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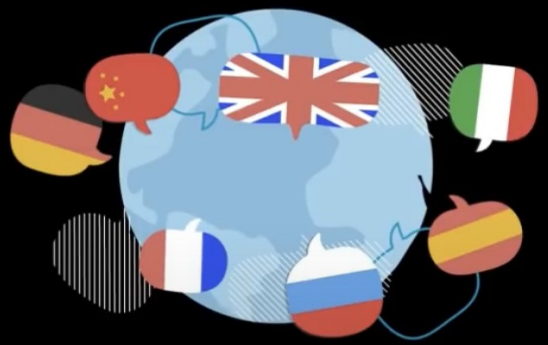
# Natural Language Processing

## Introduction, theory and application

Faizah, M.Kom

The 21st Century

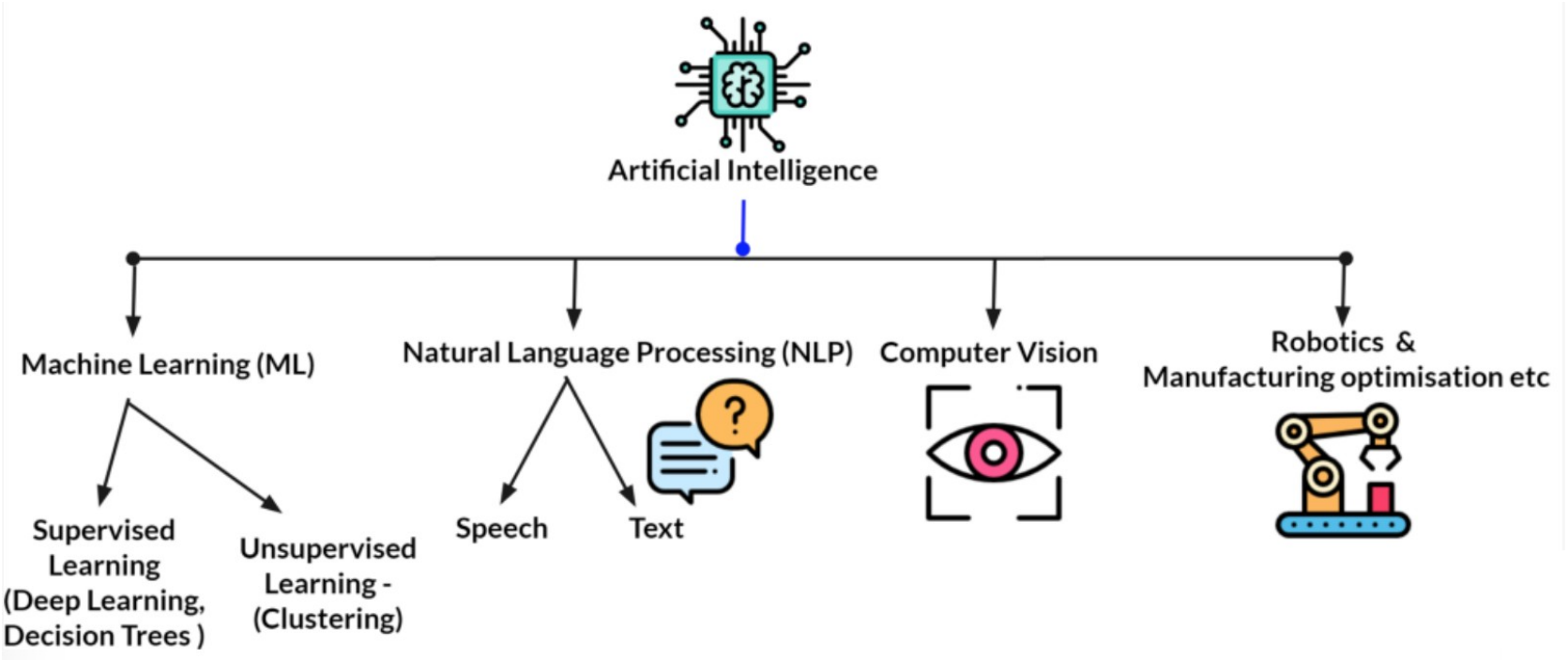


65 Bahasa

edureka!


Source : www.edureka.com

# NLP and AI

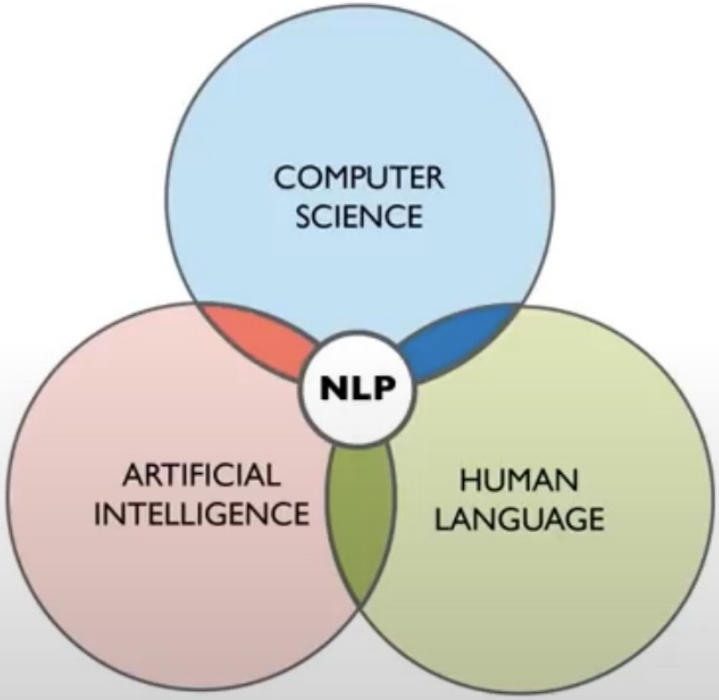



Source : www.mc.ai

# What is NLP ?

- A branch of AI that helps to understand, interpret and manipulate human language
- All about leveraging tools, techniques and algorithms to process and understand natural language based-data which is usually unstructured like text, speech, etc
- Sub-field of AI that is focused on enabling computers to understand and process human language
- NLP works based on how human use language (learn through experience)

