

# Cutting-edge Deep Learning for NLP learners

## Introduction

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6 June 2022

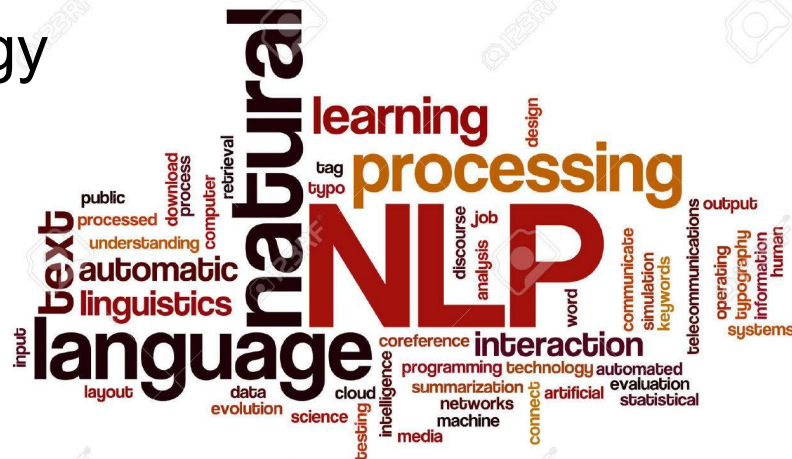
Máster Universitario en Inteligencia Artificial, UPM

# Outline

- What is Natural Language Processing? Why NLP? NLP Applications
- What is Deep Learning?
- Traditional Machine Learning vs Deep Learning
- Deep Learning applied to NLP
- Some examples of Deep Learning architectures for NLP tasks

# Natural Language Processing (NLP)

- Computational techniques for the automatic analysis and representation of human language
- Multidisciplinary: Linguistics, Mathematical and Computer Science, Psychology



# Why NLP?



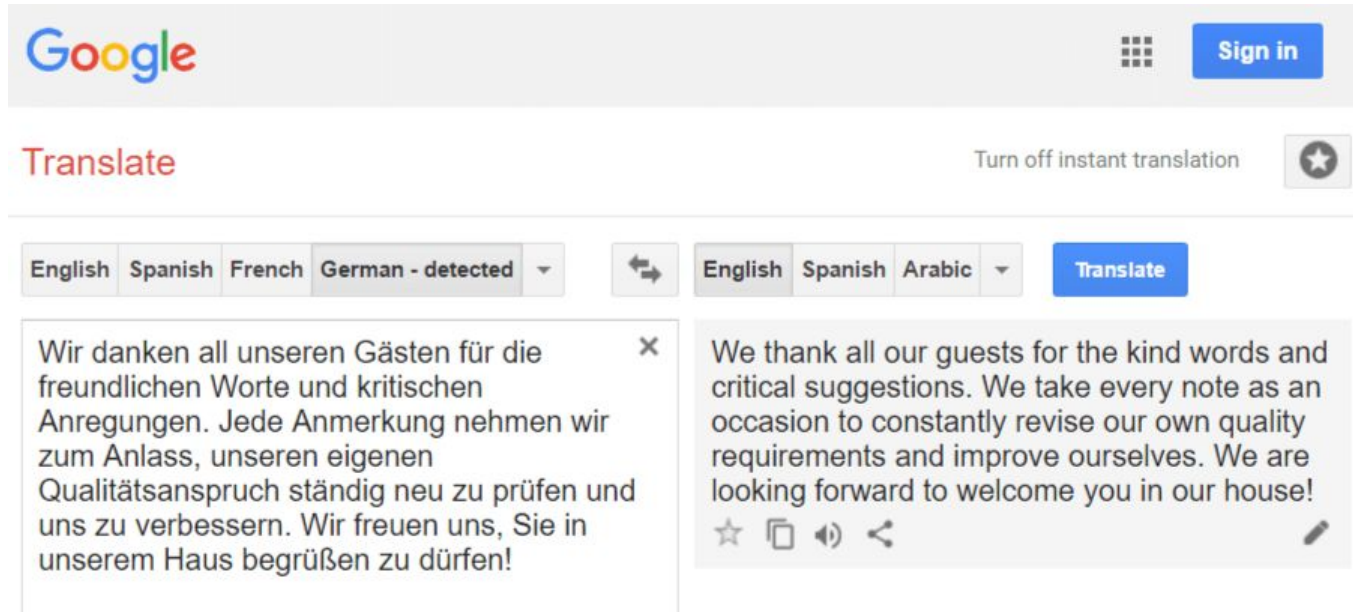
- Exponential Growth of data.
  - 2013, 3.5 ZB
  - 2022, 40 ZB
  - 2025, 180 ZB
- > 80% in unstructured form, primarily texts

\*1 ZB = 1 trillion GB

# NLP applications

- Machine translation,
- Information retrieval,
- Information extraction,
- Text classification,
- Question answering,
- Text summarization
- Text simplification,
- Conversational AI,
- ...

# Machine Translation (MT)



The screenshot displays the Google Translate web interface. At the top, the Google logo is on the left, and a 'Sign in' button is on the right. Below the logo, the word 'Translate' is written in red. To the right of 'Translate' is a link that says 'Turn off instant translation' and a star icon in a box. The main translation area has two input boxes. The left box has a dropdown menu with 'English', 'Spanish', 'French', and 'German - detected' (selected). The right box has a dropdown menu with 'English', 'Spanish', and 'Arabic' (selected). A blue 'Translate' button is to the right of the right box. Below the input boxes, the German text 'Wir danken all unseren Gästen für die freundlichen Worte und kritischen Anregungen. Jede Anmerkung nehmen wir zum Anlass, unseren eigenen Qualitätsanspruch ständig neu zu prüfen und uns zu verbessern. Wir freuen uns, Sie in unserem Haus begrüßen zu dürfen!' is shown in the left box, and the English translation 'We thank all our guests for the kind words and critical suggestions. We take every note as an occasion to constantly revise our own quality requirements and improve ourselves. We are looking forward to welcome you in our house!' is shown in the right box. There are icons for star, copy, speaker, and share below the English text, and a pencil icon for editing.

