Synergy of Linguistic Science and Technology: NLP's Linguistic Endeavors

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IIT Guwahati

OUTLINE:

1. Introduction
2. What is NLP ?
3. The Linguistic Landscape
4. NLP Tasks and Applications
5. Importance of NLP in Multidisciplinary Context
6. Synergy of Linguistic Science and Technology
7. Challenges and Future Directions
8. Conclusion and Q&A

1. Introduction

- Welcome to the presentation

- Overview
  - Explore the intersection of linguistic science and technology

- Agenda

  - Journey through key NLP applications

  - Significance of these applications in addressing everyday linguistic challenges


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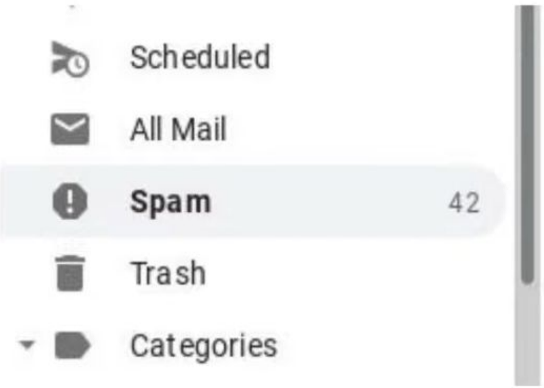
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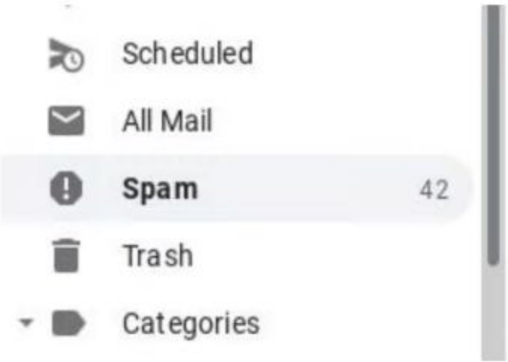
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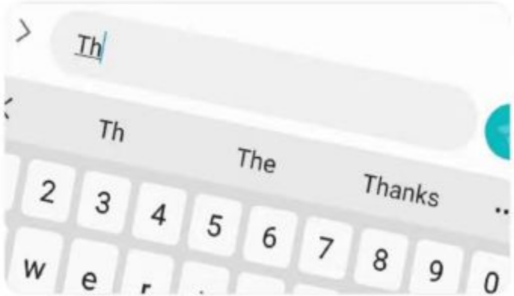
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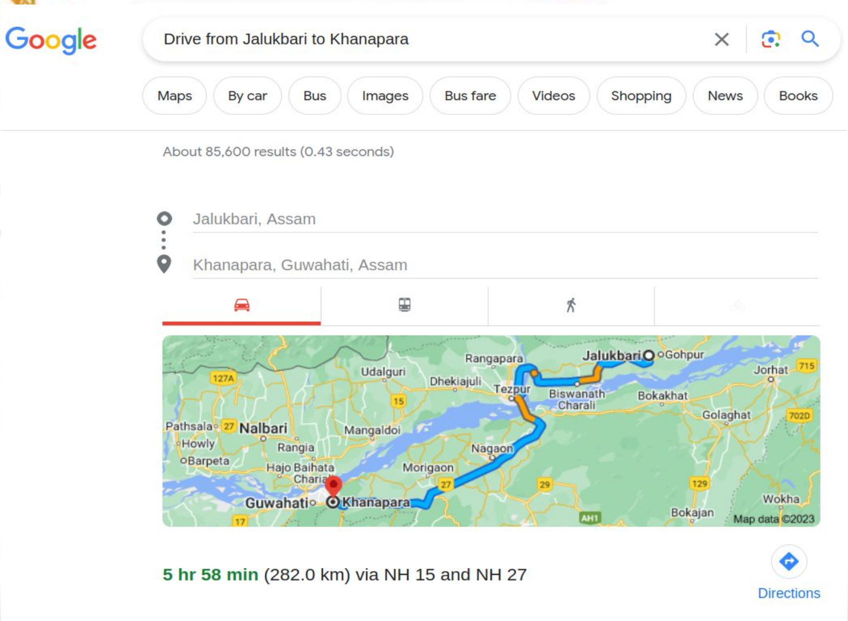
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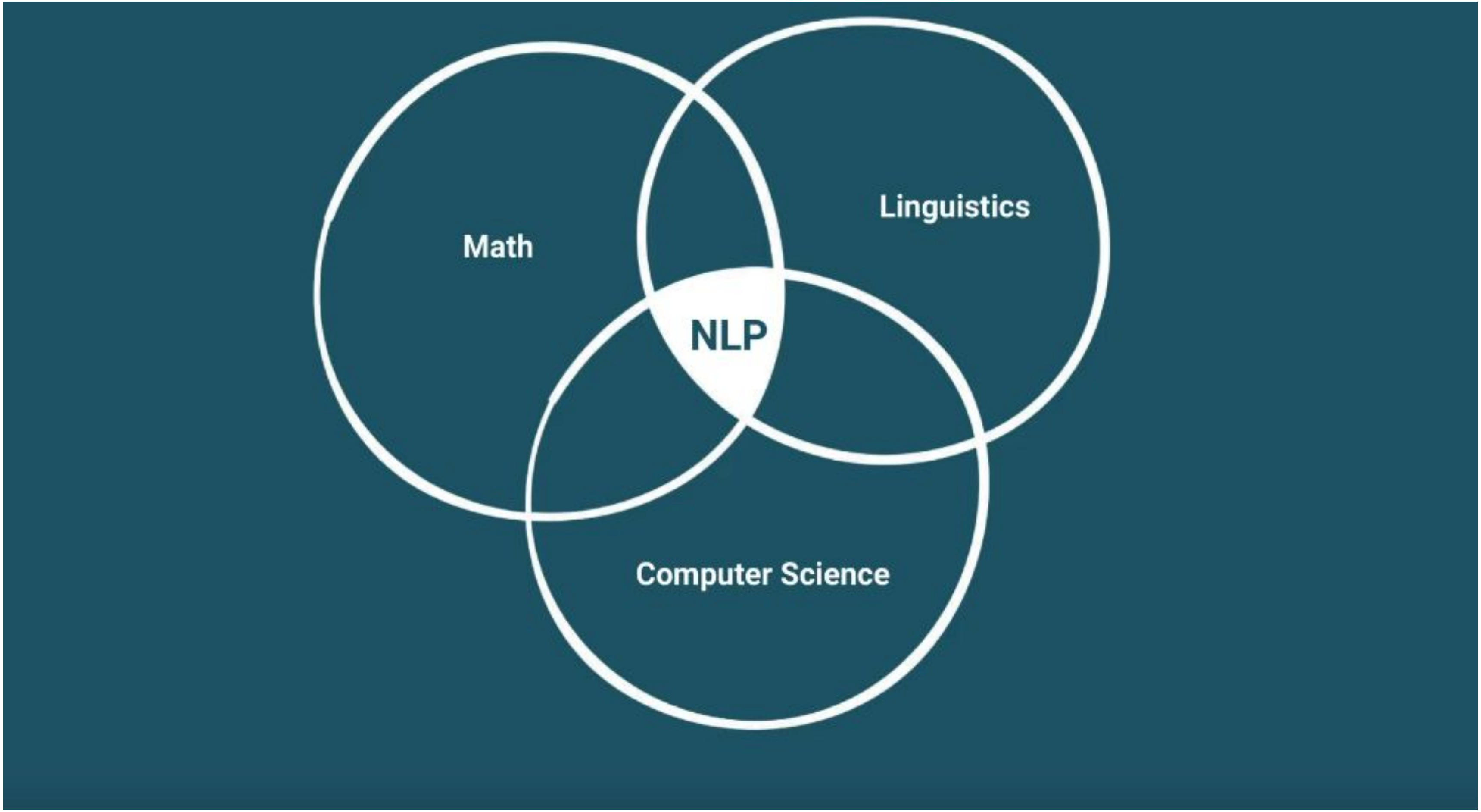
2. What is NLP ?



