

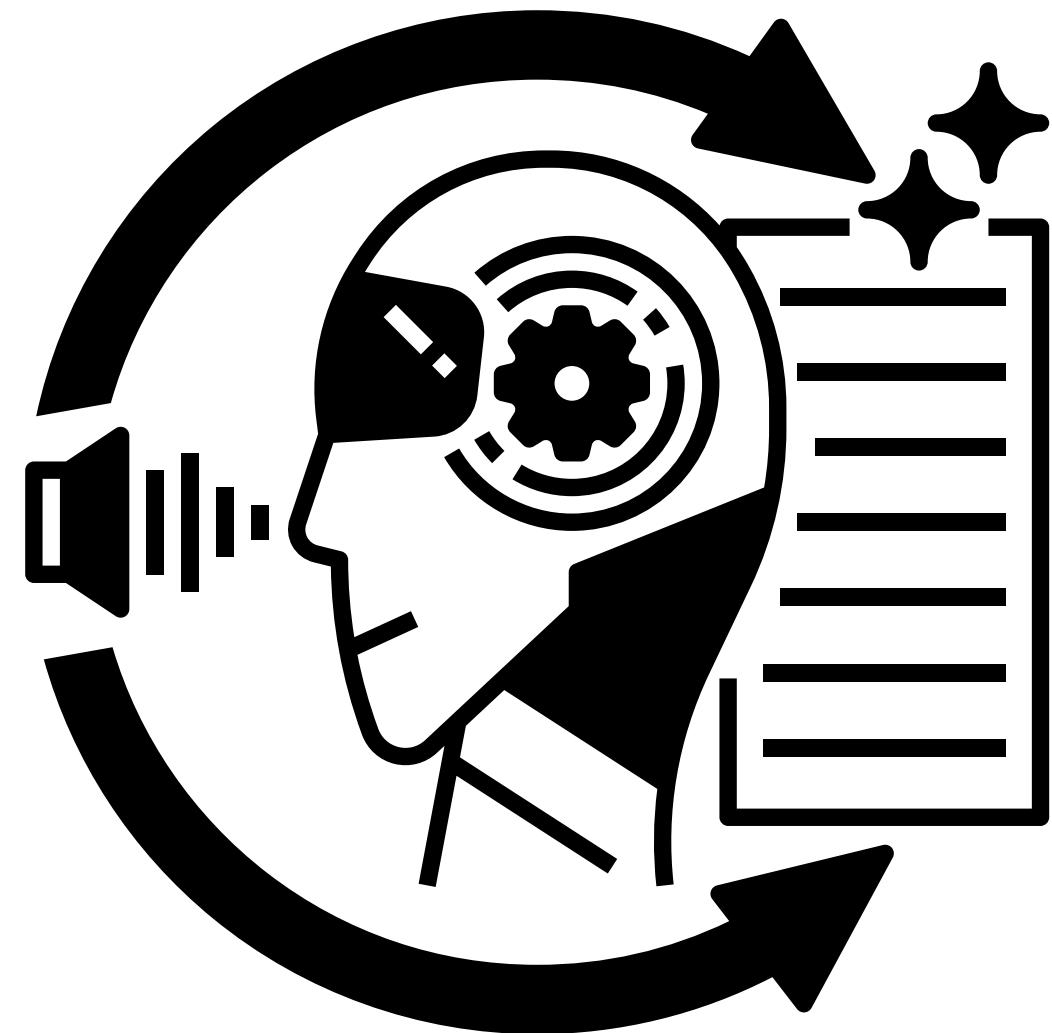
ARTIFICIAL INTELLIGENCE

BACS2003|BACS3074|BMCS2003

CHAPTER 6 NATURAL LANGUAGE UNDERSTANDING

1. Applications
2. Challenges
3. Flow of NLU and Symbolic Analysis

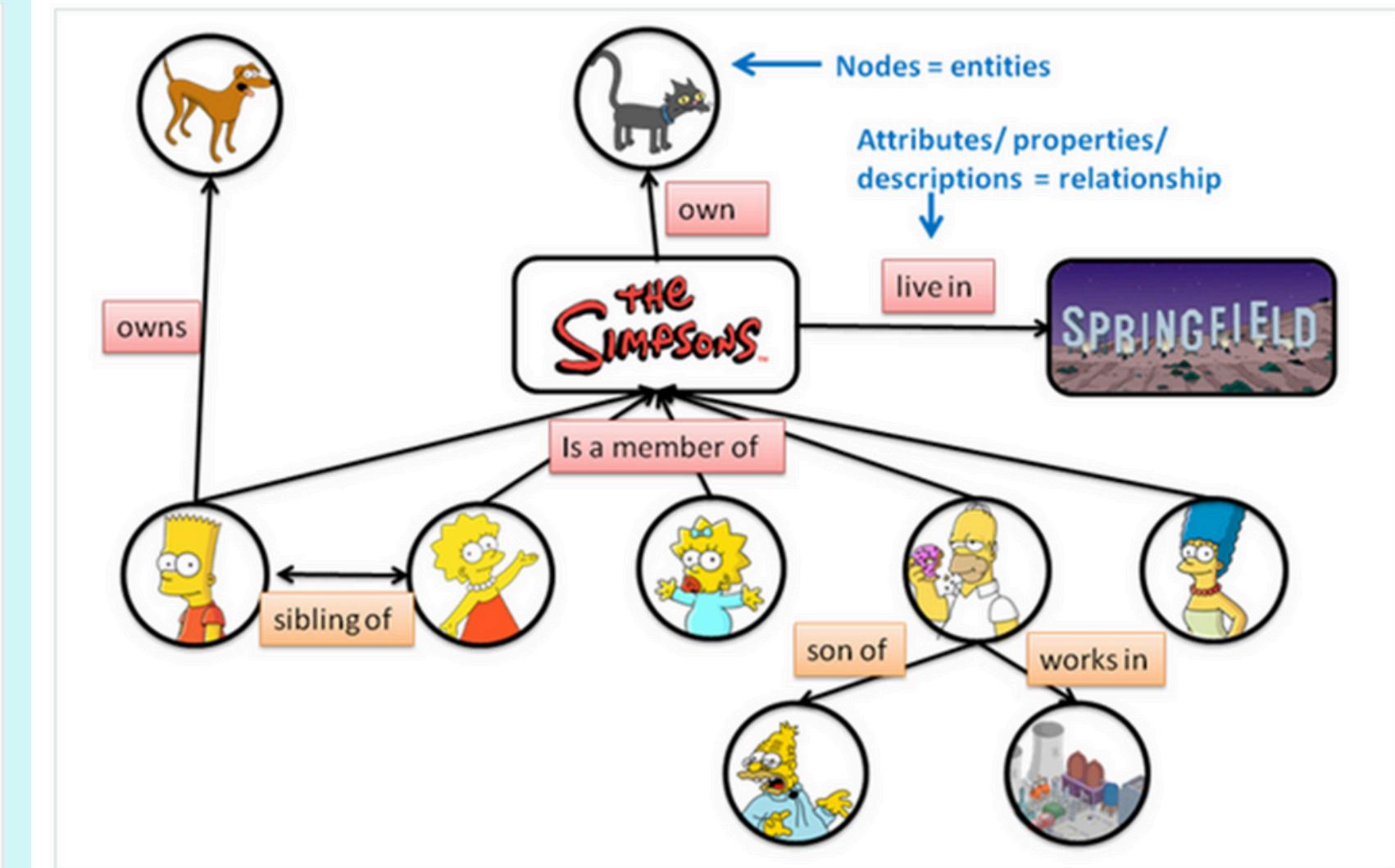
OUTCOMES



NLP EXAMPLES

SEMANTICS AND ENTITY-BASED SEARCH (SEARCH ENGINE)

Google search results for "where does homer simpson work". The search bar shows the query. Below it, the navigation bar includes Web, Images, Shopping, Videos, News, More, and Search tools. A snippet of text from Wikipedia states: "Homer and his wife Marge have three children: Bart, Lisa, and Maggie. As the family's provider, he works at the Springfield Nuclear Power Plant." To the right of the text is an illustration of Homer Simpson holding a donut. At the bottom left is a link to the Wikipedia page for Homer Simpson.



Ref: <https://moz.com/blog/what-is-semantic-search>

NLP EXAMPLES

SEMANTICS AND ENTITY-BASED SEARCH (SEARCH ENGINE)

who is the main actor in imitation game

All Images News Videos Shopping More Settings Tools

The Imitation Game / Cast

Cast Member	Role
Benedict Cumberbatch	Alan Turing
Keira Knightley	Joan Clarke
Matthew Goode	Hugh Alexa...
Allen Leech	John Cairnc...
Mark Strong	Stewart Me...
Charles Dance	Commander...
Matthew Beard	Peter Hilton
Rory Kinnock	

[The Imitation Game \(2014\) - Full Cast & Crew - IMDb](https://www.imdb.com/title/tt2084970/fullcredits)

<https://www.imdb.com/title/tt2084970/fullcredits> ▾

Sherborne Student 1. James G. Nunn ... Sherborne Student 2 (as James G Nunn). Charlie Manton ... Sherborne Student 3. David Charkham ... Joan's Father.

