LambdaKG: A Library for Pre-trained Language Model-Based Knowledge Graph Embeddings

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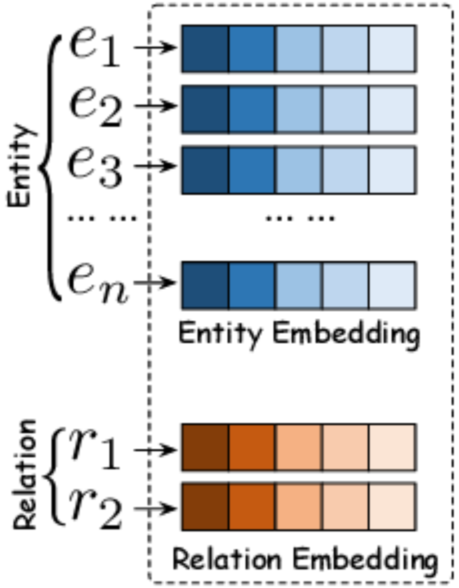
Pretrained Language Model-based KGEs

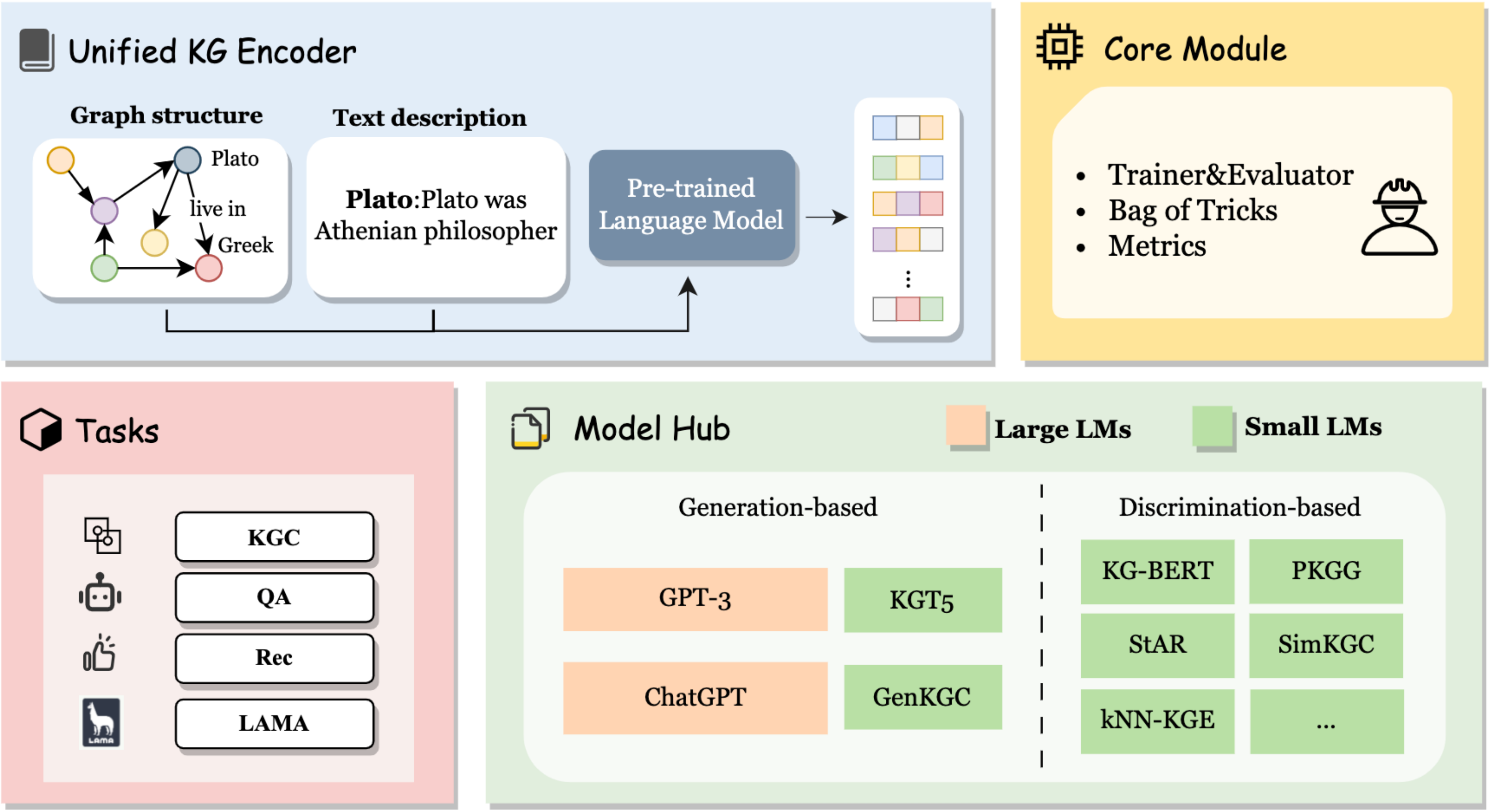
Knowledge Graph

Pretrained Language Models
BERT、T5、GPT-3…..



Knowledge Graph Embedding