# What is NLP ?



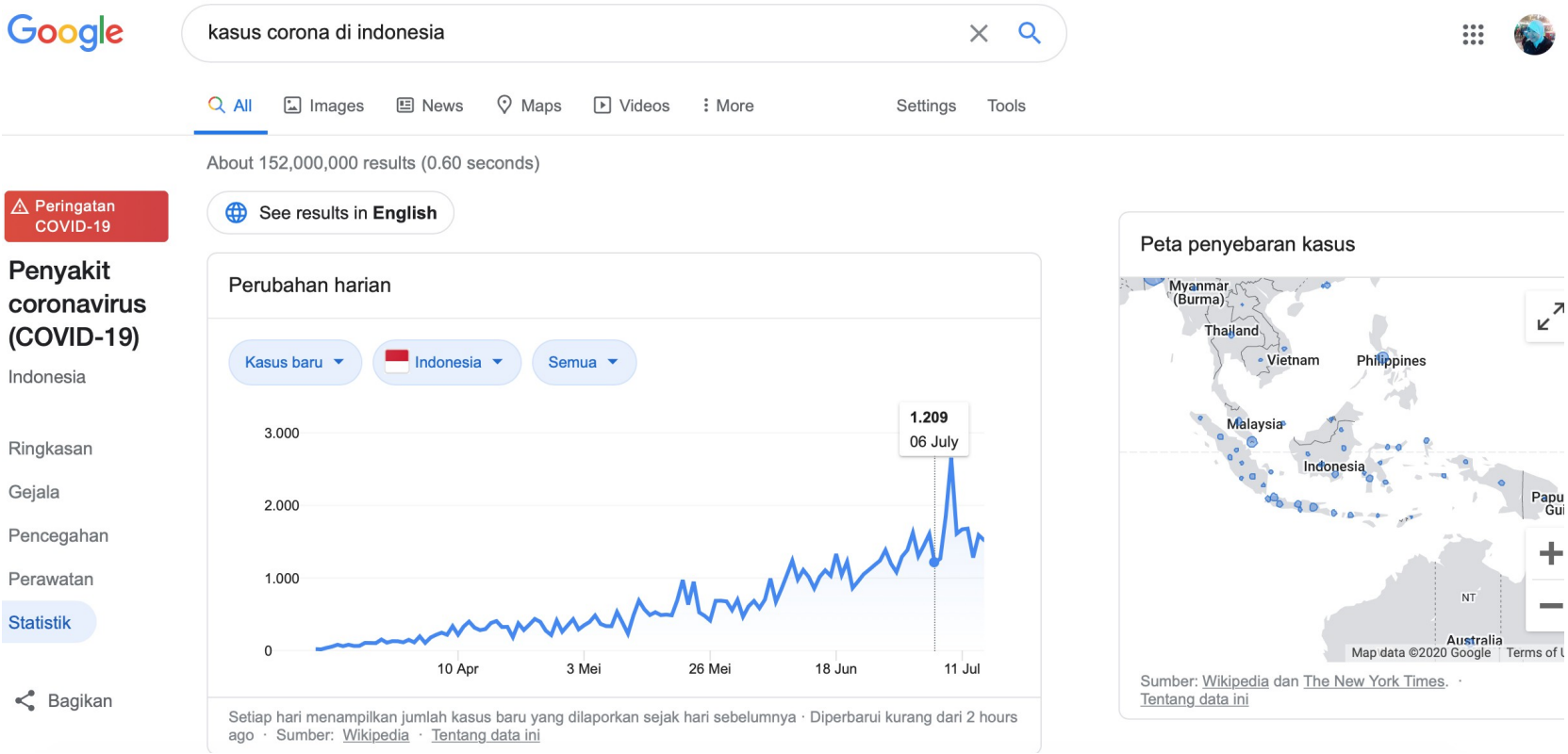

Source : www.edureka.com

# Brief History of NLP

- 1950s
  - Early MT : word translation +re-ordering
  - Chomsky's generative grammar
  - Bar-Hill's argument
- 1960-80s
  - Applications
    - BASEBALL : use NL interface to search database on baseball games
    - ELIZA : simulation of conservation with psycoanalyst
    - SHREDLU : use NL to manipulate block world
    - Message understanding : understand a newspaper article on terrorism
    - Machine translation
  - Methods
    - ATN (augmented transition networks) : extended context-free grammar
    - Case grammar (agent, object, etc)
    - DCG-Definite Clause Grammar
    - Dependency grammar : an element depends on another
- 1990s-now
  - Statistical methods
  - Speech recognition
  - MT system
  - Question-answering
  - .....

