

# Natural Language Processing (NLP)

## Unit 1 Introduction and Course Overview

By:  
Syeda Saleha Raza



AL NAFI,  
A company with a focus on education,  
wellbeing and renewable energy.

اَللّٰهُمَّ اِنِّیْ اَسْأَلُكَ عِلْمًا نَافِعًا،

وَرِزْقًا طَیِّبًا، وَعَمَلًا مُّتَقَبَّلًا،

(O Allah, I ask You for beneficial knowledge,  
goodly provision and acceptable deeds)

اے اللہ ، میں آپ سے سوال کرتی ہوں نفع بخش علم کا، طیب رزق کا، اور اس عمل کا  
جو مقبول ہو۔

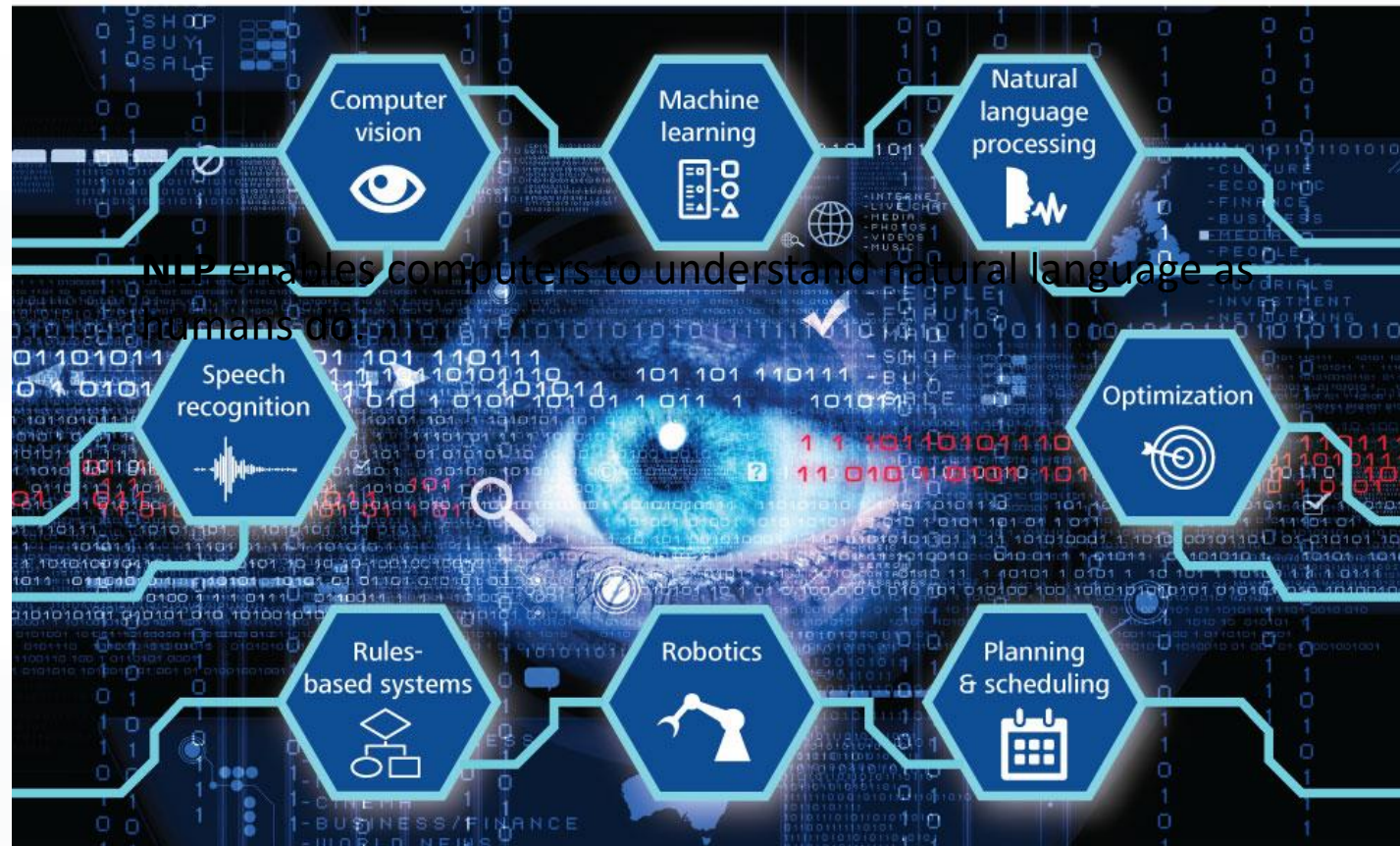
(Sunan Ibn Majah: 925)