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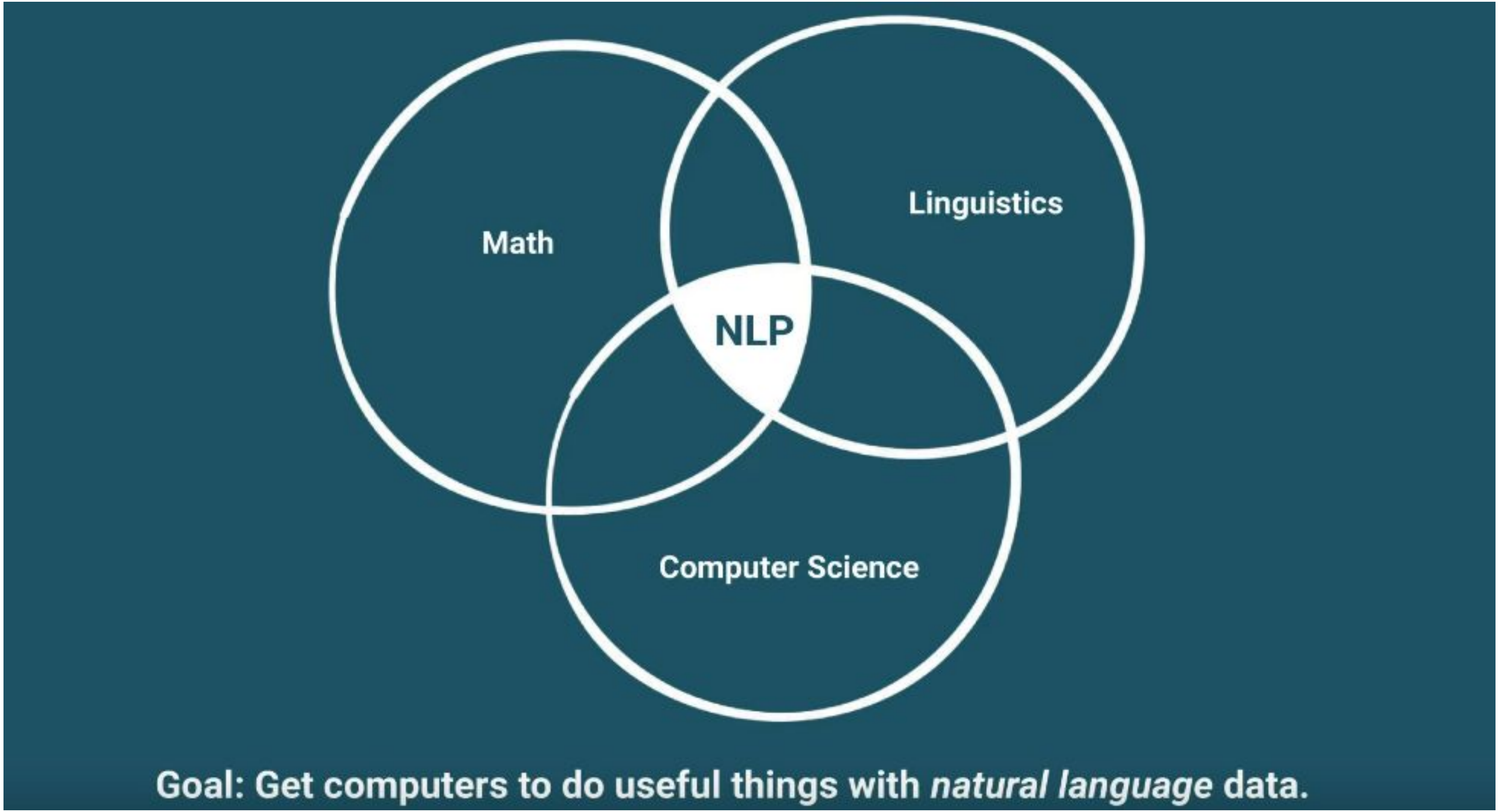
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Linguistics
NLP
Computer Science
Goal: Get computers to do useful things with *natural language* data.

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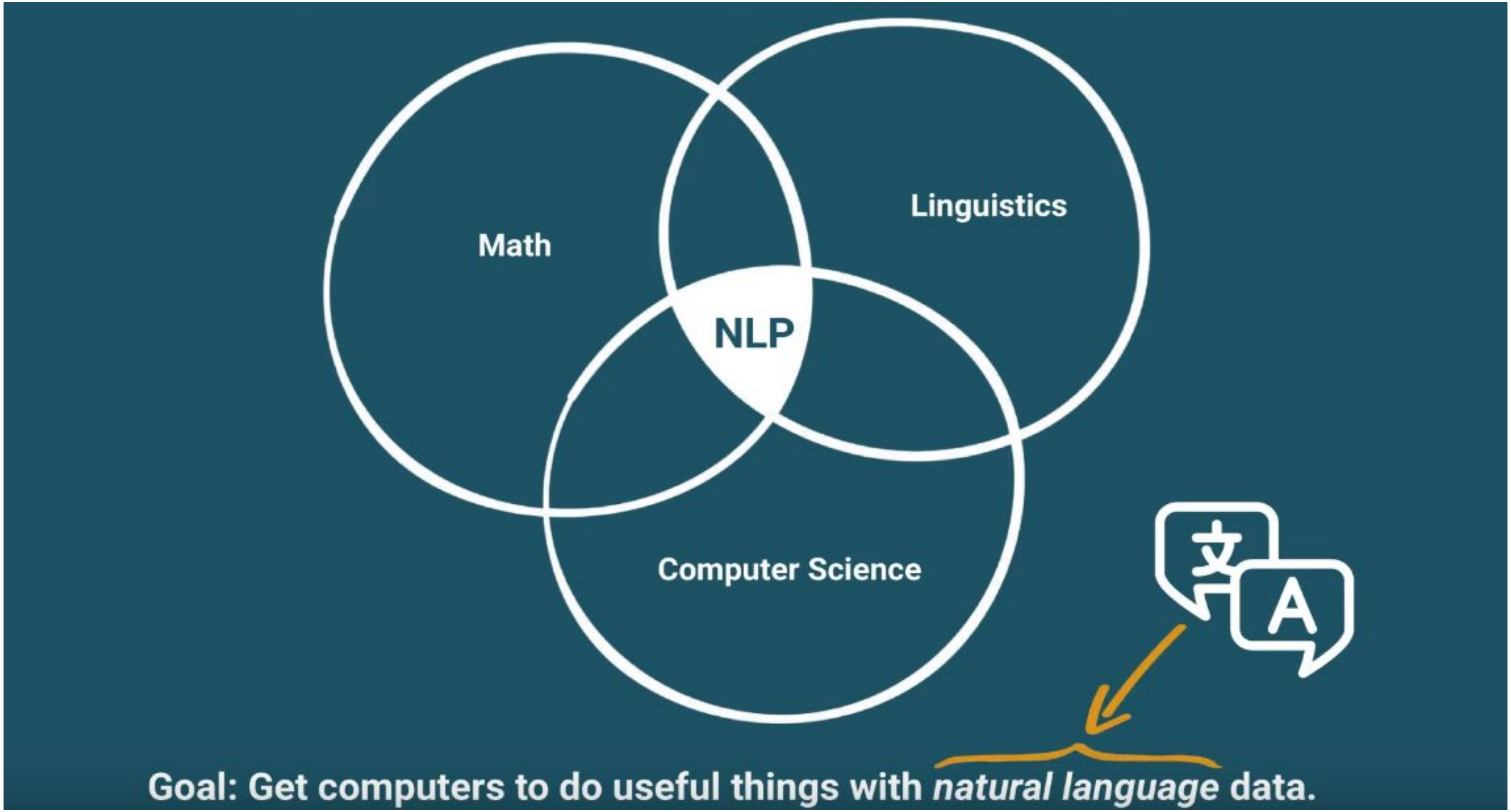
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3. The Linguistic Landscape

Why is NLP difficult?

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Ambiguity

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"Stolen painting found by tree"

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"Stolen painting found by tree"

By a tree, a stolen painting
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"Stolen painting found by tree"

By a tree, a stolen painting was found.	vs.	A tree found a stolen painting.

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Prepositional Phrase

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A tree found a stolen painting.