LambdaKG: Features & Architecture



- Bag of Tricks
- Large and Small PLMS
- Flexible Downstream Task

Discrimination-based and Generation-based Methods

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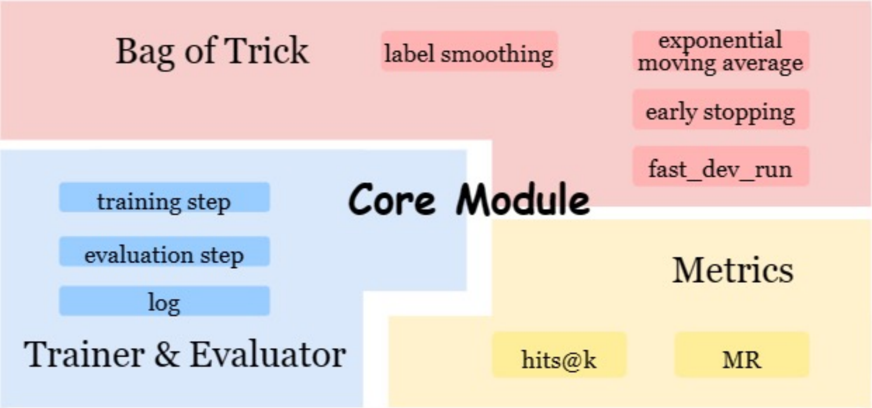
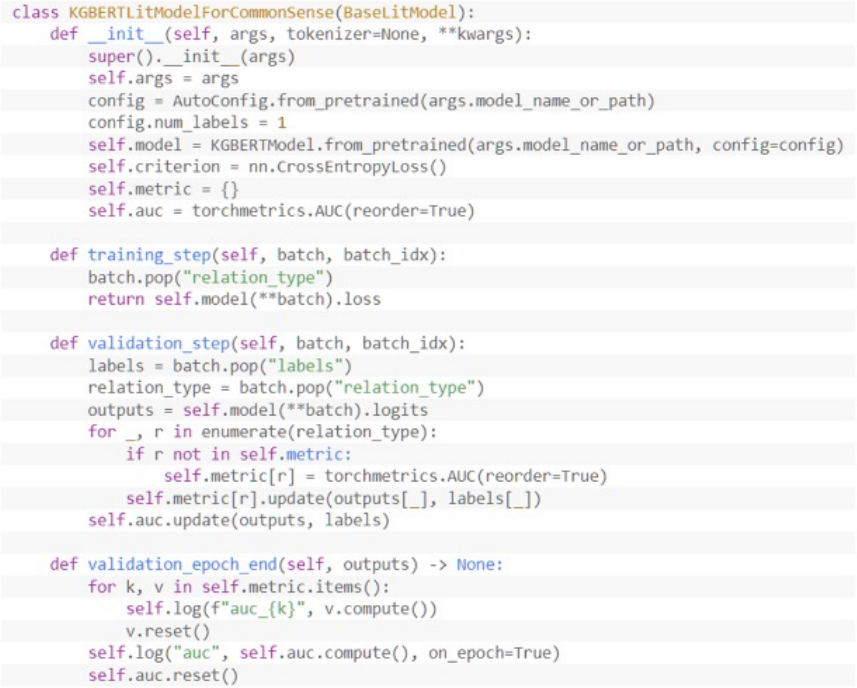
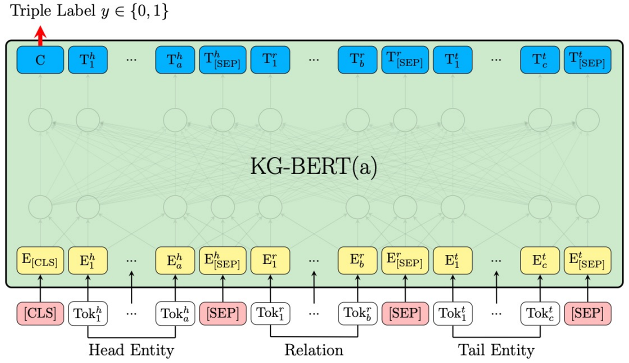
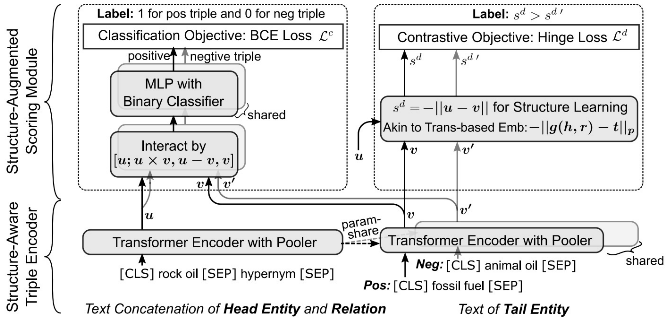