[The Imitation Game \(2014\) - IMDb](https://www.imdb.com/title/tt2084970/)

<https://www.imdb.com/title/tt2084970/> ▾

★★★★★ Rating: 8/10 - 610,380 votes

With Benedict Cumberbatch, Keira Knightley, Matthew Goode, Allen Leech. ... Cumberbatch and Sophie Hunter at an event for The Imitation Game (2014) About fifteen cast and crew worked on both the spy film Tinker Tailor Soldier Spy ...

[Full Cast & Crew](#) · [Awards](#) · [User Reviews](#) · [International Trailer](#)

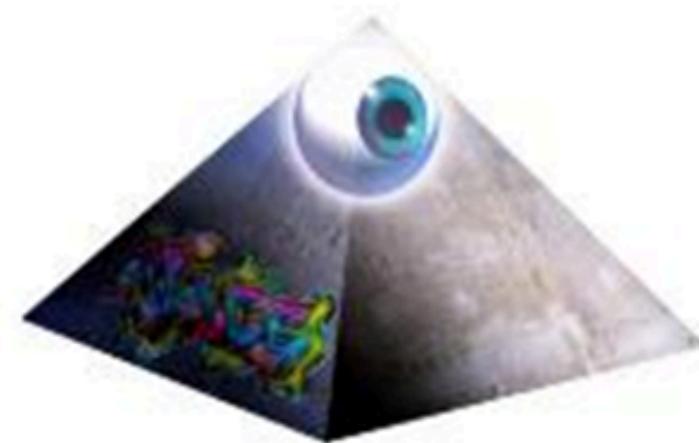


The Imitation Game

2014 · Drama/Thriller · 1h 54m

NLP EXAMPLES

A.L.I.C.E THE CHAT BOT



A. L. I. C. E. Artificial Intelligence Foundation

Promoting the development and adoption of **ALICE** and **AIML Free Software**

[A.L.I.C.E Silver Edition](#)

[DAVE E.S.L. bot](#)

[C.L.A.U.D.I.O Personality Test](#)

[GET SITEPAL AVATARS](#)



Human: May I know who is Captain Kirk?

ALICE: Not right now, maybe later.

Human: How old are you?

ALICE: I'm Eighteen in computer years.

Human: who are you?

ALICE: I am ALICE. Who are you?

You say: |

Get **ALICE Silver Edition** with talking **Sitepal[tm]**, winner of the 2004 Loebner Prize competition sponsored by **Crown Industries, Inc.**

NLP EXAMPLES

COMMERCIAL

The screenshot shows the HSBC Malaysia website. At the top, there's a navigation bar with links for Banking, Credit cards, Borrowing, Wealth, and Digital banking. Below this, a main content area features a section titled "HSBC with Apple Pay" which includes a smartphone and a smartwatch displaying the HSBC card. To the right, there are two promotional boxes: one for "RM100 cash can be yours!" and another for "As low as 4.88% p.a.". A red callout box highlights a note about the Personal Data Protection Act 2010 (PDPA) revision. At the bottom, there are links for opening a new banking account, applying for a credit card, getting personal financing, and banking on the go.

HSBC with Apple Pay

Enjoy a safe, contactless and easy way to pay by using your HSBC credit card with Apple Pay.

Get RM30 cashback after 5 transactions with your card via Apple Pay. T&Cs apply.

Find out more

RM100 cash can be yours! >
Open and use your Savings Account online to be eligible.

As low as 4.88% p.a. >
Apply for Premier Personal Financing-i online today.

① Effective 22 February 2023, our Personal Data Protection Act 2010 (PDPA) Notice has been revised for all new and existing customers of HSBC Bank and HSBC Amanah accordingly. Please click [here](#) to refer to the updated PDPA Notice. For further information on the details of the amendments made, please click [here](#).

Click [here](#) to view more details for tips on how to protect yourself from fraud.

Clarify your banking queries by simply going through our [FAQs](#) or [book](#) a branch appointment online to secure a slot that best suits you.

Open a new Banking Account >

Apply for a Credit Card >

Get a Personal Financing-i >

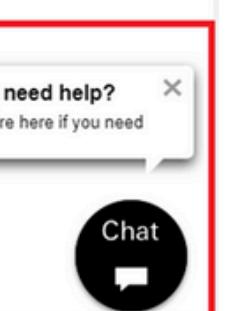
Banking on the go >

3 simple steps to opening a new bank account online.

3 simple steps to enjoy attractive online exclusive sign up gift.

Apply online for faster approval.

Manage your finances easily via the HSBC Malaysia Mobile Banking app.



The screenshot shows a conversation with the HSBC AVA virtual assistant. The interface includes a header with the HSBC logo and a user icon, and a close button. It displays a timestamp "Info at 10:23, Mar 20:" and a message from the virtual assistant: "You are now connected to HSBC AVA, your virtual assistant." Below this, it shows "HSBC AVA, your virtual assistant at 10:23, Mar 20:" followed by a large black box containing the AI's introductory message: "Hi, I'm HSBC AI Virtual Assistant but you can call me HSBC AVA. If I can't get things sorted for you, I'll connect you to one of our chat agents." The user then types "How can I assist you today?" and the AI responds with "I would like to apply a credit card, may I know what is the procedure?" The user then types "Please confirm if you are looking to apply for a new product or check credit card application status?" and the AI provides two options: "Apply for a new Product" and "Check application status". At the bottom, there's a text input field with a placeholder "Type your message" and a send button.

HSBC AVA, your virtual assistant

– X

Info at 10:23, Mar 20:

You are now connected to HSBC AVA, your virtual assistant.

HSBC AVA, your virtual assistant at 10:23, Mar 20:

Hi, I'm HSBC AI Virtual Assistant but you can call me HSBC AVA. If I can't get things sorted for you, I'll connect you to one of our chat agents.

How can I assist you today?

You at 10:24, Mar 20:

I would like to apply a credit card, may I know what is the procedure?

HSBC AVA, your virtual assistant at 10:24, Mar 20:

Please confirm if you are looking to apply for a new product or check credit card application status?

Apply for a new Product

Check application status

Type your message

NLP EXAMPLES

HOW TO BUILD A CHATBOT



platform to build a chatbot

x



Create Chatbot for Website with React and Node.js | Udemy

Shop thousands of high-quality on-demand online courses. 30-day satisfaction guarantee. Find the right instructor for you. Choose from many topics, skill levels, and languages.

14 Most Powerful Chatbot Development Platforms To Build A Chatbot For Your Business

1. WotNot. ...
2. Intercom. ...
3. Bold360. ...
4. Octane AI. ...
5. Flow XO. ...
6. ManyChat. ...
7. Botsify. ...
8. Pandorabots.



Maruti Techlabs

<https://marutitech.com> › 14-powerful-chatbot-platforms

⋮

14 most powerful platforms to build a Chatbot [2023 Update]