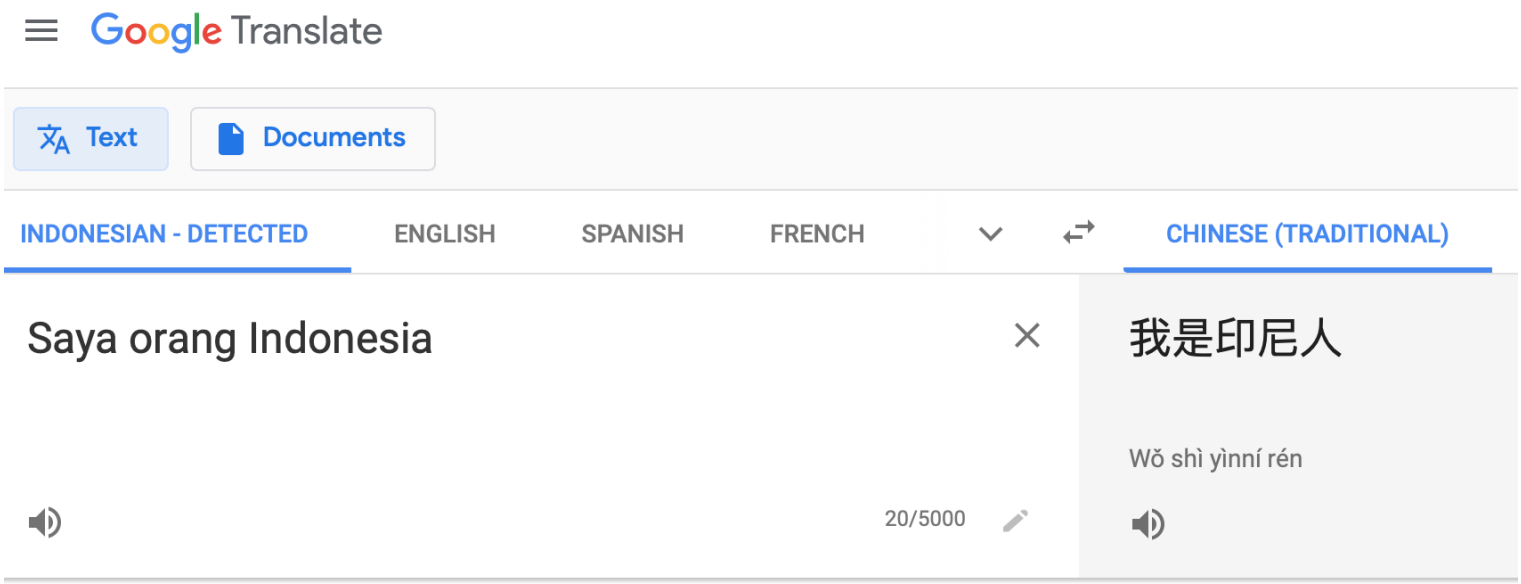
# NLP examples

- Question Answering



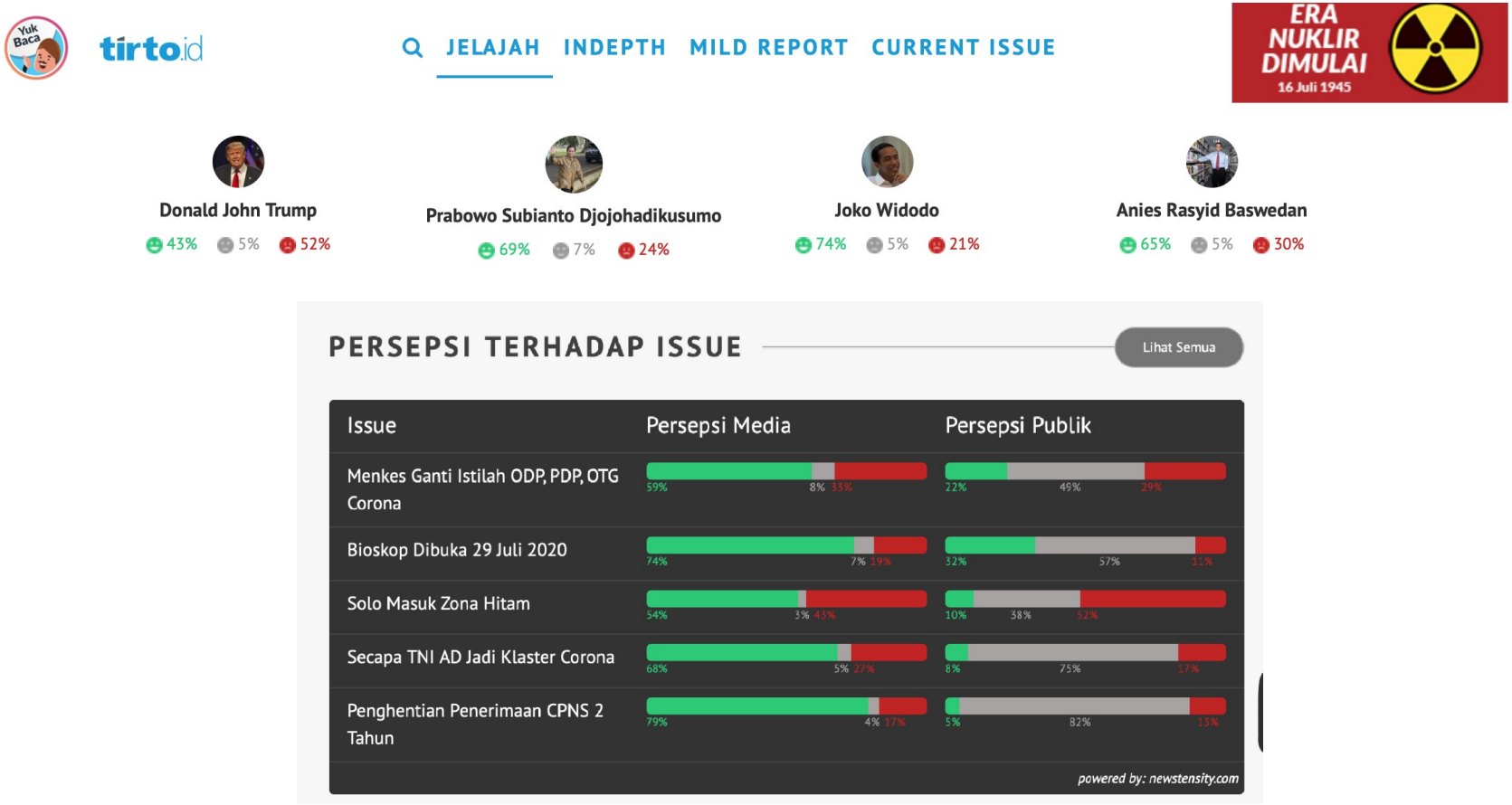
# NLP examples

- Machine Translation



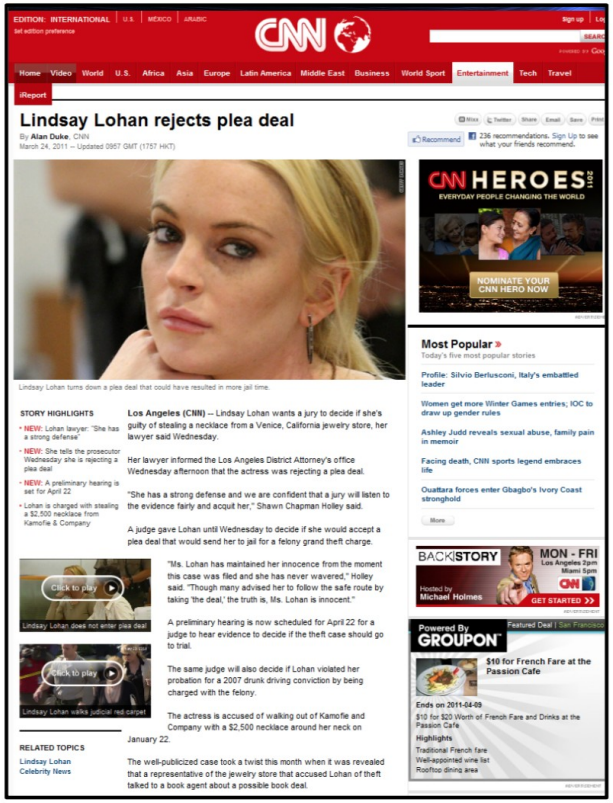
# NLP examples

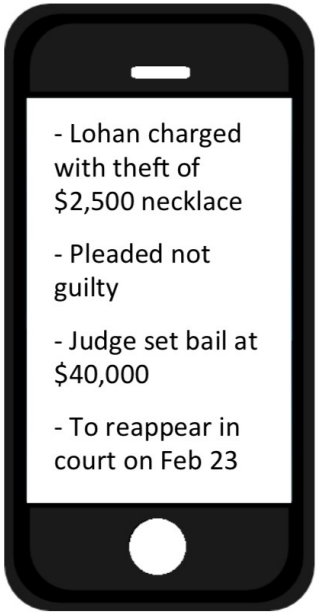
- Sentiment Analysis



# NLP Examples

- Summarization

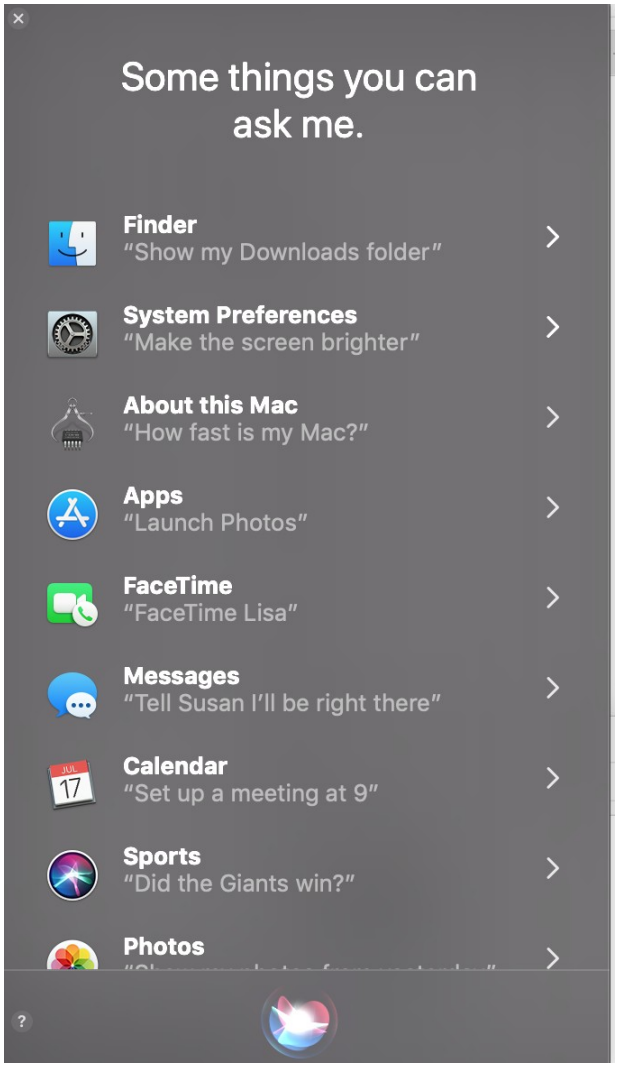



http://www.cs.unc.edu/~mbansal/

# NLP Examples

- Siri




Contains :
-Speech recognition
-Language analysis
-Dialog processing
-Text to speech

# Component of NLP

## Natural Language Understanding

- Mapping input to useful representation
- Analyzing different aspect of the language

