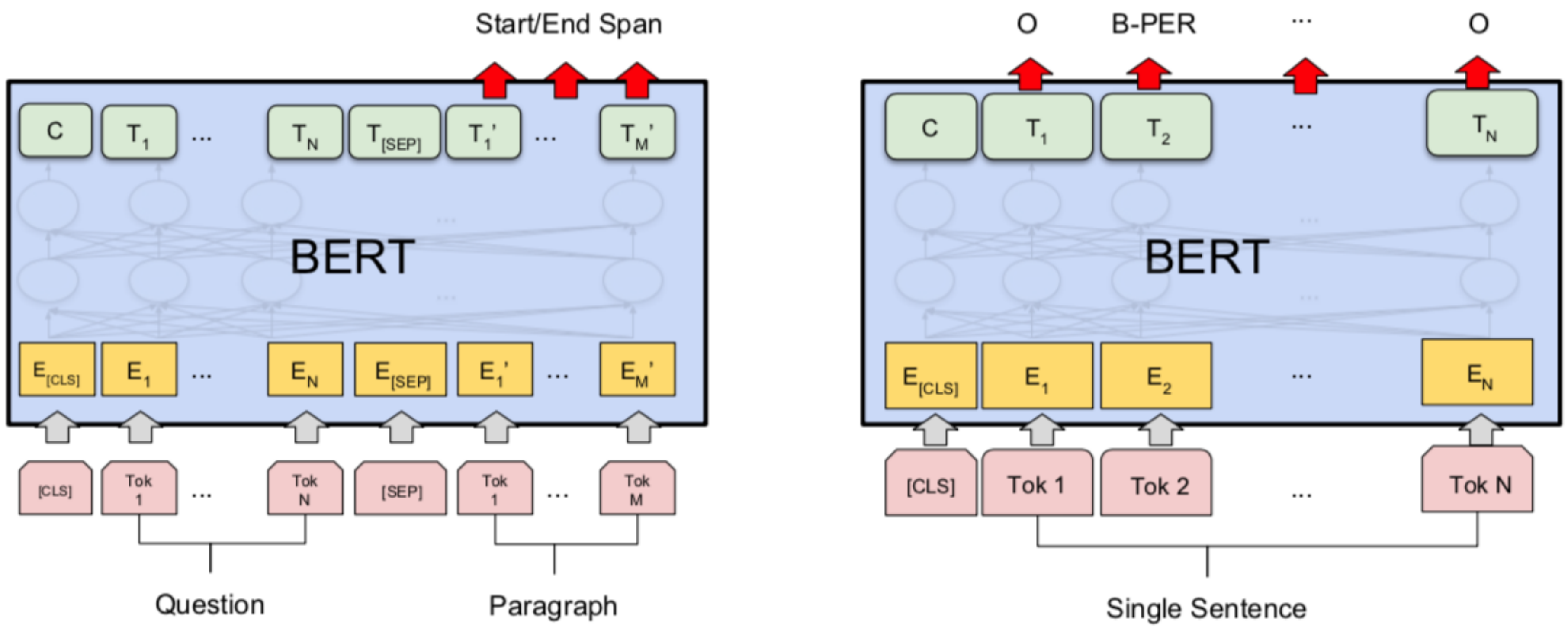
(a) Sentence Pair Classification Tasks: MNLI, QQP, QNLI, STS-B, MRPC, RTE, SWAG



(b) Single Sentence Classification Tasks: SST-2, CoLA

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018). "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding." arXiv preprint arXiv:1810.04805