About featured snippets

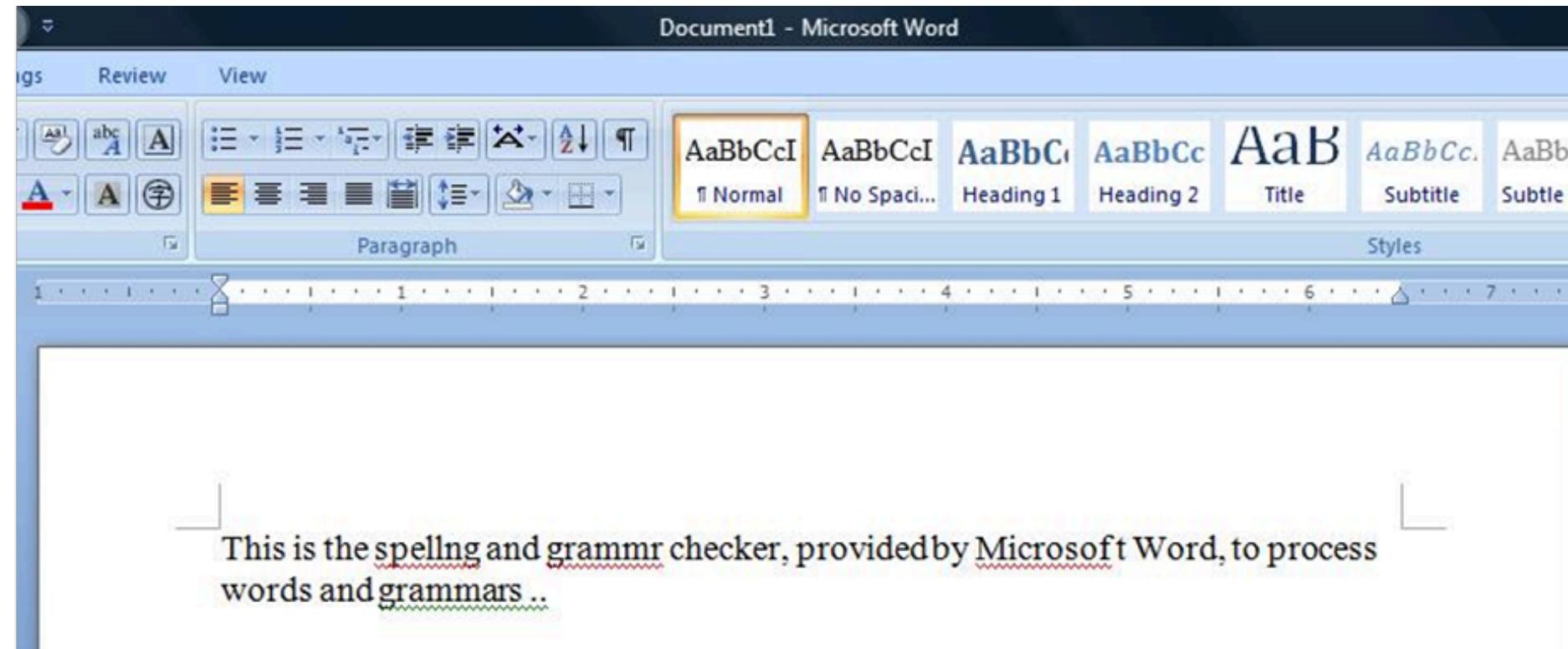


Feedback



NLP EXAMPLES

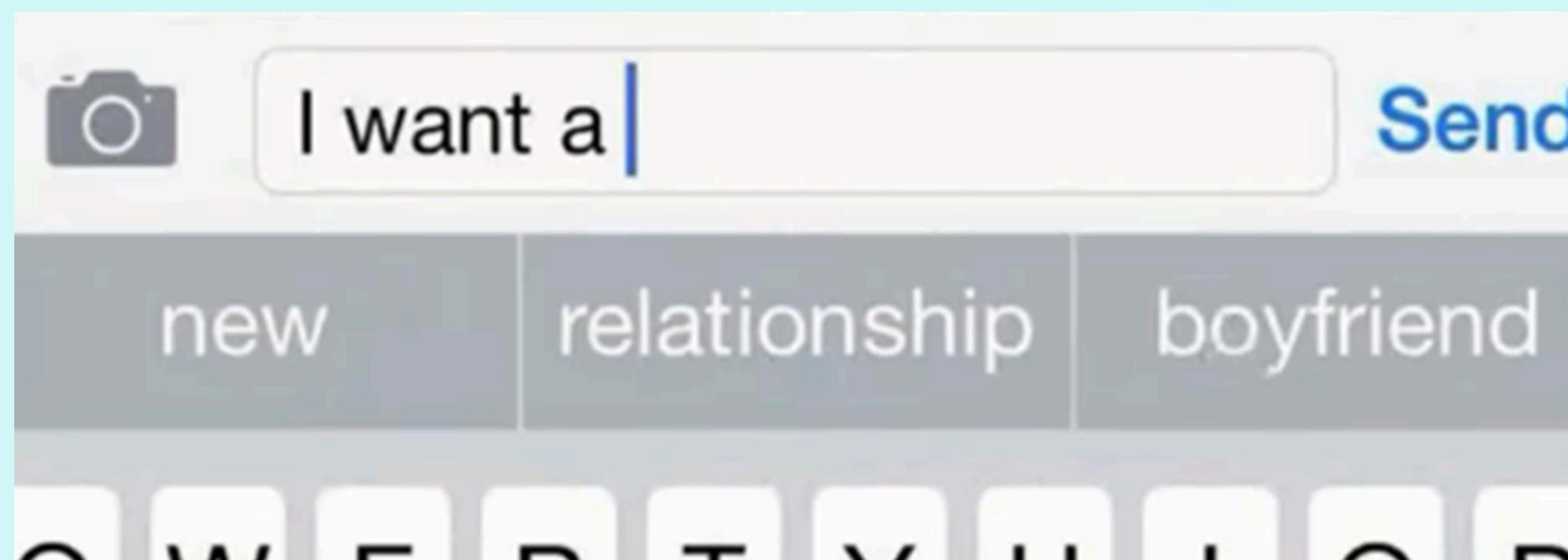
SPELLING CORRECTION & TEXT PREDICTION



- SPELLO
- PYSPELLCHECKER
- TEXTBLOB
- JAMSPELL
- SYMSPELL
- ENCHANT
- AUTOCORRECT

```
from textblob import TextBlob  
  
# Create a TextBlob object with incorrect spelling  
text = "I havv goood speling!"  
blob = TextBlob(text)  
  
# Use the correct() method to correct the spelling  
corrected_text = blob.correct()  
  
# Print the corrected text  
print(corrected_text)
```

I have good spelling!



- NLTK
- SPACY
- TEXTBLOB
- GENSIM
- PRESSAGIO
- PATTERN

```
import nltk  
from nltk import bigrams  
from nltk.corpus import reuters  
from collections import Counter, defaultdict  
  
# Ensure you have the necessary NLTK corpus downloaded  
nltk.download('reuters')  
nltk.download('punkt')  
  
# Load a corpus of text  
text = reuters.sents()  
  
# Create a list of bigrams from the corpus  
bigrams_list = list(bigrams(nltk.tokenize.word_tokenize(''.join([''.join(sent) for sent in text]))))  
.....
```

The predicted next word after 'I' is 'think'

NLP EXAMPLES

Word-sense disambiguation

- Bank
- Goal

Named entity recognition

- Canon
- Apple

Information retrieval

- Search engine

Summarization

- QuillBot's Summarizer
- Summarizer.org

Machine Translation

- Google Translate
- Microsoft Translator

Case Example: Simplified Lesk Algorithm

The bank can guarantee deposits will eventually cover future tuition costs because it invests in adjustable-rate mortgage securities.

bank ¹	Gloss	A financial institution that accepts deposits and channels the money into lending activities
	Examples	"he cashed a check at the bank," "that bank holds the mortgage on my home"
bank ²	Gloss	Sloping land (especially the slope beside a body of water)
	Examples	"they pulled the canoe up on the bank," "he sat on the bank of the river and watched the currents"

```
import nltk
from nltk.wsd import lesk
from nltk.tokenize import word_tokenize

# Ensure the necessary NLTK data is downloaded
nltk.download('wordnet')
nltk.download('omw-1.4')

# Example sentence and ambiguous word
sentence = "The bank can guarantee deposits will eventually cover future tuition costs because it invests in adjustable-rate mortgage securities."
ambiguous_word = "bank"

# Tokenize the sentence
tokens = word_tokenize(sentence)

# Apply the Lesk algorithm to the ambiguous word within the context of the given sentence
sense = lesk(tokens, ambiguous_word)

# Print the chosen sense and its definition
print(sense, sense.definition() if sense else 'No sense found')
```

Synset('bank.n.05') a supply or stock held in reserve for future use (especially in emergencies)