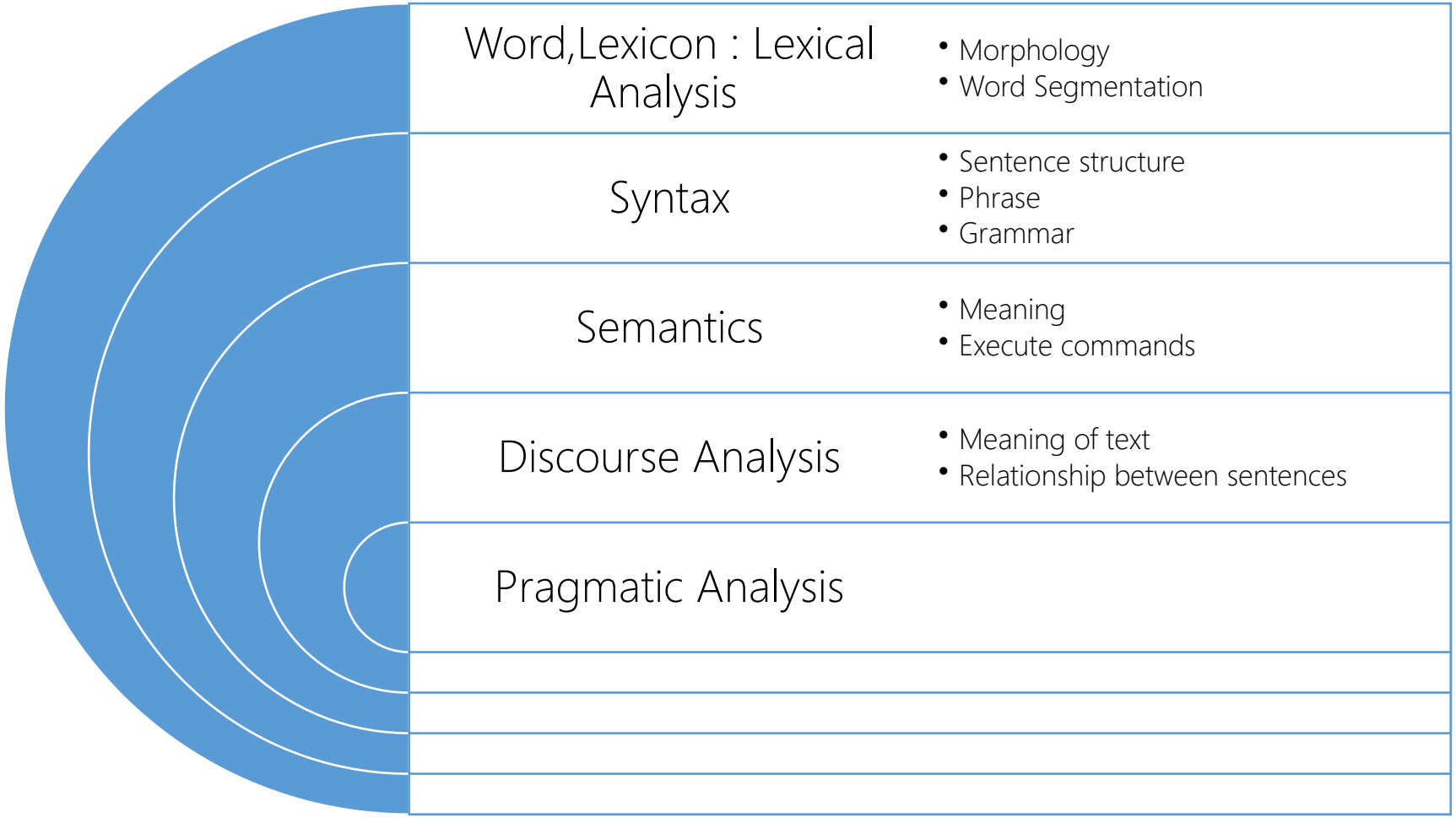
## Natural Language Generation

- Process of producing meaningful phrases and sentences in the form of natural language from some internal representation
- It involves :
  - Text Planning (retrieving the relevant content from knowledge base)
  - Sentence Planning (choosing required words, forming meaningful phrases, setting tone of the sentence)
  - Text Realization (mapping sentence plan into sentence structure)

# Problems in NLU

- Ambiguity
  - Lexical /Morphological : change (V,N), training(V,N), even(ADJ,ADV)…
  - Syntactic : Helicopter powered by human flies
  - Semantic : He saw a man on the hill with a telescope
  - Discourse : anaphora ,…
- Classical Solution
  - Using a later analysis to solve ambiguity of an earlier step
  - Eg. He gives him the change . (change as verb does not work for parsing)
    - He changes the places. (change as noun does not work for parsing)
  - However : He saw a man on the hill with a telescope
    - Correct multiple parsings
    - Correct semantics interpretations → semantic ambiguity
    - Use contextual information to disambiguate (does a sentence in the text mention that "He" holds a telescope?)

# Aspects of Language Processing



# NLP pipelines

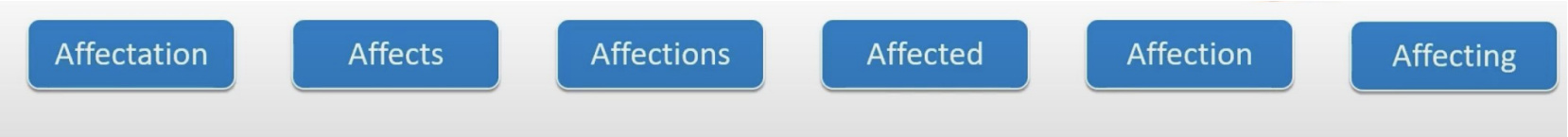
# Tokenization

- Break a complex sentence into words
- Understand the importance of each of the words with respect to the sentence
- Produce a structural description on an input sentence


Source : www.edureka.com

# ....Stemming

- Normalize words into its base form or root form




Source : www.edureka.com

# ….Lemmatization

- Group together different inflected forms of a word, called Lemma
- Somehow similar to Stemming, as it maps several words into one common root
- Output of Lemmatization is a proper word
- For example, a Lemmatizer should map gone, going and went into go

The difference with stemming is that a **stemmer** operates **without knowledge of context**, and therefore cannot understand the difference between words which have different meaning depending on parts of speech.
**Lemmatization attempts to select the correct lemma depending on the context**

# ….Lemmatization : Example

- The word “better” has “good” as its lemma. This link s missed by stemming, as it required a dictionary look-up
- The word “meeting” can be either the base form of a noun or a form of a verb (“to meet”) depending on the context ; e.g. “in our last meeting” or “we are meeting again tomorrow”

# ….Remove Stop Words

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- Stop words are words which are **filtered out** before or after processing of text
- When applying machine learning to text, these words can add a lot of **noise**
- That's why we want to remove the irrelevant word
- Some example of stop words are **a**, **an**, **the**, **and** the like

# POS : Parts of Speech

- POS are **specific lexical categories** to which words are assigned, **based on their syntactic context and role**