PP-attachment problem

syntactic ambiguity

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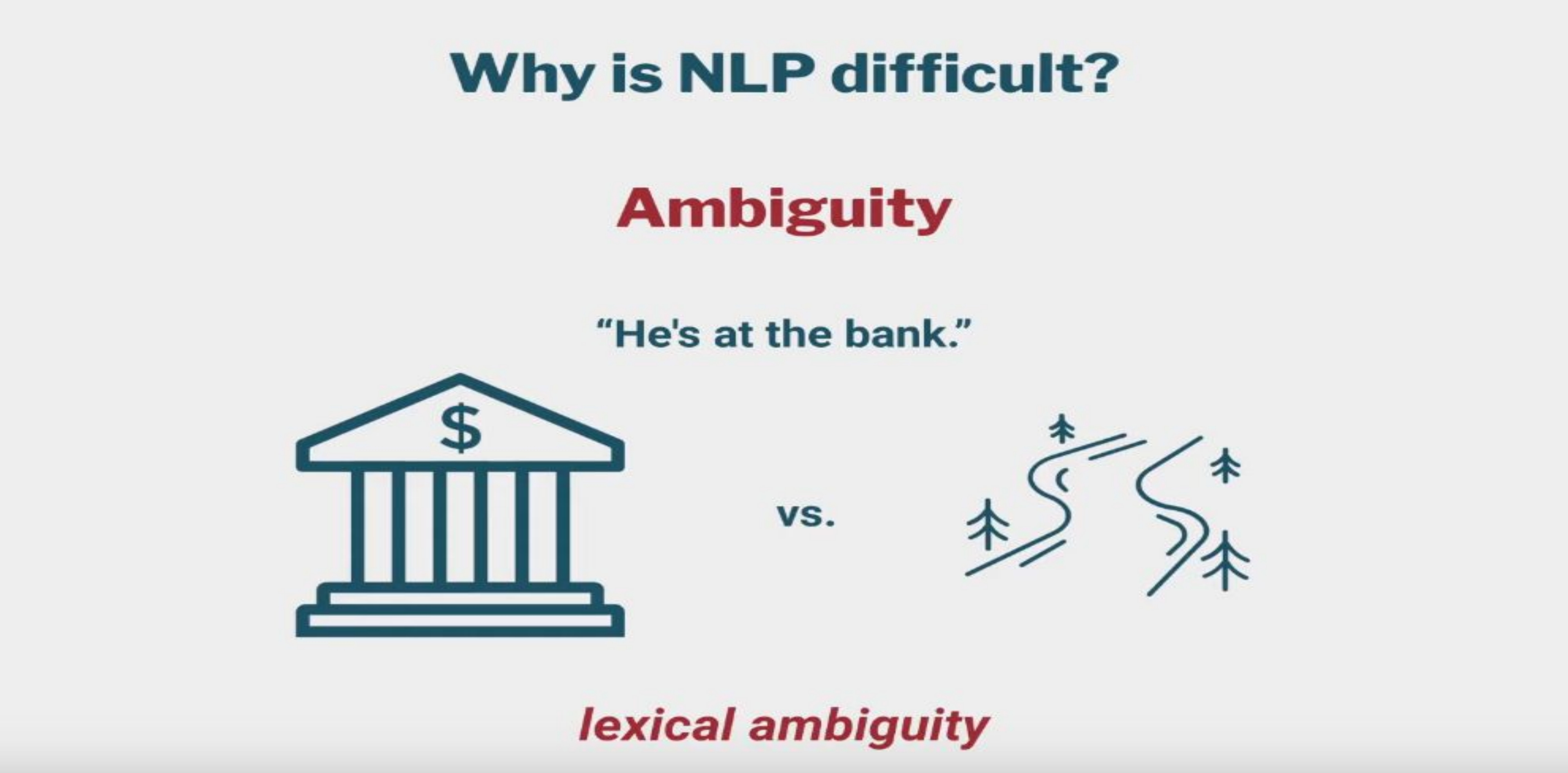
"He's at the bank."

3. The Linguistic Landscape



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“She flew in last night.”

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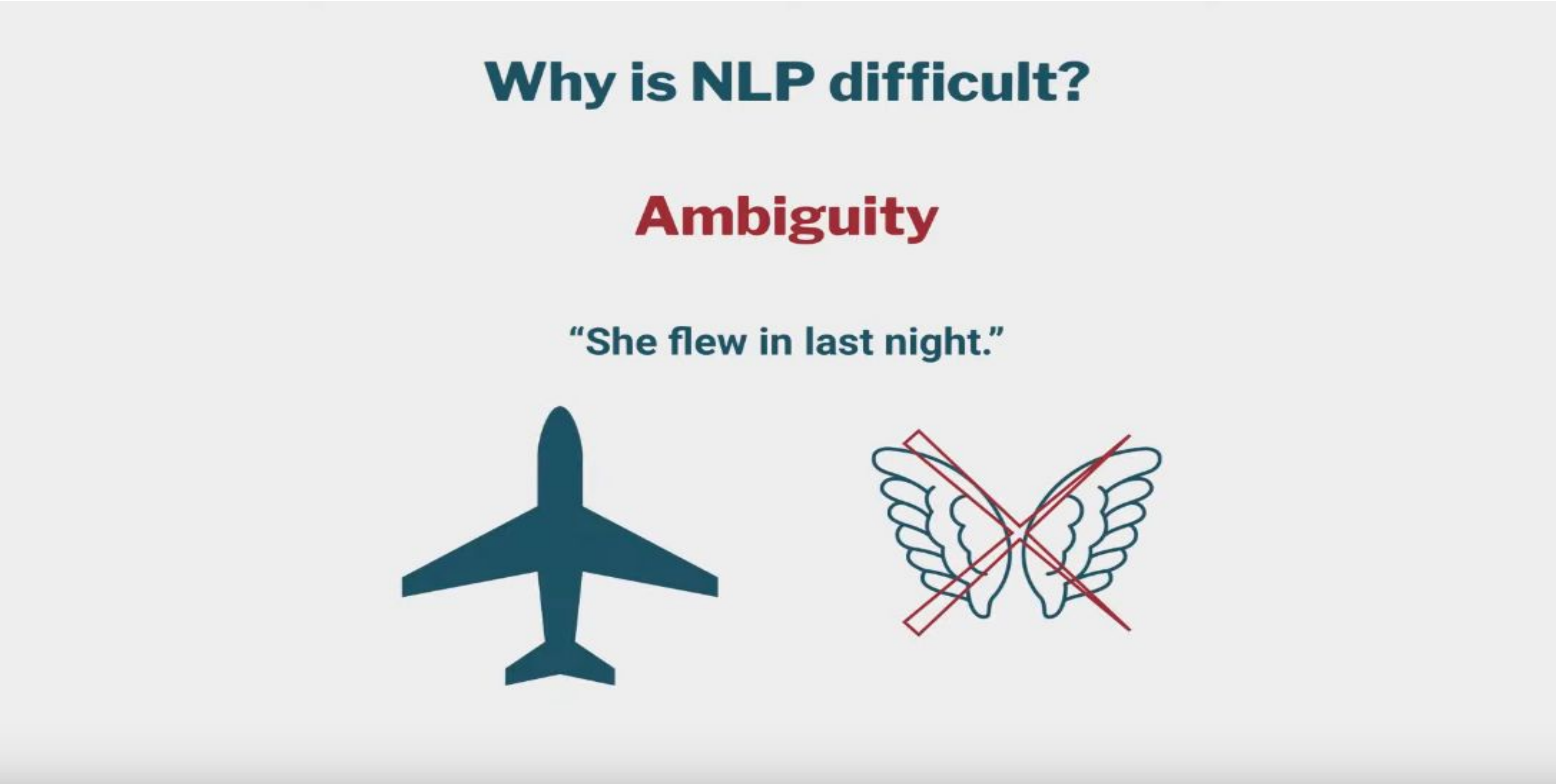