Google

Sign in

Translate

Turn off instant translation

English Spanish French German - detected


English Spanish Arabic




Translate

Wir danken all unseren Gästen für die freundlichen Worte und kritischen Anregungen. Jede Anmerkung nehmen wir zum Anlass, unseren eigenen Qualitätsanspruch ständig neu zu prüfen und uns zu verbessern. Wir freuen uns, Sie in unserem Haus begrüßen zu dürfen!




We thank all our guests for the kind words and critical suggestions. We take every note as an occasion to constantly revise our own quality requirements and improve ourselves. We are looking forward to welcome you in our house!

# Information Retrieval





Enviar comentarios



[automático](#) [artificial](#) [datos](#) [neuronal artificial](#)

Sugerencias

[https://www.xataka.com › robotica-e-ia › deep-learning...](https://www.xataka.com/robotica-e-ia/deep-learning...)

## Deep Learning: qué es y por qué va a ser una tecnología ...

29 mar 2016 — El **Deep Learning** representa un acercamiento más íntimo al modo de funcionamiento del sistema nervioso humano. Nuestro encéfalo tiene una ...

[https://es.wikipedia.org › wiki › Aprendizaje\\_profundo](https://es.wikipedia.org/wiki/Aprendizaje_profundo)

## Aprendizaje profundo - Wikipedia, la enciclopedia libre

Aprendizaje profundo (en inglés, **deep learning**) es un conjunto de algoritmos de aprendizaje automático (en inglés, **machine learning**) que intenta modelar ...


[Definiciones](#) · [Las GPU para procesamiento...](#)

[https://www.indracompany.com › blogneo › deep-learn...](https://www.indracompany.com/blogneo/deep-learn...)


## ¿Qué es el Deep Learning y para qué sirve? | indra

22 nov 2016 — El **Deep Learning** lleva a cabo el proceso de **Machine Learning** usando una red neuronal artificial que se compone de un número de niveles ...

# Information Retrieval

 **National Library of Medicine**  
National Center for Biotechnology Information

Log in



covid

Search

Advanced Create alert Create RSS User Guide


Save Email Send to

Sorted by: Best match Display options

MY NCBI FILTERS

147,246 results

RESULTS BY YEAR



1993 2022

TEXT AVAILABILITY

☐ Abstract

☐ Free full text

☐ Full text

ARTICLE ATTRIBUTE

☐ Associated data

ARTICLE TYPE

☐ Books and Documents

☐ Clinical Trial

☐ Meta-Analysis

☐ Randomized Controlled Trial

☐ Review

Use COVID-19 filters from PubMed Clinical Queries to refine your search  
Treatment Mechanism Transmission More filters

See more SARS-CoV-2 literature, sequence, and clinical content from NCBI

☐ **Laboratory testing for the diagnosis of COVID-19.**

1 Lai CKC, Lam W.

Cite Biochem Biophys Res Commun. 2021 Jan 29;538:226-230. doi: 10.1016/j.bbrc.2020.10.069. Epub 2020 Oct 28.

Share PMID: 33139015 Free PMC article. Review.

Rapid and accurate laboratory diagnosis of active **COVID-19** infection is one of the cornerstones of pandemic control. ...

☐ **Approaches towards fighting the COVID-19 pandemic (Review).**

2 Tsai SC, Lu CC, Bau DT, Chiu YJ, Yen YT, Hsu YM, Fu CW, Kuo SC, Lo YS, Chiu HY, Juan YN, Tsai FJ, Yang JS.

Cite Int J Mol Med. 2021 Jan;47(1):3-22. doi: 10.3892/ijmm.2020.4794. Epub 2020 Nov 20.

Share PMID: 33236131 Free PMC article. Review.

The causative agent of **COVID-19**, **SARS-CoV-2**, is a novel coronavirus strain. To date, remdesivir has been granted emergency use authorization for use in the management of infection. Additionally, several efficient diagnostic tools are being activ ...

☐ **COVID-19: Therapeutics and interventions currently under consideration.**

3 McFee RB.

Cite Dis Mon. 2020 Sep;66(9):101058. doi: 10.1016/j.disamonth.2020.101058. Epub 2020 Jul 28.



# Information Extraction

## Text in

**Brazil** ranks number 5 in the list of countries by population.

The term "**Ibu Negara**" (Lady/Mother of the State) is used for **wife** of the President of Indonesia.

**Game of Thrones** is an adaptation of A Song of Ice and Fire, George R. R. Martin's series of fantasy novels. It ranks **fourth** among the **IMDB Top Rated TV Shows**

## Data out

### THE COUNTRIES WITH THE LARGEST POPULATION

China	1	1,388,232,693
India	2	1,342,512,706
Unites States	3	326,474,013
Indonesia	4	263,510,146
<b>Brasil</b>	5	174,315,386

### THE COUNTRY'S' FIRST LADIES

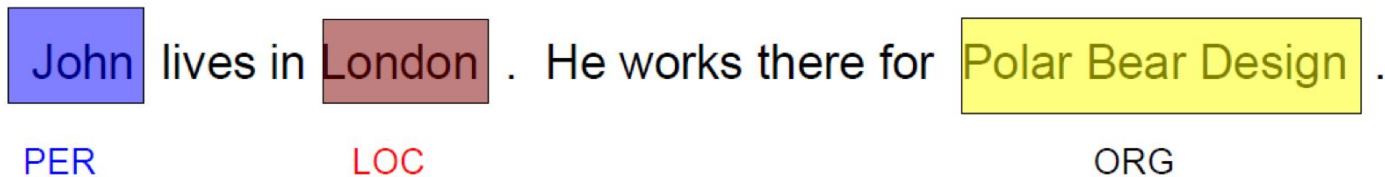
Brigitte Macron  
- Spouse: Emmanuel Macron, President of France (2017 - )  
Melania Trump  
- Spouse: Donald J. Trump, U.S. President (2017 - )  
**Iriana Widodo**  
- Spouse: **Joko Widodo**, **President of Indonesia** (2014 - )  
- Also known as: "**Ibu Negara**" (Lady/Mother of the State)