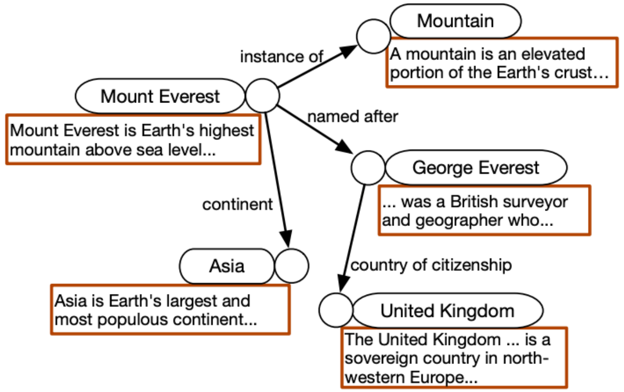
```
class KGBERTLitModelForCommonSense(BaseLitModel):
    def __init__(self, args, tokenizer=None, **kwargs):
        super().__init__(args)
        self.args = args
        config = AutoConfig.from_pretrained(args.model_name_or_path)
        config.num_labels = 1
        self.model = KGBERTModel.from_pretrained(args.model_name_or_path, config=config)
        self.criterion = nn.CrossEntropyLoss()
        self.metric = {}
        self.auc = torchmetrics.AUC(reorder=True)

    def training_step(self, batch, batch_idx):
        batch.pop("relation_type")
        return self.model(**batch).loss

    def validation_step(self, batch, batch_idx):
        labels = batch.pop("labels")
        relation_type = batch.pop("relation_type")
        outputs = self.model(**batch).logits
        for _, r in enumerate(relation_type):
            if r not in self.metric:
                self.metric[r] = torchmetrics.AUC(reorder=True)
            self.metric[r].update(outputs[_], labels[_])
        self.auc.update(outputs, labels)

    def validation_epoch_end(self, outputs) -> None:
        for k, v in self.metric.items():
            self.log(f"auc_{k}", v.compute())
            v.reset()
        self.log("auc", self.auc.compute(), on_epoch=True)
        self.auc.reset()
```



