Textual Data Preparation for Analytics

CPE 393: Text Analytics

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Update

Week	Topics	Remarks
[1] 18/01	Introduction to Text Analytics	
[2] 25/01	Pattern Matching	
[3] 01/02	Textual Data Visualization	
[4] 08/02	Web Scraping	
[5] 15/02	Textual Data Preparation for Analytics	
[6] 22/02	Textual Feature Representation	
[7] 29/02	-	Exam prep
[8] 07/03	**Midterm Exam**	
[9] 14/03	Text Classification	Proposal due
[10] 21/03	Text Clustering	
[11] 28/03	Topic Modeling	
[12] 04/04	Text Summarization	
[13] 11/04	**Holiday**	
[14] 18/04	Advanced Topic in Text Analytics	Progress report
[15] 25/04	-	Work on project
[16] 02/05	-	Work on project
[17] 09/05	Project Presentation	Project due
[18] 16/05	**Final Exam**	

Intro

Pattern Matching

Text Visualization

Web Scraping

Text Preparation

Text Feature Representation

Text Classification

Text Clustering

Topic Modeling

Extractive Summarization

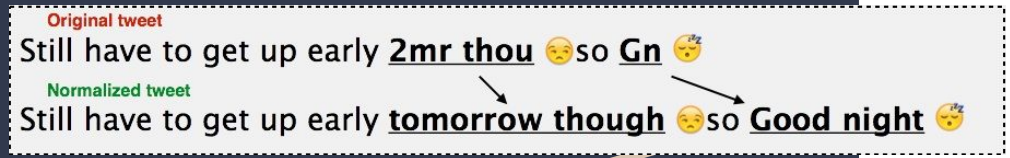
Abstractive Summarization

???

Outline

- Challenge from textual Data as-is
- Textual data preparation
  - Cleaning
  - Pre-processing

Nature of Textual Data



- Sequence of characters (tokens)
- Unstructured
- Constantly evolving
- Challenges are from:
  - Informal settings
    - e.g. social media, SMS, etc.
    - Brief and informal
  - Automatic speech recognition
  - Optical character recognition

Noises in Textual Data

More examples:

- Social media post

Hellooooooooo

- Fat finger error
- HTML tags
- Frequent words (e.g. stopwords)

```
> stopwords("english")
  [1] "i"          "me"         "my"         "myself"     "we"
  [6] "our"        "ours"       "ourselves"  "you"        "your"
 [11] "yours"      "yourself"   "yourselves" "he"         "him"
 [16] "his"        "himself"    "she"        "her"        "hers"
 [21] "herself"    "it"         "its"        "itself"     "they"
 [26] "them"       "their"      "theirs"     "themselves" "what"
 [31] "which"      "who"        "whom"       "this"       "that"
 [36] "these"      "those"      "am"         "is"         "are"
 [41] "was"        "were"       "be"         "been"       "being"
 [46] "have"       "has"        "had"        "having"     "do"
```

