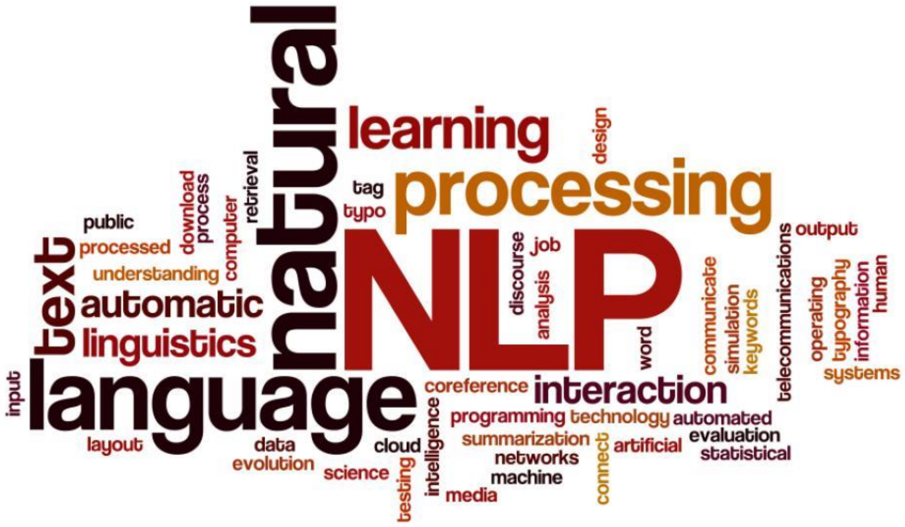
Introduction to NLP

CSX4210/INX4210 Natural Language Processing and Social Interaction

Vincent Mary School of Engineering, Science and Technology

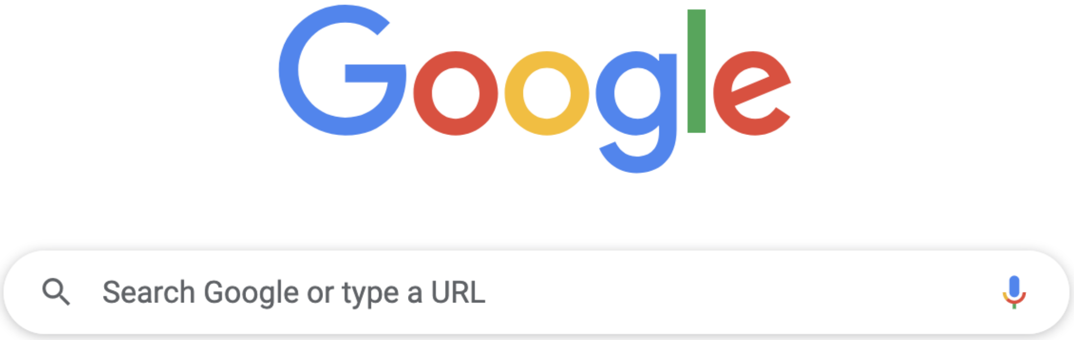
Assumption University



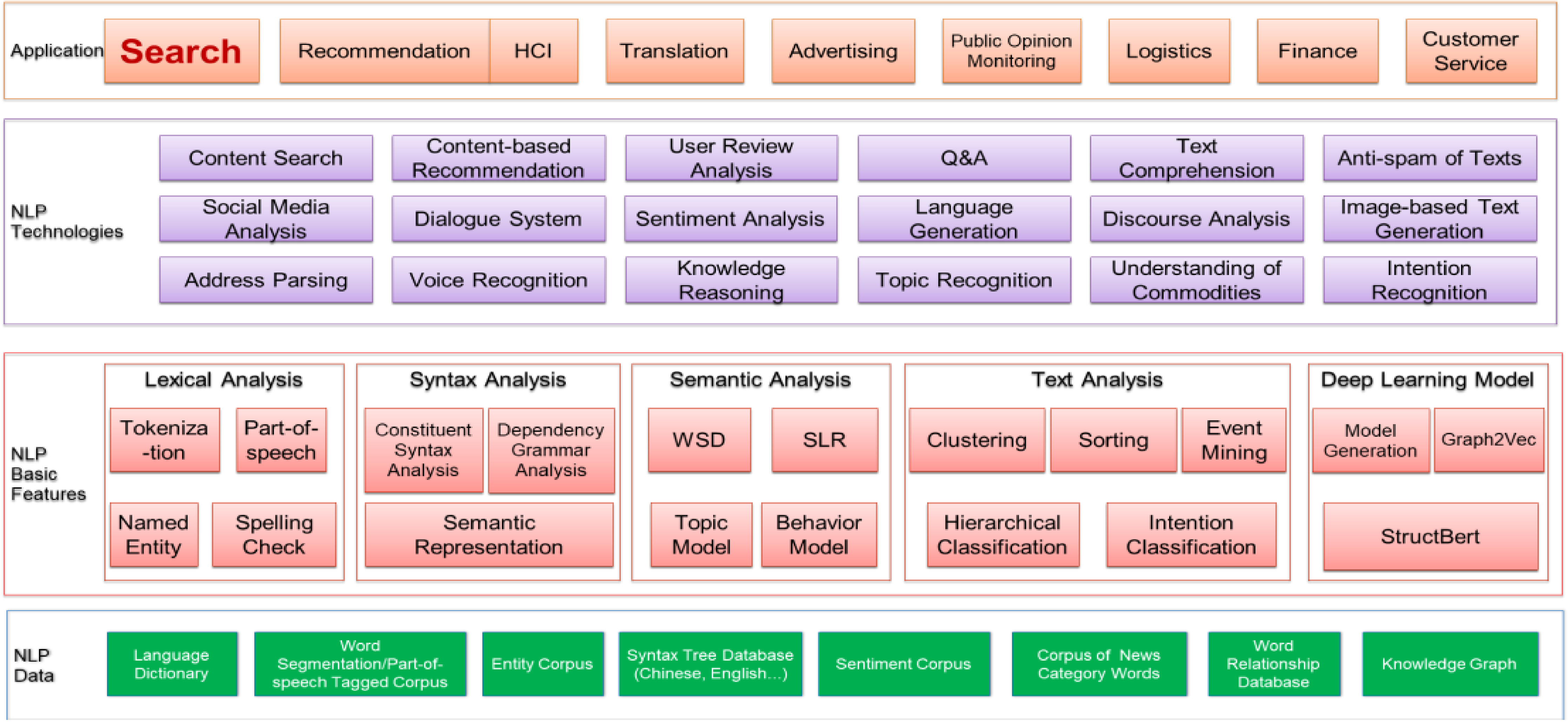
What is NLP?

Natural Language Processing (NLP) is the ability to receive language information, interpret it, complete a task based on the language information and produce appropriate human language.
[John Medicine, 2020]

How is NLP used in these applications?



Capabilities of NLP



Application

- Search
- Recommendation
- HCI
- Translation
- Advertising
- Public Opinion Monitoring
- Logistics
- Finance
- Customer Service

NLP Technologies

- Content Search
- Content-based Recommendation
- User Review Analysis
- Q&A
- Text Comprehension
- Anti-spam of Texts
- Social Media Analysis
- Dialogue System
- Sentiment Analysis
- Language Generation
- Discourse Analysis
- Image-based Text Generation
- Address Parsing
- Voice Recognition
- Knowledge Reasoning
- Topic Recognition
- Understanding of Commodities
- Intention Recognition

NLP Basic Features

Lexical Analysis

- Tokenization
- Part-of-speech
- Named Entity
- Spelling Check

Syntax Analysis

- Constituent Syntax Analysis
- Dependency Grammar Analysis
- Semantic Representation

Semantic Analysis

- WSD
- SLR
- Topic Model
- Behavior Model

Text Analysis

- Clustering
- Sorting
- Event Mining
- Hierarchical Classification
- Intention Classification

Deep Learning Model

- Model Generation
- Graph2Vec
- StructBert

NLP Data

- Language Dictionary
- Word Segmentation/Part-of-speech Tagged Corpus
- Entity Corpus
- Syntax Tree Database (Chinese, English…)
- Sentiment Corpus
- Corpus of News Category Words
- Word Relationship Database
- Knowledge Graph

Areas of NLP

How to Read

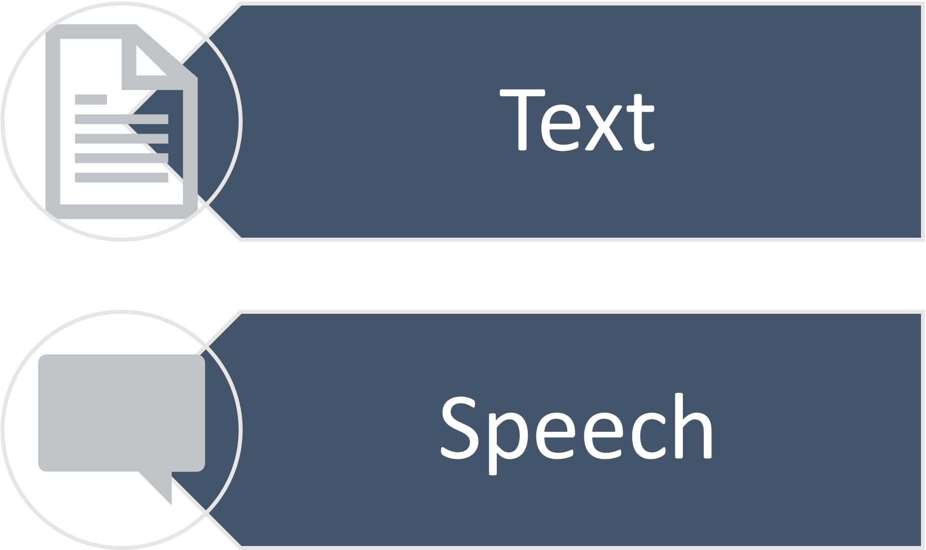
- Natural Language Understanding

How to Write

- Natural Language Generation

Formats of

Inputs



Text

Speech

Challenges in NLP

Lexical Ambiguity

- Natural language is ambiguous.
- Some words have different meaning in different context (Semantic Ambiguity).