KG-BERT Arxiv' 20


Structure-Augmented Scoring Module
Structure-Aware Triple Encoder
Label: 1 for pos triple and 0 for neg triple
Classification Objective: BCE Loss $\mathcal{L}^c$
positive
negtive triple
MLP with Binary Classifier
shared
Interact by $[u; u \times v, u - v, v]$
Label: $s^d > s^{d\prime}$
Contrastive Objective: Hinge Loss $\mathcal{L}^d$
$s^d = -\|u - v\|$ for Structure Learning
Akin to Trans-based Emb: $-\|g(h,r) - t\|_p$
Transformer Encoder with Pooler
param-share
Transformer Encoder with Pooler
shared
[CLS] rock oil [SEP] hypernym [SEP]
Neg: [CLS] animal oil [SEP]
Pos: [CLS] fossil fuel [SEP]
Text Concatenation of Head Entity and Relation
Text of Tail Entity

StAR WWW' 21


Mountain
A mountain is an elevated portion of the Earth's crust...
instance of
Mount Everest
Mount Everest is Earth's highest mountain above sea level...
named after
George Everest
... was a British surveyor and geographer who...
continent
Asia
Asia is Earth's largest and most populous continent...
country of citizenship
United Kingdom
The United Kingdom ... is a sovereign country in north-western Europe...

SimKGC ACL'22

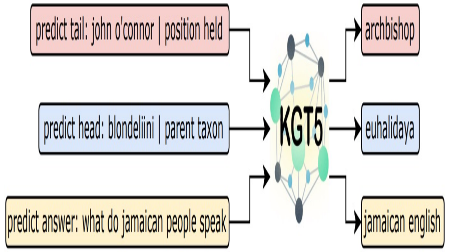

predict tail: john o'connor | position held
archbishop
predict head: blondellini | parent taxon
euhalidaya
predict answer: what do jamaican people speak
jamaican english
KGT5

Figure 1: Overview of our method KGT5. KGT5 is first trained on the link prediction task (predicting head/tail entities, given tail/head and relation). For question answering, the same model is further finetuned using QA pairs.

KGT5 ACL' 22

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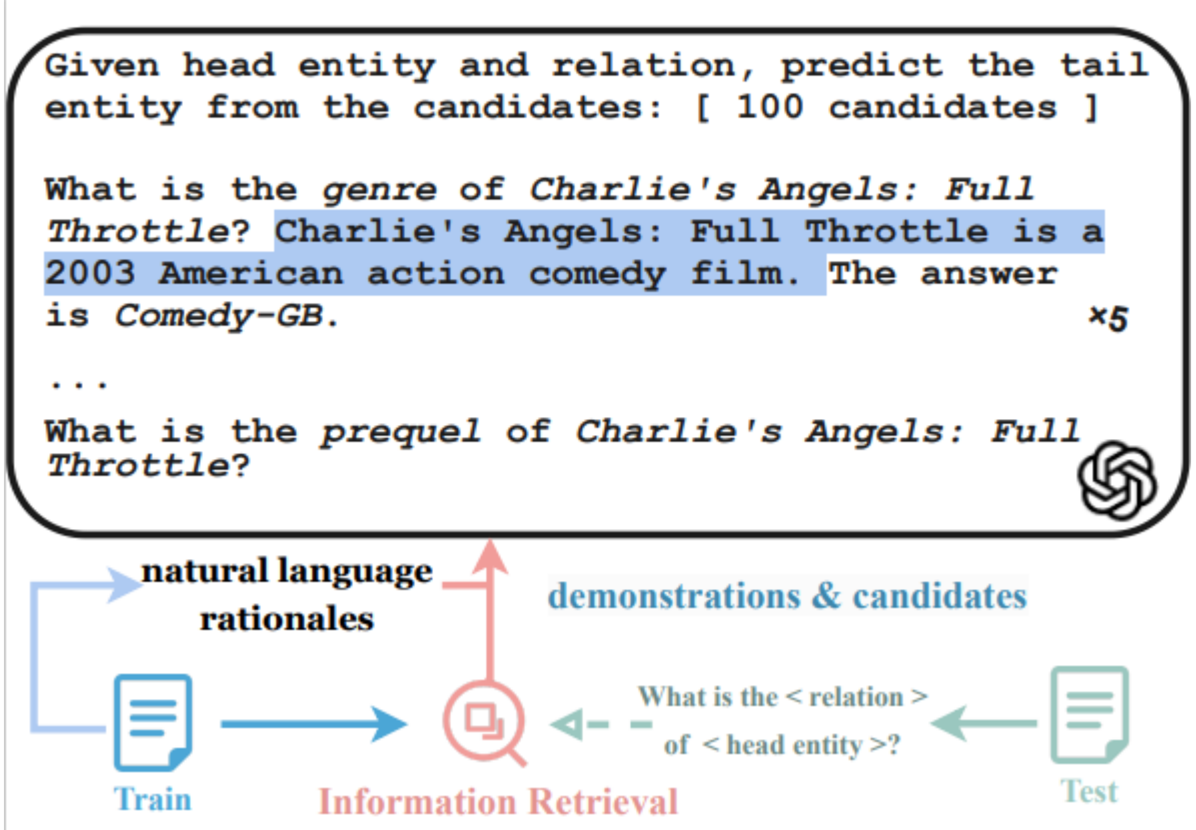
LambdaKG with LLM