### IMDB TOP RATED TV SHOWS

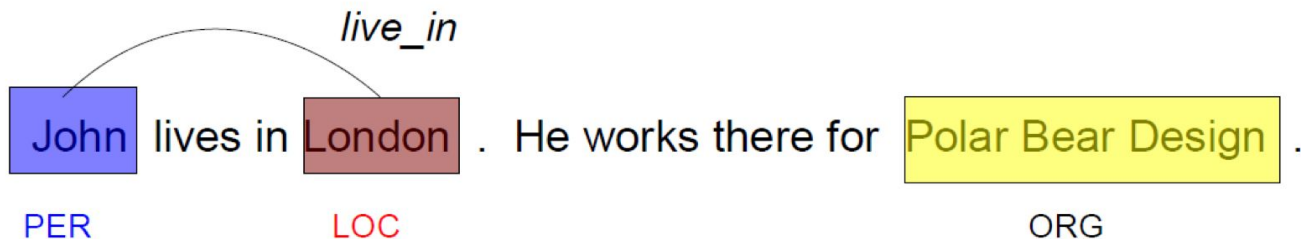
- 1 Planet Earth II (2016) 9.6.
- 2 Band of Brothers (2001) 9.5.
- 3 Planet Earth (2006) 9.5.
- 4 **Game of Thrones** (2011) 9.4.
- 5 Breaking Bad (2008) 9.4.

# IE tasks

## 1) Named Entity Recognition (NER)

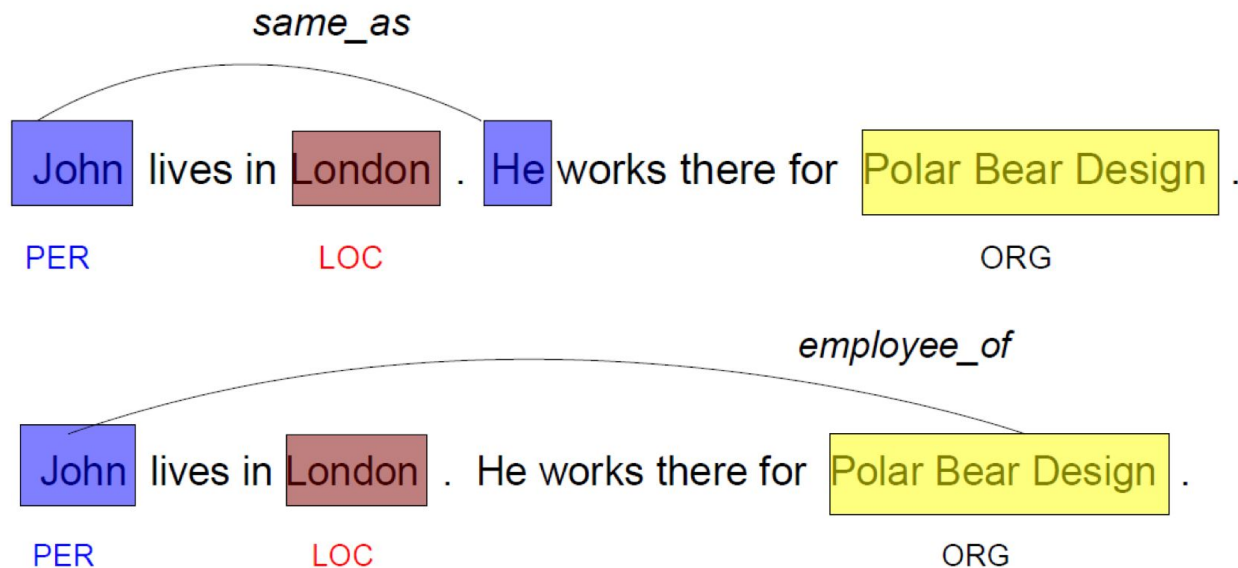


## 2) Relation Extraction

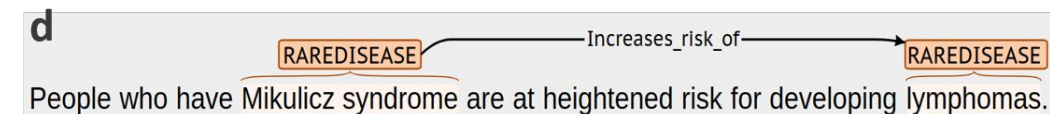
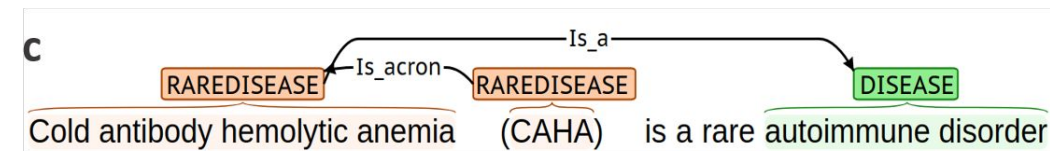
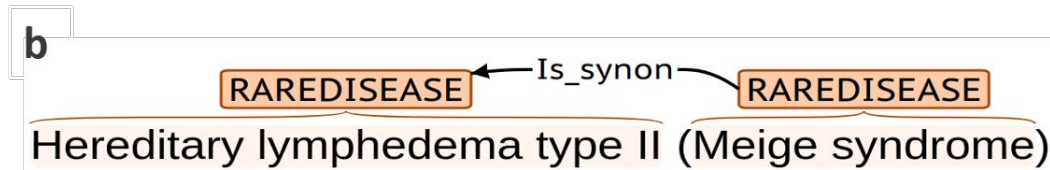