# Outline

- What is Natural Language Processing (NLP)?
- A bit of history
- Major breakthroughs
- Applications
- Why is NLP hard?
- Course Overview

# Subfields of AI

Figure 1. The field of artificial intelligence has produced a number of cognitive technologies



Graphic: Deloitte University Press | DUPress.com

# Natural Language Processing (NLP)

- **NLP** enables computers to understand natural language as humans do.
- The ultimate objective of NLP is to enable computers to understand, interpret, and generate human language in a way that is both meaningful and contextually relevant.

Hi! Would you like to hear a joke?

Yes, tell me the joke

No, I just want to read the blog

Why are obtuse angles so depressed?

I don't know...

Why?

Because they're never right.

Hahahahaha

It was terrible

That makes me a saaad chatbot 🙄

Sorry

...

Maybe you should try to create a chatbot that tells better jokes 🙄

I will

I can't ...



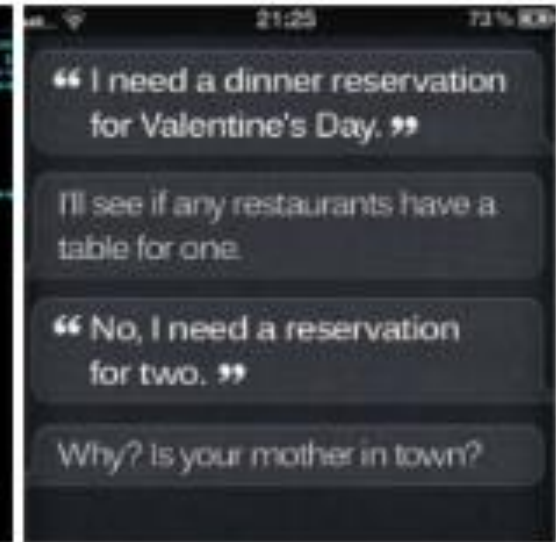
# Communication with machines



~50-70s



~80s



today

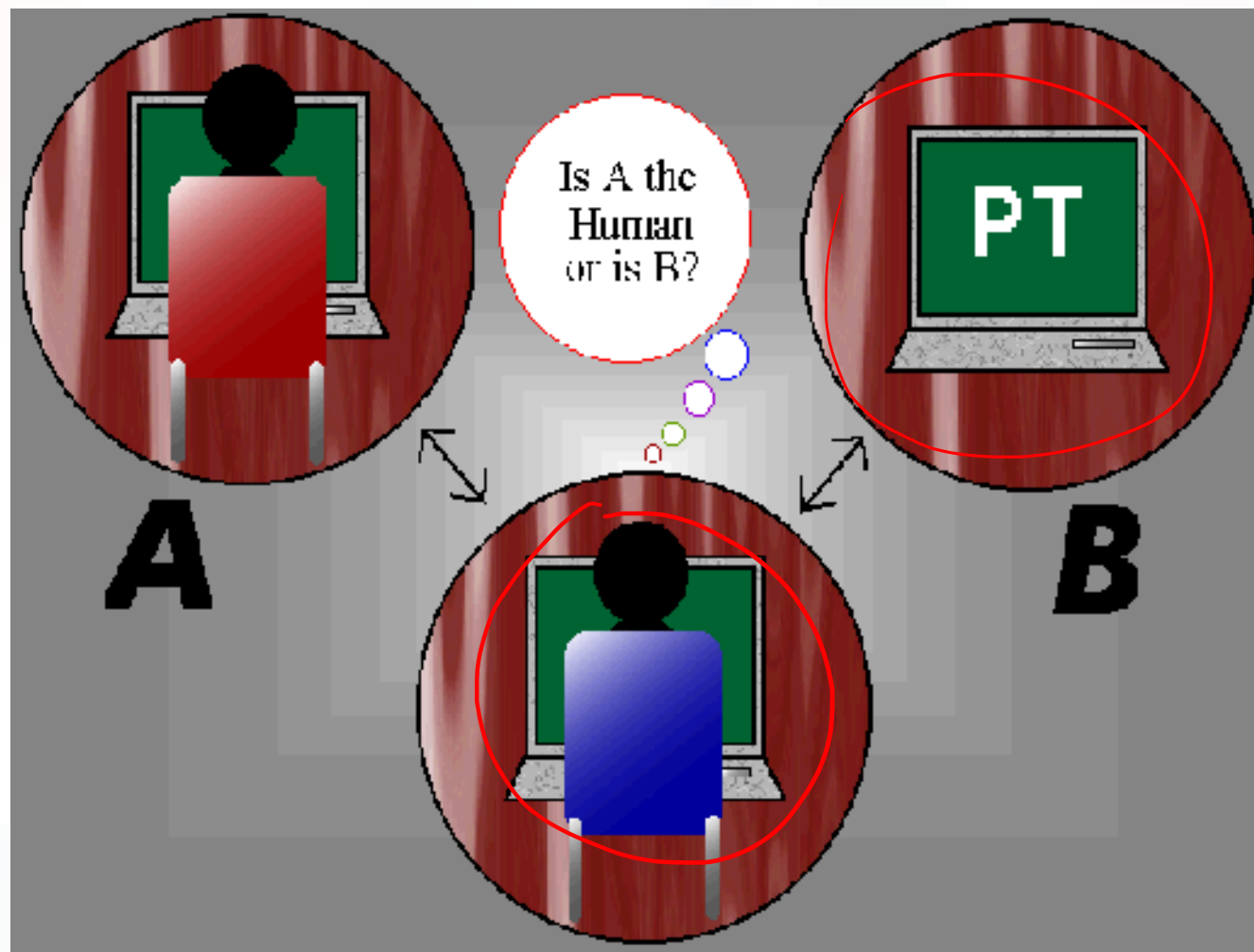
# A bit of history

# History of AI

- 1950: Turing :Turing's "Computing Machinery and Intelligence"
- 1956 birth of AI: Dartmouth meeting: "Artificial Intelligence" name adopted
- 1966–73: Reality dawns: Realization that many AI problems are intractable