Financial institution?

John went to the bank.

Bank of the river?

- Syntactic Ambiguity

Put the box on the table in the kitchen

Is the box already on the table, and to be put in the kitchen

Is the box to be put on the table which is in the kitchen?

Analysis in NLP

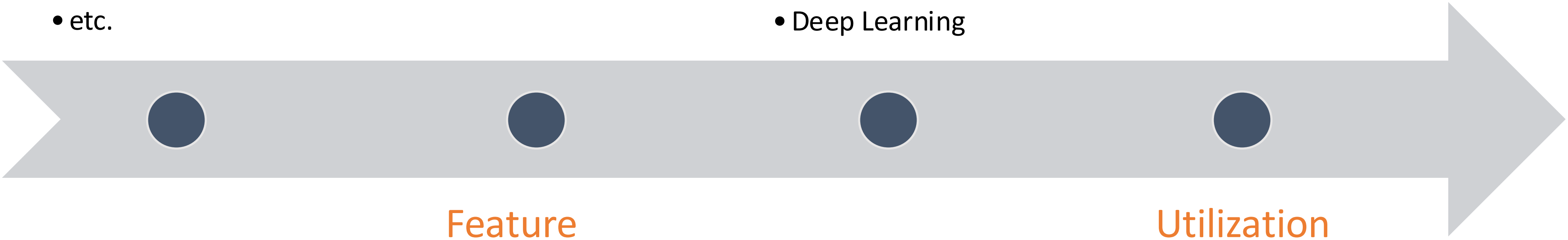
Syntactic Analysis

Structure

Semantic Analysis

Meaning

NLP Pipeline



Pre-Processing

- Tokenization
- Stop word Removal
- etc.

Feature Extraction

- Bag of Words
- TFIDF
- Word Vectors

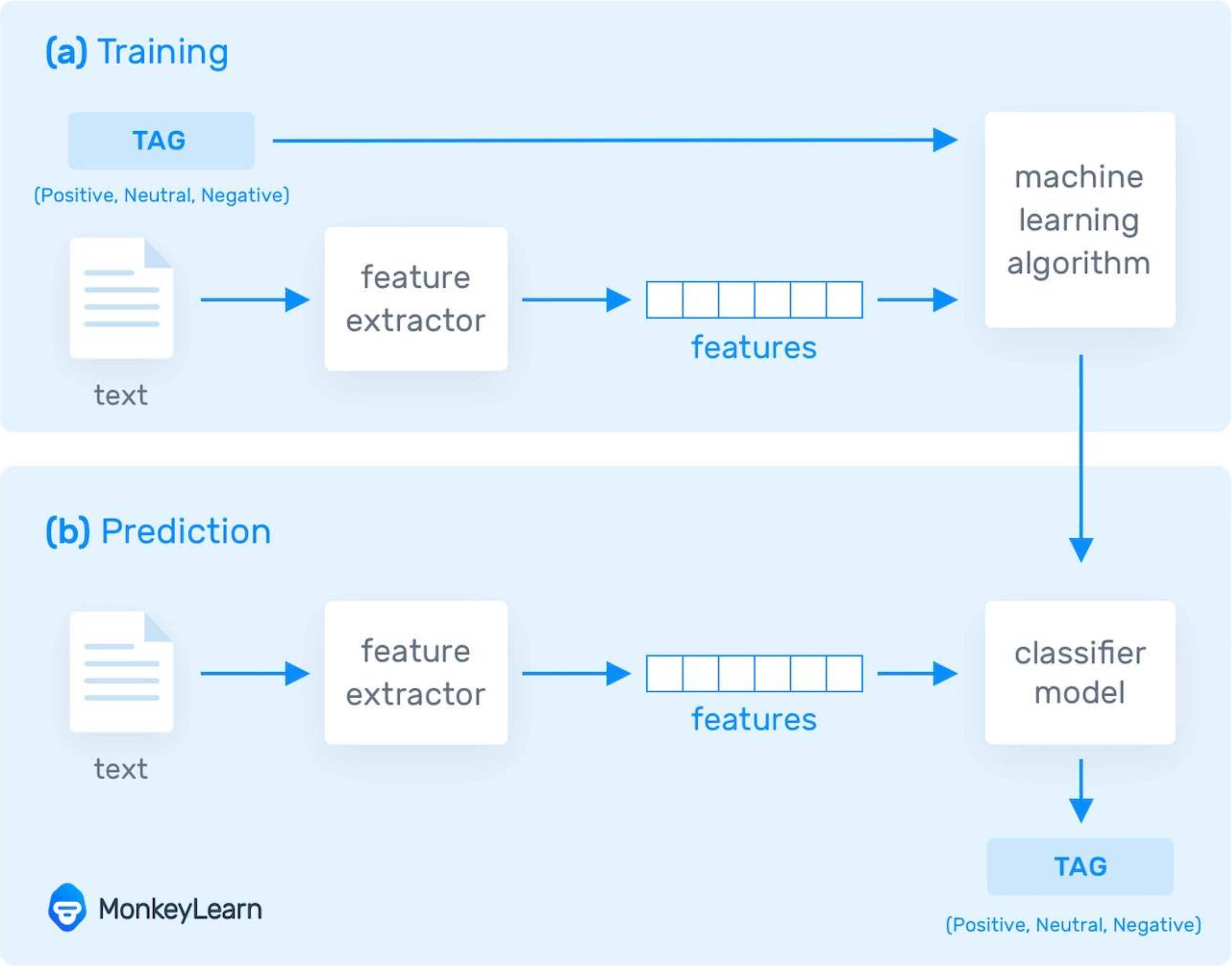
Modeling

- Rule-Based / Dictionary-Based
- Machine Learning
- Deep Learning

Utilization

ML Process in

NLP



Preparing/cleaning the data in such a way that it can be fed to the model.

Pre-Processing

Pre-Processing

- Tokenization
- Stop Words Removal
- Normalization
  - Stemming
  - Lemmatization
- Spelling Correction

Tokenization

- The process of separating streams of text into smaller units (which can be sentences, tokens or words).
- Sentence tokenization breaks long text into sentences.
- Word tokenization splits text in a sentence into words.
- Language Issues:
  - No word boundaries (no space between words) e.g. Chinese, Japanese, Thai
  - No sentence boundaries (no period at the end of the sentence) e.g. Thai
- Challenges:
  - Handling words that are often appearing together.
  - Artificial Intelligence, Computer Science, Machine Learning

Example: Tokenization

- I love to travel.

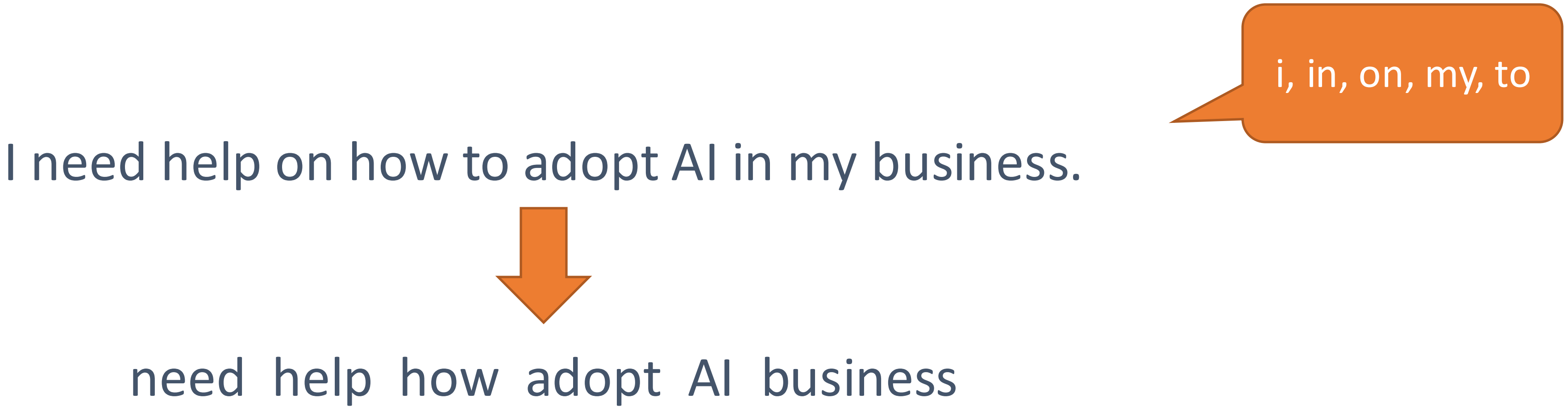
I	love	to	travel

- Artificial Intelligence can make it better.

