Natural Language Processing

Lecture 15 : Discussion & Conclusions

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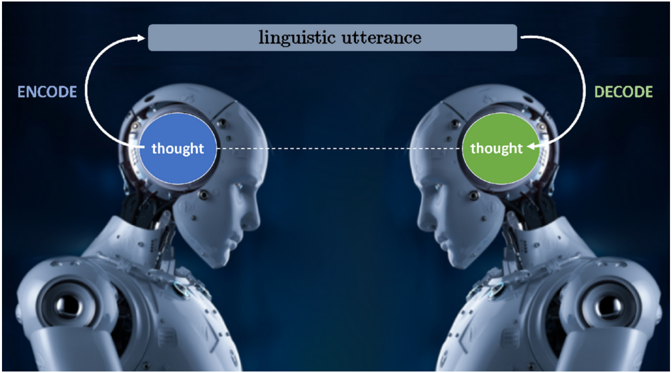
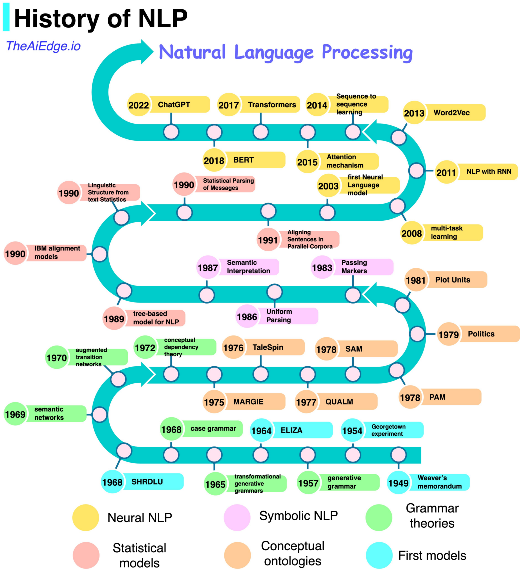
Discussion & Conclusions



The gradient, Walid S. Saba

NLP timeline



https://newsletter.theaiedge.io/p/natural-language-processing-how-did

NLP timeline

NLP is now moving on at an **unprecedented** pace.

Novel models that came out since the start of our 2023/24 class:

- GPT-4 Omni (OpenAI)
- Copilot (Microsoft)
- Gemini, Gemma (Google)
- LLaMA 3 (Meta AI)
- Claude 3 (Anthropic)

Open problems

The dominant approach to the study of meaning is **denotational semantics**: the meaning of a word, phrase, or sentence is the set of objects or situations in the world that it describes.

The dominant approach to the representation of meaning in NLP is **distributional semantics**: the meaning of a word is the distribution of the contexts in which the word appears.

The two things

- are not entirely different
- yet, they are not the same

Open problems

Missing text phenomenon: our linguistic communication is compressed, we leave out details that we can safely assume the listener/reader knows by virtue of common knowledge of the world.

Example :
Contrast ‘eastern philosophy professor’ with ‘amazing philosophy professor’.

Example :
How many interpretations for ‘the table with the book’?

Open problems

The **Winograd schema challenge** (WSC) is a multiple-choice test that employs questions of a very specific structure.

https://en.wikipedia.org/wiki/Winograd_schema_challenge

Example :
The city councilmen refused the demonstrators a permit because **they** [feared/advocated] violence.

Does the pronoun ‘they’ refer to the city councilmen or to the demonstrators?

Open problems

Adversarial testing: create adversarial examples by adding distracting sentences to the input paragraph.

Hallucination: confident response by an AI that cannot be grounded in any of its training data for the LM.

Overstability: the inability of a model to distinguish a correct answer from one that has words in common with it.

Open problems

In order to move toward **better NLP systems** we need to obtain advancements on

- correlation between language and action (pragmatics)
- principles of communications
- discourse planning
- creative aspects of language
- world common knowledge

Explainability

Model explainability refers to the concept of being able to understand the machine learning model and its decisions.