Ref: https://www.helpling.com.sg/before-vs-after-cleaning-pictures

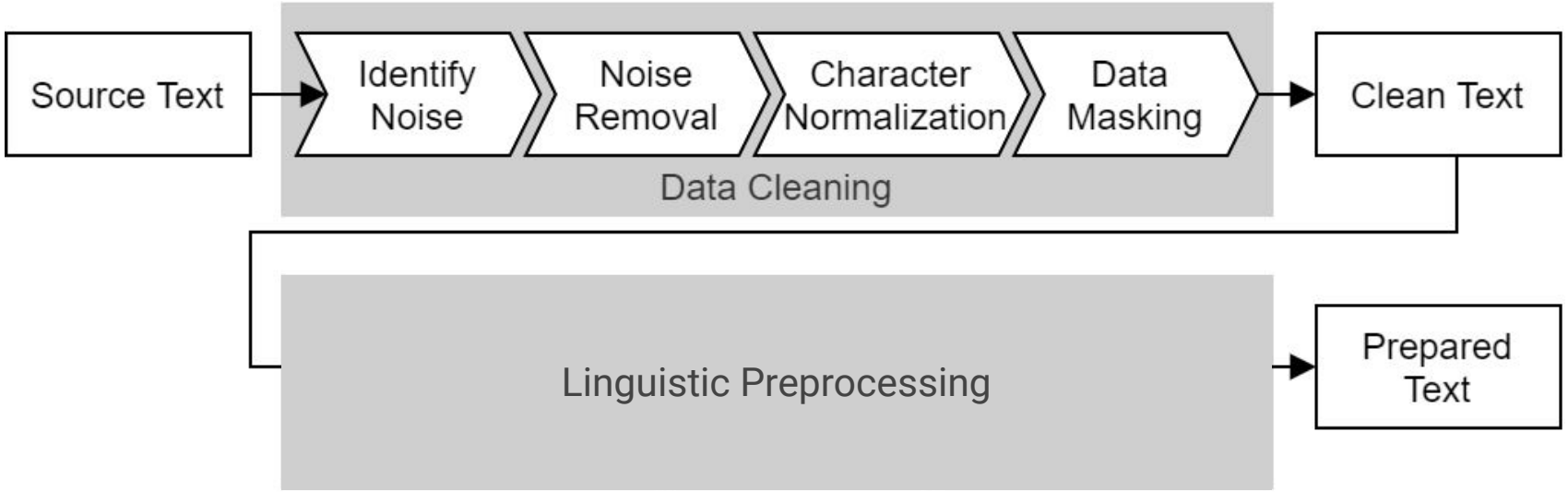
Pre-processing

(Revisiting Lecture 3)

Common Techniques:

- Tokenization
- Stopword removal
- Lemmatization (or stemming)
- Special characters

Textual Data Preprocessing ***Pipeline***



Ref:https://github.com/blueprints-for-text-analytics-python/blueprints-text/tree/master/ch04

Text Cleaning

- Noise removal
- Character normalization
- Data masking

Handling Noises

- Addressing stopwords
- Removing HTML Tags, Special Characters
- Handling Capitalization, Punctuation
- Eliminating Non-Alphabetic Characters

Let's try with short sentence first.

```
[10] # Example text
     text = "This is an example sentence with some stopwords."

     # Tokenize the text
     words = word_tokenize(text)

     # Get the English stopwords from NLTK
     stop_words = set(stopwords.words('english'))

     # Remove stopwords
     filtered_words = [word for word in words if word.lower() not in stop_words]

     # Print the original and filtered words
     print("Original Words:", words)
     print("\nFiltered Words:", filtered_words)
```

```
Original Words: ['This', 'is', 'an', 'example', 'sentence', 'with', 'some', 'stopwords', '.']

Filtered Words: ['example', 'sentence', 'stopwords', '.']
```

Remove stopwords

```
[15] # Example HTML text with tags and formatting
     html_text = """
     <!DOCTYPE html>
     <html>
     <head>
     <title>Sample HTML</title>
     </head>
     <body>
     <h1>Welcome to my website</h1>
     <p>This is a <b>sample</b> paragraph with <i>formatting</i>.</p>
     <p>Here's a <a href="https://example.com">link</a> to another page.</p>
     </body>
     </html>
     """
```

```
[16] from bs4 import BeautifulSoup
     import re

     def clean_html_tags(text):
         # Initialize BeautifulSoup with the HTML text
         soup = BeautifulSoup(text, 'html.parser')

         # Remove all HTML tags
         clean_text = soup.get_text(separator=' ')

         # Remove extra whitespace
         clean_text = re.sub(r'\s+', ' ', clean_text).strip()

         return clean_text
```

Removing HTML Tags

```
[24] import re

     def clean_punctuation(text):
         # Define a regular expression pattern to match punctuation and special characters
         # Matches any character that is not a word character (\w), space (\s), or underscore (_)
         punctuation_pattern = re.compile(r'[^\w\s]|_')

         # Replace punctuation and special characters with an empty string
         cleaned_text = re.sub(punctuation_pattern, '', text)

         return cleaned_text

     # Example text with punctuation and special characters
     text_with_punctuation = "Hello! How are you doing? I'm doing fine, thank you!"

     # Clean punctuation and special characters
     cleaned_text = clean_punctuation(text_with_punctuation)
     print(cleaned_text)
```

```
Hello How are you doing Im doing fine thank you
```

Clean special characters

```
import html

def clean(text):
    # convert html escapes like &amp; to characters.
    text = html.unescape(text)
    # tags like <tab>
    text = re.sub(r'<[^<>]*>', ' ', text)
    # markdown URLs like [Some text](https://....)
    text = re.sub(r'\[([^\[\]]*)\]\([^\(\)]*\)', r'\1', text)
    # text or code in brackets like [0]
    text = re.sub(r'\[[^\[\]]*\]', ' ', text)
    # standalone sequences of specials, matches &# but not #cool
    text = re.sub(r'(?:^|\s)[&#<>{}\[\]+|\\:-]{1,}(?:\s|$)', ' ', text)
    # standalone sequences of hyphens like --- or ==
    text = re.sub(r'(?:^|\s)[\-=\+]{2,}(?:\s|$)', ' ', text)
    # sequences of white spaces
    text = re.sub(r'\s+', ' ', text)
    return text.strip()
```