Artificial	Intelligence	can	make	it	better
Artificial Intelligence	can	make	it	better	

Stop Words Removal

- Stop words are commonly used words in the language.
  - a, an, the, in, on, and etc.
- They are normally considered unimportant; hence, usually are removed so the algorithm can focus on the more important ones.
- The set of stop words to use and the decision whether to remove them depend on applications.



i, in, on, my, to

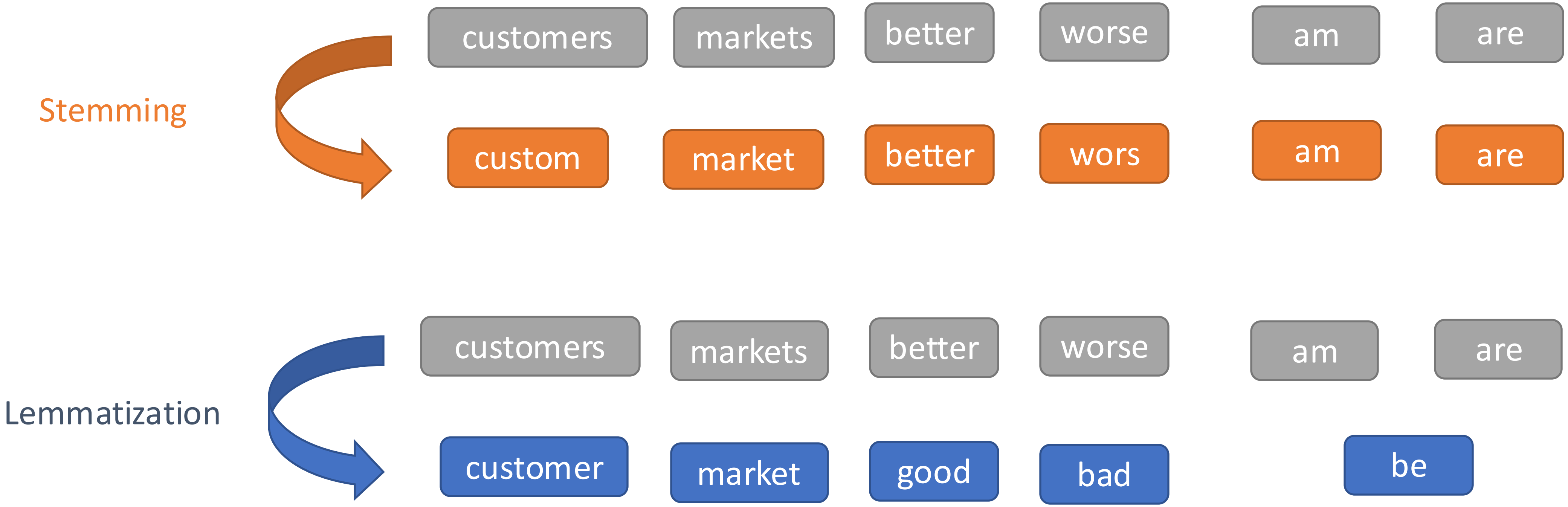
I need help on how to adopt AI in my business.

need help how adopt AI business

Normalization

- Both lemmatization and stemming reduce the inflected word to its root form.
- Stemming
  - is based on heuristic algorithm that removes the end of words.
  - may not give out the actual language words.
- Lemmatization
  - uses morphological analysis of words.
  - returns the dictionary form of the words (*aka* lemma).

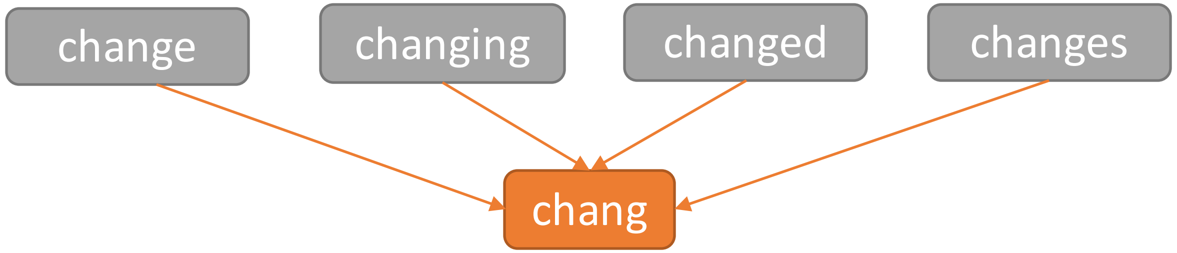
Example: Stemming vs. Lemmatization



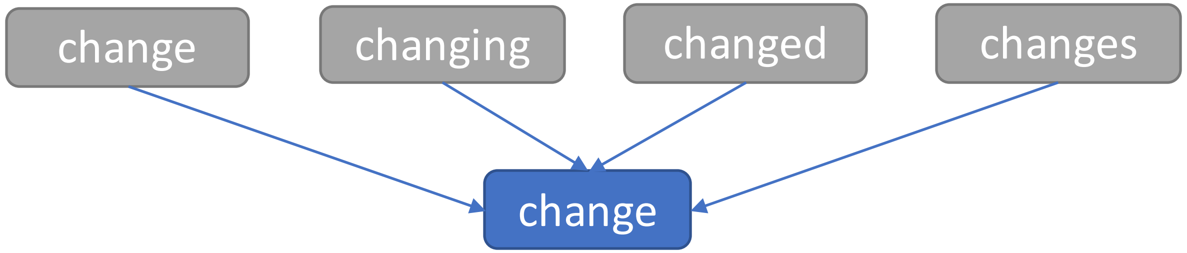
Stemming	customers	markets	better	worse	am	are
	custom	market	better	wors	am	are
Lemmatization	customers	markets	better	worse	am	are
	customer	market	good	bad	be	

Example: Stemming vs. Lemmatization

Stemming



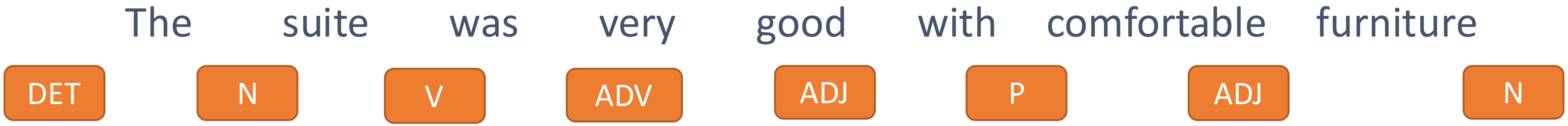
Lemmatization



NLP Subtasks

Part-of-Speech Tagging

- *aka* POS Tagging
- The process of assigning a part-of-speech or lexical class marker to each word in a collection.
- Traditional Parts of Speech
  - noun, verb, adjective, preposition, adverb, article, interjection, pronoun, conjunction, etc.

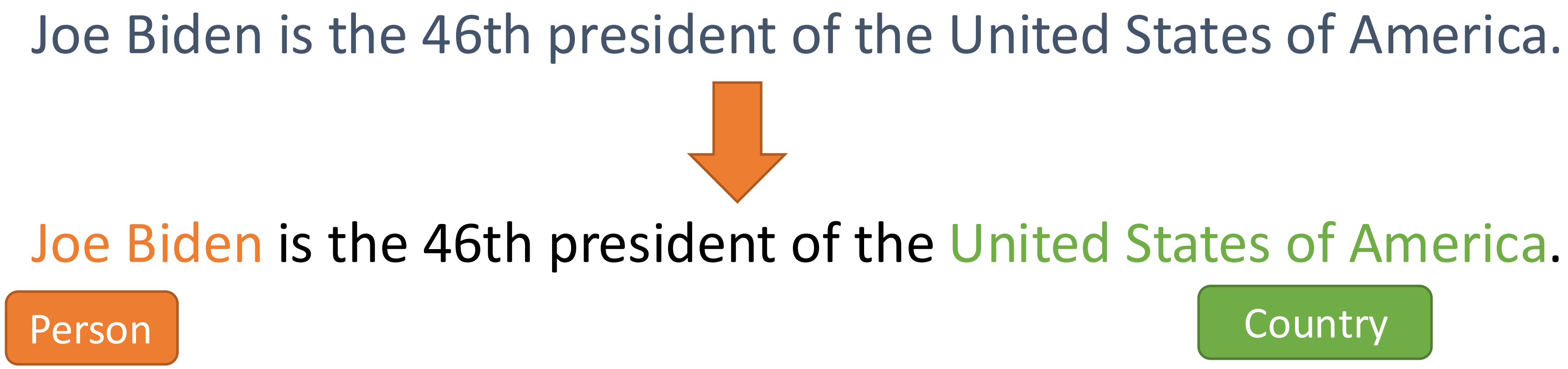


The suite was very good with comfortable furniture

DET N V ADV ADJ P ADJ N

Named Entity Recognition

- The process of detecting named entities in the given text.
- Useful in co-reference resolution.
- Examples of named entities:
  - Person’s name e.g. James Bond, Joe Biden
  - Location e.g. Bangkok, New York City
  - Organization name e.g. Assumption University, Bank of America



Joe Biden is the 46th president of the United States of America.