Given head entity and relation, predict the tail entity from the candidates: [100 candidates]

What is the *genre* of *Charlie's Angels: Full Throttle*? Charlie's Angels: Full Throttle is a 2003 American action comedy film. The answer is *Comedy-GB*. ×5

...

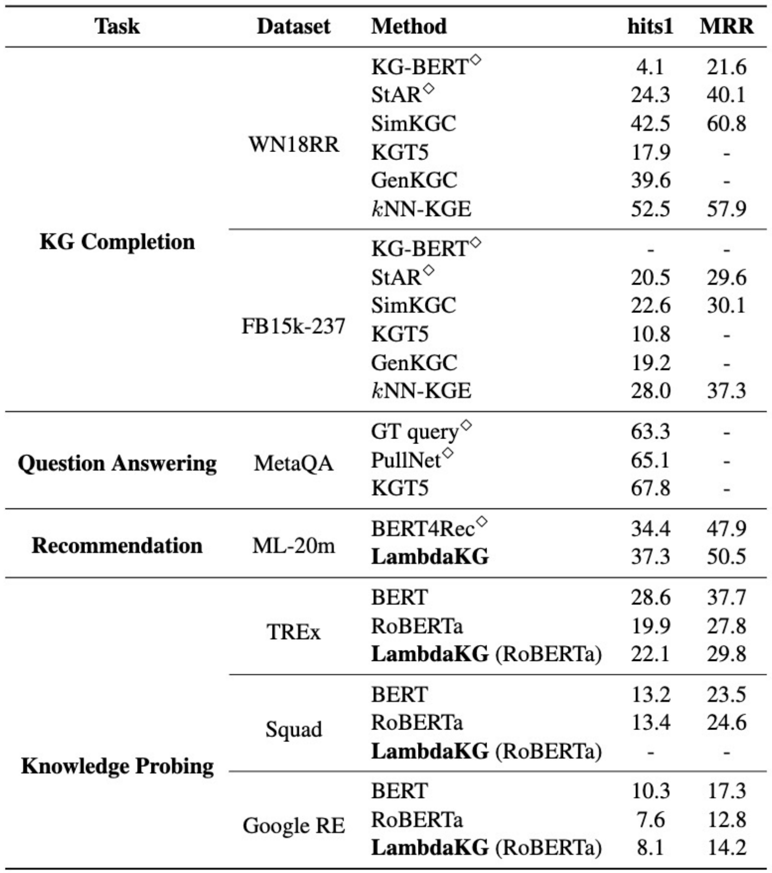
What is the *prequel* of *Charlie's Angels: Full Throttle*?

natural language rationales
demonstrations & candidates
Train
Information Retrieval
What is the < relation > of < head entity >?
Test

LambdaKG provides LLMs, namely **GPT-3** and **ChatGPT**, to evaluate their experimental effectiveness in KGE.

