

# List of NLP Applications

- Sentiment
- Name entities
- Translation
- NLP Inference
- Semantic Role Labeling
- Relation Extraction
- Semantic Parsing
- Machine Comprehension
- Textual Entailment
- Coreference Resolution
- Searching
- Question Answering
- Speaker Identification ....

NLP Market size: USD 26.4 billion by 2024

## Growth Factors

- smart device usage
- cloud-based solutions and NLP-based applications to improve customer service

## The Highest Growing Application

Sentiment Analysis: Focus on understanding end-user sentiments (customer experiences)

(Markets and Markets Report, 2019)



Image Source: Mark Newton. 2018. Dawn of the Chatbots.

# Sentiment Analysis

## Sentiment Analysis:

- a positive (1)
- negative (-1)
- neutral (0)

## Values:

- discrete
- continuous

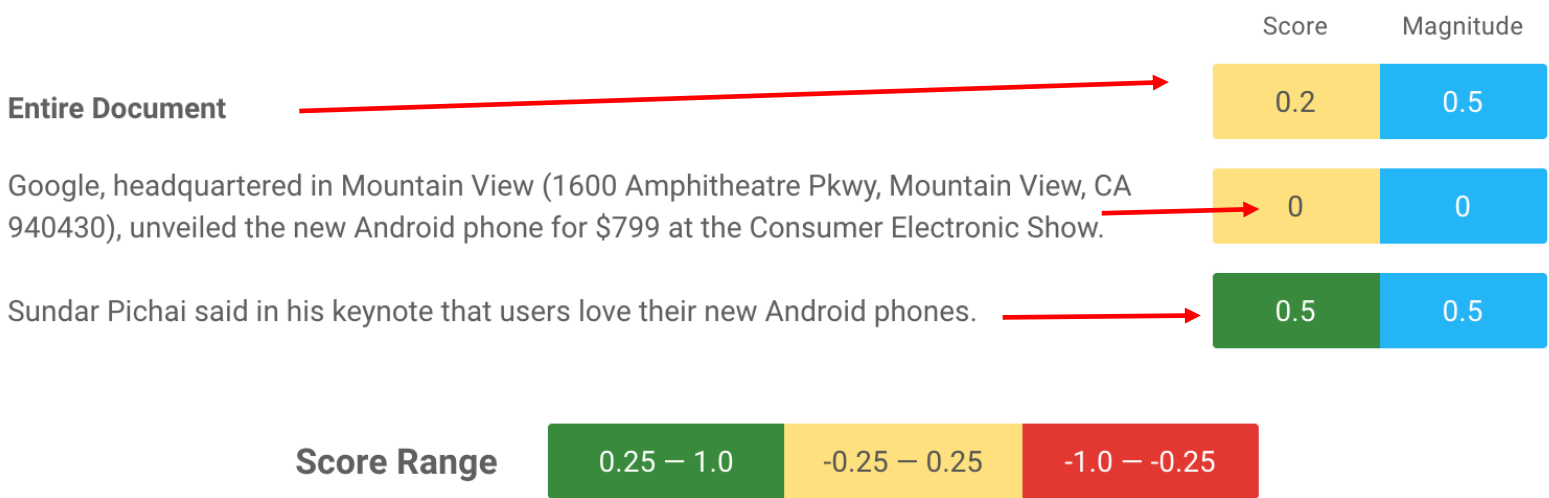
## Level:

- a document
- a sentence
- a word

Real World Applications: customer satisfaction, product popularity, fashion trends...

Google, headquartered in Mountain View (1600 Amphitheatre Pkwy, Mountain View, CA 940430), unveiled the new Android phone for \$799 at the Consumer Electronic Show. Sundar Pichai said in his keynote that users love their new Android phones.

### Document and Sentence Level Sentiment



# Name Entities Recognition

NER – a text annotation task. Words (tokens) are labeled as categories: organization, person, location etc.

⟨Google⟩<sub>1</sub>, headquartered in ⟨Mountain View⟩<sub>2</sub> (⟨1600 Amphitheatre Pkwy, Mountain View, CA⟩<sub>12</sub> ⟨1600⟩<sub>16</sub>  
⟨Amphitheatre Pkwy⟩<sub>7</sub>, ⟨Mountain View⟩<sub>2</sub>, ⟨CA 940430⟩<sub>8</sub> ⟨940430⟩<sub>14</sub>), unveiled the new ⟨Android⟩<sub>3</sub> ⟨phone⟩<sub>5</sub> for  
⟨\$799⟩<sub>13</sub> ⟨799⟩<sub>15</sub> at the ⟨Consumer Electronic Show⟩<sub>11</sub>. ⟨Sundar Pichai⟩<sub>4</sub> said in his ⟨keynote⟩<sub>9</sub> that ⟨users⟩<sub>6</sub> love their  
new ⟨Android⟩<sub>3</sub> ⟨phones⟩<sub>10</sub>.