Joe Biden is the 46th president of the United States of America.

Person

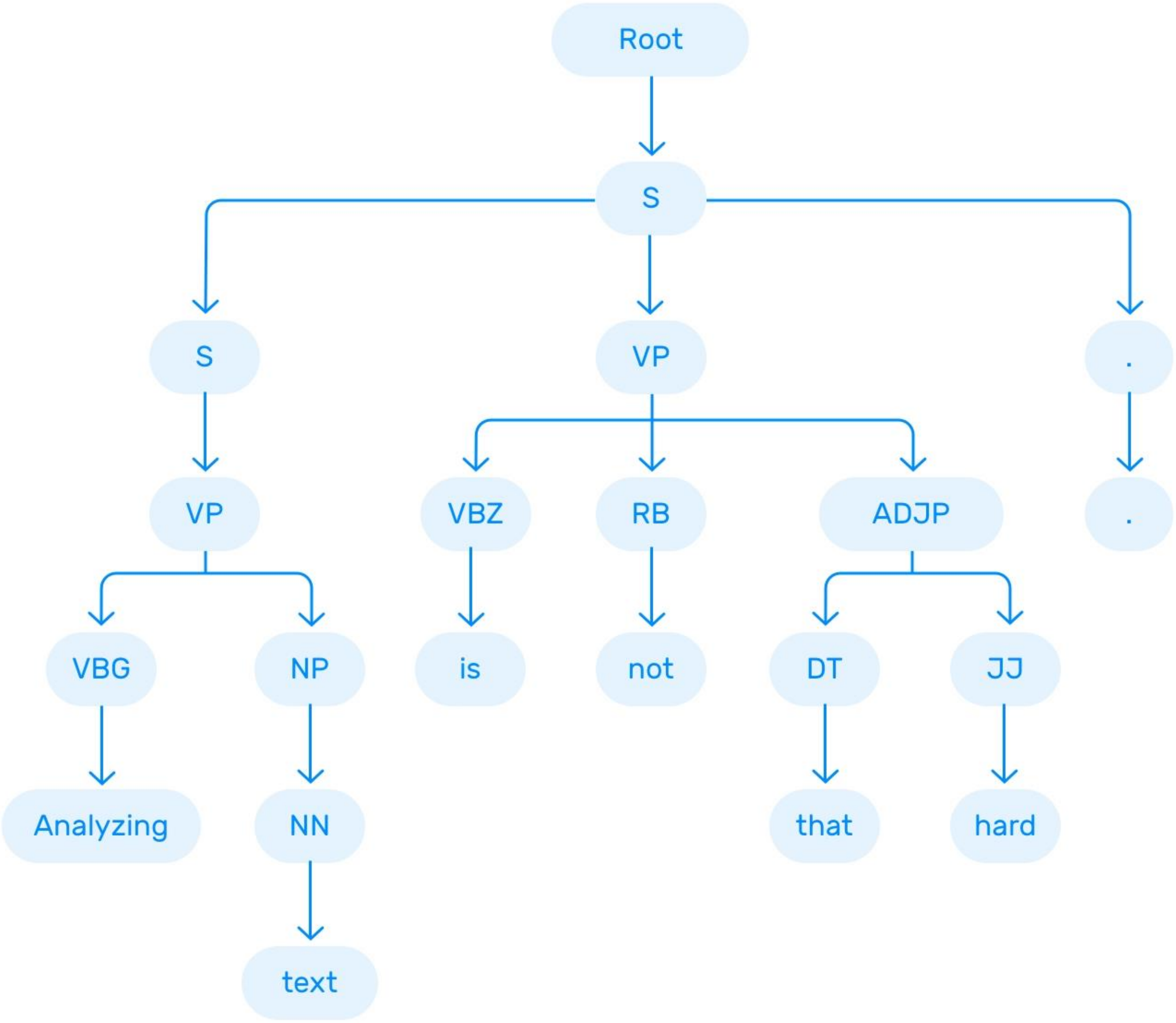
Country

Parsing

Understanding the structure of the text, check if it conforms to the grammar and form a parse tree.

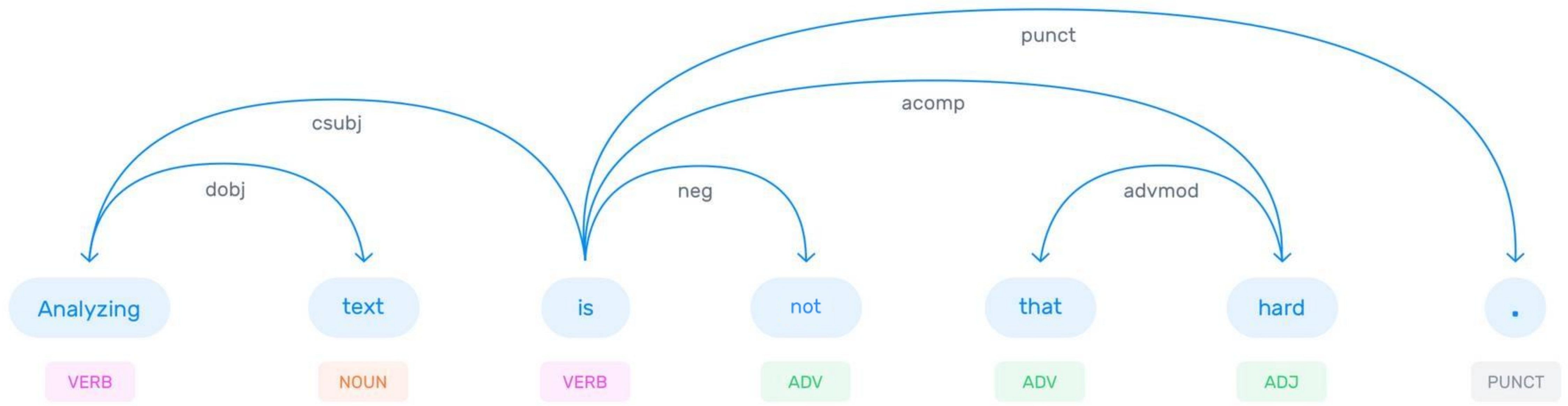
Constituency Parsing

Analyze the syntactic structure of a sentence (phrase structure).



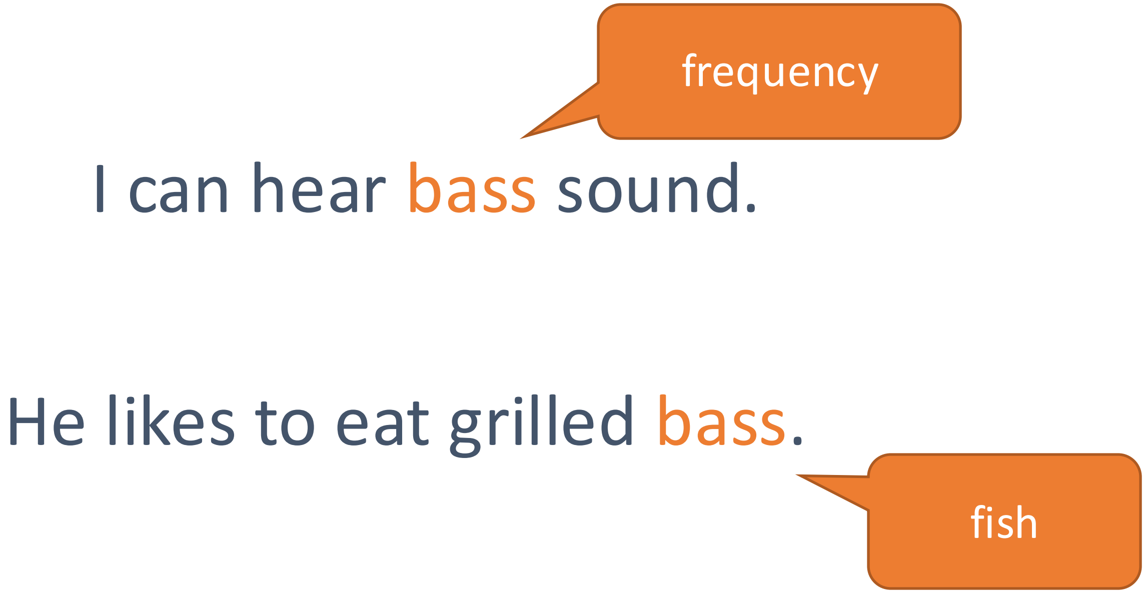
Dependency Parsing

Analyze how words in a sentence are related.



