Introduction to Computational Linguistics

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Pre-course

What is computational linguistics?

Definition

Scientific study of language from a computational perspective and build NLP tools.

Goals

- Modelling and simulating human language to make it understandable for computers.
- Improving applications integrating linguistic data structures.

Adequate representation of the properties of human language in a formal system is needed.

- Human language is prone to ambiguities and variations.
- Computers are restricted to more formal systems and are vulnerable to any ambiguous or spontaneous changes.

Natural vs. Formal Languages

Natural Language

- Languages that we speak.
- Not designed by people.
- Evolved naturally as they pass from generations to generations.

Formal Language

- Artificial languages.
- Designed by people for specific purpose.
- Main examples: programming languages

Related fields

- Linguistics
- Computer Science
- Cognitive Science (Psycholinguistics)
- Artificial Intelligence
- Mathematics (Logic)
- Philosophy
- Neuroscience
- NLP (often used as synonym)

What is Natural Language Processing?

Mapping the given input (natural language) into useful representation & analysing different aspects of the input.

- POS tagging
- Lemmatisation
- Dependency parsing

Main fields of application

Machine translation

- Google translate
- DeepL
- Linguee

Text editors/spell checkers

- Notepad
- Grammarly
- Wordtune

Main fields of application

Chatbots

- ChatGPT
- Customer support systems

Speech recognition systems/text-to-speech synthesisers

- Speech services
- Google translate
- 'Read aloud' options in browsers

Machine translation

- rules based approach
- interlingual approach
- dictionary-based approach
- statistical approach
- deep learning based approach (neural machine translation)

Chatbots

- Heavily related to artificial intelligence, machine learning and natural language processing
- Require a large amount of conversational data to train
- Input/output database is usually fixed

Career options

- Natural Language Processing Engineer
- Computational Linguist
- Data Scientist
- AI Engineer
- Programmer

Suggested literature and sources

For Introduction to CL

- Daniel Jurafsky and James H. Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. Prentice Hall, Upper Saddle River, NJ, 2nd edition edition, 2009
- Ralph Grishman. Computational linguistics: an introduction. Cambridge University Press, 1986.
- Turing, Alan (1950), "Computing Machinery and Intelligence", Mind, LIX (236).
- John R. Searle. Minds, brains, and programs. Behavioral and Brain Sciences 3, 1980.
- Dickinson, Markus, et al. Language and Computers. Wiley, 2012.

Suggested literature and sources

For Logic

- Magnus, P. D. FORALLX: An introduction to formal logic., 2017.
- L.T.F. Gamut. Logic, Language, and Meaning, Volume 1: Introduction to Logic.

For Java/DSA I

- Savitch, Walter. Java: An Introduction to Problem Solving and Programming. Pearson, 2010.

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