1. Google

ORGANIZATION

2. Mountain View

LOCATION

3. Android

CONSUMER GOOD

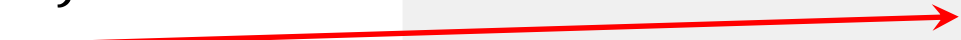


PERSON

# Name Entity Linking (NEL)

- Assigns a unique identity to name entities
- Uses a Knowledge Base (e.g., Wikipedia)

I went to Seattle last year.



Analyzed text

JSON

SENTENCE 1

NEUTRAL

1%

99%

0%

POSITIVE

NEUTRAL

NEGATIVE

i

NAMED ENTITIES:

Seattle [Location-GPE]  
last year [DateTime-DateRange]  
conference [Event]

i

LINKED ENTITIES:

I went to [Seattle](#) last year for a conference.

Seattle



From Wikipedia, the free encyclopedia

*This article is about the city. For other uses, see [Seattle \(disambiguation\)](#).*

**Seattle** (/ˈsiːətəl/ ( listen) *see-AT-el*) is a [seaport](#) city on the [West Coast of the United States](#). It is the [seat](#) of [King County, Washington](#). Seattle is the largest city in both the [state](#) of Washington and the [Pacific Northwest](#) region of [North America](#). According to [U.S. Census](#) data released in 2019, the [Seattle](#)

Analyze

# Coreference Resolution

Coreference – a reference to a word mentioned before or after within the sentence or paragraph

## Document

Paul Allen was born on January 21, 1953, in Seattle, Washington, to Kenneth Sam Allen and Edna Faye Allen. Allen attended Lakeside School, a private school in Seattle, where he befriended Bill Gates, two years younger, with whom he shared an enthusiasm for computers. Paul and Bill used a teletype terminal at their high school, Lakeside, to develop their programming skills on several time-sharing computer systems.

0

Paul Allen

 was born on January 21 , 1953 , in 

1

Seattle , Washington ,

 to Kenneth Sam Allen and Edna Faye Allen . 

0

Allen

 attended 

4

Lakeside School , a private school in

1

Seattle

 , where 

0

he

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2

Bill Gates , two years younger , with whom

0

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 shared an enthusiasm for computers .

3

0

Paul

 and 

2

Bill

 used a teletype terminal at 

4

3

their

 high school , Lakeside ,

 to develop 

3

their

 programming skills on several time - sharing computer systems .

# Semantic Role Labeling (SRL)

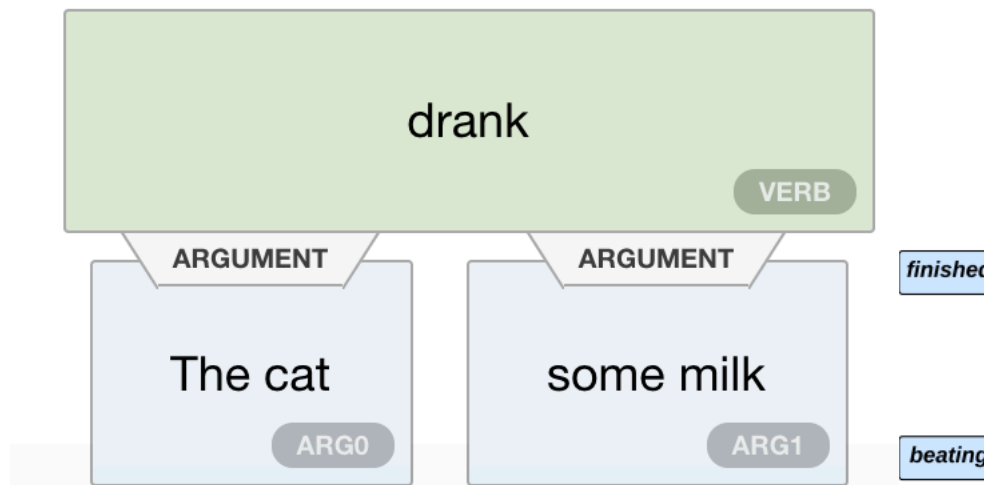
- Determines the predicate structure of a sentence (*predicate = main verb*)
- WHO does WHAT to WHOM, WHEN, WHERE

## Thematic ROLES

- **AGENT**: subject (=WHO)
- **PATIENT**: direct object (WHAT)
- **INSTRUMENT**: an object of *with* (HOW)
- **BENEFICIARY**: object of *for* (=To WHOM)
- **SOURCE**: object of *from* (WHERE)
- ...

The cat drank some milk .