Word Sense Disambiguation

- *aka* WSD
- The process of determining which sense of a word is meant in a sentence.



I can hear bass sound.

He likes to eat grilled bass.

NLP Tasks

Topic Modeling

Text Summarization

Topic Classification

Sentiment Analysis

Aspect-Based Sentiment Analysis

Emotion Analysis

Machine Translation

Speech Recognition (Speech-to-Text)

Speech Synthesis (Text-to-Speech)

and many more…

Topic Modeling

- Discover hidden topics or themes from a collection of documents

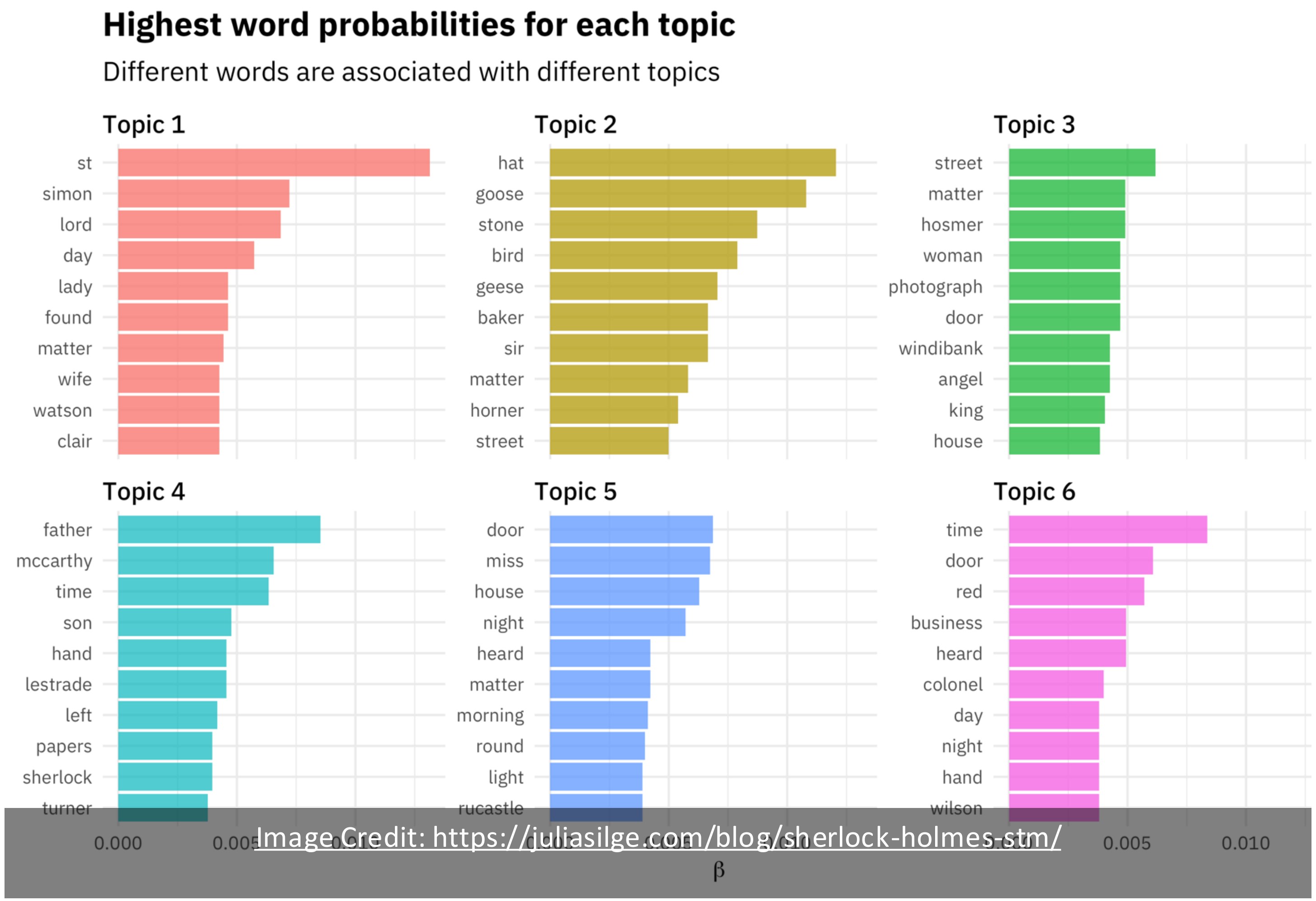
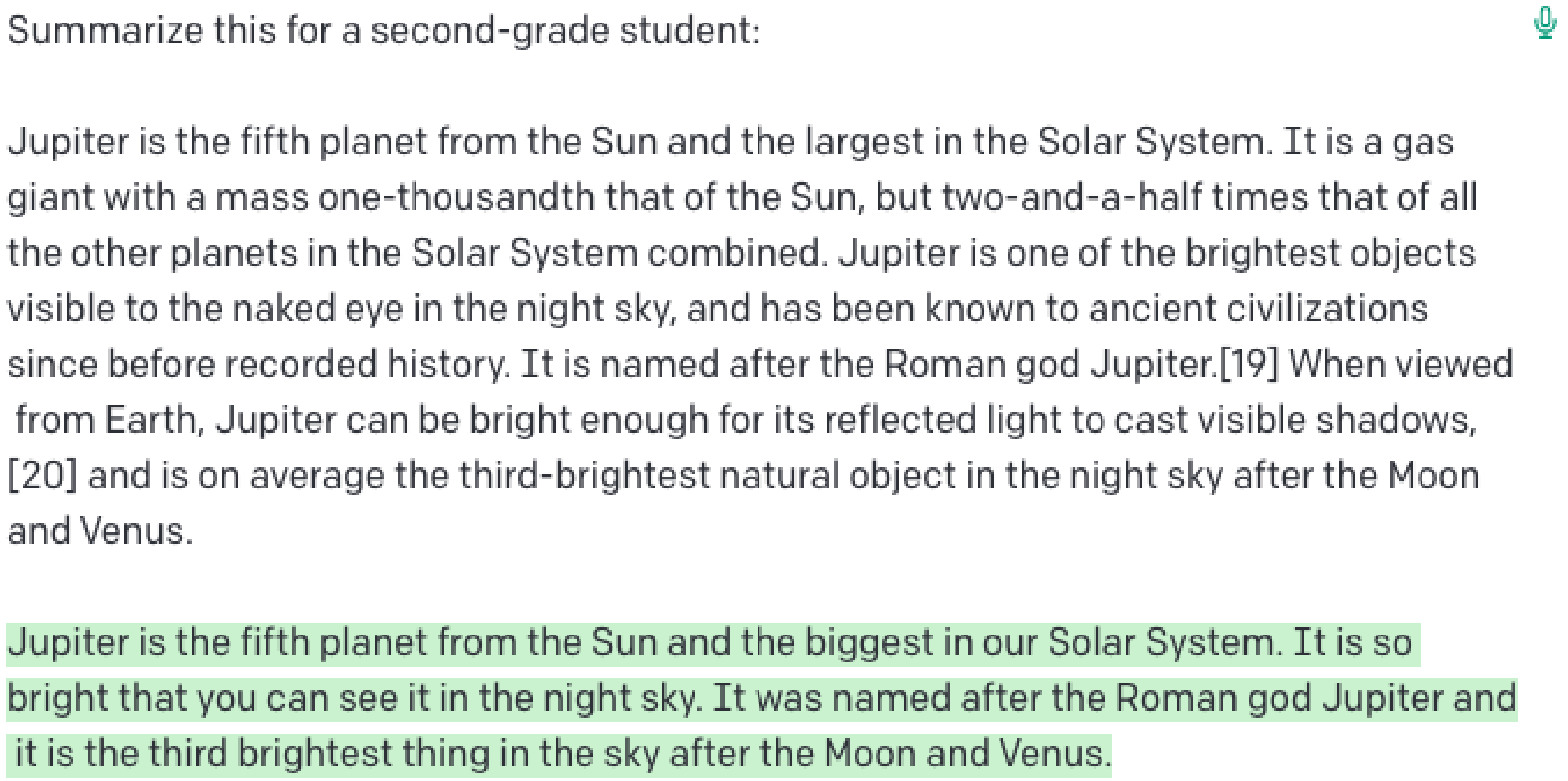


Image Credit: https://juliasilge.com/blog/sherlock-holmes-stm/

Text Summarization

- Summarize the given text.