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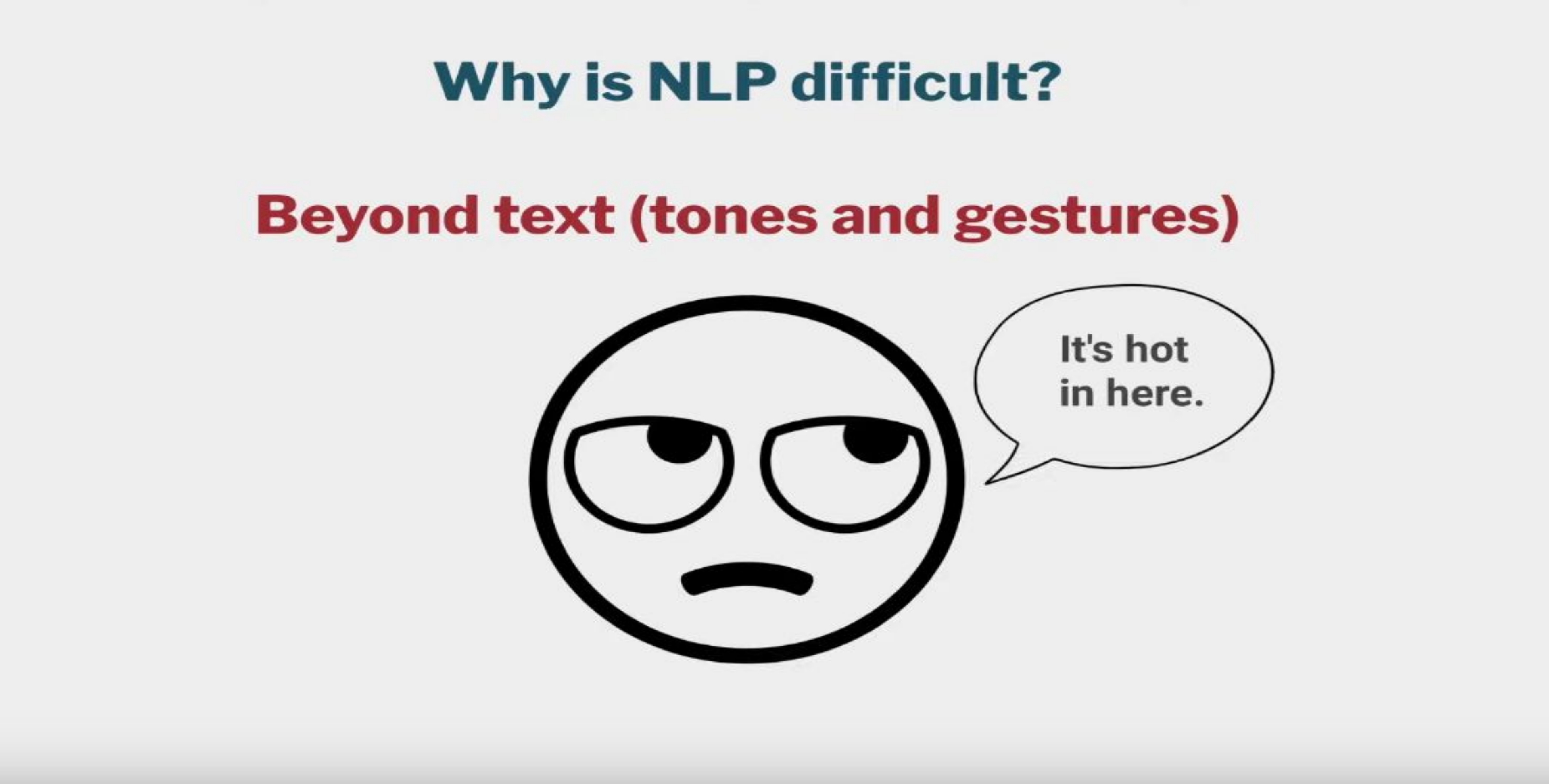

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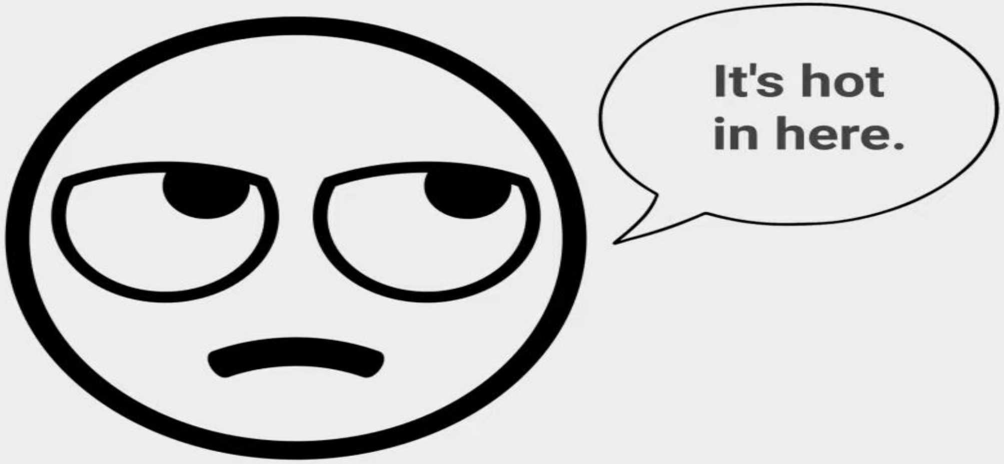
Why is NLP difficult?

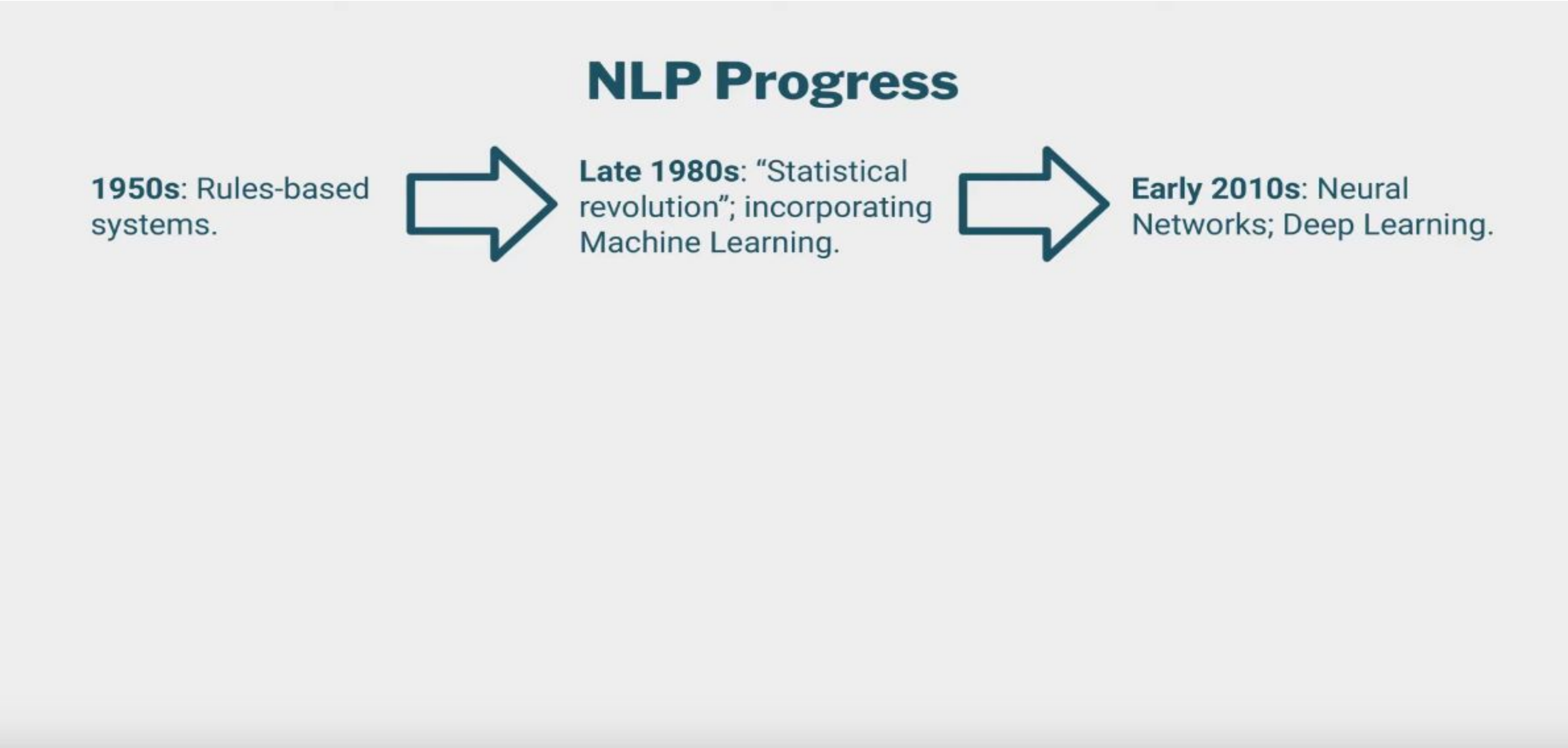
Beyond text (tones and gestures)