# IE tasks

## 3) Co-reference resolution



# IE tasks (biomedical and clinical domains)



# Question Answering



cuál es el edificio más alto del mundo



Todo

Imágenes

Noticias

Videos

Maps

Más

Configuración

Herramientas

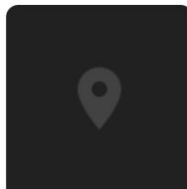
Mundo / Edificios (más altos)



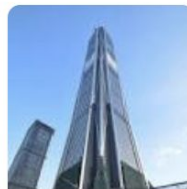
Burj Khalifa  
828 m



Torre de  
Shanghái  
632 m



Makkah Clock  
Tower  
601 m



Ping An  
Finance Cen...  
555 m



Lotte World  
Tower  
555 m








One World  
Trade Center  
541,3 m


¿Cuál es el edificio más alto del mundo? | Plataforma ...


<https://www.plataformaarquitectura.cl> > ArchDaily > Artículos ▾


23 ene. 2019 - En la actualidad existen instituciones especializadas que establecen los parámetros para definir objetivamente cuánto mide un **edificio**.


# Question Answering


**Quora**


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 Answer

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 Request








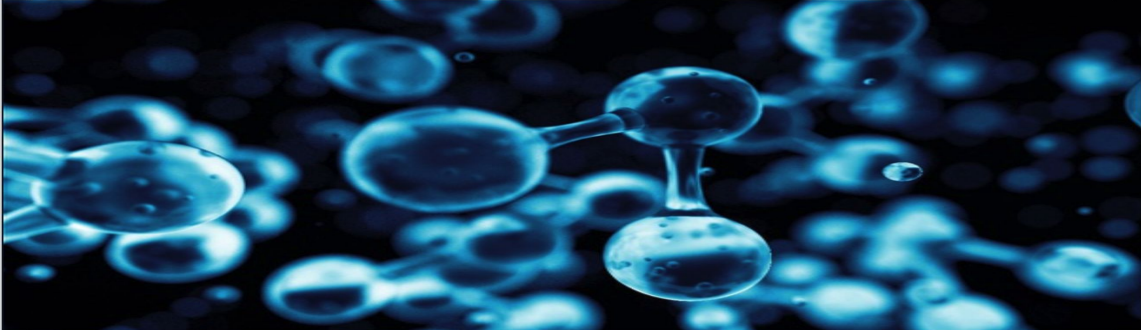
View all >


**Bhushan**  · [Follow](#)  
I speak two languages - English and Sarcasm.. · 12h ago


 Pradip Bedre · Answered June 27, 2020


**What is neno technology?**


How it Started The ideas and concepts behind nanoscience and nanotechnology started with a talk entitled "There's Plenty of Room at the Bottom" by physicist Richard Feynman at an American Physical Society meeting at the California Inst ([more](#))





 1



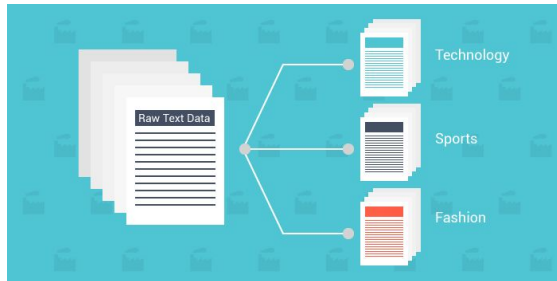
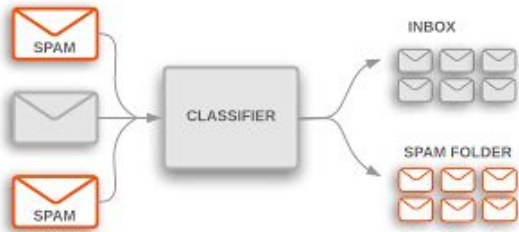








# Text Classification



# Text summarization

**Source Text:** Peter and Elizabeth took a taxi to attend the night party in the city.

While in the party, Elizabeth collapsed and was rushed to the hospital.