Remove noise with RegEx

Character Normalization

The process of transforming characters in text data to a standardized form

- Unicode
- Lowercase/Uppercase
- Diacritics, accents, or other variations

DIACRITICS					
´	(é)	acute accent	˘	(ŭ)	breve
`	(è)	grave accent	ˇ	(č)	haček
^	(ô)	circumflex	¨	(naïve)	diaeresis
~	(ñ)	tilde	¨	(glögg)	umlaut
¯	(ō)	macron	¸	(ç)	cedilla

```
[25] import unicodedata

     def normalize_characters(text):
         # Normalize text by decomposing Unicode characters and then removing combining characters
         normalized_text = unicodedata.normalize('NFKD', text).encode('ascii', 'ignore').decode('utf-8')

         # Convert text to lowercase
         normalized_text = normalized_text.lower()

         return normalized_text

     # Example text with accented characters
     text_with_accented_characters = "Café au Lait"

     # Normalize characters
     normalized_text = normalize_characters(text_with_accented_characters)
     print(normalized_text)


     cafe au lait
```

Character normalization

```
text = "The café “Saint-Raphaël” is loca-\nted on Côte d’Azur."
text
```

```
import textacy
import textacy.preprocessing as tprep

if textacy.__version__ < '0.11':
    # as in book
    def normalize(text):
        text = tprep.normalize_hyphenated_words(text)
        text = tprep.normalize_quotation_marks(text)
        text = tprep.normalize_unicode(text)
        text = tprep.remove_accents(text)
        return text

else:
    # adjusted to textacy 0.11
    def normalize(text):
        text = tprep.normalize.hyphenated_words(text)
        text = tprep.normalize.quotation_marks(text)
        text = tprep.normalize.unicode(text)
        text = tprep.remove.accents(text)
        return text
```

```
print(normalize(text))
```

```
The cafe "Saint-Raphael" is located on Cote d'Azur.
```