BERT Token-level tasks

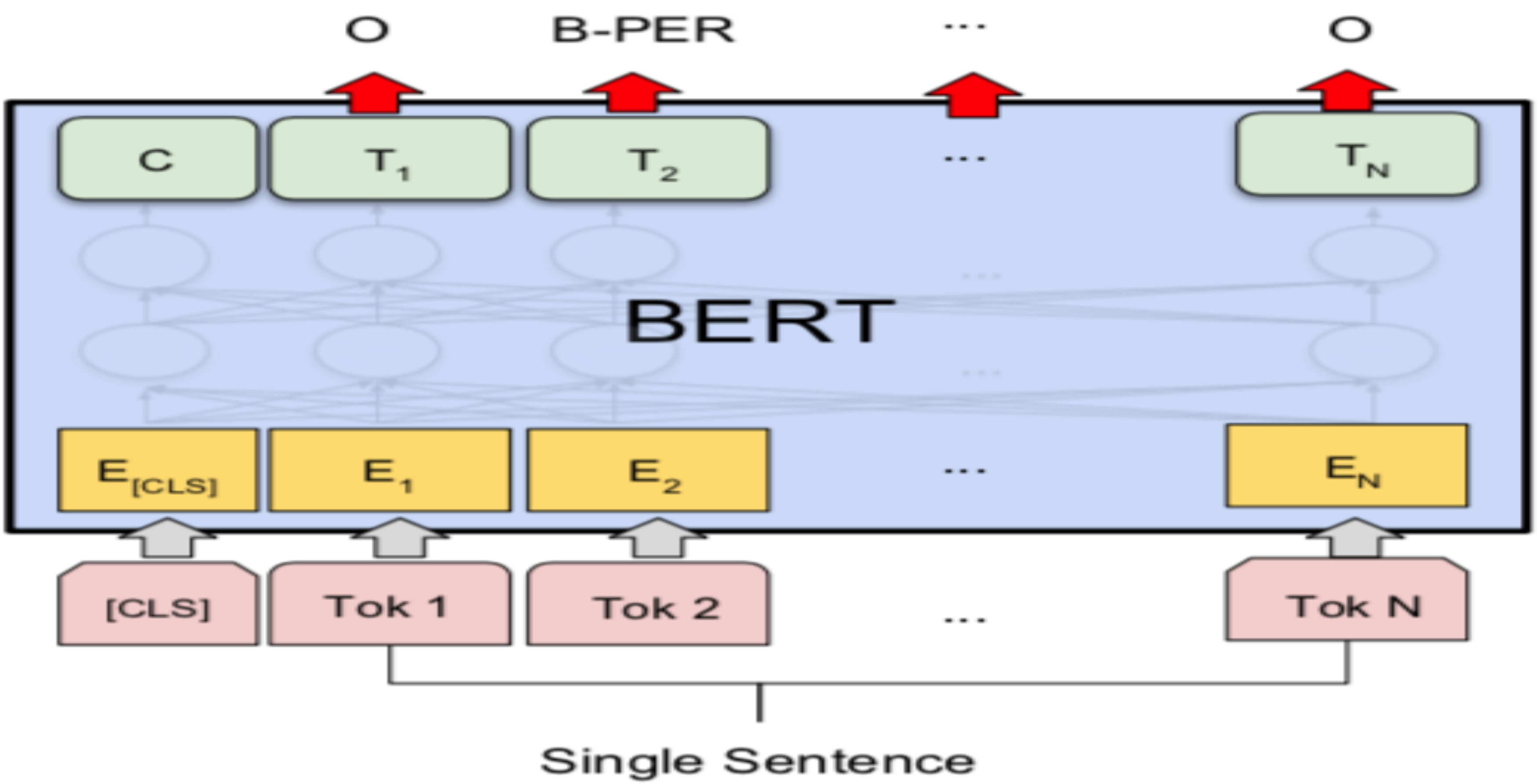


(c) Question Answering Tasks:
SQuAD v1.1

(d) Single Sentence Tagging Tasks:
CoNLL-2003 NER

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018).
"BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding." arXiv preprint arXiv:1810.04805