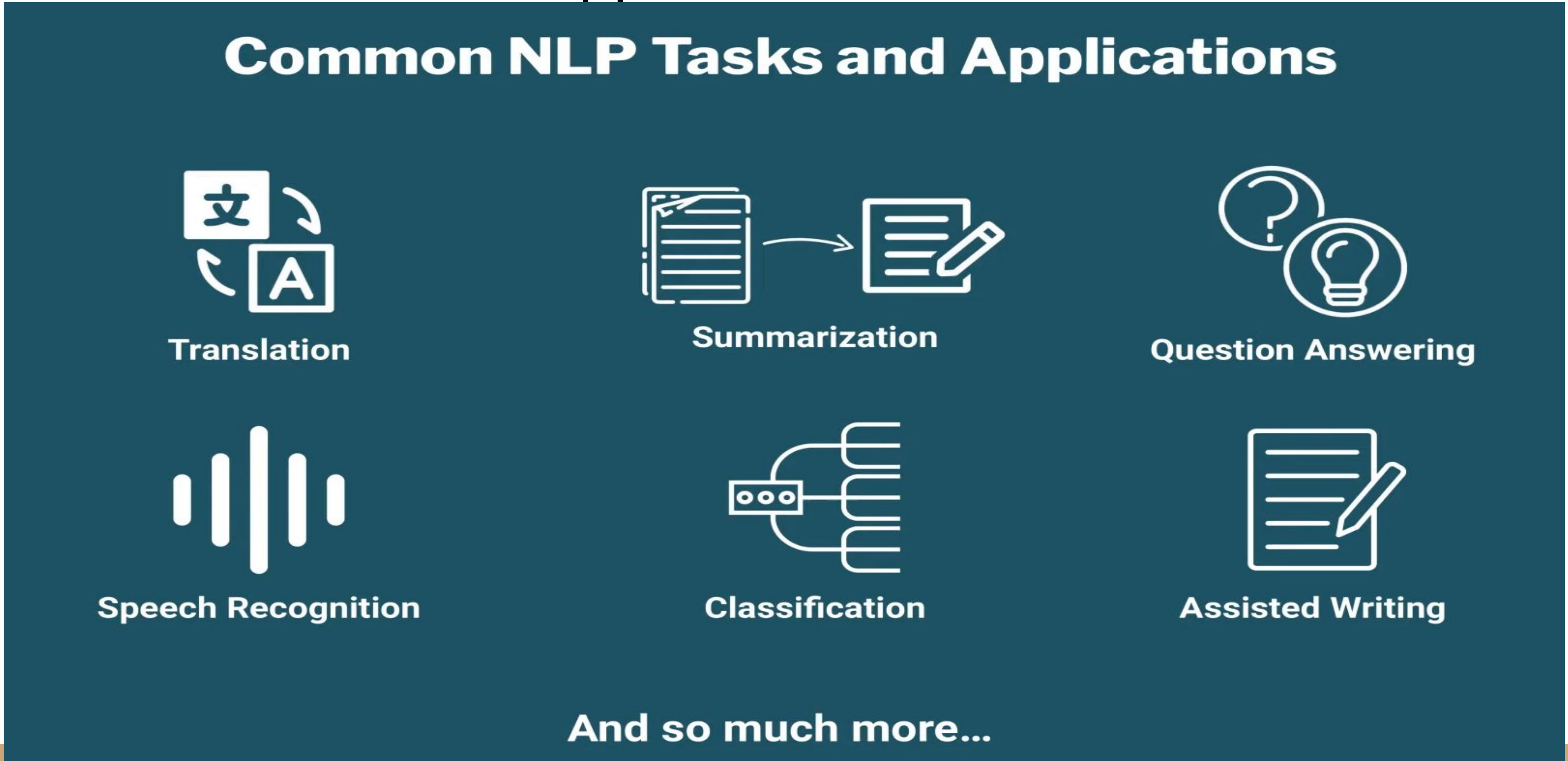
Really: "I'm bored and tired and I hate you for bringing me here."

Pragmatics (how people use language)

Progress in NLP



4. NLP Tasks and Applications



4.1 Few Classic NLP Problems: POS

Part-of-Speech (POS) Tagging

Classifying how a word is used in a sentence.

{ noun, verb, adjective, ... }

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['PROPN', 'VERB', 'DET', 'NOUN', 'ADP', 'DET', 'ADJ', 'NOUN', 'PUNCT']

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Part-of-Speech (POS) Tagging

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Parts of speech can help discover intent or action.

"How can I help you today?"

"I want to book a hotel room."

VERB

NOUN

e.g. you could scan for *VERB-NOUN* patterns. Scanning for POS patterns can also help with other tasks such as information extraction.

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Part-of-Speech (POS) Tagging

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Simply scanning for keywords like "book" isn't enough.

"I want to book a hotel room." *vs.* "I left the book in the hotel room."

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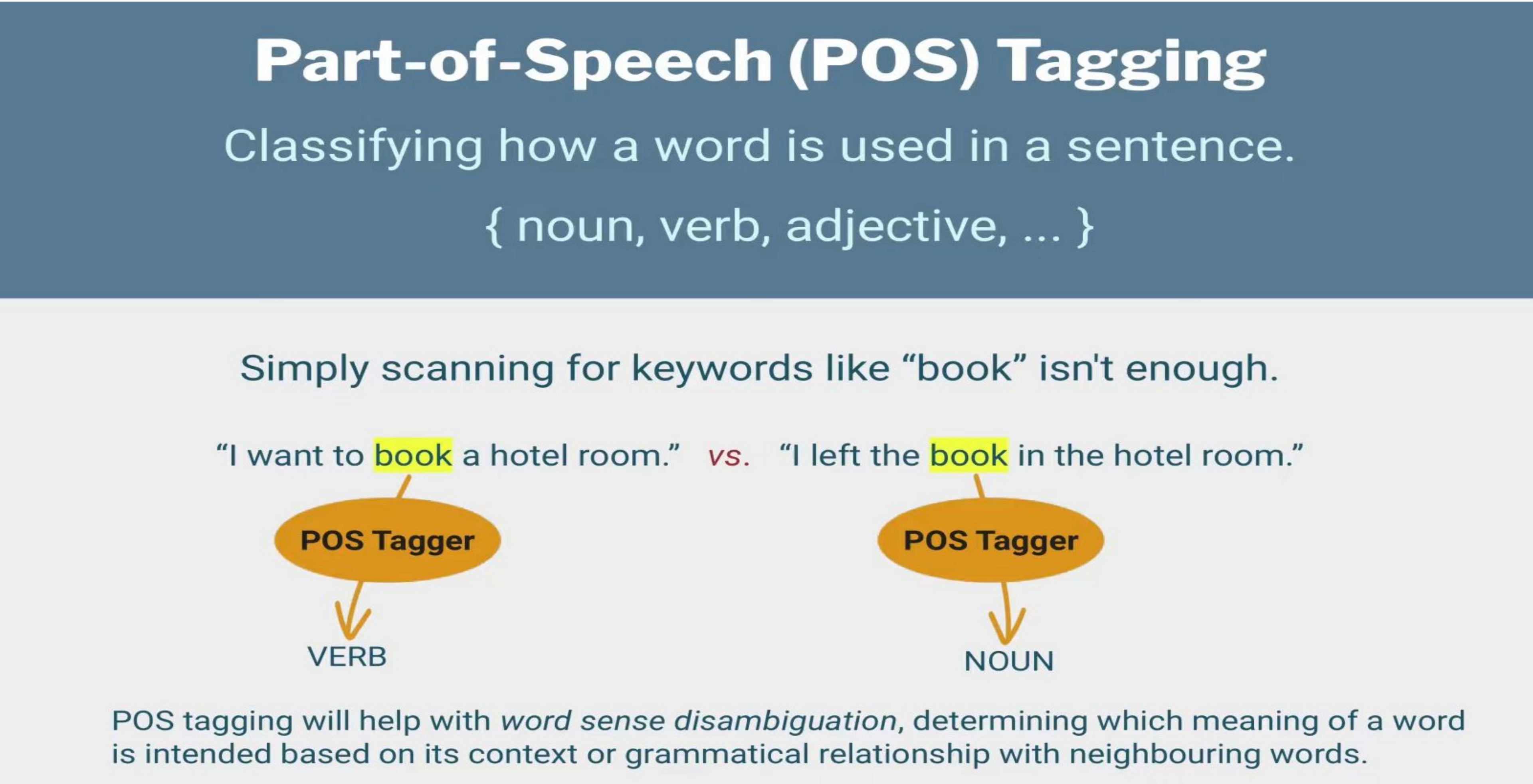

4.2 Few Classic NLP Problems: NER

Named Entity Recognition (NER)

Tagging named ("real-world") entities.

{ a person, a location, an organization, ... }

Named Entity: (roughly) anything that can be referred by a proper name. They often have a *Proper Noun (PROPN)* POS tag.

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Most Common

Person (PER)
"Alice", "Isaac Newton"

Location (LOC)
"Bay Area", "Rocky Mountains"

Geopolitical Entity (GPE)
"Canada", "Chicago"

Organization (ORG)
"Microsoft", "Porsche"

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They often have a *Proper Noun (PROPN)* POS tag.