**Shallow semantic parsing**  
(Gildea and Jurafsky, 2002)



## APPLICATIONS

- Question Answering
- Information Extraction
- Text Summarization

UCD **finished** the 2006 championship as Dublin champions ,  
by **beating** St Vincents in the final .

**finished**

Who finished something? - UCD  
What did someone finish? - the 2006 championship  
What did someone finish something as? - Dublin champions  
How did someone finish something? - by beating St Vincents in the final

**beating**

Who beat someone? - UCD  
When did someone beat someone? - in the final  
Who did someone beat? - St Vincents

# SRL: Definitions

UCD **finished** the 2006 championship as Dublin champions ,  
by **beating** St Vincents in the final .

**finished**

- Who finished something? - UCD
- What did someone finish? - the 2006 championship
- What did someone finish something as? - Dublin champions
- How did someone finish something? - by beating St Vincents in the final

Thematic Role	Definition	Example
AGENT	The volitional causer of an event	<i>The waiter</i> spilled the soup.
EXPERIENCER	The experiencer of an event	<i>John</i> has a headache.
FORCE	The non-volitional causer of the event	<i>The wind</i> blows debris from the mall into our yards.
THEME	The participant most directly affected by an event	Only after Benjamin Franklin broke <i>the ice</i> ...
RESULT	The end product of an event	The city built a <i>regulation-size baseball diamond</i> ...
CONTENT	The proposition or content of a propositional event	Mona asked " <i>You met Mary Ann at a supermarket?</i> "
INSTRUMENT	An instrument used in an event	He poached catfish, stunning them <i>with a shocking device</i> ...
BENEFICIARY	The beneficiary of an event	Whenever Ann Callahan makes hotel reservations <i>for her boss</i> ...
SOURCE	The origin of the object of a transfer event	I flew in <i>from Boston</i> .
GOAL	The destination of an object of a transfer event	I drove <i>to Portland</i> .

(Jurafsky, 2015)

PREDICATE #1: finish takes TWO arguments (ROLES)

UCD

the 2006 championship

Can you identify the semantic roles?

FrameNet Data

## Finish\_game

### Definition:

A **Player** finishes a **Game**, possibly with an outcome of winning or losing. A **Game** is an activity associated pleasure, as well as social interaction, material reward, or status. Not all games can be competitions are defined in the inheriting frame Finish\_competition. In some LUs, the **Game** is

**John** **WON** **the lottery**!



# Semantic Parsing - SQL Queries

- Mapping sentences to meaning representations
- Executing commands for robotic navigations, query parsing in conversational agents

## Utterance

show me the flights from detroit to westchester county



## SQL Query

```
(SELECT DISTINCT flight . flight_id
FROM flight
WHERE (flight . from_airport IN
  (SELECT airport_service . airport_code
  FROM airport_service
  WHERE airport_service . city_code IN
    (SELECT city . city_code
    FROM city
    WHERE city . city_name = 'DETROIT' ) )
AND flight . to_airport IN
  (SELECT airport_service . airport_code
  FROM airport_service
  WHERE airport_service . city_code IN
    (SELECT city . city_code
    FROM city
    WHERE city . city_name = 'WESTCHESTER COUNTY' ) ) ) ) ;
```



# Textual Entailment

## Entailment

The truth of the sentence **implies** the truth of the other sentence.

### Premise

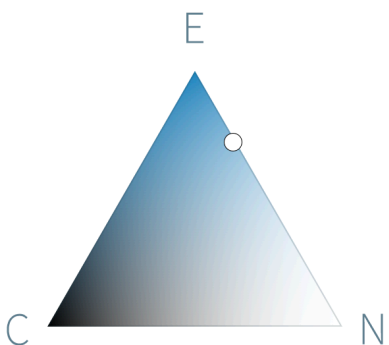
The elephant's size is likely to be huge.

### Hypothesis

The elephant is big.

#### Summary

It is **somewhat likely** that the premise **entails** the hypothesis.



Judgment	Probability
Entailment	72.3%
Contradiction	0.8%
Neutral	26.9%

<https://demo.allennlp.org/textual-entailment/>

## Contradiction

The truth of the sentence **implies** the falsehood of the other sentence

### Premise

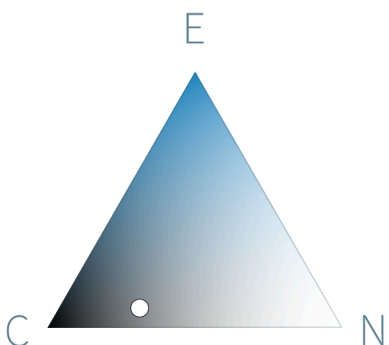
The elephant's size is likely to be huge.

### Hypothesis

The elephant is small.

#### Summary

It is **somewhat likely** that the premise **contradicts** the hypothesis.