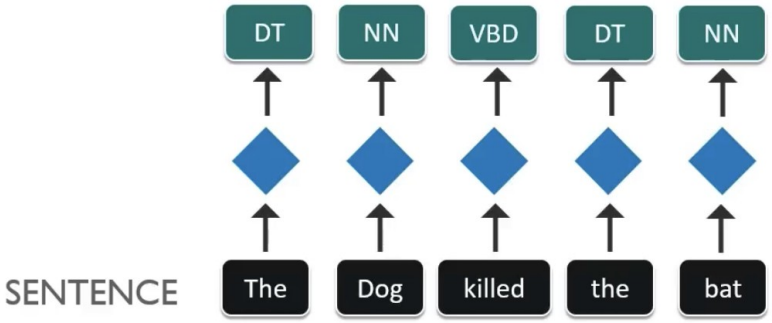
## POS : Tags and Descriptions

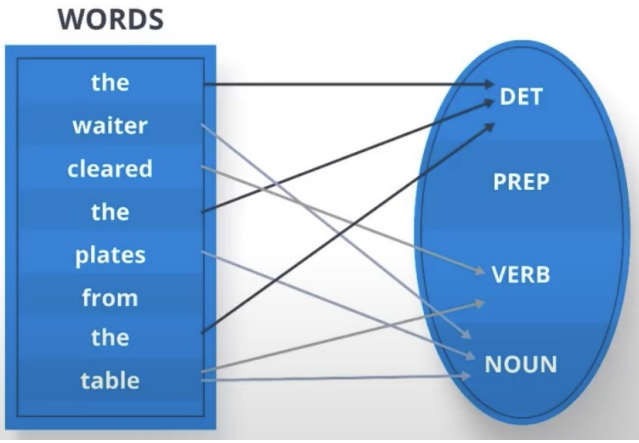
| Tag | Description |
|---|---|
| CC | Coordinating conjunction |
| CD | Cardinal number |
| DT | Determiner |
| EX | Existential there |
| FW | Foreign word |
| IN | Preposition or subordinating conjunction |
| JJ | Adjective |
| JJR | Adjective, comparative |
| JJS | Adjective, superlative |
| LS | List item marker |
| MD | Modal |
| NN | Noun, singular or mass |
| NNS | Noun, plural |
| NNP | Proper noun, singular |
| NNPS | Proper noun, plural |
| PDT | Predeterminer |
| POS | Possessive ending |
| PRP | Personal pronoun |

| Tag | Description |
|---|---|
| PRP$ | Possessive pronoun |
| RB | Adverb |
| RBR | Adverb, comparative |
| RBR | Adverb, superlative |
| RP | Particle |
| SYM | Symbol |
| TO | to |
| UH | Interjection |
| VB | Verb, base form |
| VBD | Verb, past tense |
| VBG | Verb, gerund or present participle |
| VBN | Verb, past participle |
| VBP | Verb, non3rd person singular present |
| VBZ | Verb, 3rd person singular present |
| WDT | Whdeterminer |
| WP | Whpronoun |
| WP$ | Possessive whpronoun |
| WRB | Whadverb |

Source : www.edureka.com

# POS : Examples

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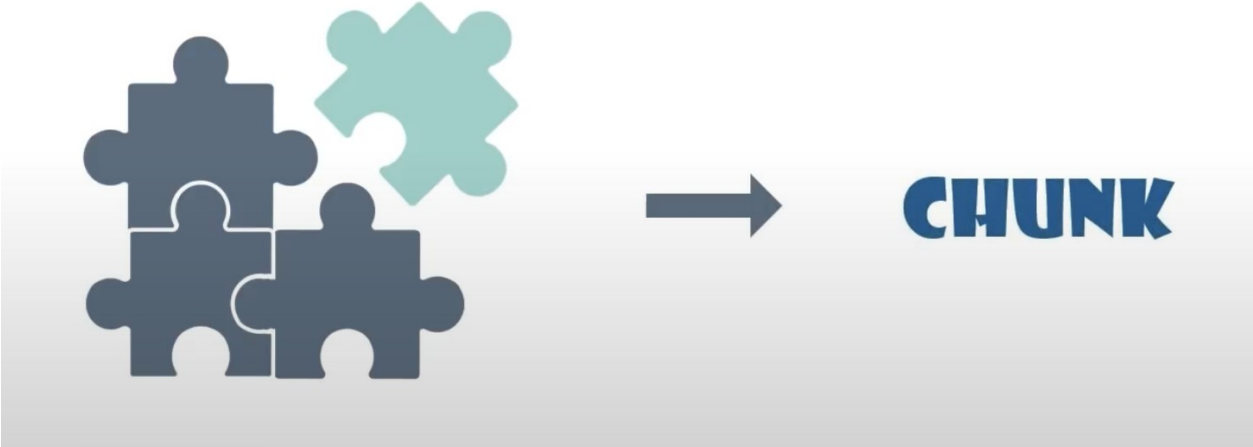
# Chunking

- Picking up Individual pieces of information and grouping them into bigger pieces

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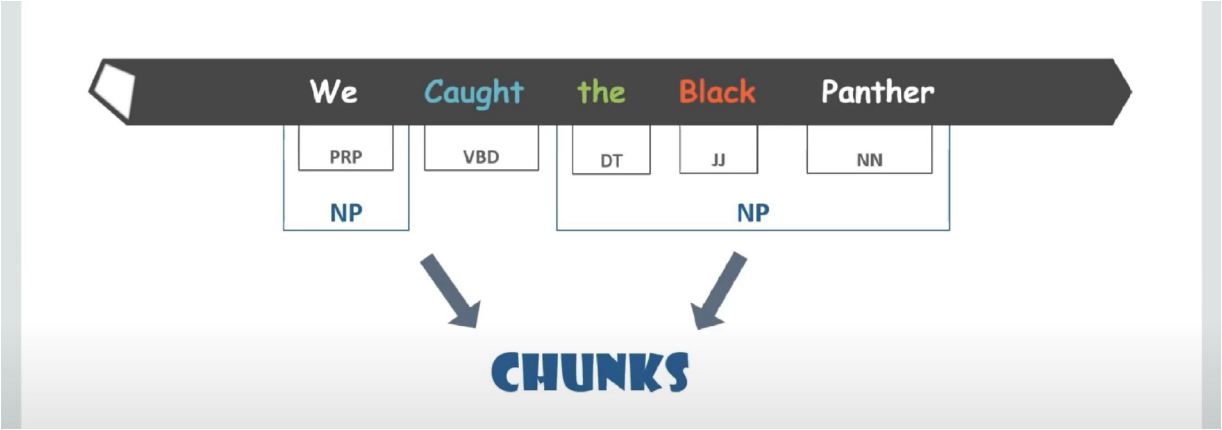
# Chunking : Example

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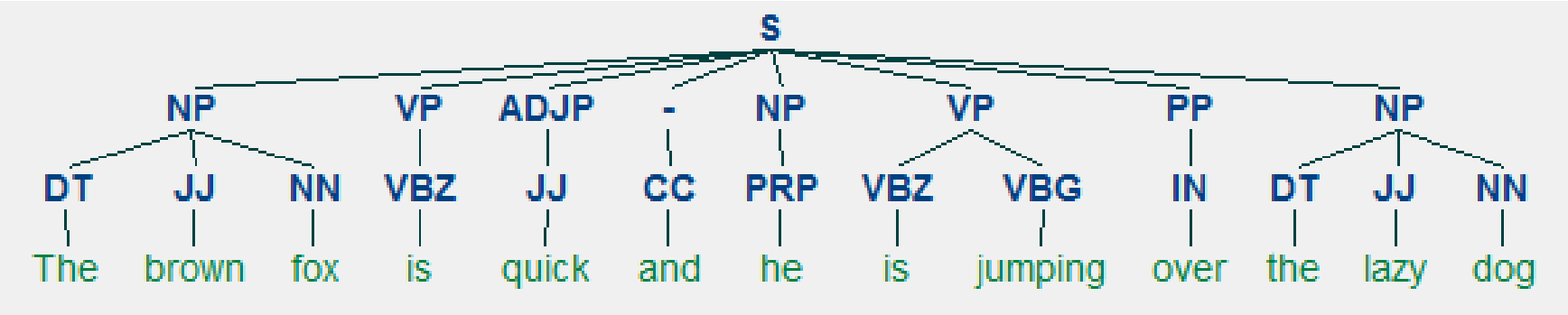
# Parsing

- Technique of analyzing the structure of a sentence to break its down into its smallest constituents (which are tokens such as words) and group them together into higher-level phrases.