But also often extended to other types

- **Money**
- **Time**
- **Date**

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4.2 Few Classic NLP Problems: NER

Named Entity Recognition (NER)

Tagging named ("real-world") entities.

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"Volkswagen is developing an electric sedan which could potentially come to America next fall."

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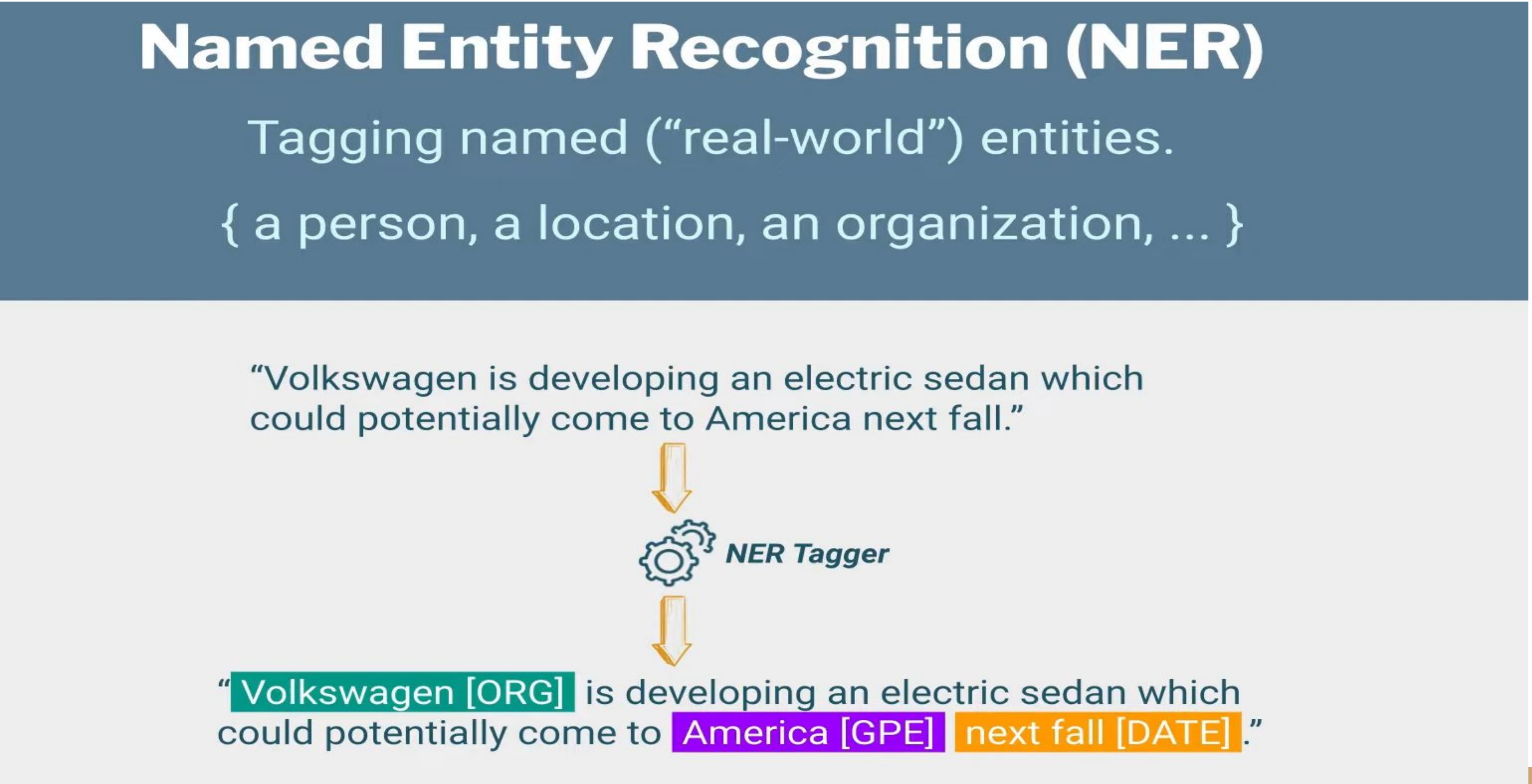

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Organizing/Categorizing corpus

e.g. identify medical procedures or diseases in research, or categorize support tickets based on entities mentioned.

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Critical in information extraction

e.g. extracting events and relationships between entities.

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Challenges...

An entity can span multiple tokens

"Alexander Hamilton"

Entity *spans* two tokens and the system must identify the boundaries correctly.

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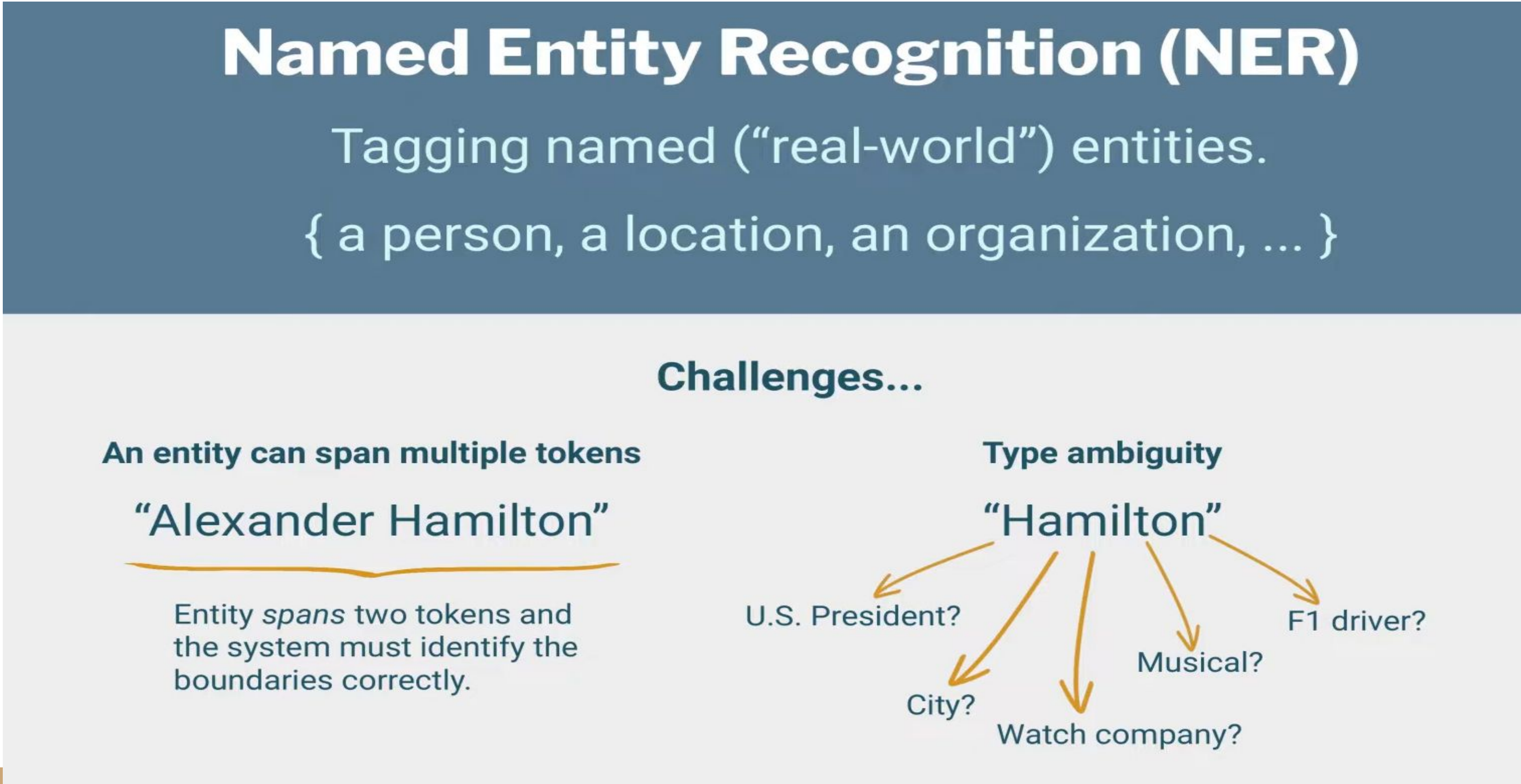