NLP EXAMPLES

Word-sense
disambiguation

- Bank
- Goal

Named entity
recognition

- Canon
- Apple

Information
retrieval

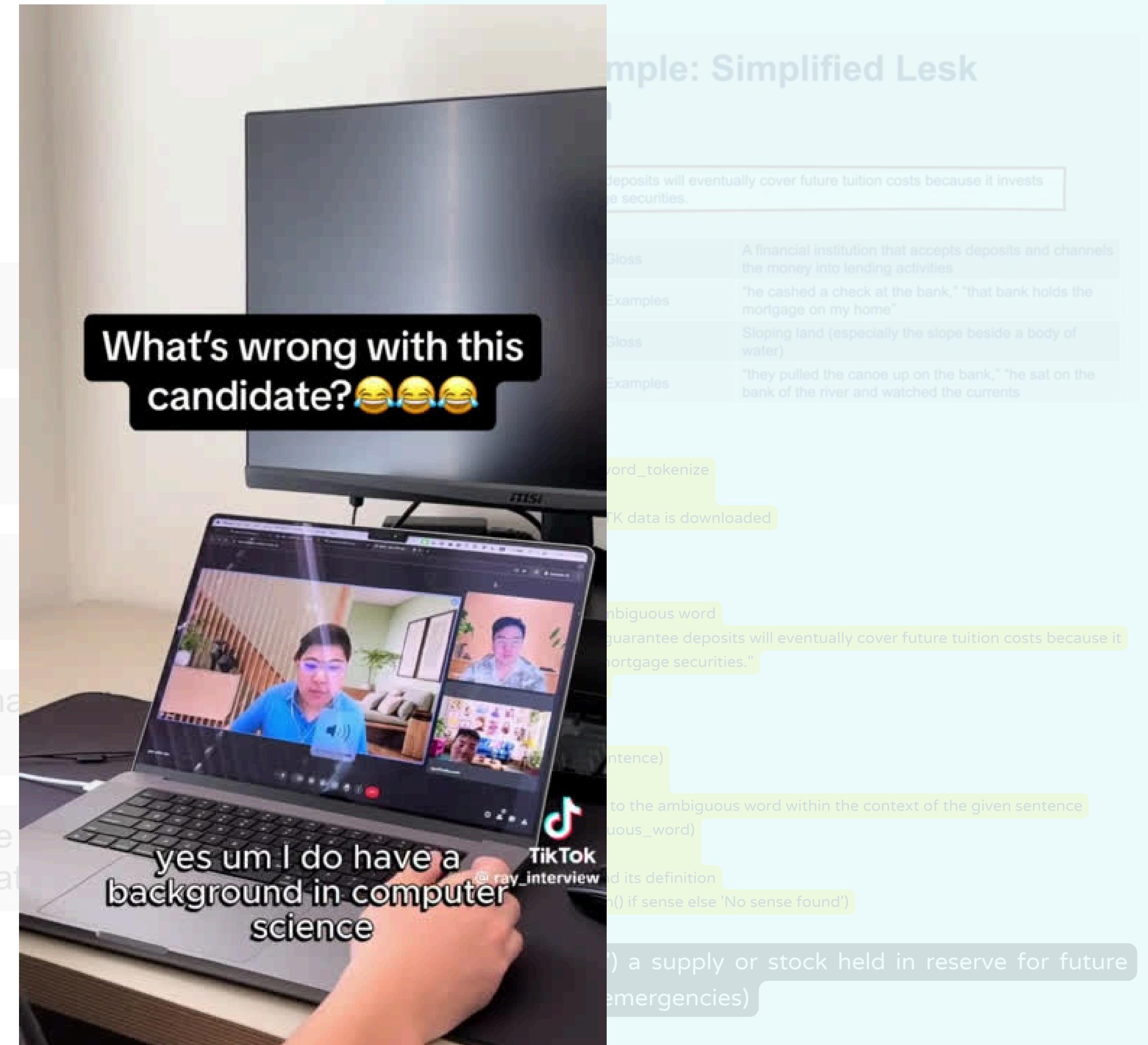
- Search engine

Summarization

- QuillBot's Summa
- Summarizer.org

Machine
Translation

- Google Translate
- Microsoft Translat



NLP EXAMPLES

Word-sense
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- Google Translate
- Microsoft Translator

```
import nltk
from nltk.tokenize import word_tokenize
from nltk.tag import pos_tag
from nltk.chunk import ne_chunk

# Ensure the necessary NLTK data is downloaded
nltk.download('punkt')
nltk.download('averaged_perceptron_tagger')
nltk.download('maxent_ne_chunker')
nltk.download('words')

# Define a sample text
text = "Janice bought an Apple Smartwatch from Apple store. It costs RM 1200"
```

```
# Tokenize and part-of-speech tag the text
tokens = word_tokenize(text)
pos_tags = pos_tag(tokens)

# Perform Named Entity Recognition
named_entities = ne_chunk(pos_tags)
```

```
# Print the named entities
print(named_entities)
```

(S
(PERSON Janice/NNP)
bought/VBD
an/DT
Apple/NNP
Smartwatch/NNP
from/IN
(GPE Apple/NNP)
store/NN
./
It/PRP
costs/VBZ
RM/JJ
1200/CD)

TYPE	DESCRIPTION
PERSON	People, including fictional.
NORP	Nationalities or religious or political groups.
FAC	Buildings, airports, highways, bridge, etc.
ORG	Companies, agencies, institutions etc.
GPE	Countries, cities, states.
LOC	Non-GPE locations, mountain ranges, bodies of water.
PRODUCT	Objects, vehicles, foods, etc. (Not services)
EVENT	Named hurricanes, battles, wars, sports events, etc.
WORK_OF_ART	Titles of books, songs, etc.
LAW	Named documents made into laws.
LANGUAGE	Any named language.
DATE	Absolute or relative dates or periods.
TIME	Times smaller than a day.
PERCENT	Percentage, including "%".
MONEY	Monetary values, including unit.
QUANTITY	Measurements, as of weight or distance.
ORDINAL	"first", "second", etc.
CARDINAL	Numerals that do not fall under another type.

NLP EXAMPLES

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YAHOO!



Aol.



NLP EXAMPLES

Word-sense disambiguation

- Bank
- Goal

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- Apple

Information retrieval

- Search engine

Summarization

- QuillBot's Summarizer
- Summarizer.org

Machine Translation

- Google Translate
- Microsoft Translator

QuillBot for Chrome

Write like a pro, everywhere you write

Modes:

Paragraph

Bullet Points

Summary Length: Short



Natural Language Understanding (NLU) is a subfield of artificial intelligence (AI) and natural language processing (NLP) that focuses on the interpretation and comprehension of human language by machines. NLU systems are designed to understand the meaning of text or spoken language in a way that is similar to how humans understand language. This involves not just recognizing individual words, but also grasping the context, intent, and nuances of the language used.

Natural Language Understanding (NLU) is a subfield of AI and NLP that focuses on machine interpretation and comprehension of human language, recognizing context, intent, and nuances of spoken or written language.

- NLTK
- Gensim
- Sumy
- TextBlob
- spaCy
- SumEval
- BERT and Transformer Models

NLP EXAMPLES

Word-sense
disambiguation

- Bank
- Goal

Named entity
recognition

- Canon
- Apple

Information
retrieval

- Search engine

Summarization

- QuillBot's Summarizer
- Summarizer.org

Machine
Translation

- Google Translate
- Microsoft Translator

English  Malay 

Natural Language Understanding (NLU) is a subfield of artificial intelligence (AI) and natural language processing (NLP) that focuses on the interpretation and comprehension of human language by machines.

```
!pip install googletrans==4.0.0-rc1
from googletrans import Translator

# English text to be translated
english_text = "Hello, how are you?"

# Create a Translator object
translator = Translator()

# Translate the text to Bahasa Malay (Malay)
malay_translation = translator.translate(english_text, src='en', dest='ms')

# Print the translated text
print(malay_translation.text)
```

Hello, apa khabar?

NLU CHALLENGE

Communication with natural language, whether text or as speech acts, depends heavily on our knowledge within the domain of discourse.

It involves:

- Transmission of words
- Inferences about speaker's goals
- Knowledge
- Assumptions
- The context of the interaction



EXAMPLE

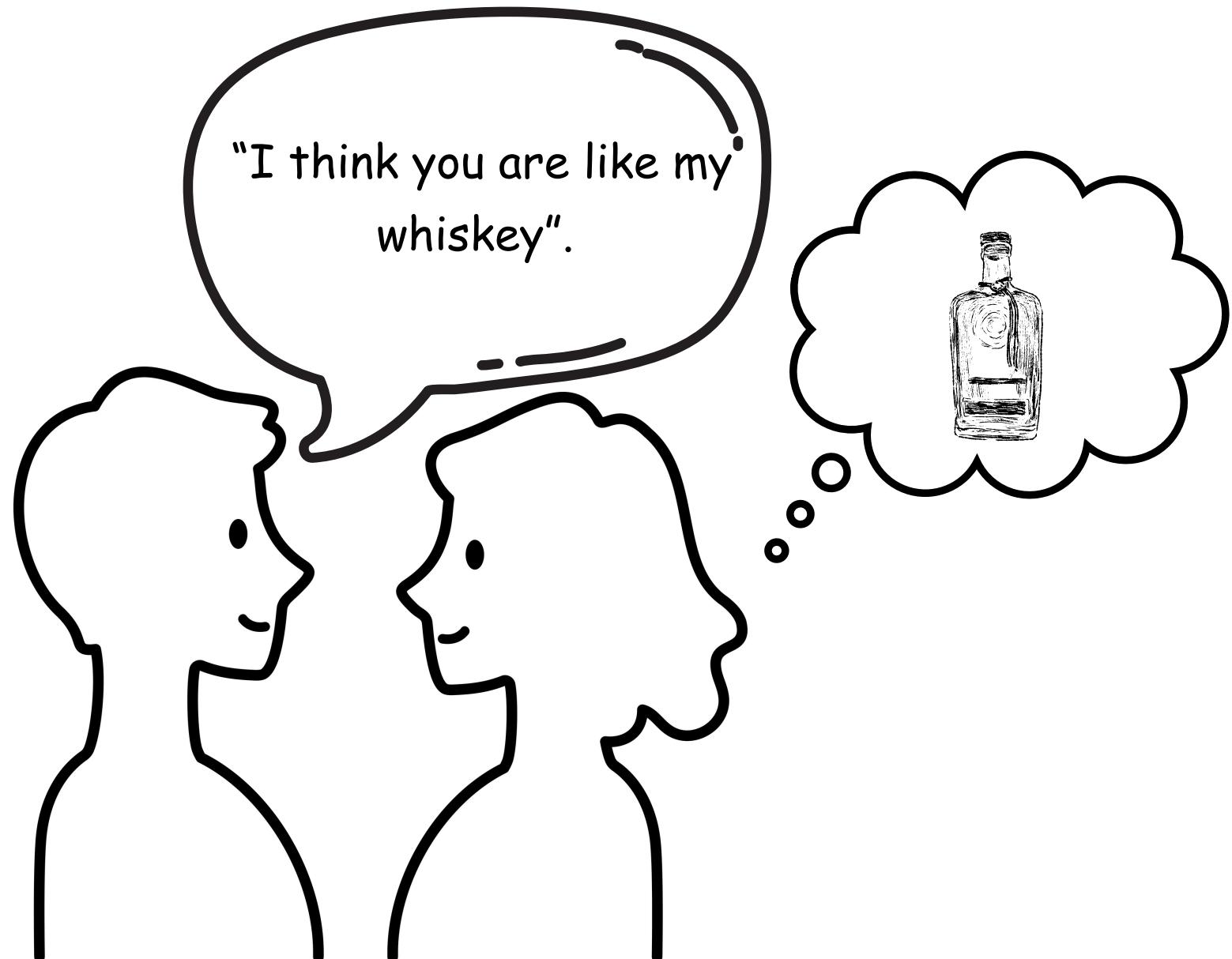
NLU CHALLENGE

A guy told a girl:



EXAMPLE

NLU CHALLENGE



We cannot understand this line “I think you are like my whiskey” through a simplistic, literal treatment of meaning.