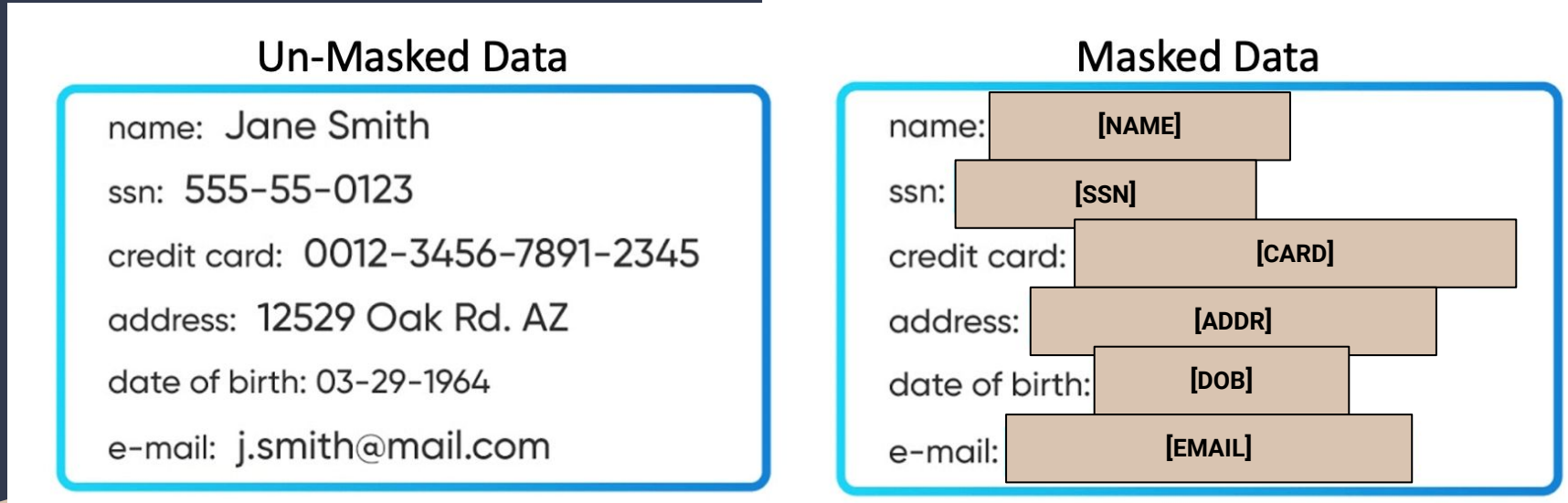
Character normalization

Function	Description
normalize_hyphenated_words	Reassembles words that were separated by a line break
normalize_quotation_marks	Replace all kind of fancy quotation marks with an ASCII equivalent
normalize_Unicode	Unifies different codes of accented characters in Unicode
remove_accents	Replaces accented characters with ASCII, if possible, or drops them
replace_urls	Similar for URLs like https://xyz.com
replace_emails	Replace emails with _EMAIL_
replace_hashtags	Similar for tags like #sunshine
replace_numbers	Similar for numbers like 12345
replace_phone_numbers	Similar for telephone number +1 800 456-6553
replace_user_handles	Similar for user handles like @pete
replace_emojis	Replaces smiley etc. with _EMOJI_

Preprocessing functions of Textacy

Data *Masking*

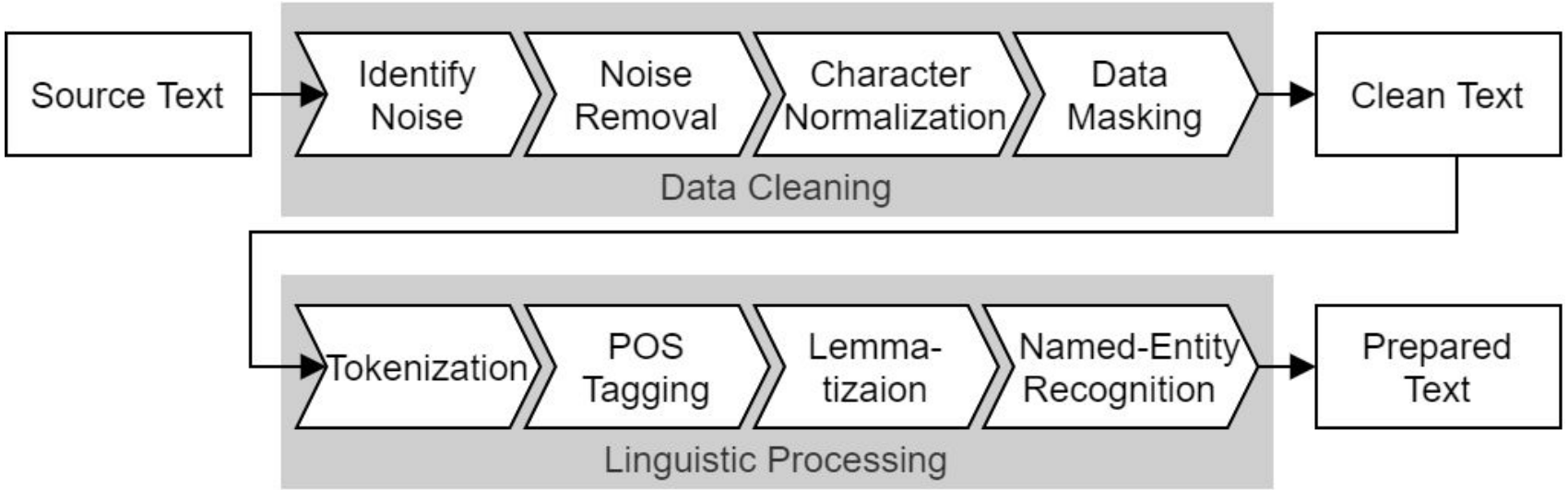
A process of replacing sensitive information with generic placeholders to protect privacy.



```
[36] import re

     def mask_email_addresses(text):
         # Define a regular expression pattern to match email addresses
         email_pattern = re.compile(r'\b[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Z|a-z]{2,}\b')

         # Replace email addresses with a generic placeholder
         masked_text = re.sub(email_pattern, '[EMAIL]', text)

         return masked_text

     def mask_phone_numbers(text):
         # Define a regular expression pattern to match phone numbers
         phone_pattern = re.compile(r'(\d{3})-(\d{3})-(\d{4})')

         # Replace phone numbers with a generic placeholder
         masked_text = re.sub(phone_pattern, '[PHONE]', text)

         return masked_text

     # Example text with email addresses and phone numbers
     text_with_sensitive_info = "Please contact me at john.doe@example.com or 123-456-7890. Thank you!"

     # Mask sensitive information
     masked_text = mask_email_addresses(text_with_sensitive_info)
     masked_text = mask_phone_numbers(masked_text)
     print(masked_text)

     Please contact me at [EMAIL] or [PHONE]. Thank you!
```