4.3 Few Common NLP Problems: Classification

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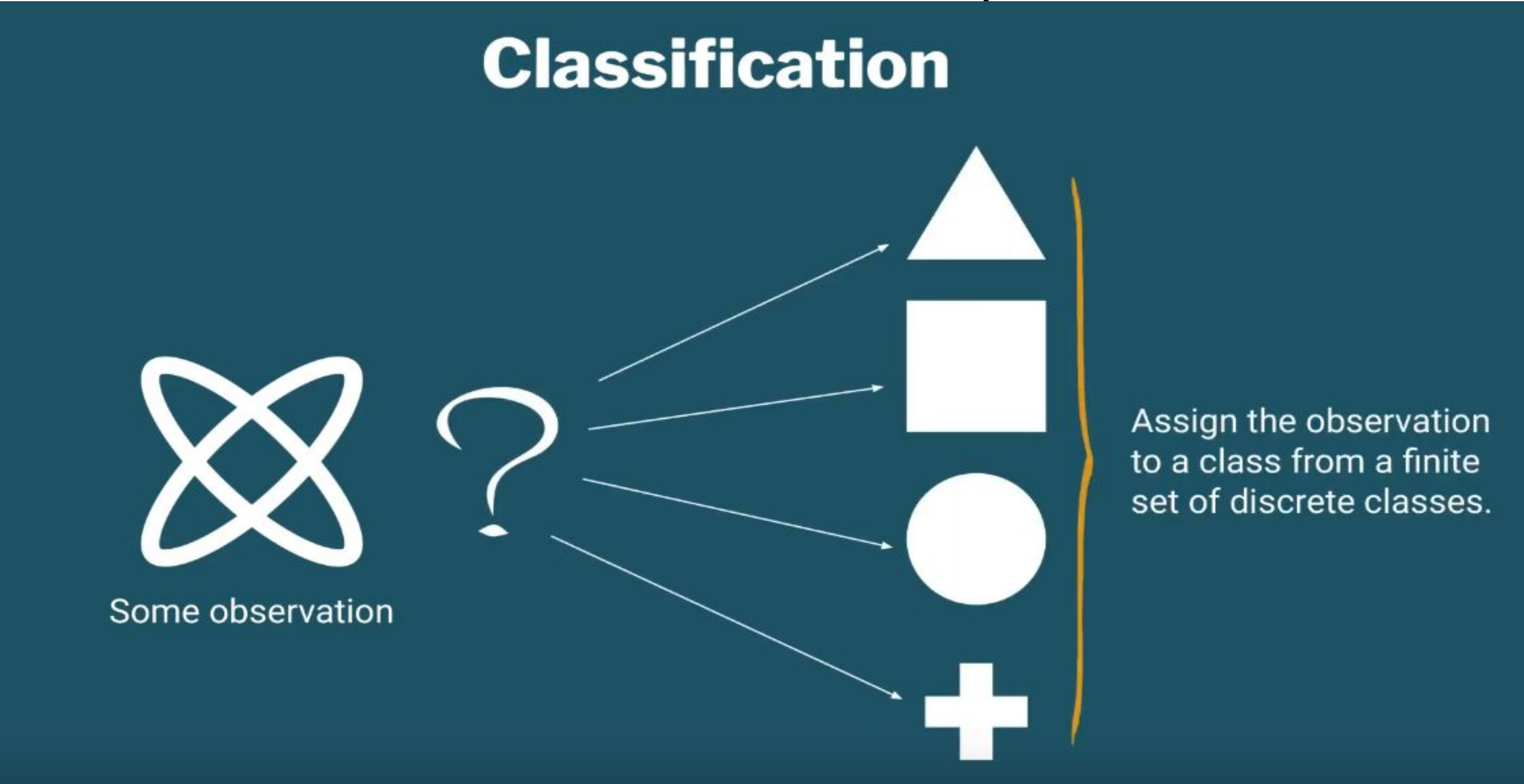

4.3 Few Common NLP Problems: Classification

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4.4 Few Advanced NLP Problems: Sequence2Sequence

Translation

Summarization

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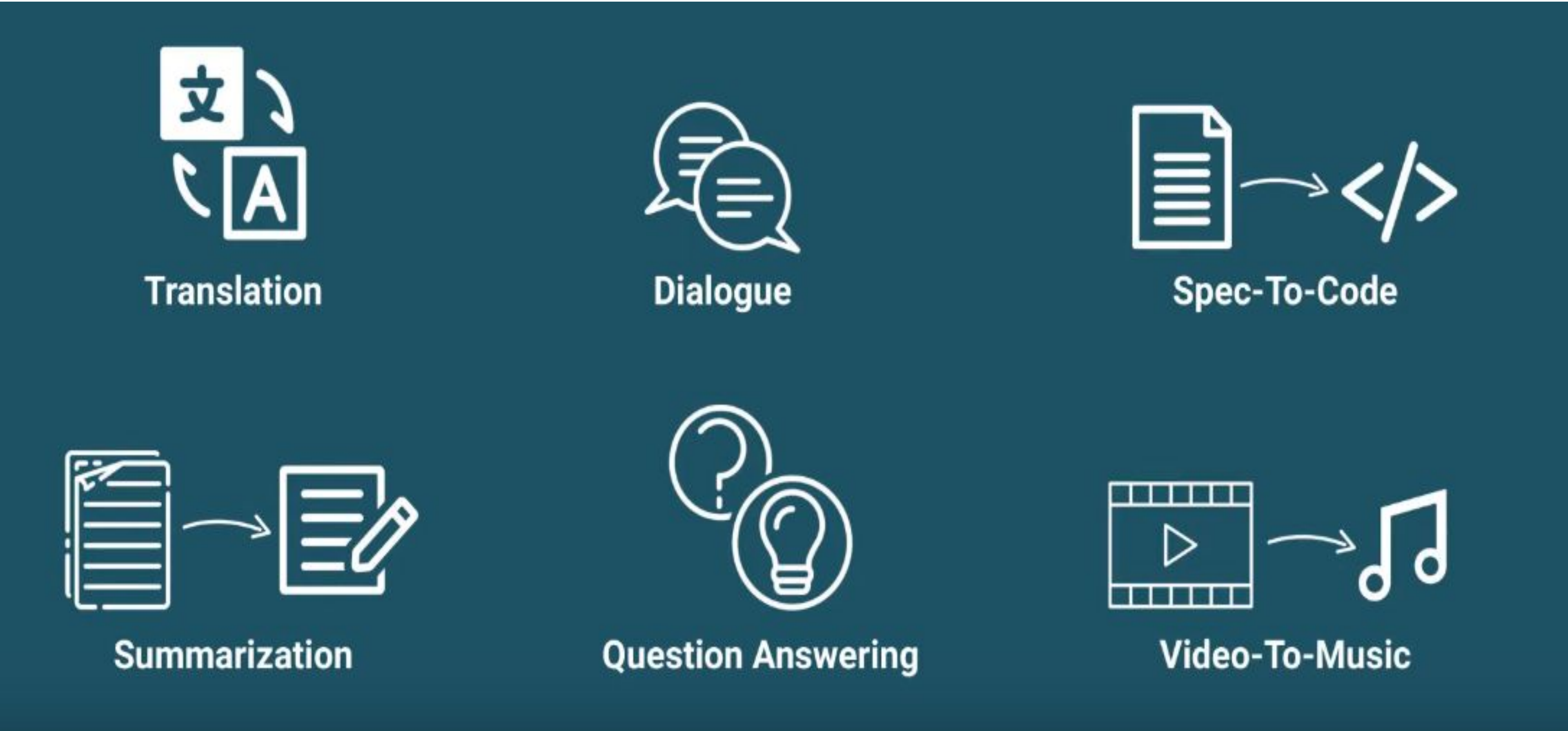

5. Importance of NLP in Multidisciplinary Context

- **Cross-Industry Applications: Similar NLP approaches can be applied in various industries:**
  - **Healthcare:** Accurate translation in medical contexts for better patient care.

5. Importance of NLP in Multidisciplinary Context

- **Cross-Industry Applications: Similar NLP approaches can be applied in various industries:**
  - **Law:** Help with the precedence search in Law.

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- **Cross-Industry Applications: Similar NLP approaches can be applied in various industries:**
    - **Finance:** Report and News analysis in Finance.

5. Importance of NLP in Multidisciplinary Context

- **Cross-Industry Applications: Similar NLP approaches can be applied in various industries:**
  - **Education:** Language learning apps that adapt to individual needs.