  - Neural network research almost disappears
- 1969–85: Adding domain knowledge: Development of knowledge-based systems
  - Success of rule-based expert systems,
    - E.g., DENDRAL, MYCIN
- 1986-- Rise of machine learning: Neural networks return to popularity
  - Major advances in machine learning algorithms and applications
- 1990-- Role of uncertainty: Bayesian networks as a knowledge representation framework
- 1995-- AI as Science: Integration of learning, reasoning, knowledge representation
  - AI methods used in vision, language, data mining, etc



# Turing Test



- **1960s: ELIZA (1966):**
- Joseph Weizenbaum developed ELIZA, an early natural language processing computer program. ELIZA simulated conversation by using simple pattern-matching potential for human-com

User: I am unhappy.  
ELIZA: DO YOU THINK COMING HERE WILL HELP YOU NOT TO BE UNHAPPY  
User: I need some help, that much seems certain.  
ELIZA: WHAT WOULD IT MEAN TO YOU IF YOU GOT SOME HELP  
User: Perhaps I could learn to get along with my mother.  
ELIZA: TELL ME MORE ABOUT YOUR FAMILY  
User: My mother takes care of me.  
ELIZA: WHO ELSE IN YOUR FAMILY TAKES CARE OF YOU  
User: My father.  
ELIZA: YOUR FATHER  
User: You are like my father in some ways.

Weizenbaum (1966)