Data masking

Textual Data Preprocessing ***Pipeline***



Ref:https://github.com/blueprints-for-text-analytics-python/blueprints-text/tree/master/ch04

Linguistic (Text)

Preprocessing

- Tokenization
- Lemmatization
- POS tagging
- Name-Entity Recognition (NER)

POS Tagging

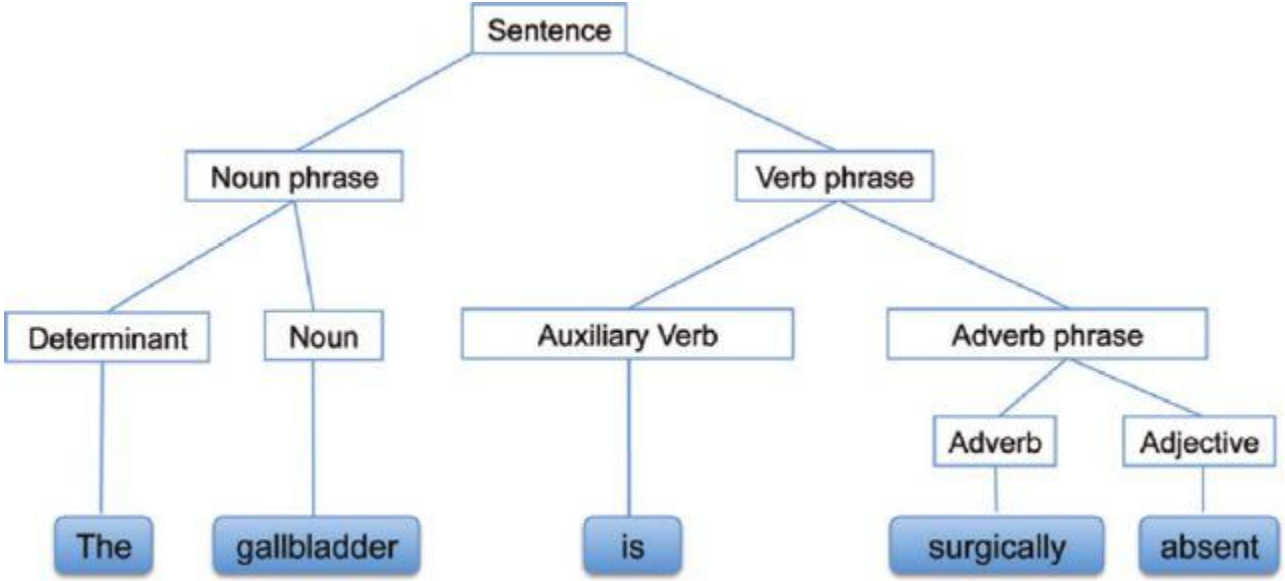
Ref:
https://dataingovernment.blog.gov.uk/2019/06/14/natural-language-processing-in-government/

The process of assigning grammatical categories.

- Noun
- Verb
- Adjective
- Adverb
- etc.

based on its definition and its context within the sentence.

Useful for NLP tasks such as syntax parsing, text analysis, and information extraction.



Syntactic analysis of the sentence

3 List of tags with corresponding part of speech

This section contains a list of tags in alphabetical order and the parts of speech corresponding to them.

1.	CC	Coordinating conjunction
2.	CD	Cardinal number
3.	DT	Determiner
4.	EX	Existential *there*
5.	FW	Foreign word
6.	IN	Preposition or subordinating conjunction
7.	JJ	Adjective
8.	JJR	Adjective, comparative
9.	JJS	Adjective, superlative
10.	LS	List item marker
11.	MD	Modal
12.	NN	Noun, singular or mass
13.	NNS	Noun, plural
14.	NNP	Proper noun, singular
15.	NNPS	Proper noun, plural
16.	PDT	Predeterminer
17.	POS	Possessive ending
18.	PRP	Personal pronoun
19.	PRP$	Possessive pronoun
20.	RB	Adverb
21.	RBR	Adverb, comparative
22.	RBS	Adverb, superlative
23.	RP	Particle
24.	SYM	Symbol
25.	TO	*to*
26.	UH	Interjection
27.	VB	Verb, base form
28.	VBD	Verb, past tense
29.	VBG	Verb, gerund or present participle
30.	VBN	Verb, past participle
31.	VBP	Verb, non-3rd person singular present
32.	VBZ	Verb, 3rd person singular present
33.	WDT	Wh-determiner
34.	WP	Wh-pronoun
35.	WP$	Possessive wh-pronoun
36.	WRB	Wh-adverb