**Summary:** Elizabeth was hospitalized after attending a party with Peter.





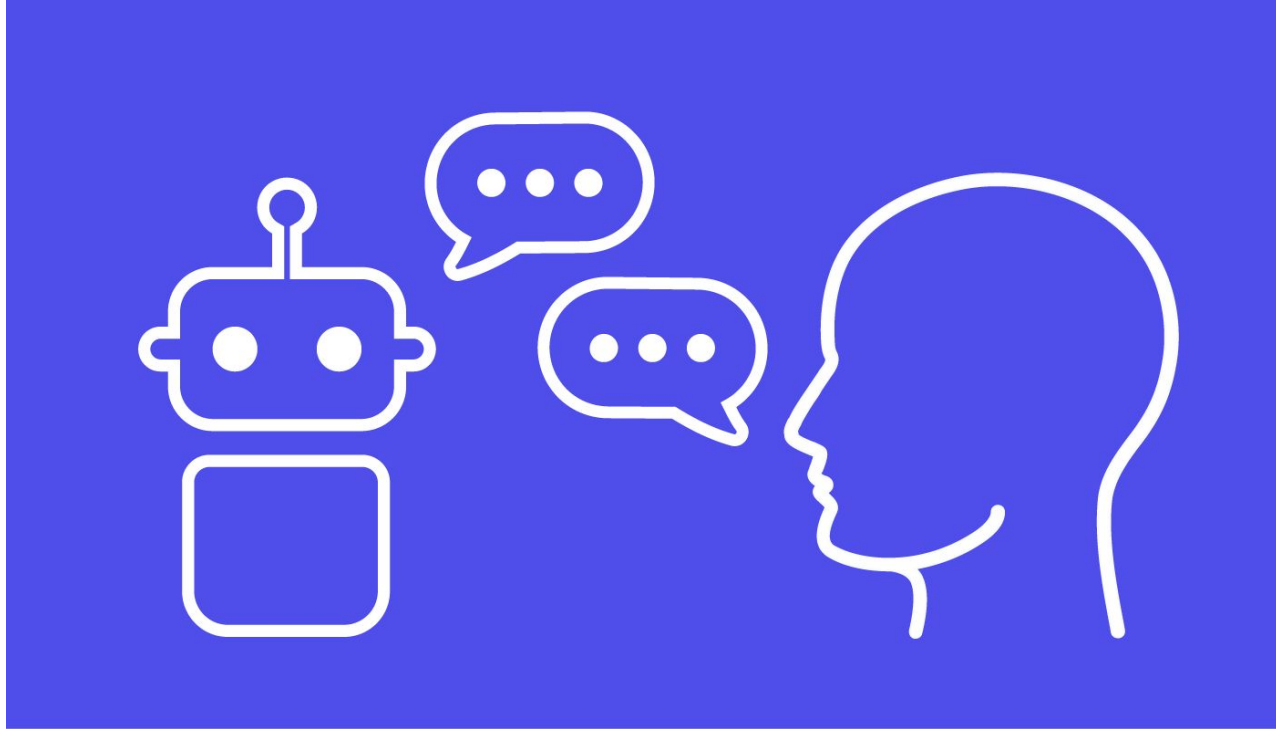
# Text simplification

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Normal: Alfonso Perez *Munoz, usually referred to as Alfonso*, is a former Spanish *footballer, in the striker position*.

Simple: Alfonso Perez is a former Spanish *football player*.

# Conversational AI (Chatbots)



# TIMELINE OF NLP

*Alan Turing released his paper known as "Turing Test"*

*Some successful NLP systems were developed like SHRDLU, ELIZA*

*Machine learning algorithms were introduced for natural language processing*

*A large quantity of spoken and textual data became accessible.*

**1940**

**1950**

**1957**

**1960**

**1970**

**1980**

**1990**

**2000**

**2010**

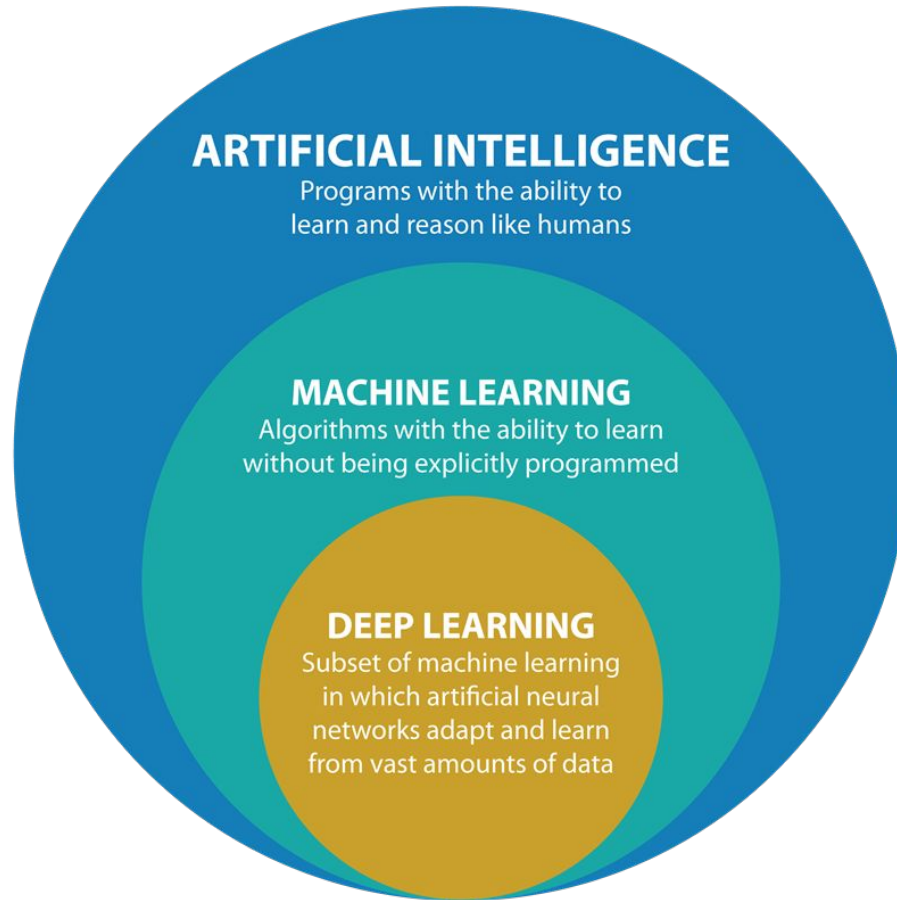
*First idea of machine translation developed*

*Noam Chomsky's Syntactic Structures revolutionized Linguistics with 'universal grammar',*

