



ACL 2022 Tutorial

Knowledge-Augmented Methods for Natural Language Processing

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Disclaimer: This tutorial is our own opinions



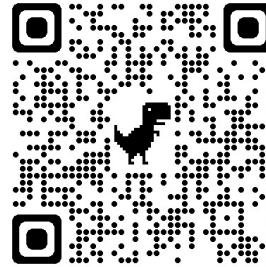
- Not Microsoft's, USC's or Univ. of Notre Dame's
- To access mentioned models + datasets, please refer to corresponding licensing information
- We're not promoting the use of any particular model and/or datasets
- There are slides / figures borrowed from respective papers
- This tutorial is by no means exhaustive: we've tried our best to include relevant materials

How to access tutorial materials



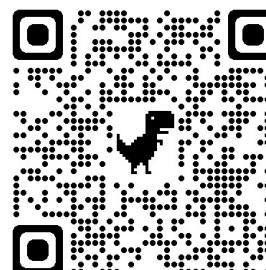
- Detailed information about our tutorial can be found at:

<https://www.2022.aclweb.org/tutorials>



- Talk slides are at:

https://github.com/zcgzcgzcg1/ACL2022_KnowledgeNLP_Tutorial/



What is this tutorial about?



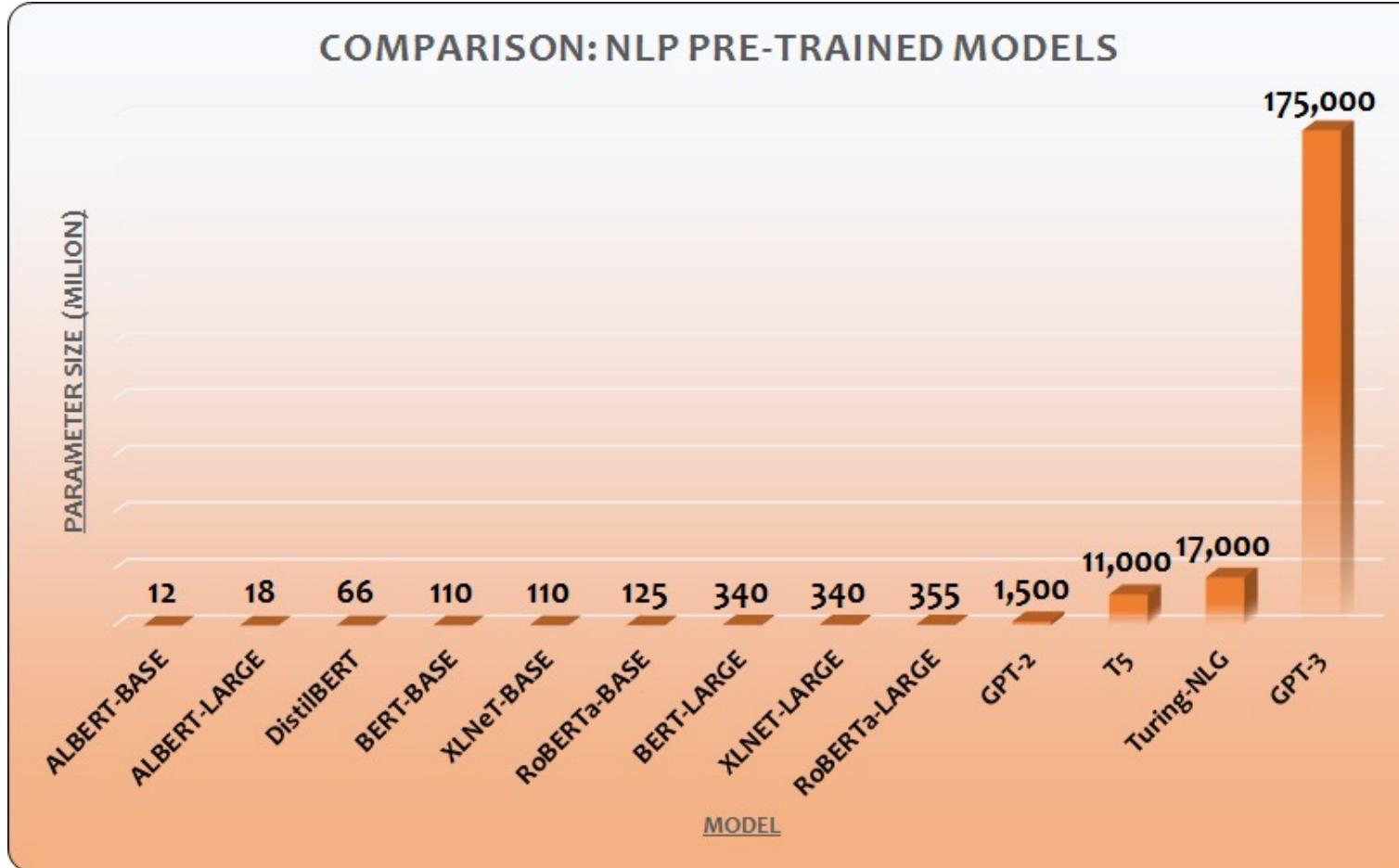
- **How to fuse knowledge and common sense into natural language processing**
- Knowledge in natural language understanding (NLU)
 - Natural language inference, sentence classification, sequence labeling, etc.
- Knowledge in natural language generation (NLG)
 - Text summarization, dialogue response generation, story generation, etc.
- Commonsense reasoning
 - Commonsense Q&A, commonsense generation