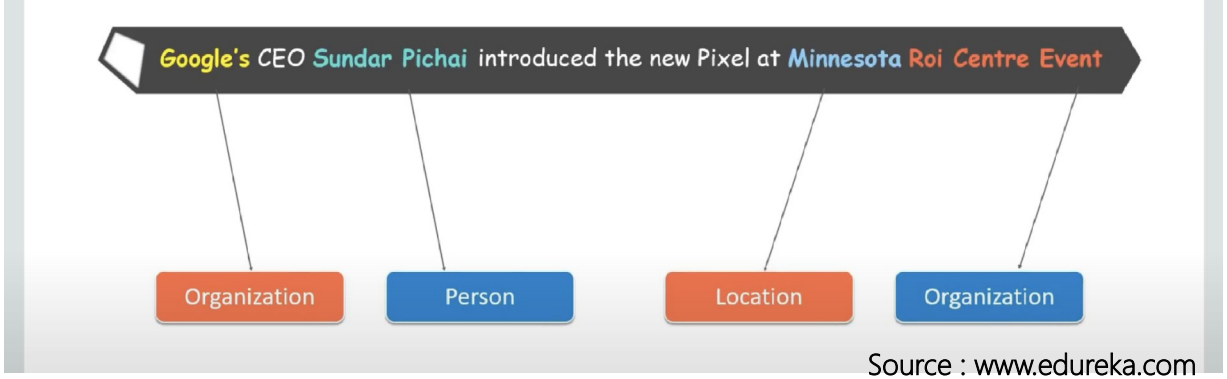



Source : www.towardsdatascience.com

# Named Entity Recognition (NER)

- A particular term that represent specific entities that are more informative and have unique context
- These entities are knows as named entities, which  more specifically refer to terms that represent real-world object like people, place,organization, and so on, which are often denoted by proper name

# NER : examples




Source : www.edureka.com

US GPE unveils world's most powerful supercomputer, beats China GPE . The US GPE has unveiled the world's most powerful supercomputer called 'Summit', beating the previous record-holder China GPE 's Sunway TaihuLight ORG . With a peak performance of 200,000 CARDINAL trillion calculations per second ORDINAL , it is over twice as fast as Sunway TaihuLight ORG , which is capable of 93,000 CARDINAL trillion calculations per second. Summit has 4,608 CARDINAL servers, which reportedly take up the size of two CARDINAL tennis courts.

Source : www.towardsdatascience.com

# How to implement NLP?

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## Machine Learning

- The learning NLP procedures used during machine learning
- It automatically focuses on the most common case

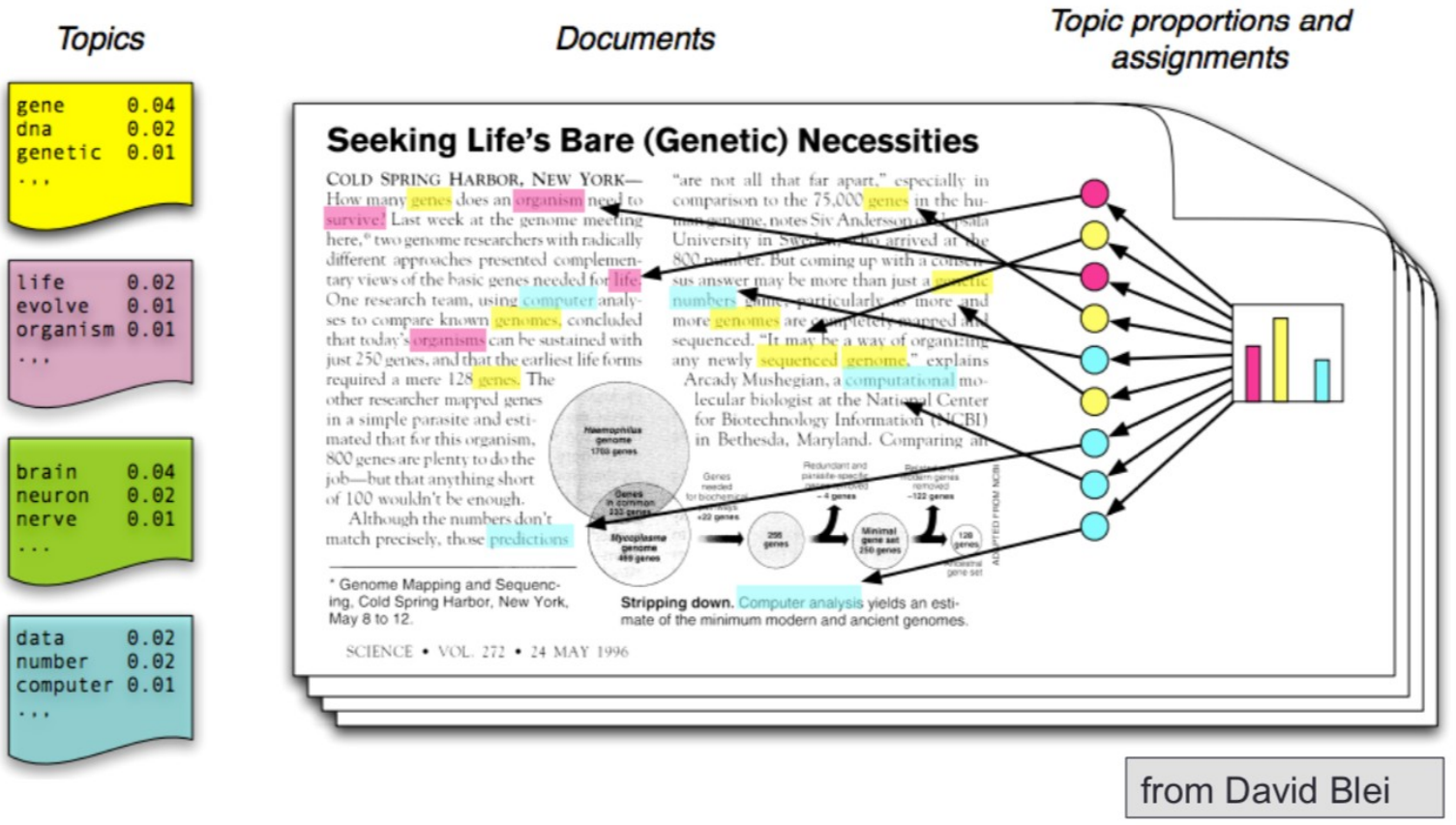
## Statistical Inference

- NLP can make use of statistical inference algorithm
- It help us to produce model that are robust
  - e.g. containing words or structures which are known to everyone

# Statitical Inference : example

- Topic Modeling
  - Type of statistical model for discovering the abstract "topics" that occur in collection of document
  - Frequently used text mining tool for discovery of hidden semantic structures in a text body
  - Topic models can help you automatically discover patterns in a corpus
    - **unsupervised** learning
  - Topic models automatically…
    - group topically-related words in "topics"
    - associate tokens and documents with those topics