EXAMPLE

NLU CHALLENGE

- She stole a pair of shoes



- She stole my heart

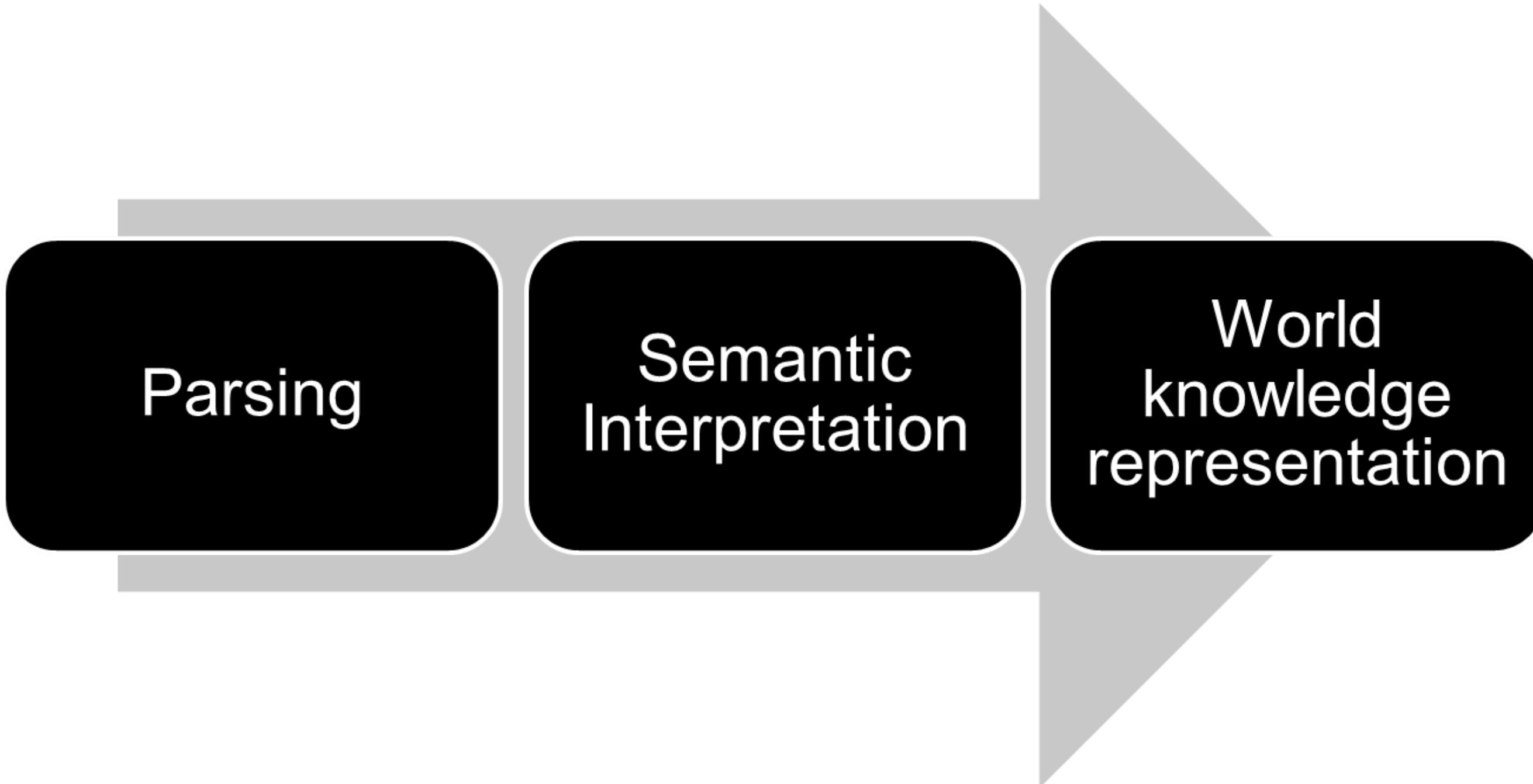


We cannot merely chain together the dictionary meanings of “steal” to both of the sentences.

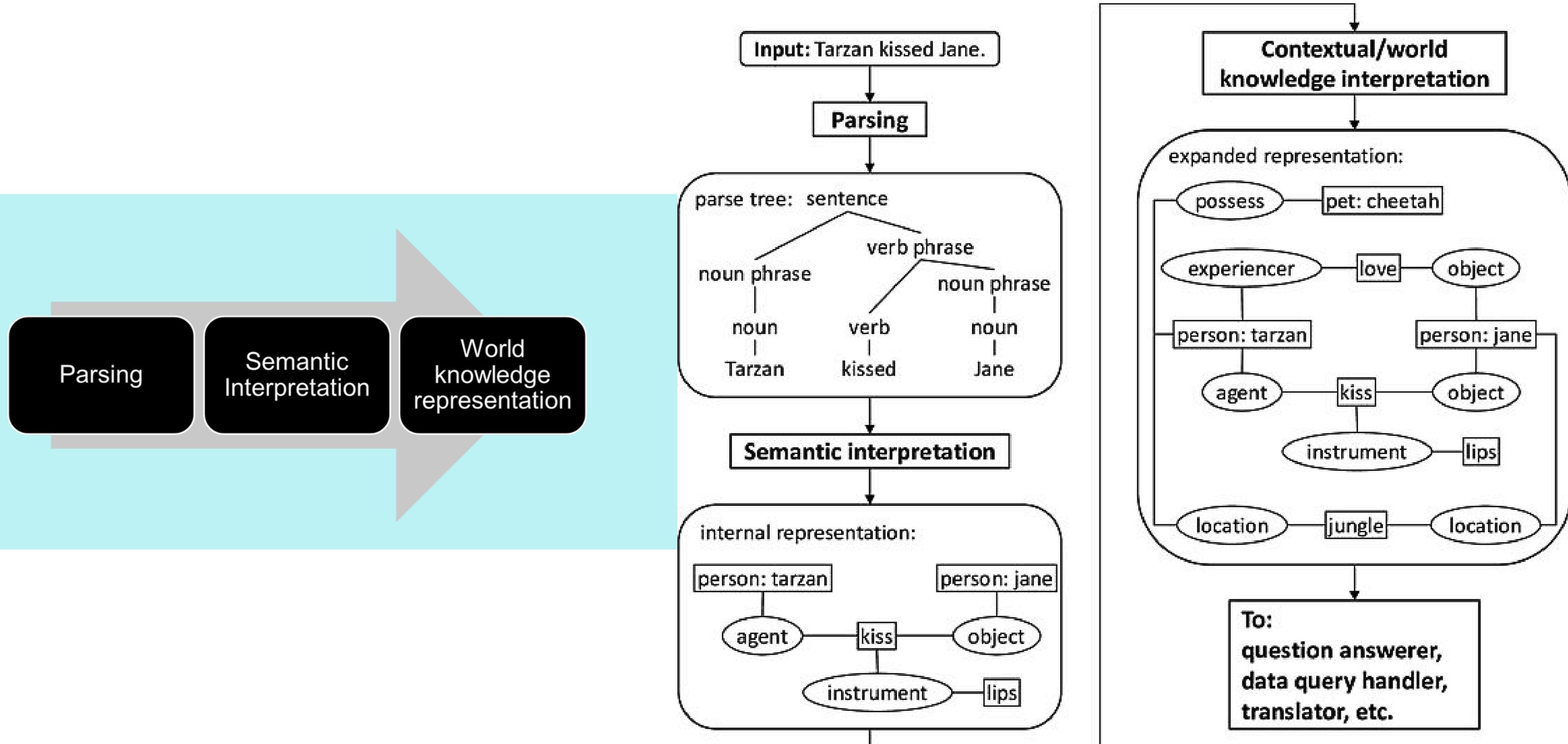
Instead, we must employ a complex process of understanding the words, parsing (syntax analysis) the sentence, constructing a representation of the semantic meaning, and interpret the meaning of our knowledge of the problem domain.