Judgment	Probability
Entailment	7.8%
Contradiction	64.9%
Neutral	27.3%

# Machine Reading Comprehension

- The ability to read and understand a text and answer questions about the text

## Passage

The Matrix is a 1999 science fiction action film written and directed by The Wachowskis, starring Keanu Reeves, Laurence Fishburne, Carrie-Anne Moss, Hugo Weaving, and Joe Pantoliano. It depicts a dystopian future in which reality as perceived by most humans is actually a simulated reality called "the Matrix", created by sentient machines to subdue the human population, while their bodies' heat and electrical activity are used as an energy source. Computer programmer "Neo" learns this truth and is drawn into a rebellion against the machines, which involves other people who have been freed from the "dream world."

## Question

Who stars in The Matrix?

## Answer

Keanu Reeves, Laurence Fishburne, Carrie-Anne Moss, Hugo Weaving, and Joe Pantoliano

## Passage Context

The Matrix is a 1999 science fiction action film written and directed by The Wachowskis, starring **Keanu Reeves, Laurence Fishburne, Carrie-Anne Moss, Hugo Weaving, and Joe Pantoliano** . It depicts a dystopian future in which reality as perceived by most humans is actually a simulated reality called "the Matrix", created by sentient machines to subdue the human population, while their bodies' heat and electrical activity are used as an energy source. Computer programmer "Neo" learns this truth and is drawn into a rebellion against the machines, which involves other people who have been freed from the "dream world."

<https://demo.allennlp.org/reading-comprehension>

Try Demo:  
<https://www.microsoft.com/en-us/research/welcome-to-canada-demo/>

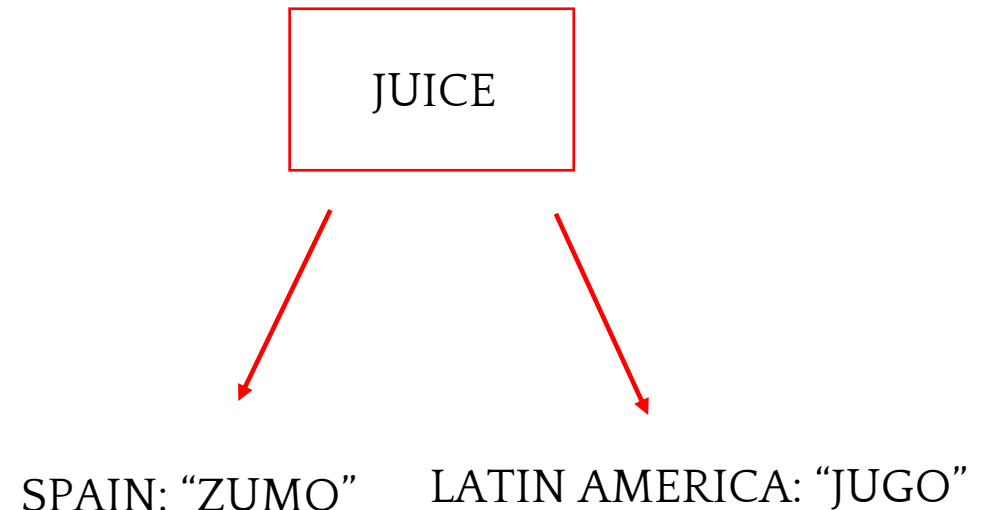
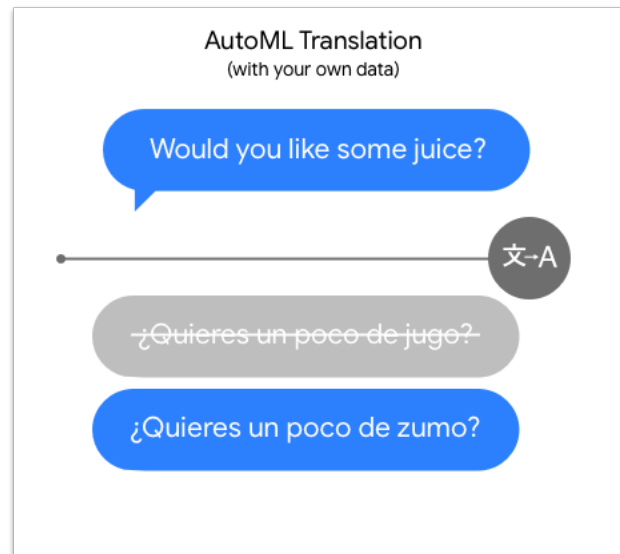
# Language Identification and Machine Translation

- Many language-related tasks are dependent on language-specific NLP models.
- Language Identification (LID) is used to load autocorrection lexicon, select NLP tagger or machine translation model.
- Machine translation – the task of translating from a source to a target language

## General Purpose



## Specific Vocabulary



# Question Answering - Chatbots