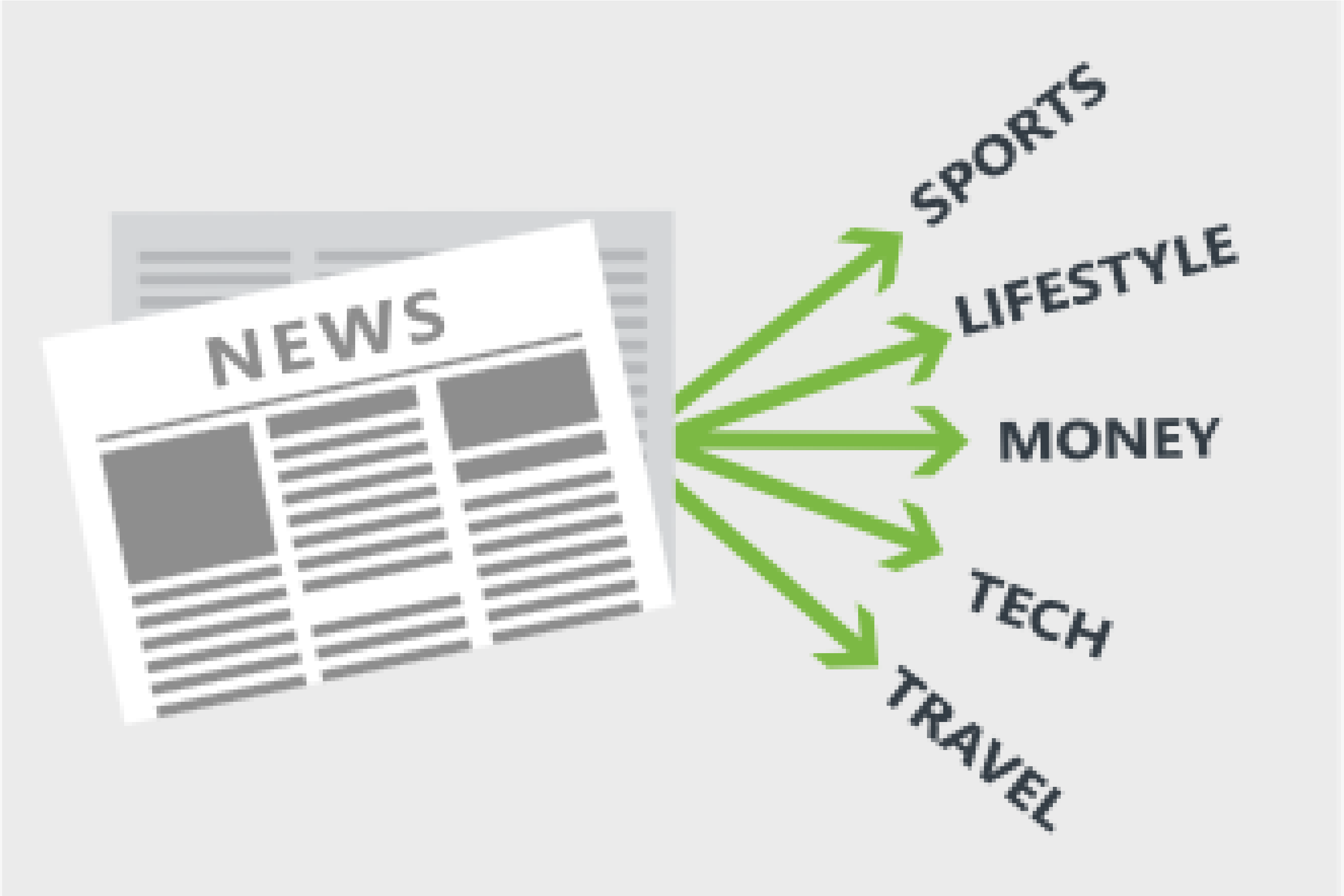
Summarize this for a second-grade student:

Jupiter is the fifth planet from the Sun and the largest in the Solar System. It is a gas giant with a mass one-thousandth that of the Sun, but two-and-a-half times that of all the other planets in the Solar System combined. Jupiter is one of the brightest objects visible to the naked eye in the night sky, and has been known to ancient civilizations since before recorded history. It is named after the Roman god Jupiter.[19] When viewed from Earth, Jupiter can be bright enough for its reflected light to cast visible shadows, [20] and is on average the third-brightest natural object in the night sky after the Moon and Venus.

Jupiter is the fifth planet from the Sun and the biggest in our Solar System. It is so bright that you can see it in the night sky. It was named after the Roman god Jupiter and it is the third brightest thing in the sky after the Moon and Venus.

Topic Classification

- Classify a document or article based on a predefined set of topics.



Sentiment Analysis

- Determine general feelings e.g. positive or negative.

Aspect-Based Sentiment Analysis

- Identify the fine-grained polarity or sentiment towards an aspect.

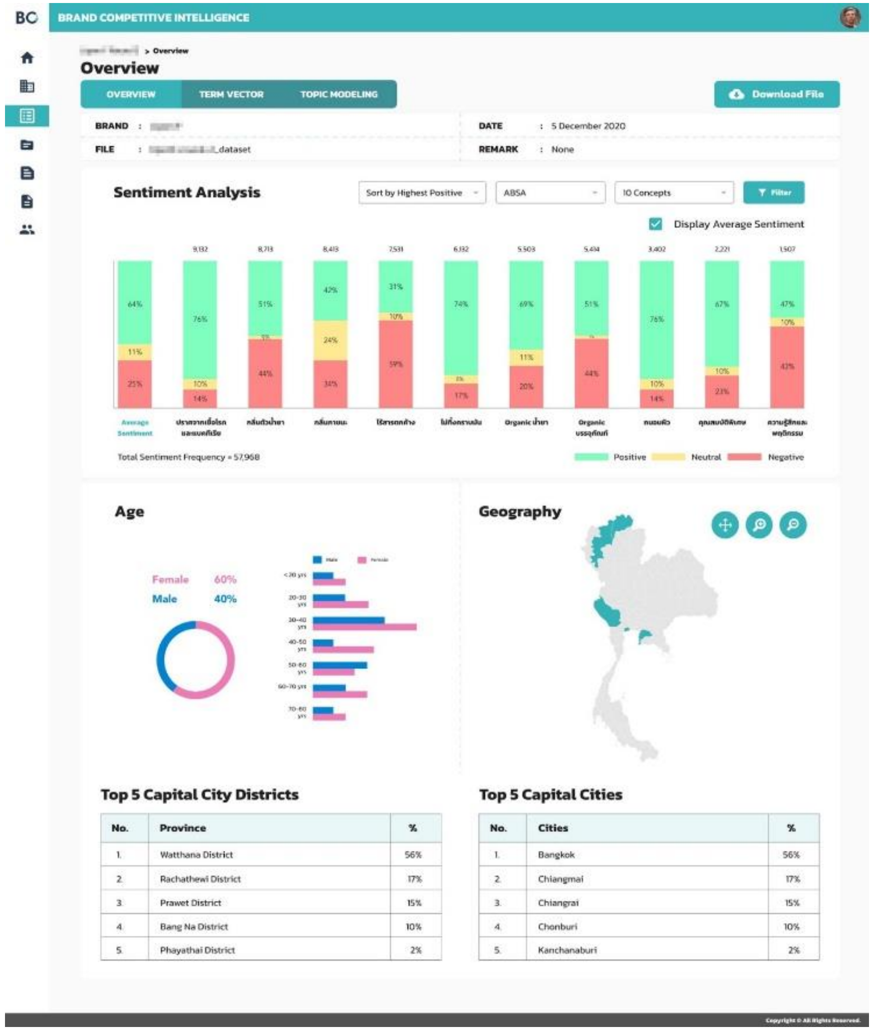
Very friendly and helpful staff. Amazing and very quiet location directly at the beach.

The grounds were beautiful but the price of the townhouse was a little pricey considering what you got

Emotion Analysis

- Determine emotions conveyed in the given data (text or speech).