STAGES OF LANGUAGE ANALYSIS

Translate the original sentence into an internal representation of its meaning by the following stages:



STAGES OF LANGUAGE ANALYSIS



PARSING

Parsing

Semantic
Interpretation

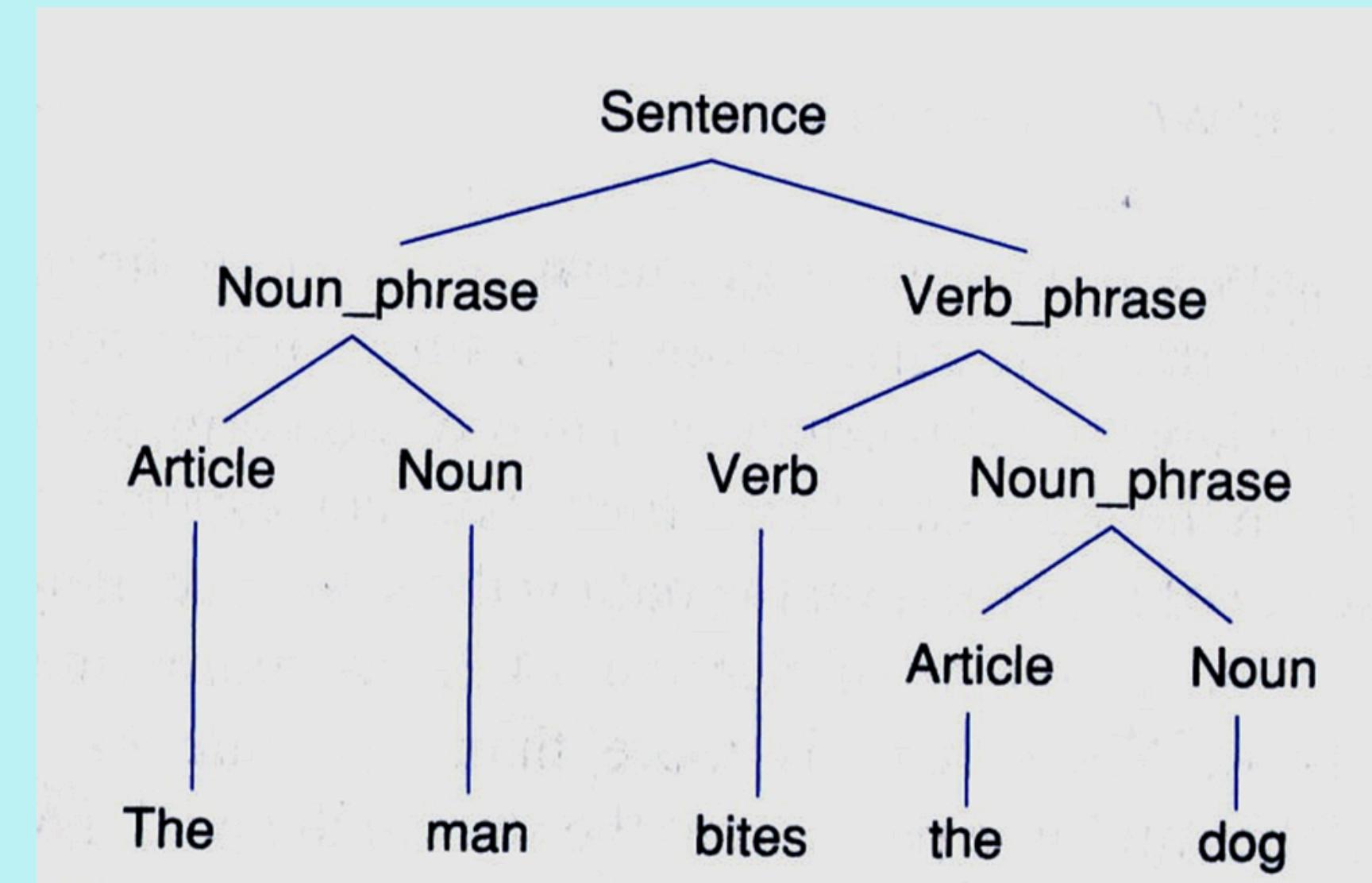
World
knowledge
representation

- Analyze the **syntactic structure** of sentences
- Identifying the major relations such as subject-verb, verb-object, noun-modifier
- Often represented as **parse tree**
- Employs knowledge of language syntax, morphology, and some semantics

PARSING :PARSE TREE

Sentence: “**The man bites the dog**”

1. Sentence \leftrightarrow noun_phrase verb_phrase
2. Noun_phrase \leftrightarrow noun
3. Noun_phrase \leftrightarrow article noun (the man, the dog)
4. Verb_phrase \leftrightarrow verb
5. Verb_phrase \leftrightarrow verb noun_phrase (bites the dog)
6. Article \leftrightarrow a
7. Article \leftrightarrow the
8. Noun \leftrightarrow man
9. Noun \leftrightarrow dog
10. Verb \leftrightarrow bites



SEMANTIC INTERPRETATION

Parsing

Semantic Interpretation

World knowledge representation

- Representation of the meaning
 - Use semantic network, conceptual graph, conceptual dependencies, frames, etc.
 - Uses knowledge about the meaning of words and linguistic
 - e.g. “kiss” and “lips”
- Perform consistency checks and include constraints
 - E.g. “kiss” can be performed by person, but not tree.

WHY SEMANTIC REPRESENTATION?

- Semantic representation can solve canonical form of sentences
- “Canonical Form” – two different sentences with the same meaning

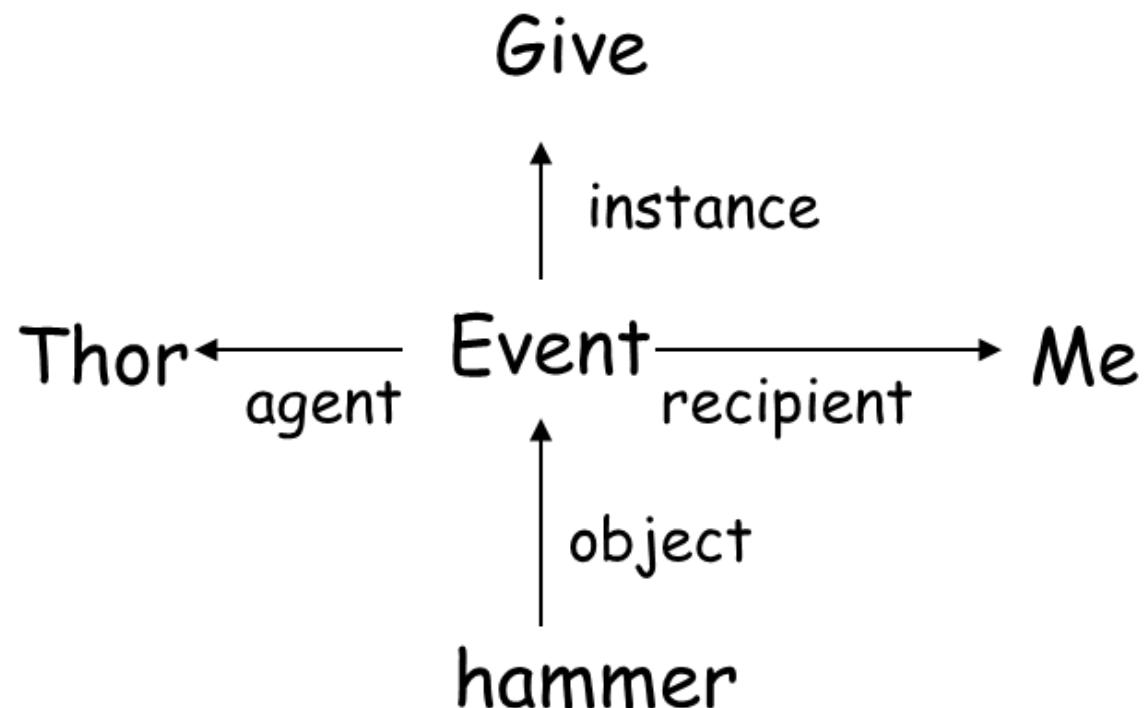
• “I was given this hammer by Thor”
• “Thor gave me this hammer”

- Representation allows canonical form sentences get transformed to the same “meaning representation”

WHY SEMANTIC REPRESENTATION?

- “I was given this hammer by Thor”
- “Thor gave me this hammer”

By using Semantic Net



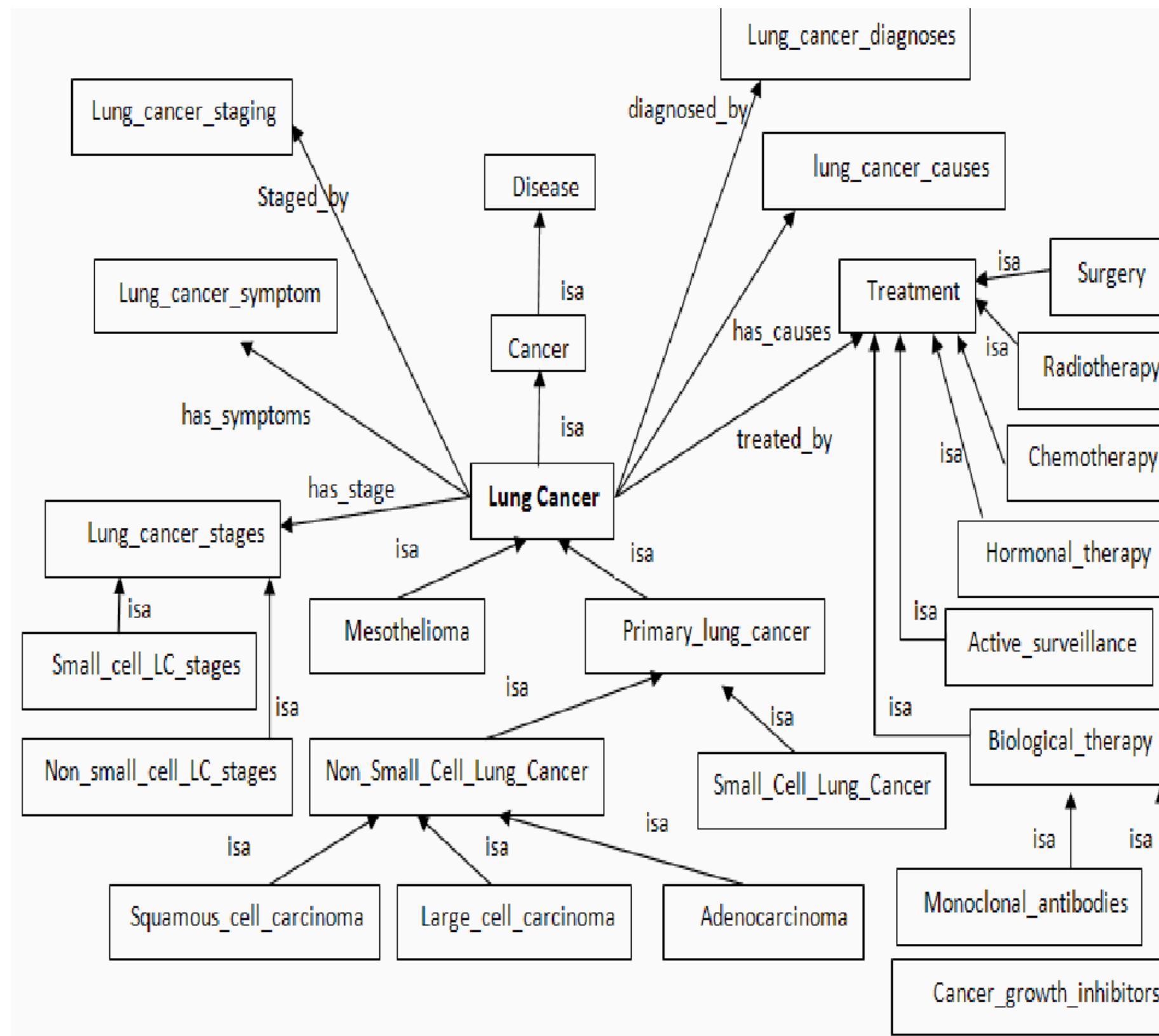
gives(thor, me, hammer)