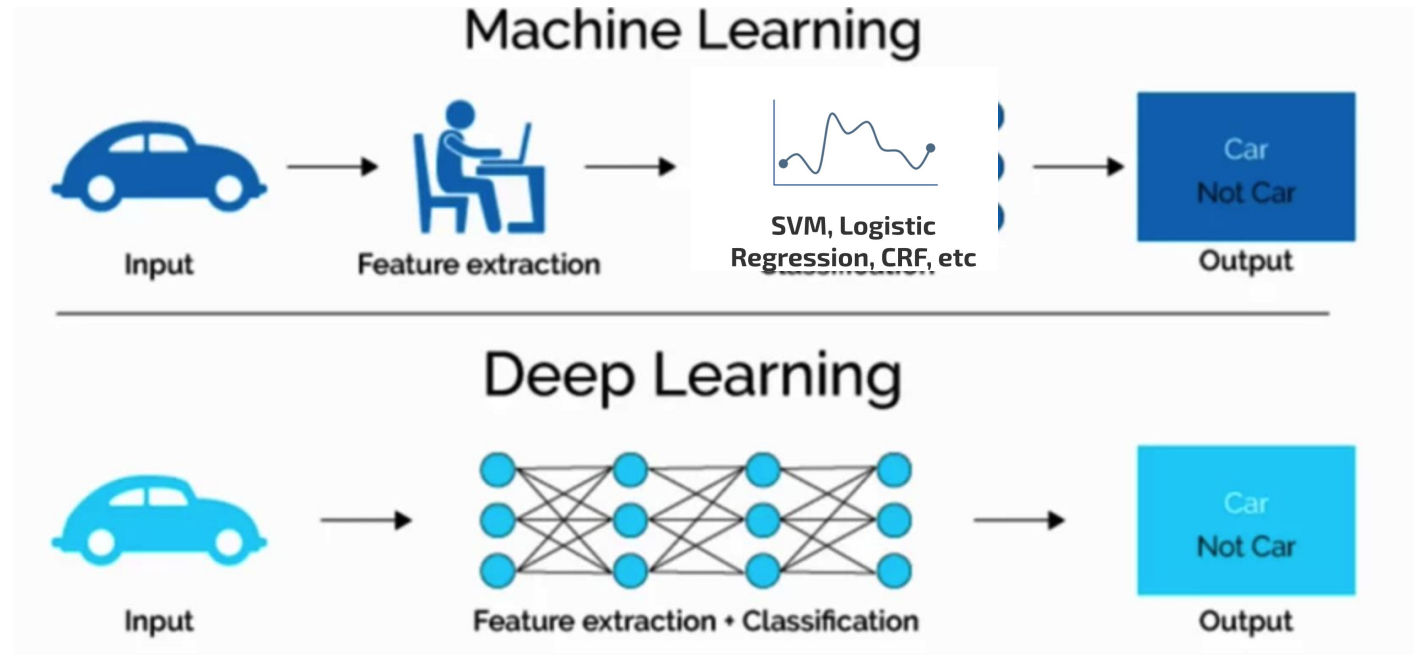
*Many chatterbots were written for eg. Parry*

*Many of the notable early successes on statistical methods in NLP occurred in the field of machine translation*

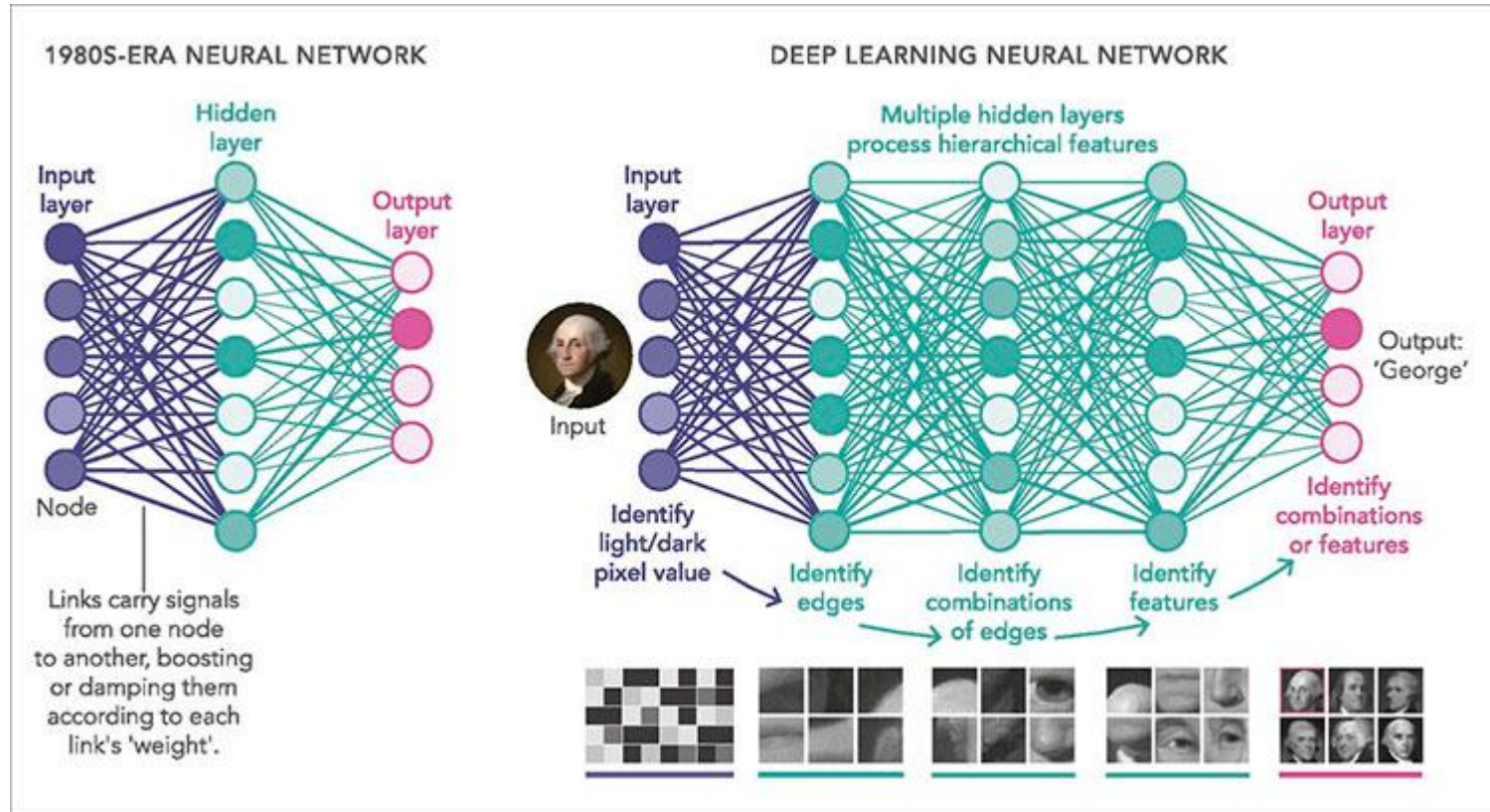
*Representation learning and Deep learning methods started implementing in NLP*