# Big Milestones

14 February 2011 Last updated at 09:31 GMT



## IBM supercomputer challenges humans on TV quiz

By Maggie Shiels

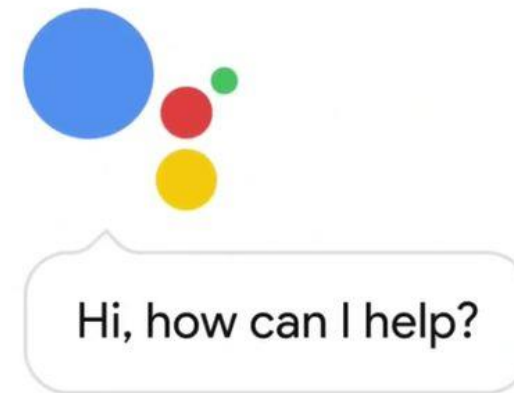
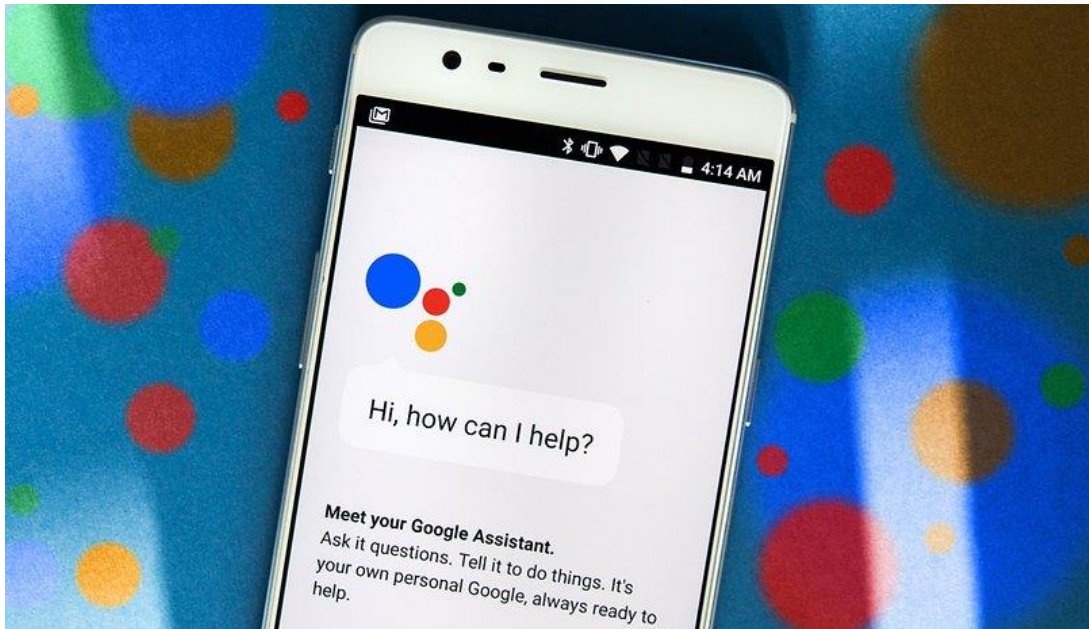
Technology reporter, BBC News, Silicon Valley

A supercomputer, designed by IBM, is to face two human contestants on the US quiz show Jeopardy.



IBM machines have previously taken on chess players

# Chatbots/Personal Assistants



# Evolution of NLP

# Evolution of NLP

- **Pre-1990s** – Rule-based systems
- **1990s** – Statistical Methods and Hidden Markov Model (HMM)
- **2000s** – Machine Learning advances and rise of web data
- **2010** – Deep Learning and Neural Networks based systems
- **2018** – Attention-based architectures, Transformers, Pre-trained Large Language Models (LLMs) such as BERT, GPT etc



# NLP Applications

- Sentimental Analysis
- Chatbots
- Virtual Assistants
- Speech Recognition
- Machine Translation
- Advertise Matching
- Information Extraction
- Grammatical error detection
- Fake news detection
- Text Summarize

<https://www.youtube.com/watch?v=mWTySUGXR2k&list=PLD7HFcN7LXRd4kd2XgZjlbQ8TwTC32Zc9&index=3>

# Why is NLP hard?

# Why is NLP hard?

- Language is a complex and ever-evolving system that is open-ended.
- Language can be used to convey an infinite number of meanings, and people use varied sentence structures, idioms, slang, cultural references, and expressions of emotion to communicate.

# Why is NLP hard?

- **Ambiguity**

- Word senses: **bank** (finance or river ?)
- Part of speech: **chair** (noun or verb ?)
- Syntactic structure: **I can see a man with a telescope**
- Multiple: **I made her duck**