# Topic Model




from David Blei

# Implementation : Example

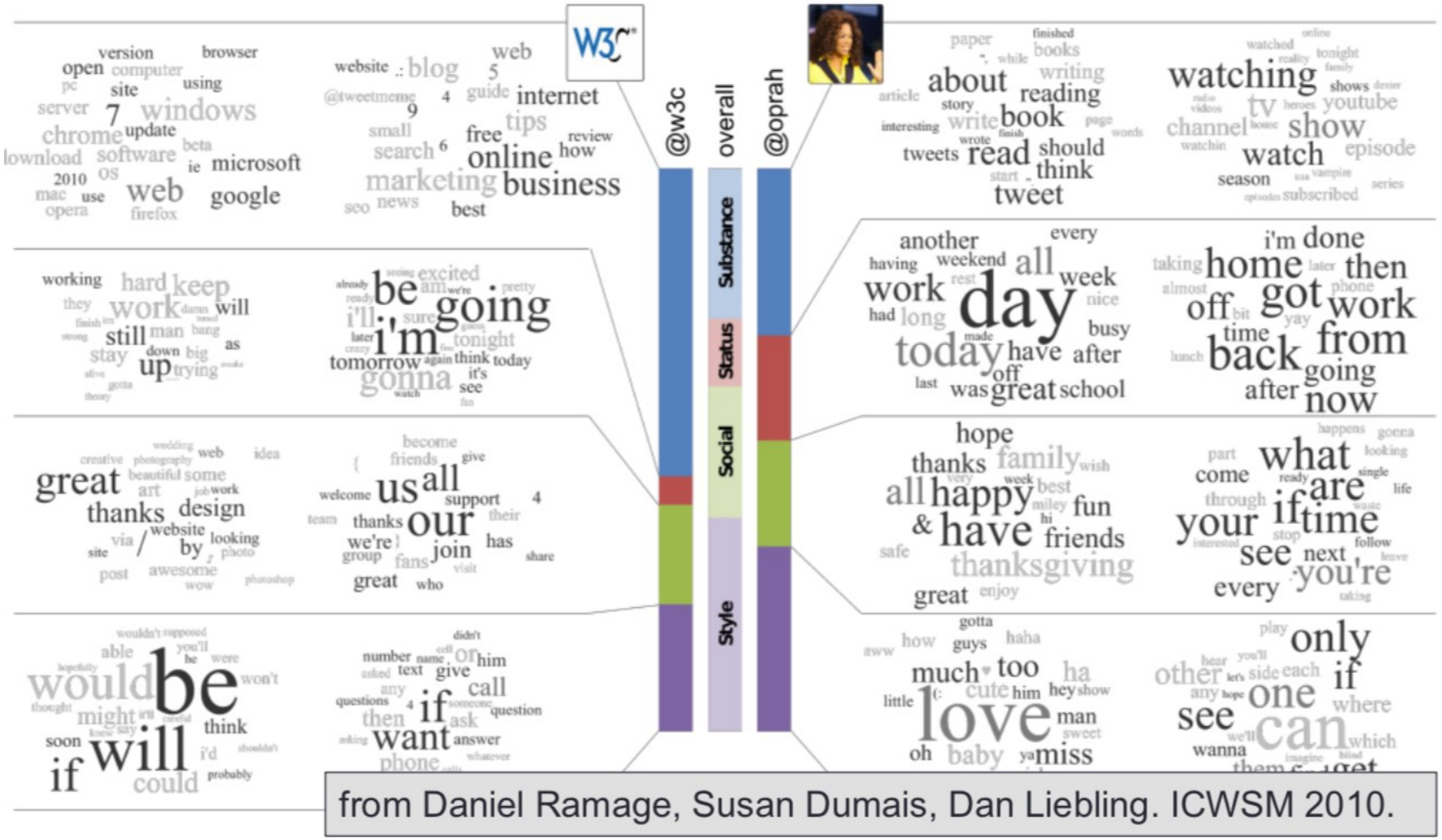
Suppose you want to learn something about a corpus that's too big to read

- What topics are trending today on Twitter?
- What research topics receive grant funding (and from whom)?
- What issues are considered by Congress (and which politicians are interested in which topic)?
- Are certain topics discussed more in certain languages on Wikipedia?

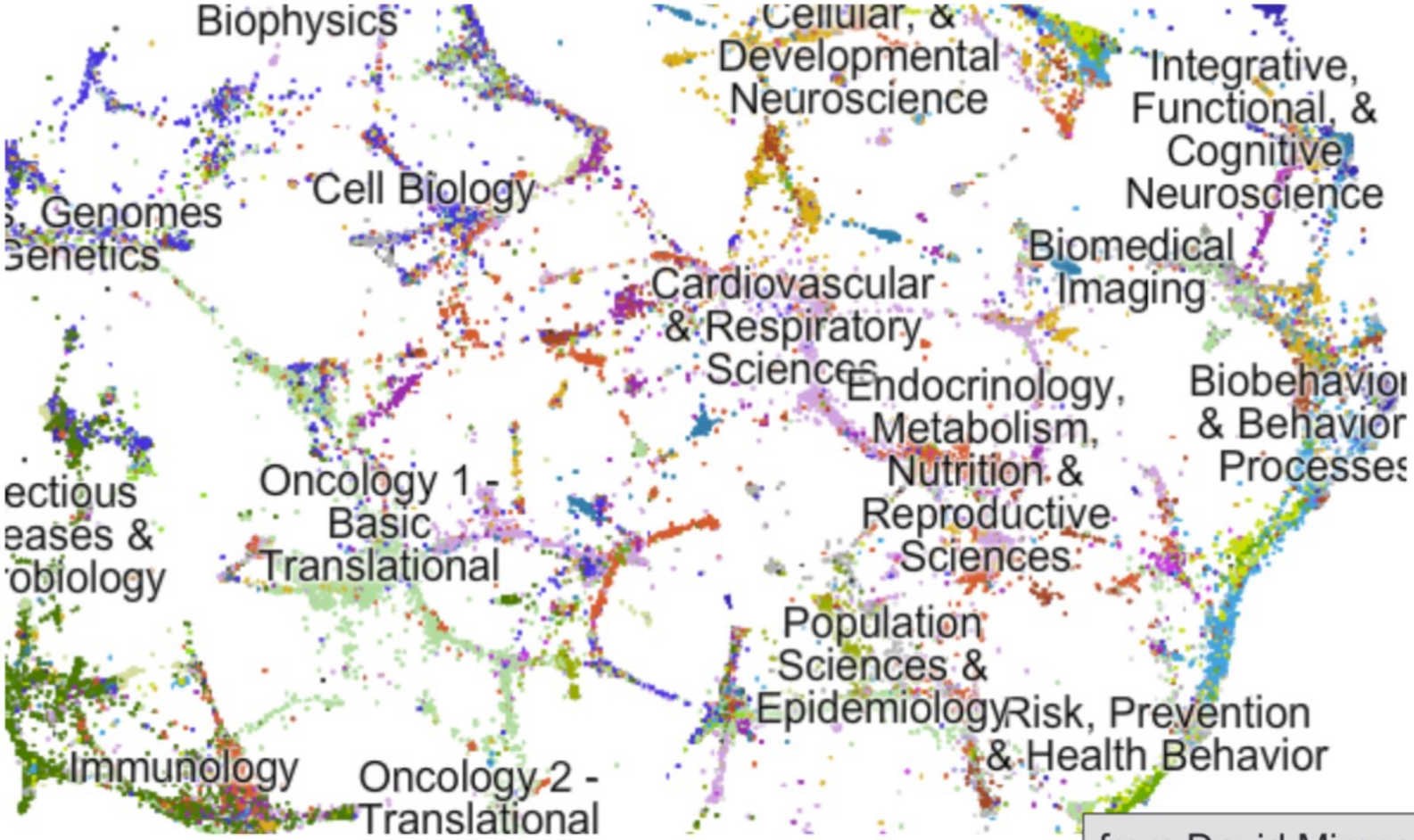
need to make sense of…

- **half a billion** tweets daily
- **80,000** active NIH grants
- **hundreds** of bills each year
- **Wikipedia** (it's big)