List of tags (Ref: https://www.cis.upenn.edu/~bies/manuals/tagguide.pdf)

```
[51] import spacy

     # Load the English language model
     nlp = spacy.load("en_core_web_sm")

     def pos_tagging(text):
         # Process the text using spaCy
         doc = nlp(text)

         # Extract POS tags for each token in the text
         pos_tags = [(token.text, token.pos_) for token in doc]

         return pos_tags

     # Example text
     text = "I love eating pizza with my friends"

     # Perform POS tagging
     pos_tags = pos_tagging(text)
     print(pos_tags)
```

('I', 'PRON')

('love', 'VERB')

('eating', 'VERB')

('pizza', 'NOUN')

('with', 'ADP')

('my', 'PRON')

('friends', 'NOUN')

Part-of-speech tagging

Name-Entity Recognition

The process of identifying and classifying named entities in text into predefined categories

- Person
- Organization
- Location
- Date
- Quantity
- etc.

The purpose of NER task is to:

- Extract and classify entities mentioned in text data
- Understand the context and extract structured information from unstructured text

contentSkip to site indexPoliticsSubscribeLog InSubscribeLog InToday's PaperAdvertisementSupported ORG byF.B.I. Agent Peter Strzok PERSON , Who Criticized Trump PERSON in Texts, Is FiredImagePeter Strzok, a top F.B.I. GPE counterintelligence agent who was taken off the special counsel investigation after his disparaging texts about President Trump PERSON were uncovered, was fired. CreditT.J. Kirkpatrick PERSON for The New York TimesBy Adam Goldman ORG and Michael S. SchmidtAug PERSON . 13 CARDINAL , 2018WASHINGTON CARDINAL — Peter Strzok PERSON , the F.B.I. GPE senior counterintelligence agent who disparaged President Trump PERSON in inflammatory text messages and helped oversee the Hillary Clinton PERSON email and Russia GPE investigations, has been fired for violating bureau policies, Mr. Strzok PERSON 's lawyer said Monday DATE .Mr. Trump and his allies seized on the texts — exchanged during the 2016 DATE campaign with a former F.B.I. GPE lawyer, Lisa Page — in PERSON assailing the Russia GPE investigation as an illegitimate "witch hunt." Mr. Strzok PERSON , who rose over 20 years DATE at the F.B.I. GPE to become one of its most experienced counterintelligence agents, was a key figure in the early months DATE of the inquiry.Along with writing the texts, Mr. Strzok PERSON was accused of sending a highly sensitive search warrant to his personal email account.The F.B.I. GPE had been under immense political pressure by Mr. Trump PERSON to dismiss Mr. Strzok PERSON , who was removed last summer DATE from the staff of the special counsel, Robert S. Mueller III PERSON . The president has repeatedly denounced Mr. Strzok PERSON in posts on

NER example

```python
import spacy

# Load the English language model
nlp = spacy.load("en_core_web_sm")

def ner(text):
    # Process the text using spaCy
    doc = nlp(text)

    # Extract named entities from the processed text
    entities = [(entity.text, entity.label_) for entity in doc.ents]

    return entities

# Example text
text = "KMUTT is located in Bangkok, Thailand."

# Perform NER
named_entities = ner(text)
print(named_entities)
```

```
[('KMUTT', 'ORG'), ('Bangkok', 'GPE'), ('Thailand', 'GPE')]
```

NER application

Conclusion

- Challenge from textual Data as-is
- Text Cleaning
  - Noise removal
  - Character normalization
  - Data masking
- Text Preparation
  - Tokenization
  - Lemmatization
  - POS tagging
  - Name-Entity Recognition (NER)

Lab

(30 mins)

- Pick a forum from one of the websites below:
  - Stackoverflow
    https://stackoverflow.com/
  - Ubuntu forum
    https://ubuntuforums.org/
- Select ONE question and ONE answer from that forum *(medium to long in length)*
- Apply what we have learned today:
  - Clean (at least 2 techniques)
  - Preprocess (at least 2 techniques)

Q & A