This is usually done through the technique of **probing**

- parametric probing based on multi-layer perceptron (MLP)
- non-parametric probing based on focus words and minimal pairs

Grounding

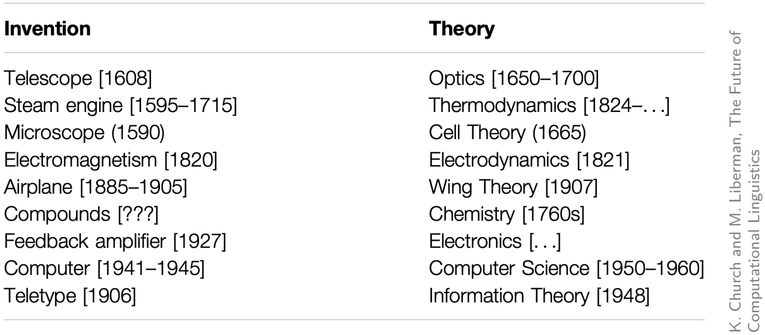
Language is **grounded** in experience. Humans understand many basic words in terms of associations with sensory-motor experiences.

This is in contrast to dictionaries, which define words in terms of other words.

We need to train our models on **multi-modal data sets**, where words are linked to, for instances, image segments.

Theory vs. invention

Theory often follows invention.



Invention	Theory
Telescope [1608]	Optics [1650–1700]
Steam engine [1595–1715]	Thermodynamics [1824–. . .]
Microscope (1590)	Cell Theory (1665)
Electromagnetism [1820]	Electrodynamics [1821]
Airplane [1885–1905]	Wing Theory [1907]
Compounds [???]	Chemistry [1760s]
Feedback amplifier [1927]	Electronics [. . .]
Computer [1941–1945]	Computer Science [1950–1960]
Teletype [1906]	Information Theory [1948]

K. Church and M. Liberman, The Future of Computational Linguistics

Source: The Future of Computational Linguistics: On Beyond Alchemy, Kenneth Church and Mark Liberman, 2021

Ethics

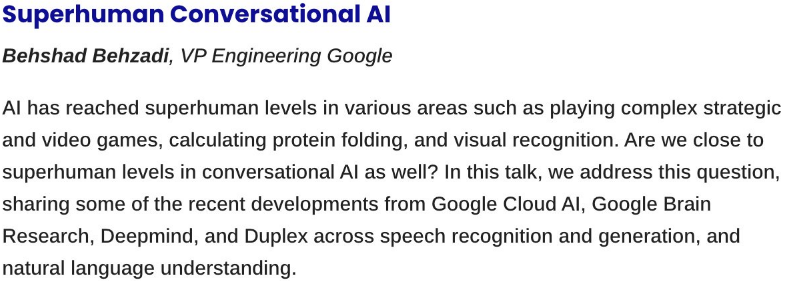
Growing research literature/activities on **value sensitive design** in NLP and allied AI fields.

Also called FAccT: Fairness, Accountability, and Transparency.

The main problems are not yet solved. We seek to answer the following questions

- What can go wrong when we use NLP systems, in terms of specific harms to people?
- How can we fix/prevent/mitigate those harms?
- What are our responsibilities as NLP researchers and developers in this regard?

NLP Hype

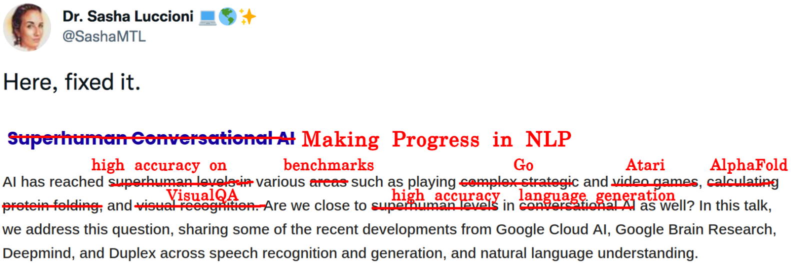


Superhuman Conversational AI

***Behshad Behzadi**, VP Engineering Google*

AI has reached superhuman levels in various areas such as playing complex strategic and video games, calculating protein folding, and visual recognition. Are we close to superhuman levels in conversational AI as well? In this talk, we address this question, sharing some of the recent developments from Google Cloud AI, Google Brain Research, Deepmind, and Duplex across speech recognition and generation, and natural language understanding.

NLP Hype



Dr. Sasha Luccioni 💻🌎✨
@SashaMTL

Here, fixed it.

~~Superhuman Conversational AI~~ Making Progress in NLP

AI has reached ~~superhuman levels in~~ high accuracy on various ~~areas~~ benchmarks such as playing ~~complex strategic~~ Go and ~~video games~~ Atari, ~~calculating protein folding~~ AlphaFold, and ~~visual recognition.~~ VisualQA Are we close to ~~superhuman levels~~ high accuracy in ~~conversational AI~~ language generation as well? In this talk, we address this question, sharing some of the recent developments from Google Cloud AI, Google Brain Research, Deepmind, and Duplex across speech recognition and generation, and natural language understanding.