# Why is NLP hard?

- Morphology + Syntax



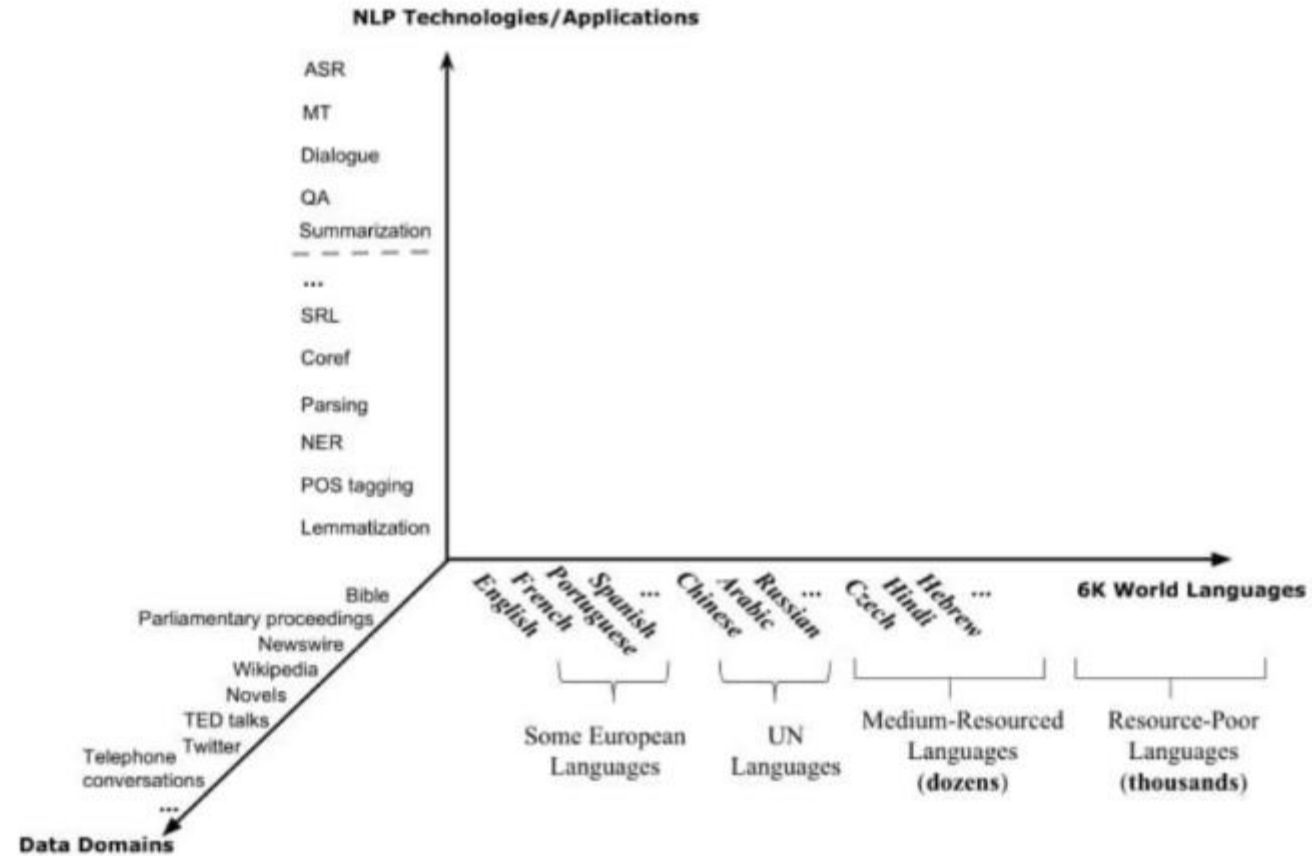
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ship, shipping  
shipping-ships

# Why is NLP hard?

- Syntax + Semantics
  - We saw the woman with the telescope wrapped in paper.
    - Who has the telescope?
    - Who or what is wrapped in paper?
    - An even of perception, or an assault?



# Variations



# Expressivity

- Not only can one form have different meanings (ambiguity) but the same meaning
- can be expressed with different forms:
  - ■ *She gave the book to Tom* vs. *She gave Tom the book*
  - ■ *Some kids popped by* vs. *A few children visited*
  - ■ *Is that window still open?* vs. *Please close the window*

# World Knowledge

- World knowledge
  - I dropped the glass on the floor and it broke
  - I dropped the hammer on the glass and it broke

# Factors Changing NLP Landscape

- Increases in computing power
- The rise of the web, then the social web
- Advances in machine learning
- Advances in understanding of language in social context

# Outline of this course

Topics	Python Library
Introduction	Python, re library
Regular Expressions	
NLP Basics	
Tokenization, Lemming, Stemming, POS tagging etc.	NLTK, Spacy
Topic Modeling	
Machine Learning and NLP	
Supervised and Unsupervised learning	Scikit-learn
Text Classification	
Feed-forward Neural Networks	
Deep Learning	Keras
Recurrent Neural Networks (RNN)	
Long-Short Term Memory (LSTM)	
Gated Recurrent Unit (GRU)	HuggingFace
Encoder – Decoder	
Developing NLP based applications	

# References

- [From Traditional to Modern: A Comprehensive Guide to Text Representation Techniques in NLP | by Susovan Dey | Medium](#)
- [sites.cc.gatech.edu/classes/AY2020/cs7650\\_spring/slides/1\\_intro.pdf](#)





# Thanks