WORLD KNOWLEDGE INTERPRETATION

Parsing

Semantic Interpretation

World knowledge representation



- Methods and structures used to model and store information about the real world that can be understood and utilized by AI systems.
- This encompasses the encoding of entities, concepts, relationships, and facts about the world in a way that facilitates reasoning, understanding, and intelligent behavior by machines.

SYMBOLIC ANALYSIS IN NLP

Morphology

- Components such as prefixes (un-, non-, anti-) and suffixes (-ing, -ly)
- Meaning of root words may change

Morphological analysis is the first phase of natural language processing (NLP) that examines the internal structure of words. It involves breaking words down into their smallest meaning-bearing units called morphemes.

SYMBOLIC ANALYSIS IN NLP

Prosody

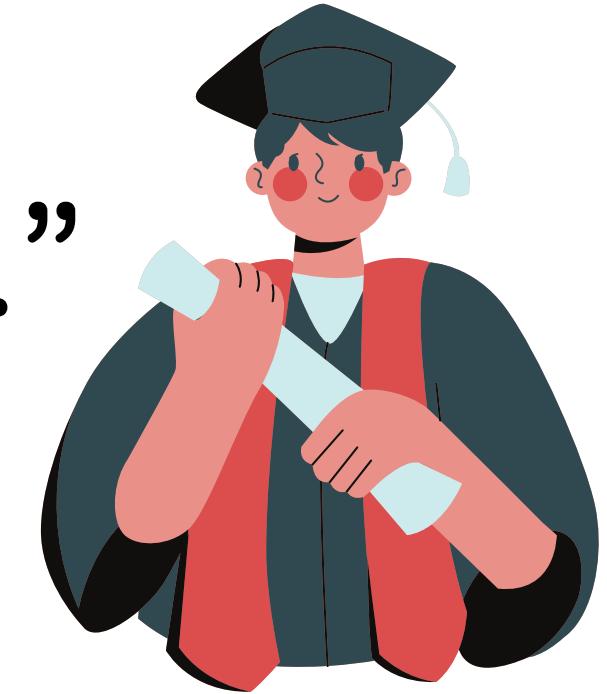
- Rhythm and intonation of language
- Relate to emotion

Phonology

- Combination of sounds to form language
- Pronunciation

TRY THIS

“Sam got an A in Calculus.”



“Sam? Got an A? In Calculus?”

SYMBOLIC ANALYSIS IN NLP

Syntax

- Rules for combining words into legal phrases and sentences
- i.e. grammar

Semantics

- The meaning of words, phrases, and sentences

SYNTACTIC VS SEMANTIC AMBIGUITY

Syntactic ambiguity

The same sequence of words is interpreted as having different syntactic structures.



Semantic ambiguity

The structure remains the same, but the individual words are interpreted differently.



*"They are **hunting dogs**"*

*"Meet me at the **bank**"*

SYNTACTIC AMBIGUITY

Syntactic ambiguity

The same sequence of words is interpreted as having different syntactic structures.

“Thor hits Captain America with a hammer”