NLP & teaching

One concern with the end-to-end approach is that it encourages students to focus

- too much on network architecture and training methods
- not enough on methodology and content

Unfortunately, NLP courses are under increasing pressure to make room for currently popular methods at the expense of traditional topics.

NLP lecturers ought to provide a broad education, because we do not know what will be important next.

Source: The Future of Computational Linguistics: On Beyond Alchemy, Kenneth Church and Mark Liberman, 2021

NLU Datasets

General Language Understanding Evaluation (GLUE) benchmark is a collection of 9 datasets for evaluating natural language understanding (NLU) systems:

- Corpus of Linguistic Acceptability (CoLA)
- Stanford Sentiment Treebank (SST)
- Microsoft Research Paragraph Corpus (MRPC)
- Quora Question Pairs (QQP)
- Multi-Genre NLI (MNLI)
- Question NLI (QNLI)
- Recognizing Textual Entailment (RTE)
- Winograd NLI
- Diagnostics Main

https://gluebenchmark.com.

NLU Datasets

Massive Multitask Language Understanding (MMLU) is a test set to measure a model multitask accuracy.

The test covers 57 tasks, including among others

- science, technology, engineering and mathematics (STEM)
- social science and humanities
- finance, accounting, and marketing
- professional medicine

To attain high accuracy on this test, models must possess extensive world knowledge and problem solving ability.

https://paperswithcode.com/dataset/mmlu.

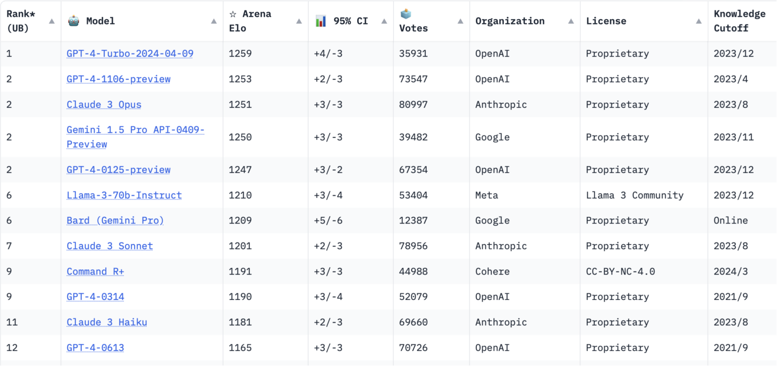
ChatBot Arena

Chatbot Arena Leaderboard is a novel platform that leverages crowdsourced human evaluation to rank LLMs

- LLMs take on the role of “players” in head-to-head comparisons
- users are invited to vote on which LLM they find more engaging, informative, or helpful

The **Elo** system is used to dynamically adjusts the LLMs’ scores, generating a ranking.

ChatBot Arena



Rank* (UB)	🤖 Model	☆ Arena Elo	📊 95% CI	🗳️ Votes	Organization	License	Knowledge Cutoff
1	GPT-4-Turbo-2024-04-09	1259	+4/-3	35931	OpenAI	Proprietary	2023/12
2	GPT-4-1106-preview	1253	+2/-3	73547	OpenAI	Proprietary	2023/4
2	Claude 3 Opus	1251	+3/-3	80997	Anthropic	Proprietary	2023/8
2	Gemini 1.5 Pro API-0409-Preview	1250	+3/-3	39482	Google	Proprietary	2023/11
2	GPT-4-0125-preview	1247	+3/-2	67354	OpenAI	Proprietary	2023/12
6	Llama-3-70b-Instruct	1210	+3/-4	53404	Meta	Llama 3 Community	2023/12
6	Bard (Gemini Pro)	1209	+5/-6	12387	Google	Proprietary	Online
7	Claude 3 Sonnet	1201	+2/-3	78956	Anthropic	Proprietary	2023/8
9	Command R+	1191	+3/-3	44988	Cohere	CC-BY-NC-4.0	2024/3
9	GPT-4-0314	1190	+3/-4	52079	OpenAI	Proprietary	2021/9
11	Claude 3 Haiku	1181	+2/-3	69660	Anthropic	Proprietary	2023/8
12	GPT-4-0613	1165	+3/-3	70726	OpenAI	Proprietary	2021/9