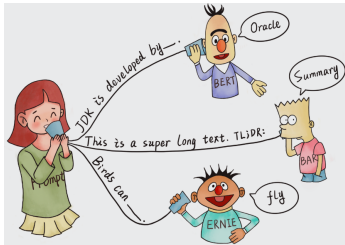


Basics

Learning Paradigms



Learning goals

- Understand the different learning paradigms
- Linguistic tasks vs. higher-level tasks

CATEGORIZATION OF LEARNING

Disclaimer:

- This categorization is rather coarse
- The list of paradigms is extendable
- Not everything is unambiguous, there might be overlap

Connection to tasks/data:

- Given the task, some paradigms are more suitable
- Given the amount of data, a specific paradigm might be preferable
- Presence/Absence of labels makes certain paradigms (in)feasible

CATEGORIZATION OF LEARNING

Distinction between:

- Embedding texts
- Pre-training & fine-tuning a model
- Prompting
- Interaction & Generation
- Agents

EMBEDDING

Problem statement

- Words are discrete units composed of characters
- We can represent them (high-dimensional) one-hot vectors
- This makes it difficult/impossible to e.g. capture similarity between synonyms
- Documents can be represented as a vector of word occurrences (bag-of-words)

Example (one-hot)

$$\vec{w}^{(\text{football})} = [0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]$$

$$\vec{w}^{(\text{basketball})} = [0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]$$

EMBEDDING

Problems of one-hot embeddings

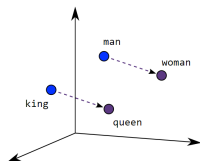
- high dimensionality
- not possible to measure similarity

Example (dense embedding)

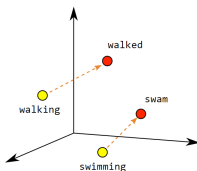
$$\vec{w}^{(\text{football})} = \begin{bmatrix} 0.359 \\ -0.174 \\ 0.701 \\ \vdots \\ 0.445 \\ -0.123 \\ 0.509 \end{bmatrix}$$

EMBEDDING

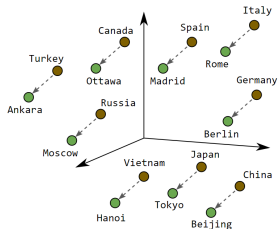
Measuring similarity



Male-Female



Verb Tense

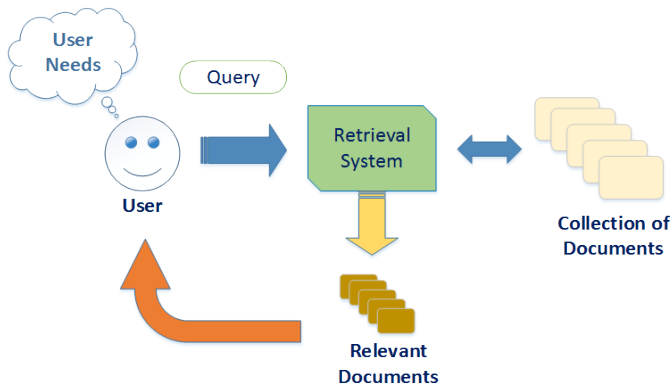


Country-Capital

► Source: Google

EMBEDDING

Document retrieval



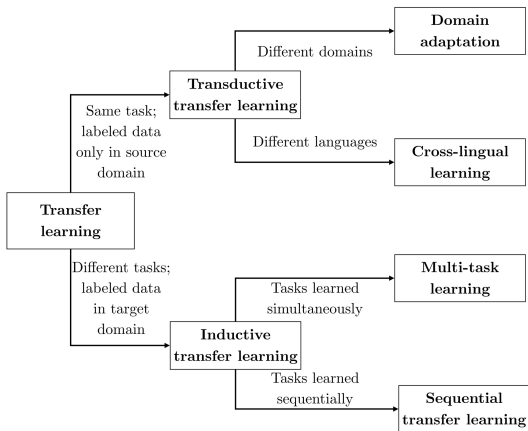
► Source: Analytics Vidhya

PRE-TRAIN/FINE-TUNE

Problem statement

- The larger the models, the more data is needed to train them
- (Labeled) Data is scarce and expensive!
- Many languages in the world are highly underrepresented in terms of existing resources
Often: *Number of speakers \neq Amount of available written text*
- Unlabeled (English) text data is ubiquitous

PRE-TRAIN/FINE-TUNE



► Taxonomy of transfer learning (Source: Ruder, 2019)

PRE-TRAIN/FINE-TUNE

Pre-training:

- Using unlabeled corpora in conjunction with self-supervised objectives is commonly referred to as *Pre-Training* the model
- Generation of samples for pre-training basically effortless, exploiting the inherent structure of the text
- Construction of different self-supervised objectives, which are assumed
 - to cover different phenomena better than the others
 - to work more efficiently for learning