Traditional ML algorithms for NLP tasks heavily require on hand-crafted features. Feature engineering is a time-consuming process. Moreover, it is not usually robust enough (low recall)



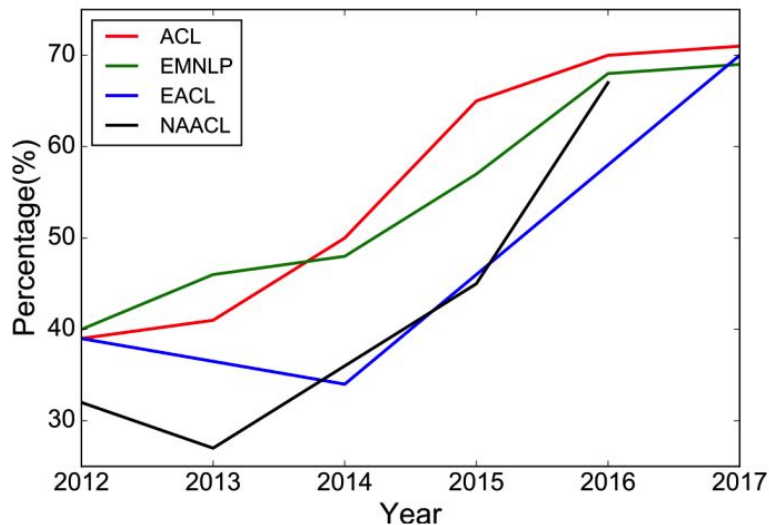
Employ multiple processing layers to learn hierarchical representations of data



<https://www.futurespace.es/redes-neuronales-y-deep-learning-capitulo-1-preludio/>

Produce state-of-the-art results in many domains  
(such as computer vision, pattern recognition)

# DEEP LEARNING for NLP

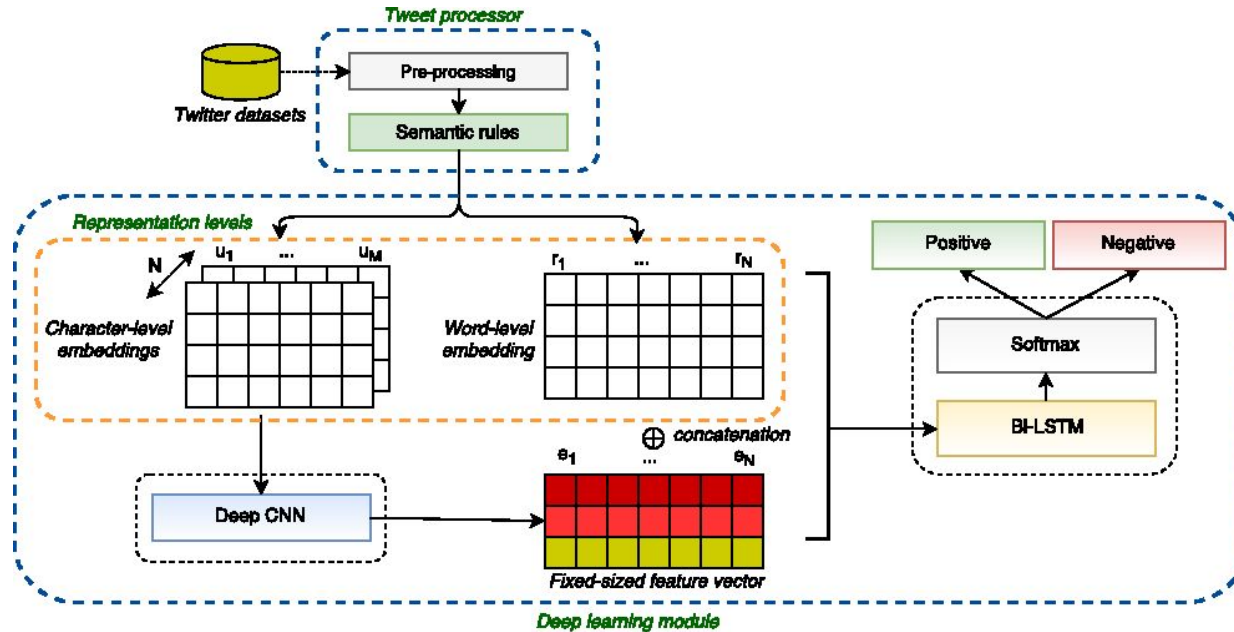


Produce state-of-the-art results in many NLP applications (machine translation, IE, text summarization, etc)

**Results**

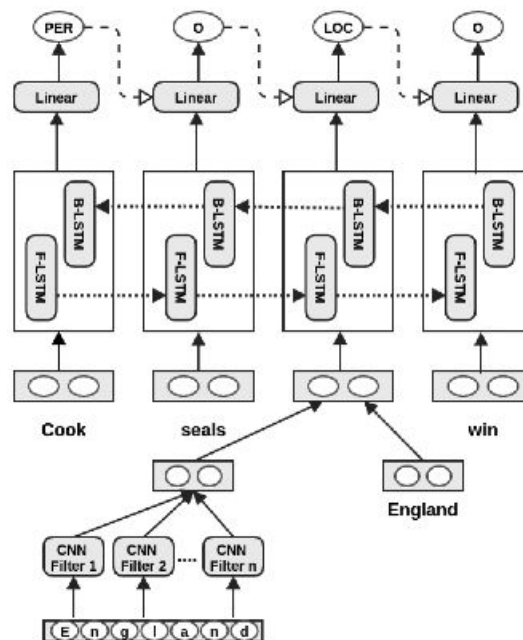
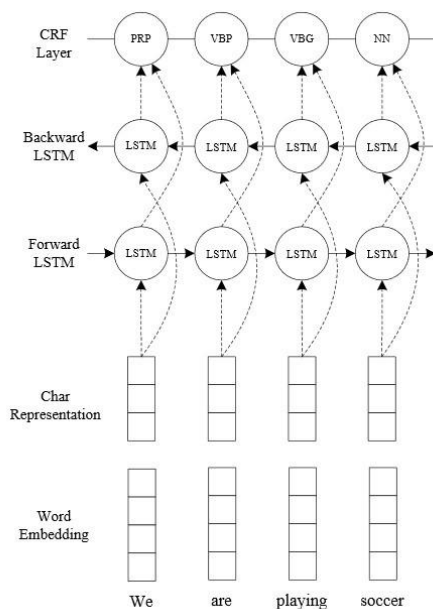