Schedule

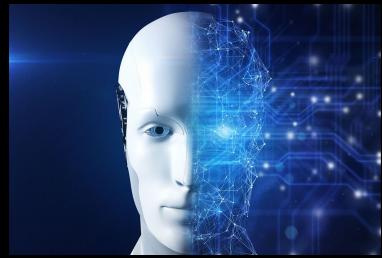


Local time (GMT)	Content	Presenter
09:30-09:45	Motivation and Introduction of Knowledge in NLP	Chenguang Zhu
09:45-10:35	Knowledge in Natural Language Understanding	Yichong Xu
10:35-11:00	Knowledge in Natural Language Generation	Wenhao Yu / Meng Jiang
11:00-11:30	Coffee Break	
11:30-11:55	Knowledge in Natural Language Generation	Wenhao Yu / Meng Jiang
11:55-12:45	Commonsense Knowledge and Reasoning for NLP	Yuchen Lin / Xiang Ren
12:45-13:00	Summary and Future Direction	Meng Jiang / Xiang Ren

Where is NLP heading?



- Large, Huge, Gigantic Language models
- Training cost affordable only by few large companies
- Even fine-tuning is impossible for a majority of researchers and practitioners
- Does model size solve everything?
 - *Unfortunately, no*
- Then why are we doing it?



Integration of External Knowledge



- A language model (LM) learns **how to express**

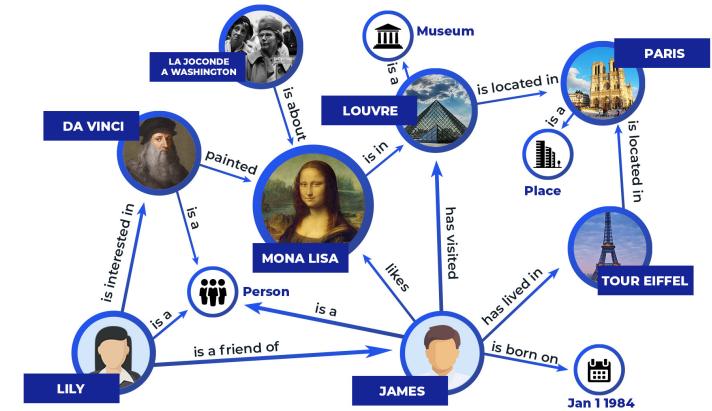
I go school to to want. 

I want to go to school. 

- Knowledge indicates **what to express**

Q: Where is the painting **Mona Lisa**?

A: It is in **Louvre, Paris**.

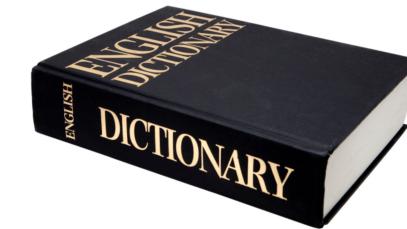
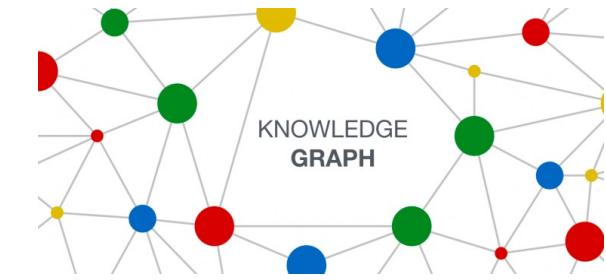


Knowledge sources



Structured

- **Knowledge graph:** A meta-representation of knowledge, common sense, entities, relations
- **Dictionary:** explanation of words and phrases



Unstructured

- **Text data:** Knowledge from data without a predefined format, e.g., documents, emails
- **Large language models,** e.g., GPT-3

Knowledge is any external information absent from the input but helpful for generating the output





- Step 1: **Ground** language into related knowledge
- Step 2: **Represent** knowledge
- Step 3: **Fuse** knowledge representation into language model

- **Ground** language into related knowledge
 - String matching, NER, Entity linking, information retrieval
 - Identify concepts and relations in the knowledge source

The **pen** is on the desk.

- **Represent knowledge**

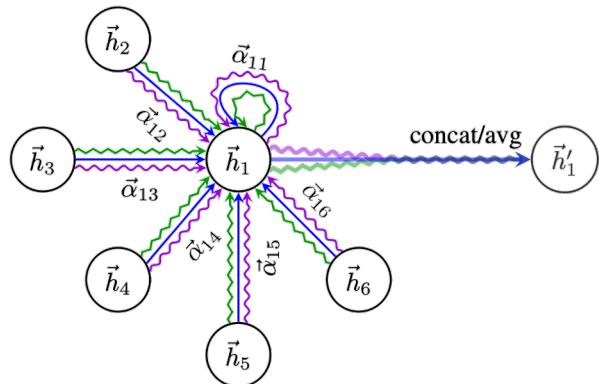
- Concept names

Desk

- Description of concepts

Desk: A table, frame, or case, now usually with a flat top, for writers and readers. It often has a drawer or repository underneath.

- Graph embeddings



- **Fuse** knowledge representation into language model
 - Concatenate concept names/descriptions into input

The pen is on the desk. [SEP] desk: a table, ...

- Append/add concept embeddings into input embeddings

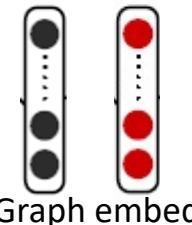
The pen is on the desk.

- Attention

Graph embedding of pen



Graph embedding of desk



LM Transformer