6. Synergy of Linguistic Science and Technology

- **Linguistic Expertise Enhances NLP**

  - **Rule Formulation:**
    - **Linguistic experts formulate rules and guidelines. For example, understanding that names can have different forms, titles, or nicknames helps improve the precision of NER models.**
  - **Training Data Creation:**
    - **Expertise crucial for creating training data in tasks like Machine Translation, POS Tagging, Dependency Parsing etc. for state-of-the-art models.**
  - **Outcome Validation:**
    - **Only linguistic experts can effectively validate outcomes of certain linguistic experiments.**
  - **Key to Research:**
    - **Well-versed linguistic experts are essential for multidisciplinary computational linguistic research.**

6. Synergy of Linguistic Science and Technology

- **Technology Facilitates Linguistic Research**
  - **Automatic POS and NER Tagger:**
    - **Build an automatic system for part-of-speech (POS) tagging and Named Entity Recognition (NER) to enhance linguistic analysis**
  - **Automatic Translator and Transliterator:**
    - **Create an automated system for translation and transliteration tasks.**
  - **Automatic Sentiment Analyzer, Language Identifier:**
    - **Build an automated system for sentiment analysis and language identification.**
  - **Chatbots, Conversational AI models:**
    - **Develop intelligent Chatbots and state-of-the-art Conversational AI model like ChatGPT, GPT4 for interactive linguistic interactions.**

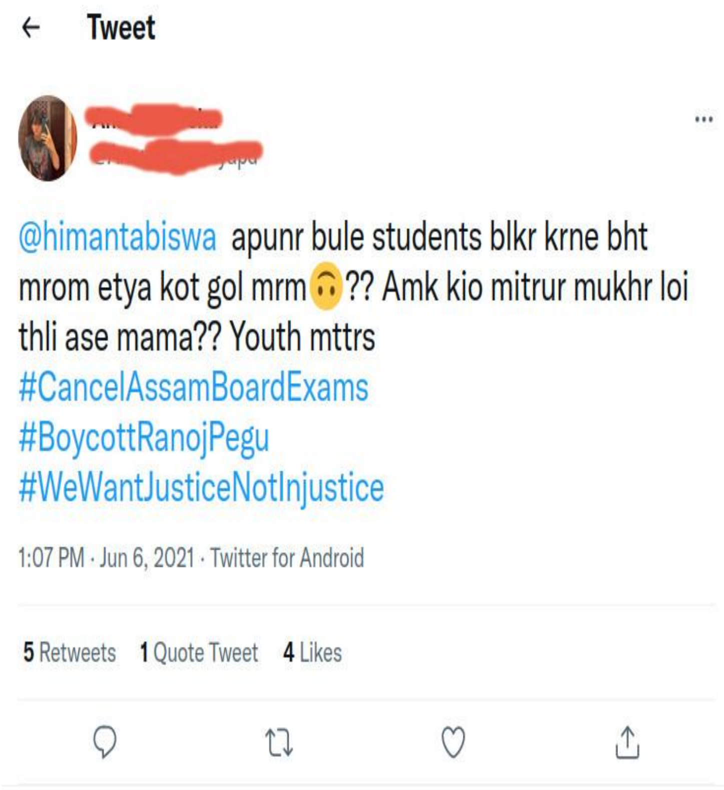
7. Challenges and Future Directions:

- Sentiment Analysis & Sarcasm Detection

  On user generated Social Media Content

7. Challenges and Future Directions:

- Language Identification, Machine Translation & Transliteration in code-mixed Social Media Data



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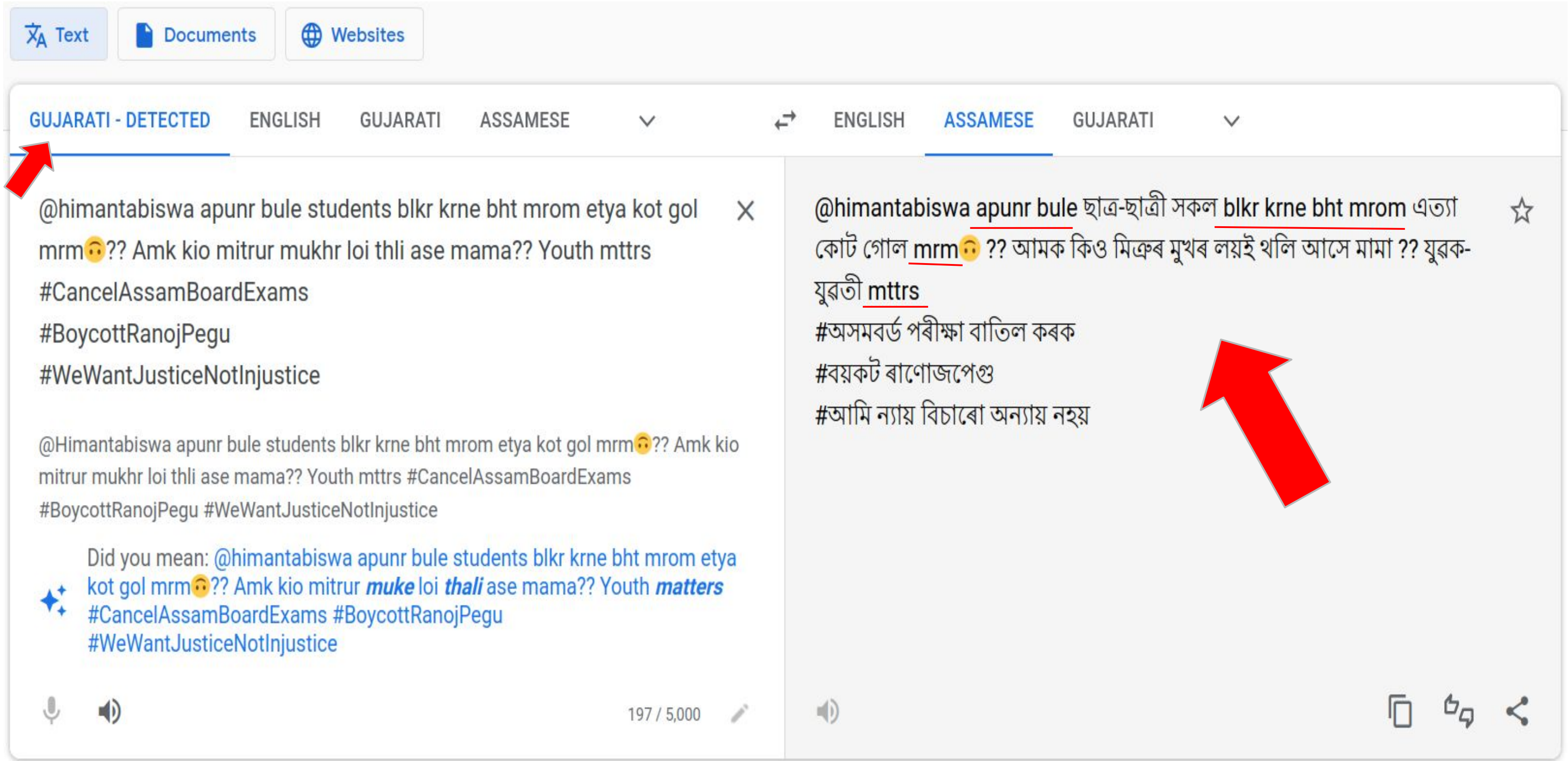

8. Conclusion

- **Linguistic-Technology Fusion**
- **Diverse NLP Applications**
- **Significance in Multidisciplinary Context**
- **Ongoing Challenges and Future Directions**
- **Call to Collaborate**

Q&A

THANK YOU

FOR

LISTENING

References

https://krishnaik.in/

http://jalammar.github.io/

https://colah.github.io/

https://www.nlpdemystified.org

8. Conclusion and Q&A

1. **Linguistic-Technology Fusion:**
   - **The presentation showcased the powerful fusion of linguistic insights with technological advancements in the realm of Natural Language Processing (NLP).**
2. **Diverse NLP Applications:**
   - **From automatic POS and NER tagging to translation, sentiment analysis, and chatbots, NLP applications demonstrated the versatility of linguistic science and technology collaboration.**
3. **Significance in Multidisciplinary Context:**
   - **Highlighted the relevance of NLP in diverse fields, emphasizing its importance in healthcare, business, education, and beyond.**
4. **Ongoing Challenges and Future Directions:**
   - **Acknowledged current challenges in tasks like sentiment analysis, processing user-generated data and looked ahead to future directions, indicating the continuous evolution of NLP.**
5. **Call to Collaborate:**
   - **Encouraged ongoing collaboration between linguists and technologists, underlining the collective impact in advancing natural language understanding and technology integration.**