PRE-TRAIN/FINE-TUNE

Fine-tuning:

- The second phase of transfer learning, i.e. adapting the pre-trained model to a labeled data set for a specific downstream task is referred to as *Fine-Tuning*
- Far less labeled data required compared to a scenario w/o pre-training

PROMPTING

Accessing pre-trained models:

- Fine-tune them
- Also possible: No fine-tuning, but ..
 - *Zero-Shot Transfer* w/o ANY labeled data
 - *Few-Shot Transfer* w/ FEW labeled data points
- In both of the latter cases, good pre-training becomes even more important

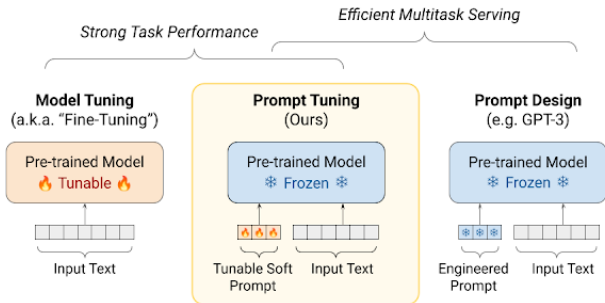
PROMPTING

Definition(s):

- *GPT-3 paper:*
"Task Description" (accompanied by samples + labels)
- *Prompt:* Describing the task the model is expected to perform
- *Prompt Engineering:*
Finding the best prompt(s) for one (or across multiple) task(s)
- *Prompt Tuning:*
Add trainable weights ("soft prompt") to inputs and fine-tune

PROMPTING

Differences:



► Source: Google

CHATting / GENERATION

Interacting with the model

- Larger model sizes, reduced latency and improved training regimes enable conversations with the models
- Enables the user to ..
 - .. have multi-turn conversations, with the model "remembering" previous inputs
 - .. refine the prompt in case of unsatisfactory output
 - .. used increased context sizes for the prompts
- Still: Static, pre-trained model with "knowledge"

CHATTING / GENERATION

Interacting with the model

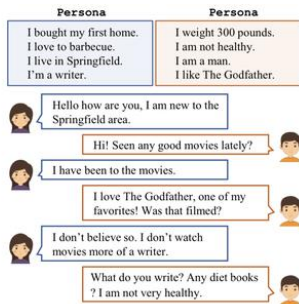
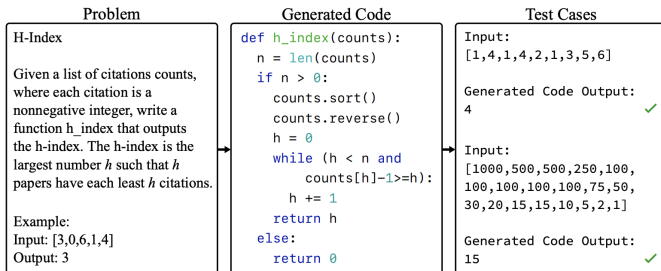


Figure 1: A clipped dialogue from PERSONA-CHAT.

► Source: Papers with code (example for Persona-Chat)

CHATTING / GENERATION

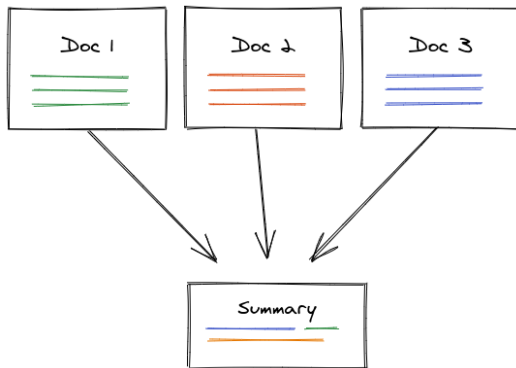
Code generation



► Source: Papers with code

CHATTING / GENERATION

(Multi-)Document summarization



► Source: Aylien

OUTLOOK

Agents

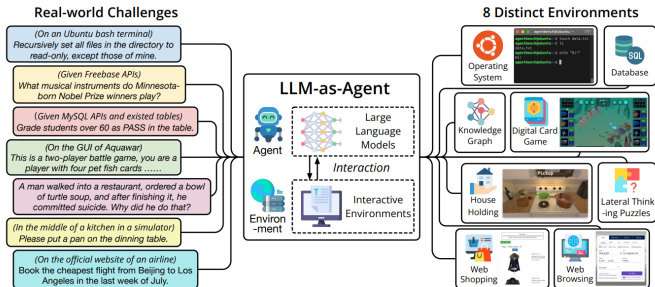


Figure 2: AgentBench is the first systematic benchmark to evaluate LLM-as-Agent on a wide array of real-world challenges and 8 distinct environments. In total, 25 LLMs are examined in its first edition.

► Source: Liu et al., 2023