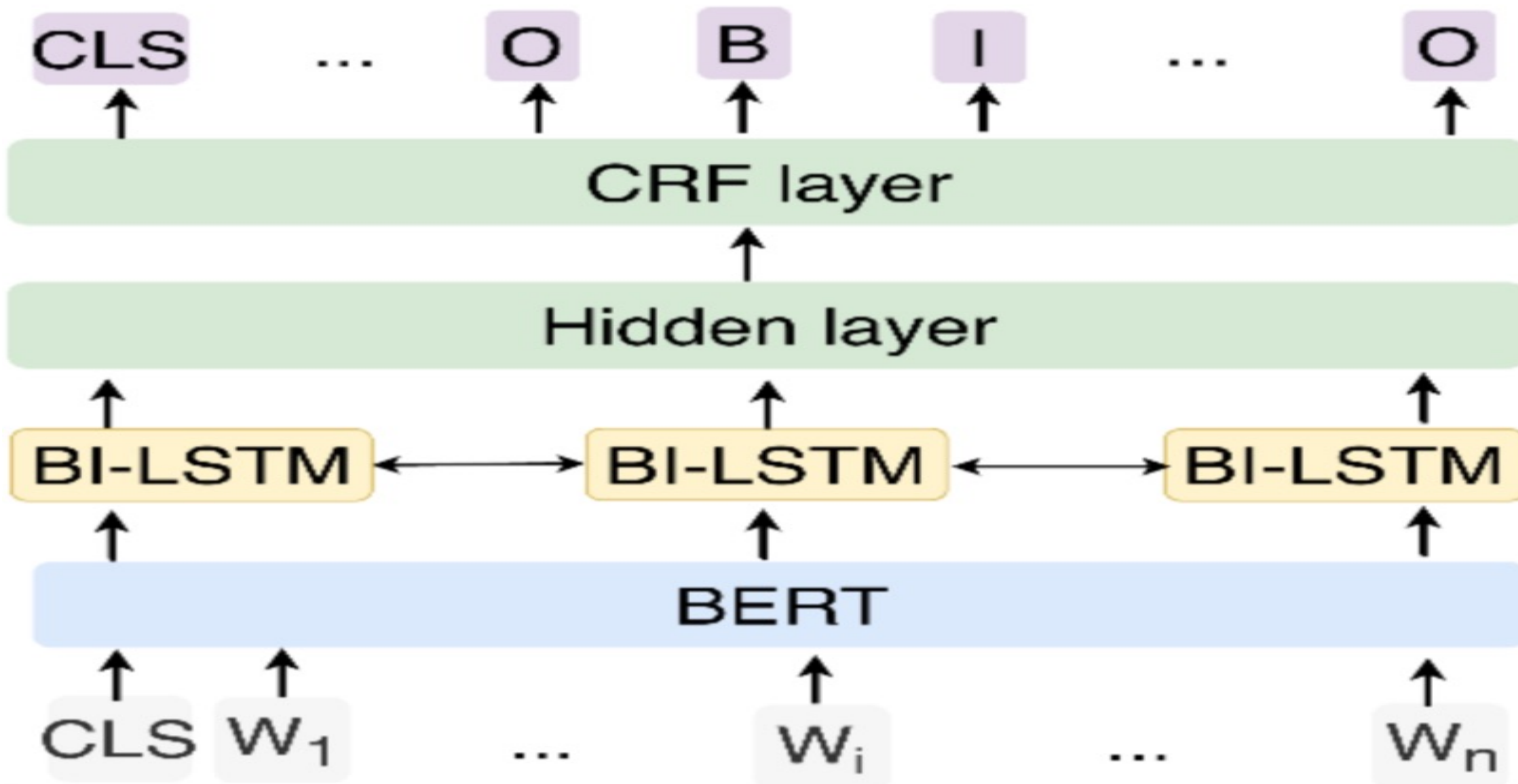
NER: Single Sentence Tagging



(d) Single Sentence Tagging Tasks: CoNLL-2003 NER

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018).
"BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding." arXiv preprint arXiv:1810.04805

NER: Fine-tuning BERT with Bi-LSTM CRF



Source: Zhang, Xiaohui, Yaoyun Zhang, Qin Zhang, Yuankai Ren, Tinglin Qiu, Jianhui Ma, and Qiang Sun. "Extracting comprehensive clinical information for breast cancer using deep learning methods." International Journal of Medical Informatics 132 (2019): 103985.

Python in Google Colab (Python101)

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

python101.ipynb

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Semantic Analysis and Named Entity Recognition (NER)

- Source: Dipanjan Sarkar (2019), Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition. APress. https://github.com/Apress/text-analytics-w-python-2e

Semantic Analysis

[1]

```python
import nltk
from nltk.corpus import wordnet as wn
import pandas as pd
nltk.download('wordnet')
# WordNet Synsets
word = 'fruit'
synsets = wn.synsets(word)
print('Word:', word)
print('Wordnet Synsets:', len(synsets))
df = pd.DataFrame([{'Synset': synset,
                    'Part of Speech': synset.lexname(),
                    'Definition': synset.definition(),
                    'Lemmas': synset.lemma_names(),
                    'Examples': synset.examples()}
                   for synset in synsets])
df
```

```
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Unzipping corpora/wordnet.zip.
Word: fruit
Wordnet Synsets: 5
```

	Synset	Part of Speech	Definition	Lemmas	Examples
0	Synset('fruit.n.01')	noun.plant	the ripened reproductive body of a seed plant	[fruit]	[]
1	Synset('yield.n.03')	noun.artifact	an amount of a product	[yield, fruit]	[]

https://tinyurl.com/imtkupython101

Python in Google Colab (Python101)

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

https://tinyurl.com/imtkupython101

Summary

- Semantic Analysis
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  - Word sense disambiguation
- Named Entity Recognition (NER)

References

- Dipanjan Sarkar (2019),
  Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition. APress. https://github.com/Apress/text-analytics-w-python-2e
- Benjamin Bengfort, Rebecca Bilbro, and Tony Ojeda (2018),
  Applied Text Analysis with Python, O'Reilly Media.
  https://www.oreilly.com/library/view/applied-text-analysis/9781491963036/
- HuggingFace (2020), Transformers Notebook,
  https://huggingface.co/transformers/notebooks.html
- The Super Duper NLP Repo, https://notebooks.quantumstat.com/
- Min-Yuh Day (2020), Python 101, https://tinyurl.com/imtkupython101