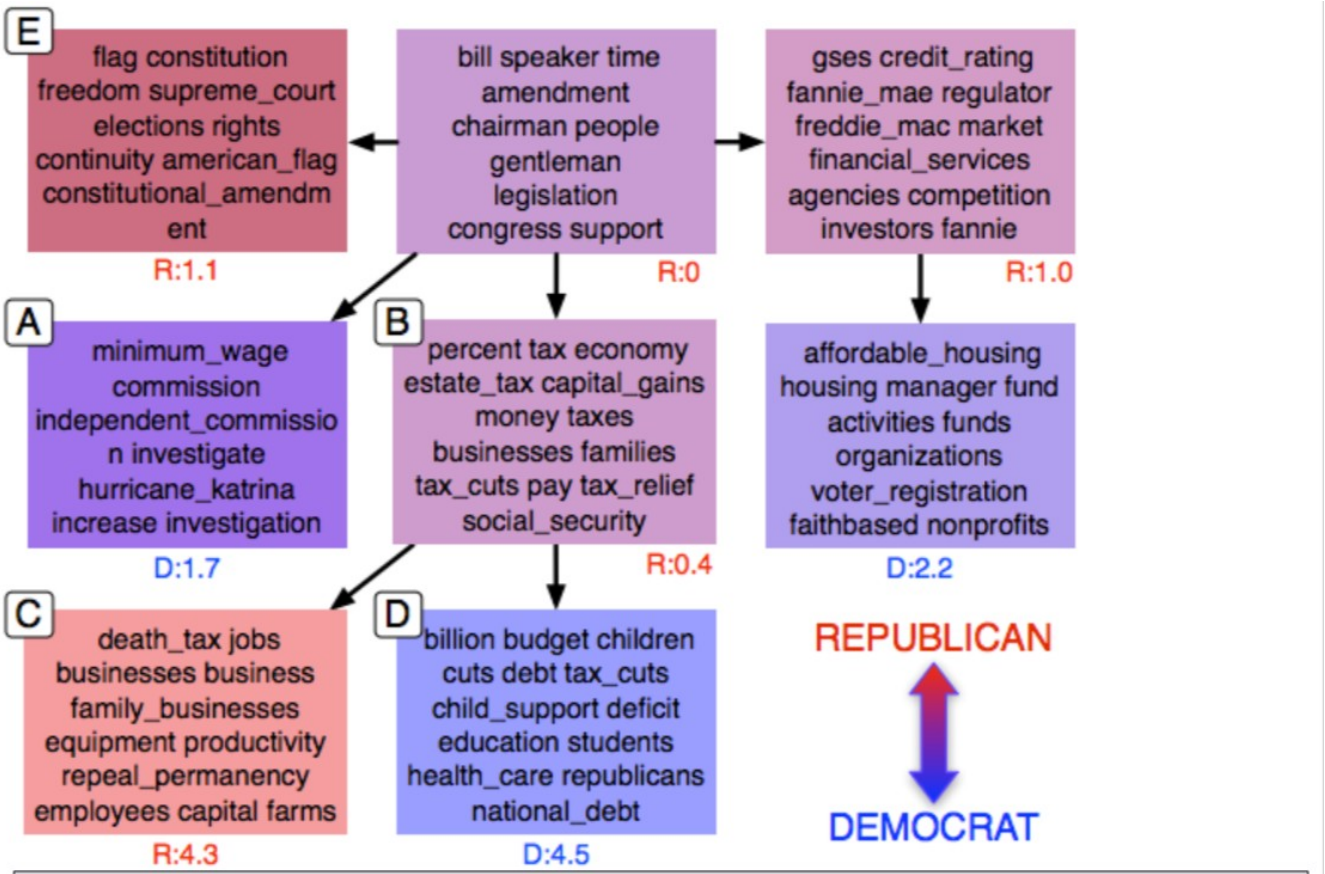
# Twitter Topic



# Research Grant Trends

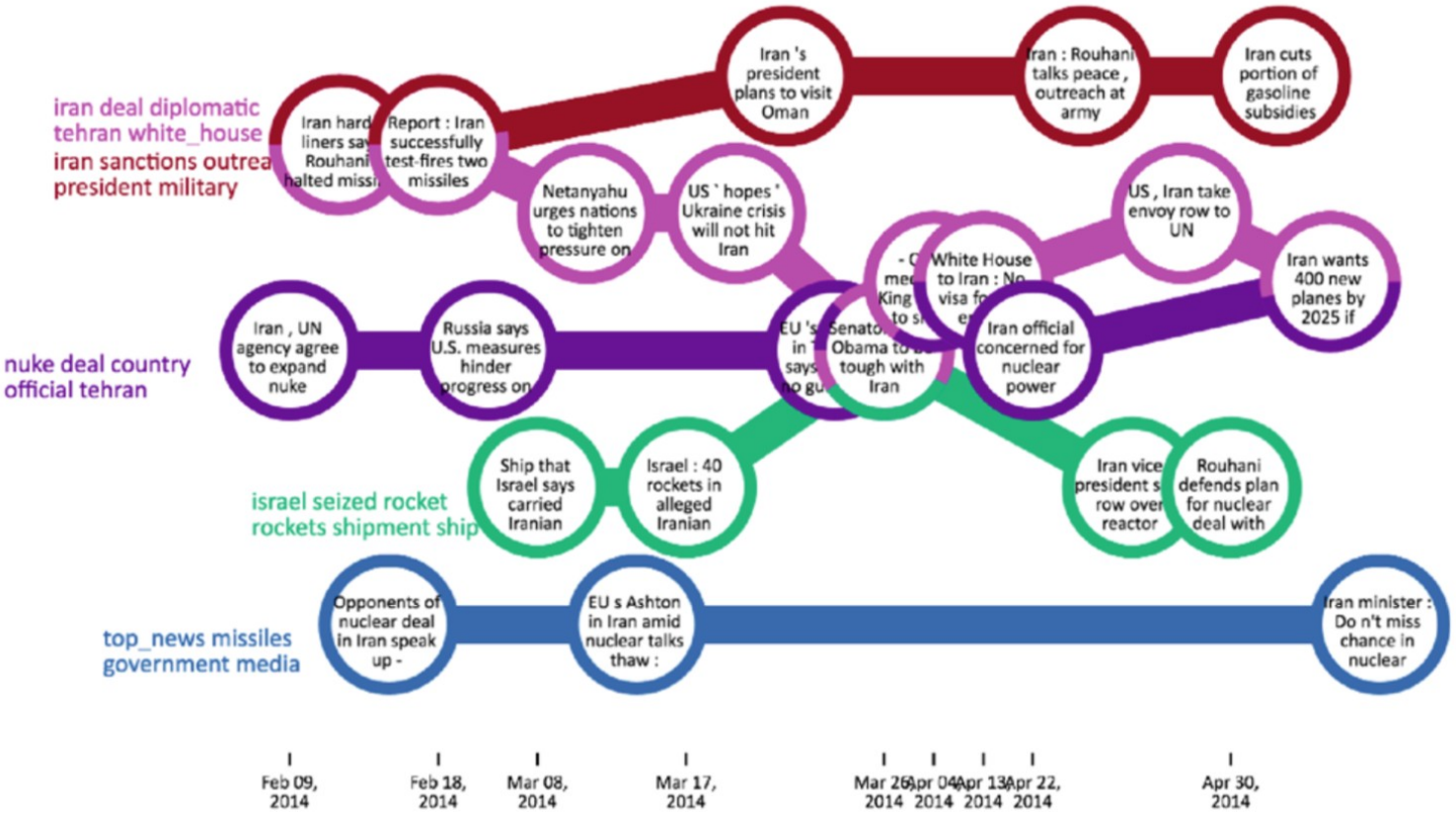


# Political Issues




from Viet-An Nguyen, Jordan Boyd-Graber, Phillip Resnik. NIPS 2013.

# Analyzing evolving stories in new




Roberto C.B, et,al, 2019

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Matur nuwun...
Thank you...
謝謝 ... .