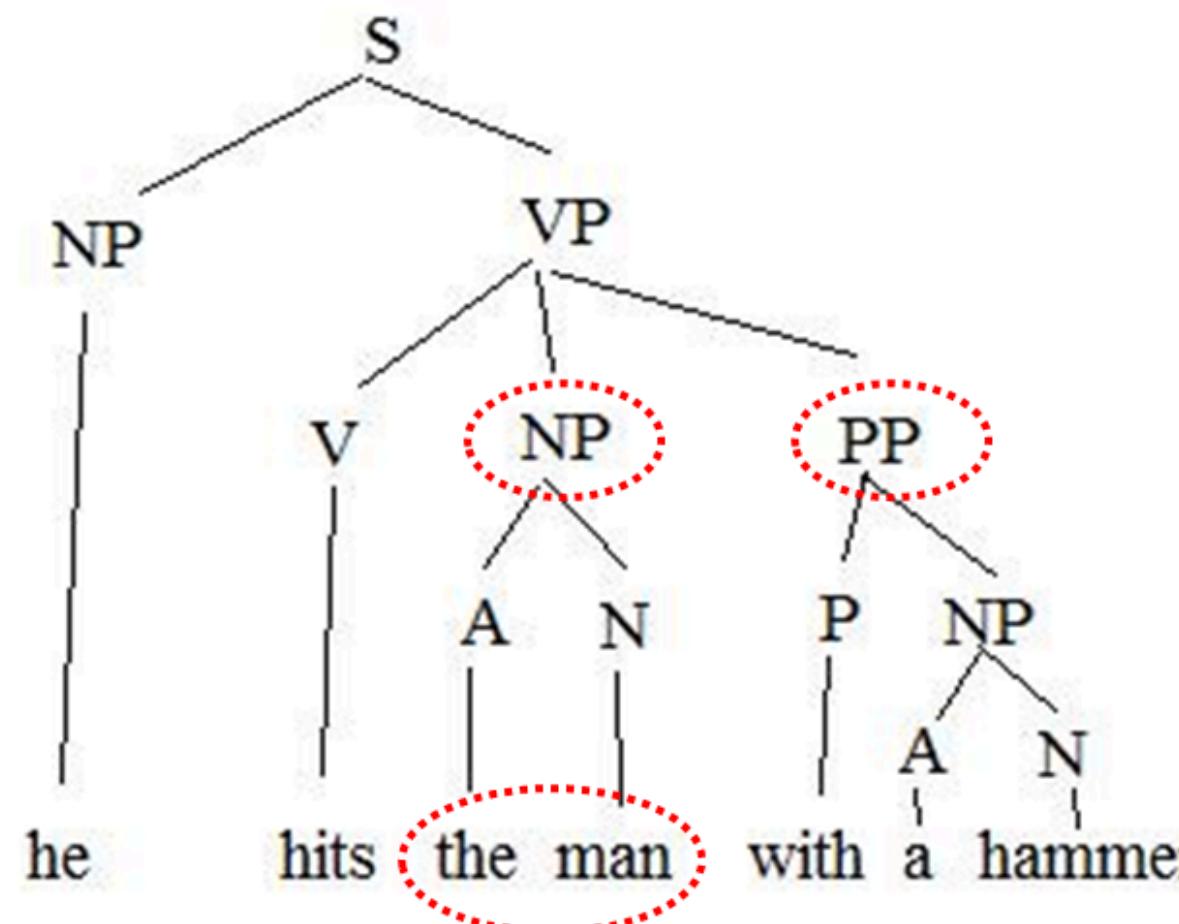


SYNTACTIC AMBIGUITY

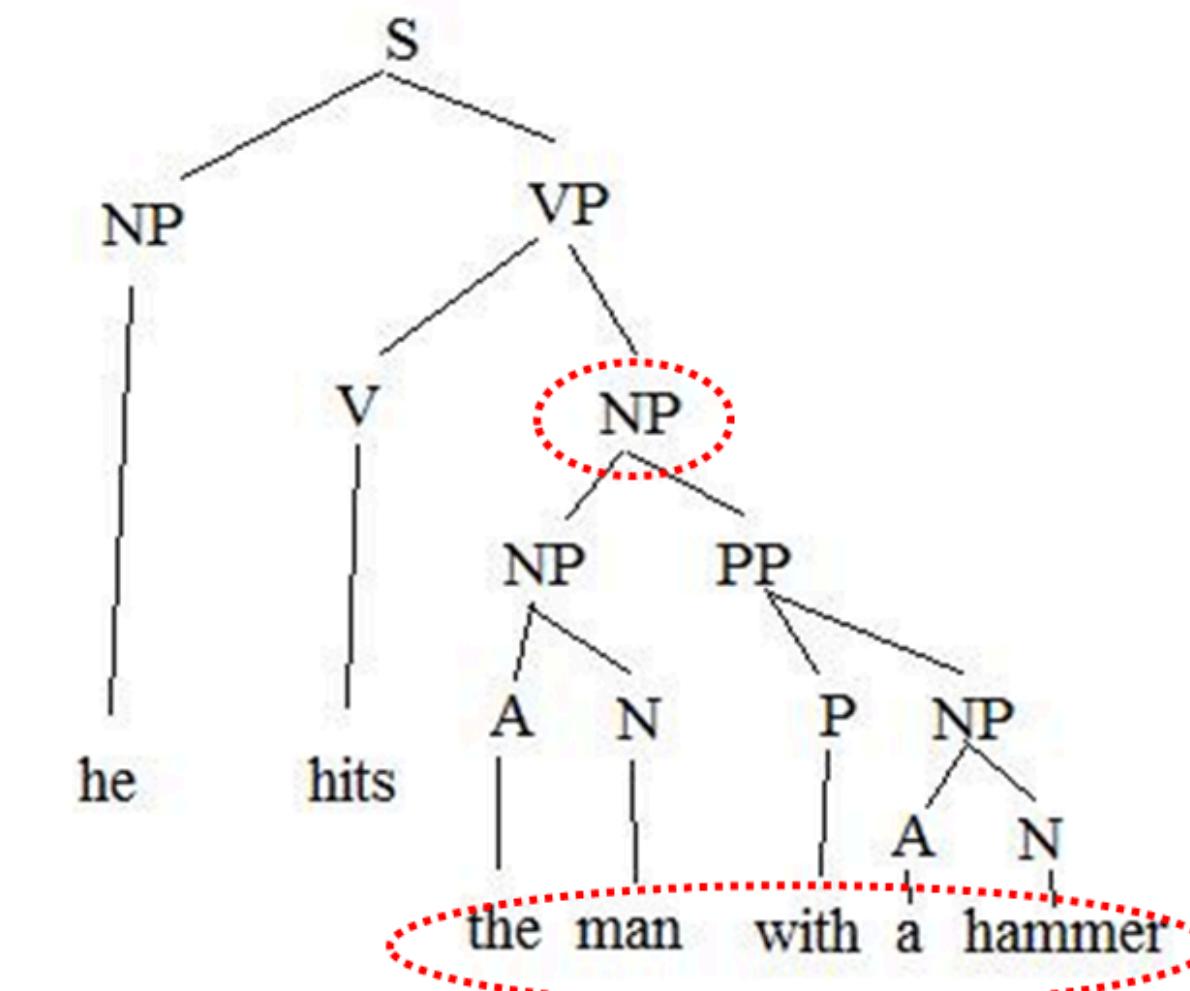
Usually two different parse trees can be drawn

He hits the man with a hammer

Parse Tree 1



Parse Tree 2

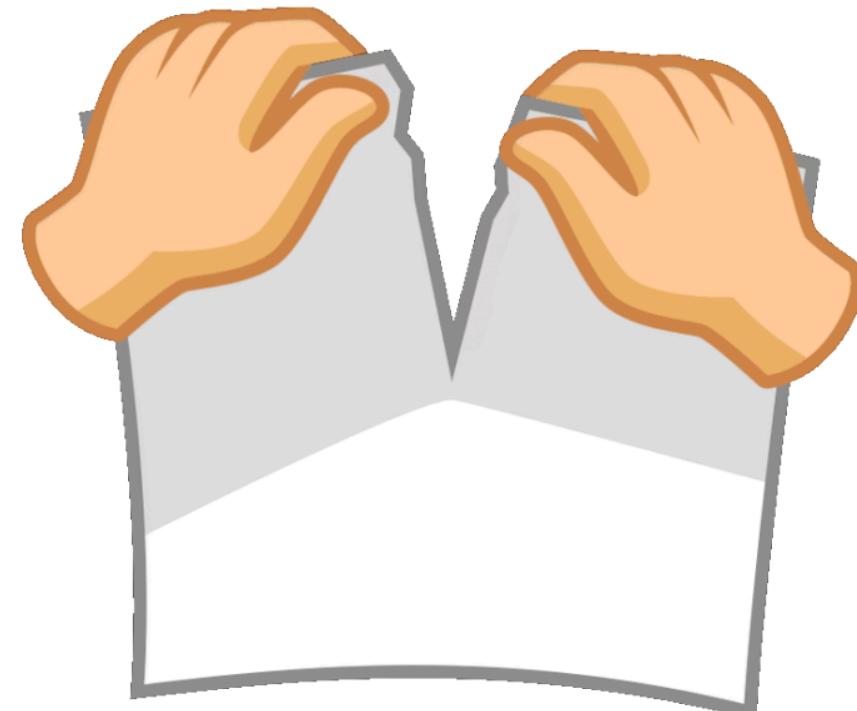


SEMANTIC AMBIGUITY

Semantic ambiguity

The structure remains the same, but the **individual words are interpreted differently.**

Be careful with the paper, or you might cause a tear.



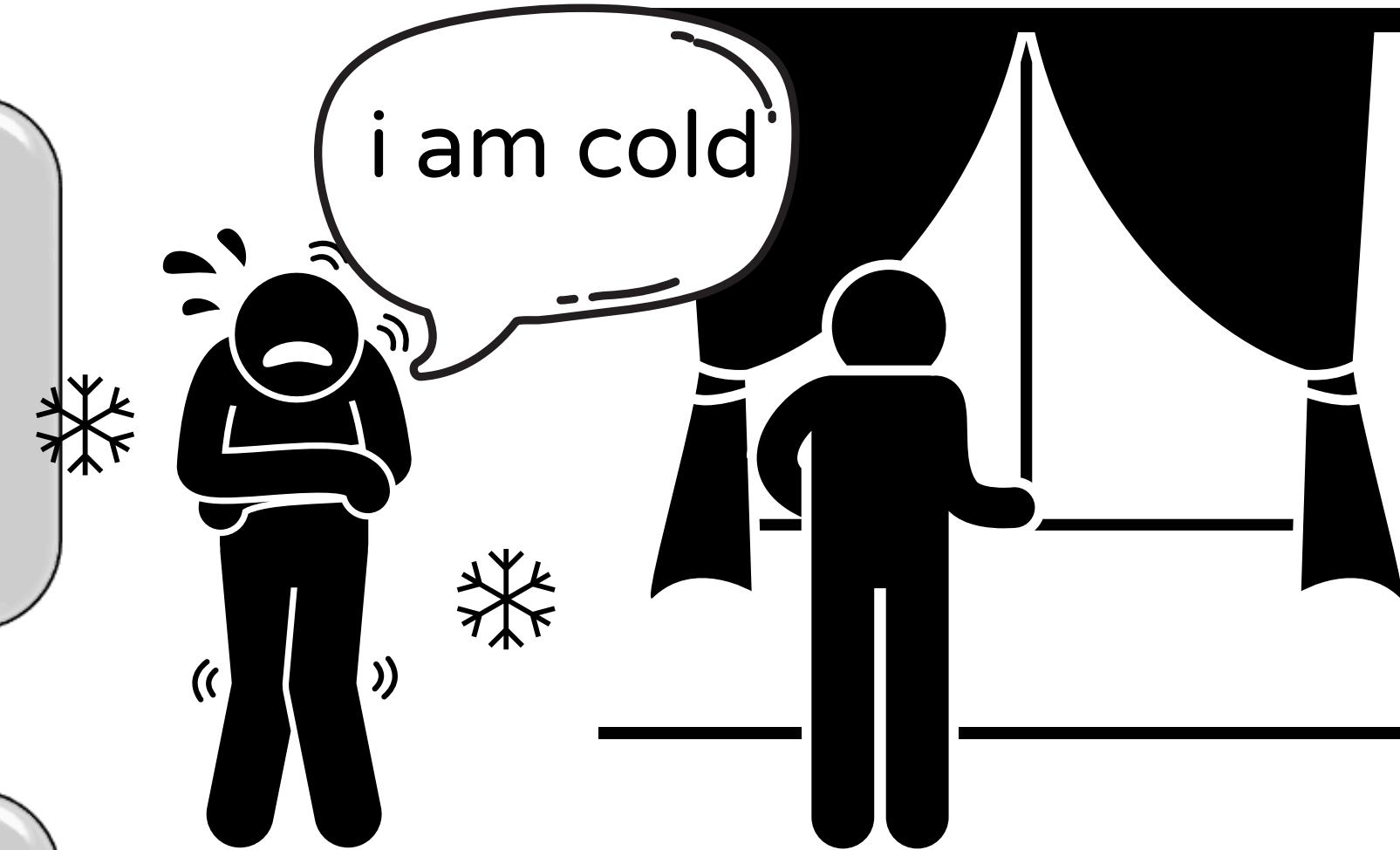
TRY THIS

- I saw her duck
- If you think about it, you will eventually see the light
- Time flies like an arrow

SYMBOLIC ANALYSIS IN NLP (CONT)

Pragmatics

- The study of the ways in which language is used and its effects on the listener
- Through experience



World knowledge

- Knowledge of the physical world, human interaction, the role of goals and intentions in communication.
- Ontology

THE END



NEXT LECTURE

Machine Learning (Supervised)