NLP for Market Research



BC BRAND COMPETITIVE INTELLIGENCE

> Overview

Overview

OVERVIEW | TERM VECTOR | TOPIC MODELING | Download File

BRAND	:	DATE	: 5 December 2020
FILE	: _dataset	REMARK	: None

Sentiment Analysis

Sort by Highest Positive | ABSA | 10 Concepts | Filter

☑ Display Average Sentiment

Total Sentiment Frequency = 57,968

Age

Geography

Top 5 Capital City Districts

No.	Province	%
1.	Watthana District	56%
2.	Rachathewi District	17%
3.	Prawet District	15%
4.	Bang Na District	10%
5.	Phayathai District	2%

Top 5 Capital Cities

No.	Cities	%
1.	Bangkok	56%
2.	Chiangmai	17%
3.	Chiangrai	15%
4.	Chonburi	10%
5.	Kanchanaburi	2%

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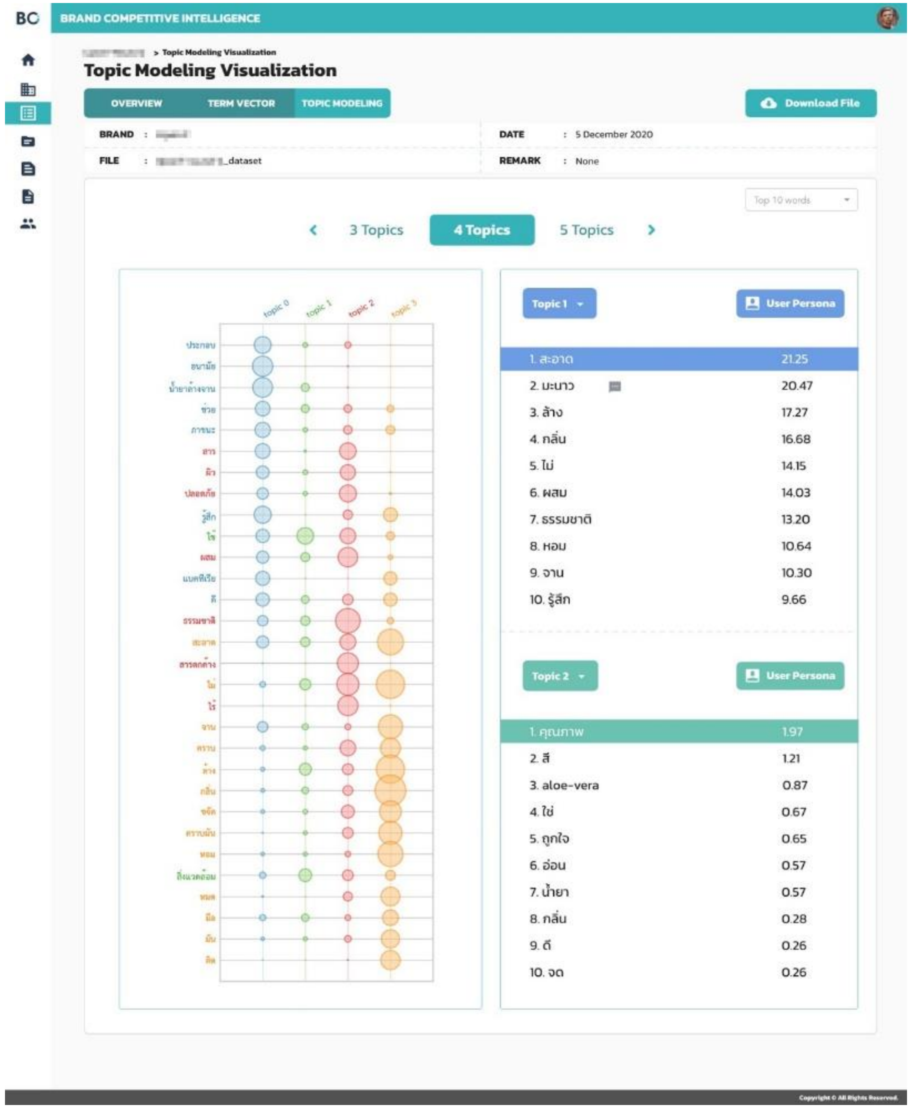

BC BRAND COMPETITIVE INTELLIGENCE

> Topic Modeling Visualization

Topic Modeling Visualization

OVERVIEW | TERM VECTOR | TOPIC MODELING | Download File

BRAND	:	DATE	: 5 December 2020
FILE	: _dataset	REMARK	: None

Top 10 words

‹ 3 Topics | 4 Topics | 5 Topics ›

Topic 1 | User Persona

1. สะอาด	21.25
2. มะนาว	20.47
3. ล้าง	17.27
4. กลิ่น	16.68
5. ไม่	14.15
6. ผสม	14.03
7. ธรรมชาติ	13.20
8. หอม	10.64
9. จาน	10.30
10. รู้สึก	9.66

Topic 2 | User Persona

1. คุณภาพ	1.97
2. สี	1.21
3. aloe-vera	0.87
4. ใช่	0.67
5. ถูกใจ	0.65
6. อ่อน	0.57
7. น้ำยา	0.57
8. กลิ่น	0.28
9. ดี	0.26
10. จด	0.26

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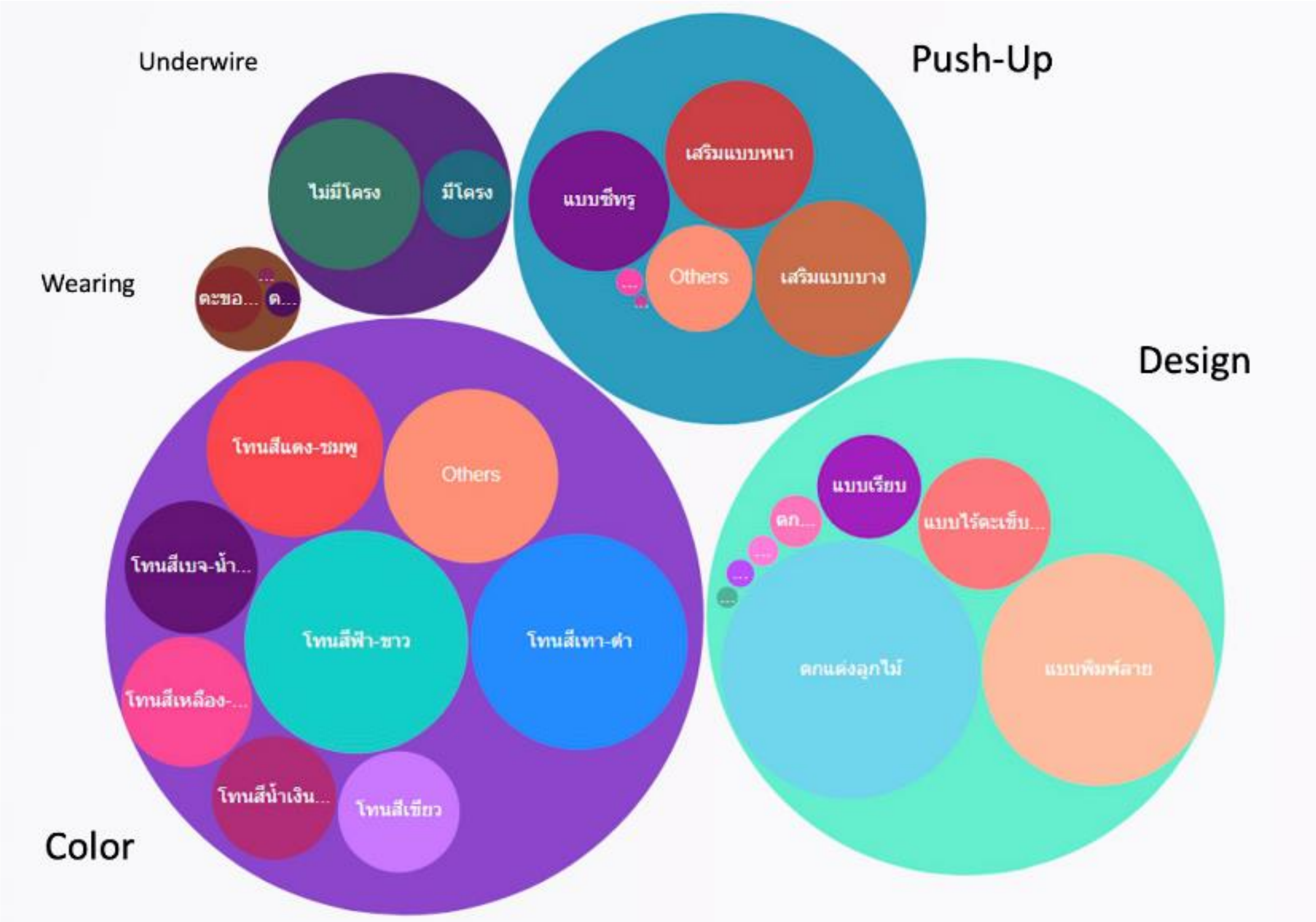
NLP for

