T-(538|725)-MALV, Natural Language Processing

Introduction

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Outline

1. Language Technology/Natural Language Processing
2. Language Technology Projects
3. The disciplines of linguistics
4. Why is LT difficult?
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4. Why is LT difficult?
Goal

- The goal of (human) language technology (HLT, LT) is to develop systems which allow people to communicate with computers using natural languages.
- The Icelandic term is “Máltækni”
- Interdisciplinary field – interplay of fields like linguistics, statistics, psychology, engineering and computer science.

Two main subfields

- Text (Language) Processing (í. Textavinnsla)
- Speech Processing (í. Talvinnsla)
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**LT vs. NLP**

- Language Technology (LT) $\approx$ Natural Language Processing (NLP)
- í. Máltækni $\approx$ málvinnsla
- In NLP, the emphasis is on:
  - The analysis (í. greining) of structure (í. formgerð) and semantics (í. merking) of a language
  - The generation (í. myndun) of language from structure/semantics.
- NLP $\approx$ Computational Linguistics (í. tölvufræðileg málvísiðn)
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LT Projects

Examples

- Grammar checking (í. Málfræðileiðrétting)
- Information retrieval (í. Upplýsingaheimt) and Information Extraction (í. Upplýsingaútdráttur)
  - http://en.wikipedia.org/wiki/Information_extraction
- Question-Answering Systems (í. Fyrirspurnarkerfi)
- Machine Translation (í. Vélrænar þýðingar)
More examples

- **Speech recognition** (í. Talkennsl/Talgreining)
- **Speech synthesis; text-to-speech** (í. Talgerving)
- **Dialogue Systems** (í. Samræðukerfi)
  - [http://nlp.shef.ac.uk/research/dialogue.html](http://nlp.shef.ac.uk/research/dialogue.html)
A speaking robot

**HAL**

- The movie made a prediction 33 years into the future.
- How close is this prediction to reality?
- What is needed to construct an agent, like HAL, which possesses language generation and language understanding capabilities?
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The disciplines of linguistics – from sounds to meaning

- Phonetics and Phonology (í. Hljóðfræði og hljóðkerfisfræði)
- Morphology (í. Orðhlutafræði)
- Syntax (í. Setningafræði)
- Semantics (í. Merkingarfræði)
- Discourse and Dialogue (í. Orðræða og samræða)

Theses disciplines comprise the different levels of LT.
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Ambiguity occurs when more than one linguistic structure is associated with a particular input.

In other words, when different kinds of meanings can be associated with the input.

In most cases, humans remove the ambiguity unconsciously.

On the other hand, ambiguity is a major obstacle in language processing and can occur in all the different levels of LT.

Ambiguity is removed by applying disambiguation (í. einræðing).
Ambiguity in speech recognition

Example

- Input: The boys eat the sandwiches.
- Possible output:
  - The boy seat the sandwiches.
  - The boy seat this and which is.
  - The boys eat this and which is.
  - The boys eat the sand which is.
  - etc.
Ambiguity in part-of-speech tagging (í. mörkun)

**Example**

- **Input:** Hann á við (he owns wood).
- **Tags of individual words:**
  - Hann=fpken_fpkeo
  - á=aþ_ao_sfg1en_sfg3en_aa_nven_nveo_nveþ
  - við=ao_fp1fn_aþ_aa_nkeo

**Meaning of individual letters in tags:**

- n=nominative, nefnifall, o=accusative, polfall,
- þ=dative, þágufall, e=genitive, eignarfall
- n=noun, nafnorð, f=pronoun, fornafn, p=personal pronoun, persónuformafn,
- a=adverb, atviskorð, s=verb, sögn
- k=mascuine, karlkyn, v=feminine, kvenkyn
- e=singular, eintala, f=plural, fleirtala
- f=indicative mood, framsöguháttur, g=active voice, germynd
Ambiguity in syntax/semantic analysis

Example

- **Input:** I saw the boy with the telescope.
- **Meaning:**
  - I used a telescope to see the boy.
  - I saw the boy who had a telescope.
Ambiguity in anaphora resolution

**Definition**

In linguistics, *anaphora* is an instance of an expression referring to another.

**Example**

- **Input 1**: The City Council refused the women a permit because they feared violence.
- **Input 2**: The City Council refused the women a permit because they were communists.
- **Question**: To which noun phrase does the pronoun “they” refer to?
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When a natural language is analysed:

- A formal model needs to be developed.
  - A good model is difficult to design.
  - A language is closely tied to human thought and understanding.

- The model needs to be implemented in a program.