# BiLSTM for Text Classification (Sentiment Analysis of Tweets)

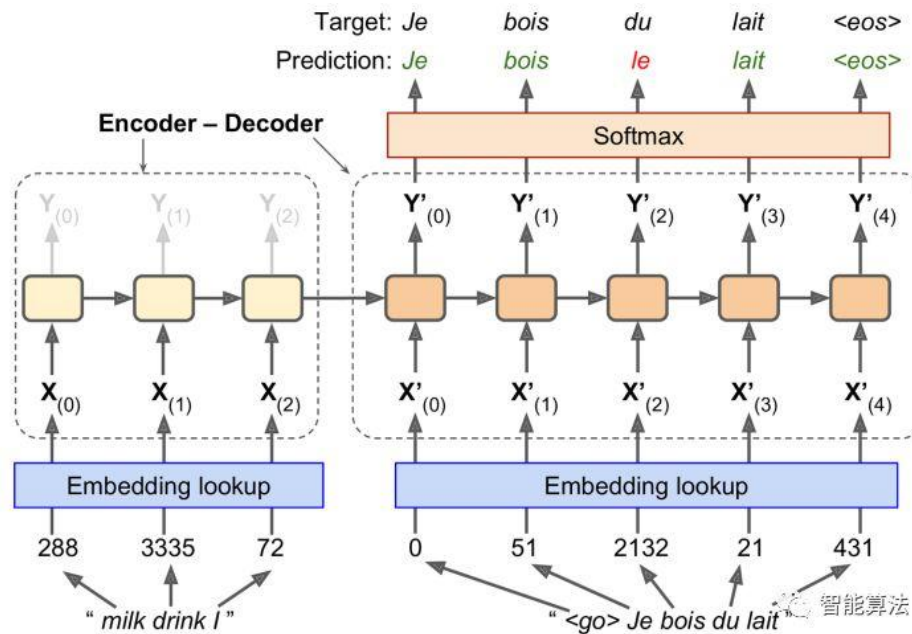




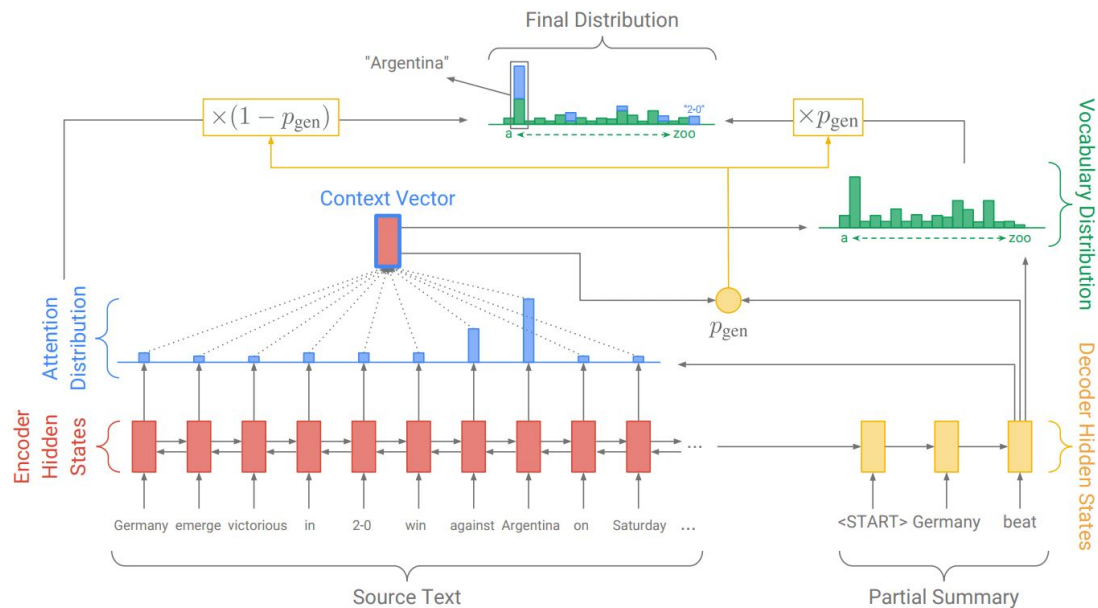
# BiLSTM + CRF for Sequence Labeling tasks (PoS tagging and NER)



# Seq2Seq for Machine translation



# Transformers for Text summarization



# Key Take-aways

- **NLP**: automatic understanding of the human language.
- **Deep Learning** architectures are artificial neural networks with multiple layers
- **Feature engineering** is a crucial task in traditional ML.
- **Deep Learning avoids the feature engineering** task as the network learns the **best representation of the data**.
- **Deep Learning** has sparked a **revolution in NLP**, achieving **state-of-the-art results in many NLP applications**.
- The cutting edges of deep learning for NLP:
  - word embeddings -> CNN -> BiLSTM -> Transformers

Thank you  
Question time!!!

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<https://hulat.inf.uc3m.es/nosotros/miembros/isegura>

<https://github.com/isegura>