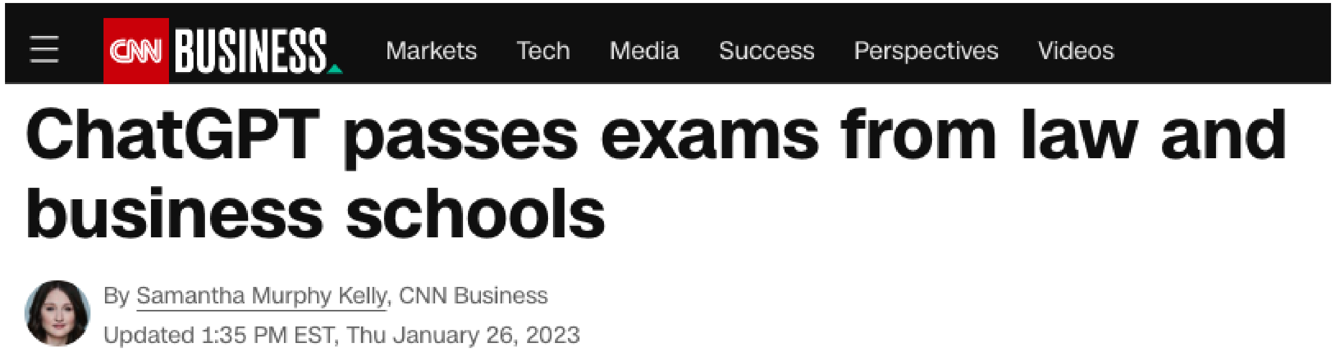
Market Research



New Kid in Town

ChatGPT

- Chat Generative Pre-Trained Transformer
- A chatbot by OpenAI launched in November 2022

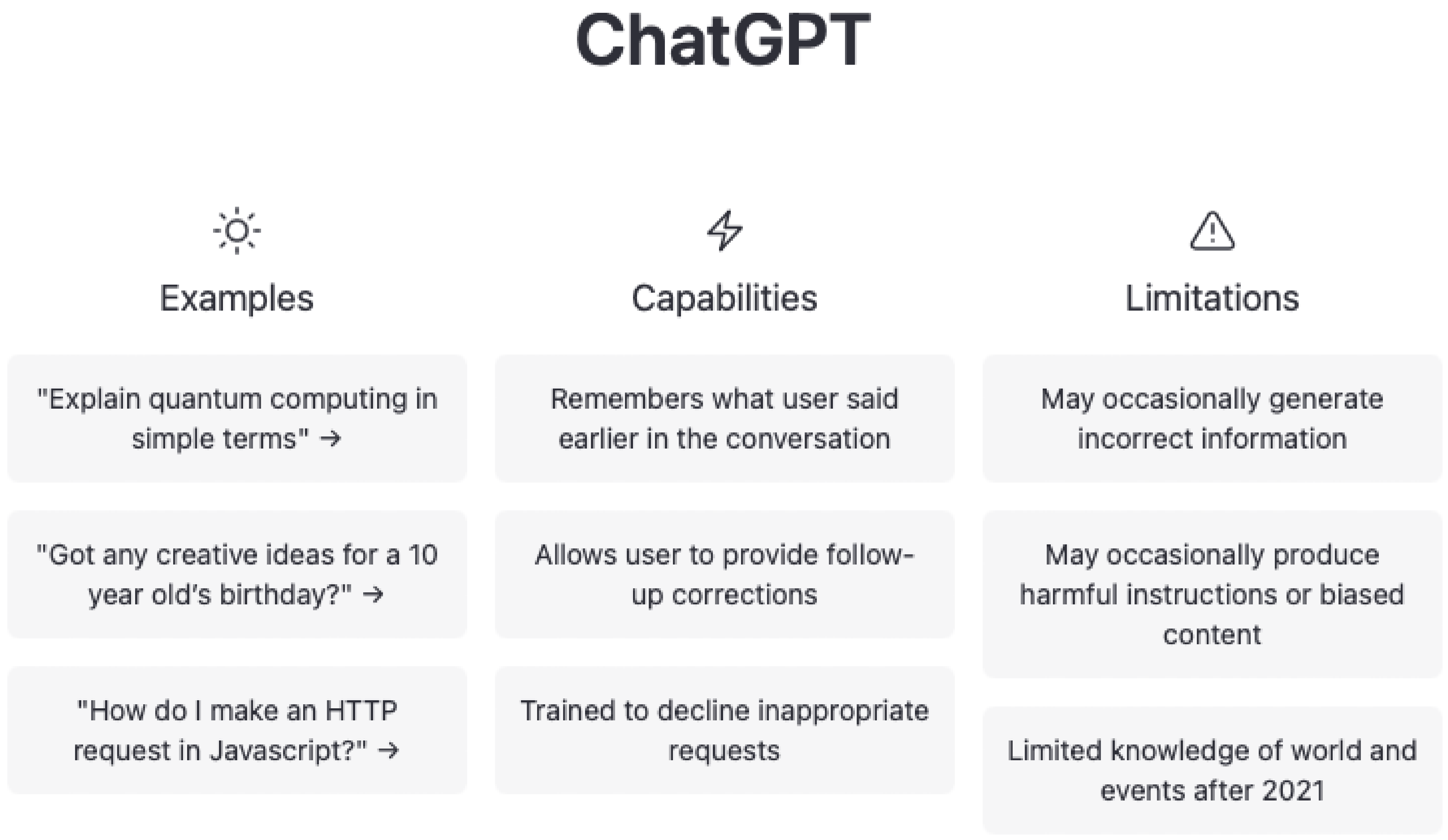


ChatGPT passes exams from law and business schools

By Samantha Murphy Kelly, CNN Business
Updated 1:35 PM EST, Thu January 26, 2023

- Try it out at chat.openai.com

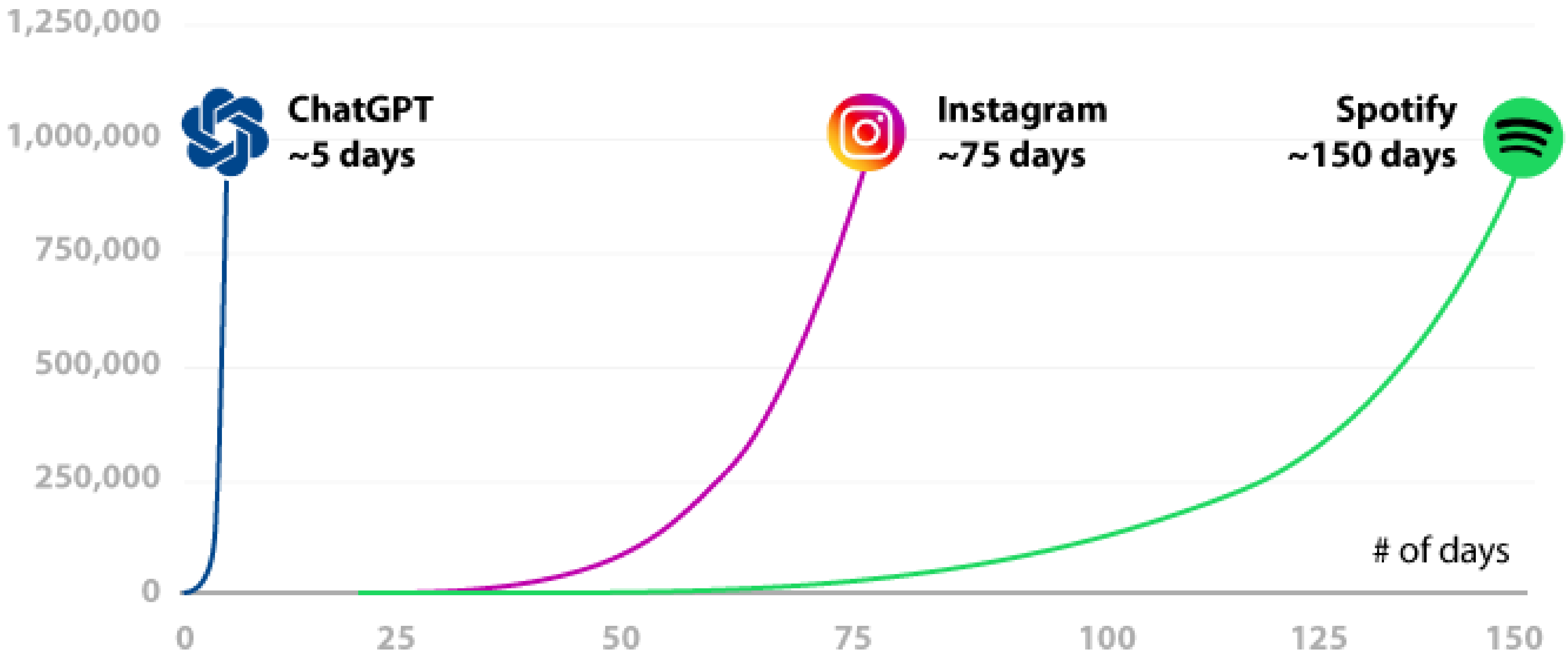
Conversational AI



ChatGPT

Examples	Capabilities	Limitations
"Explain quantum computing in simple terms" →	Remembers what user said earlier in the conversation	May occasionally generate incorrect information
"Got any creative ideas for a 10 year old's birthday?" →	Allows user to provide follow-up corrections	May occasionally produce harmful instructions or biased content
"How do I make an HTTP request in Javascript?" →	Trained to decline inappropriate requests	Limited knowledge of world and events after 2021

~ Path to 1 million users* (# of days from launch)



Sources: Google, Subredditstats, Media Reports