The prompt comprises three components:
task description with **candidates, demonstrations,** and **test information**.

Small vs. Large PLMs and Various KG-based Tasks



Task	Dataset	Method	hits1	MRR
KG Completion	WN18RR	KG-BERT◇	4.1	21.6
		StAR◇	24.3	40.1
		SimKGC	42.5	60.8
		KGT5	17.9	-
		GenKGC	39.6	-
		*k*NN-KGE	52.5	57.9
	FB15k-237	KG-BERT◇	-	-
		StAR◇	20.5	29.6
		SimKGC	22.6	30.1
		KGT5	10.8	-
		GenKGC	19.2	-
		*k*NN-KGE	28.0	37.3
Question Answering	MetaQA	GT query◇	63.3	-
		PullNet◇	65.1	-
		KGT5	67.8	-
Recommendation	ML-20m	BERT4Rec◇	34.4	47.9
		LambdaKG	37.3	50.5
Knowledge Probing	TREx	BERT	28.6	37.7
		RoBERTa	19.9	27.8
		LambdaKG (RoBERTa)	22.1	29.8
	Squad	BERT	13.2	23.5
		RoBERTa	13.4	24.6
		LambdaKG (RoBERTa)	-	-
	Google RE	BERT	10.3	17.3
		RoBERTa	7.6	12.8
		LambdaKG (RoBERTa)	8.1	14.2

Table 2: Hits1 and MRR (%) results on KGC, question answering, recommendation and knowledge probing tasks. ◇ refers to the results from origin papers.

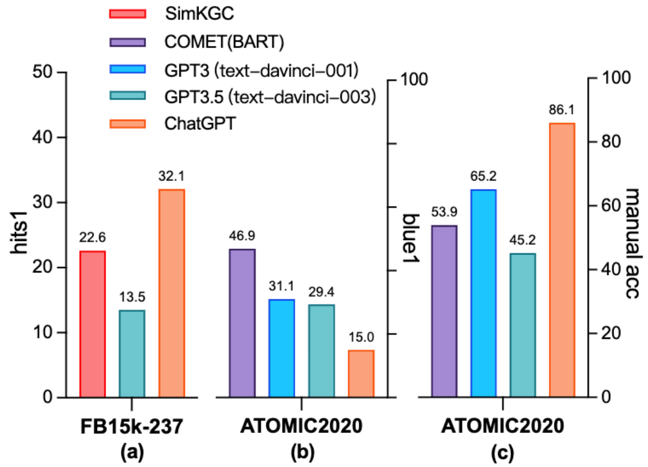


Figure 4: Results on small and large LMs. (a) hit@1 scores on FB15k-237. (b) blue-1 scores on ATOMIC2020. (c) acc scores on ATOMIC2020 by manual evaluation.

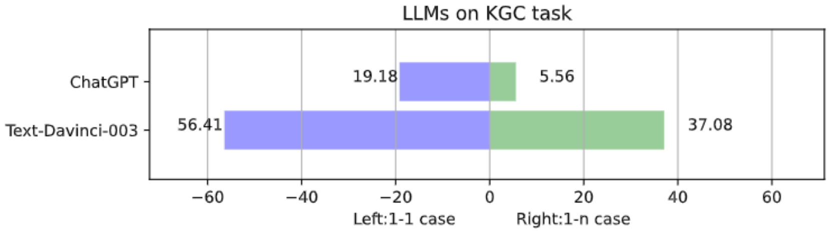
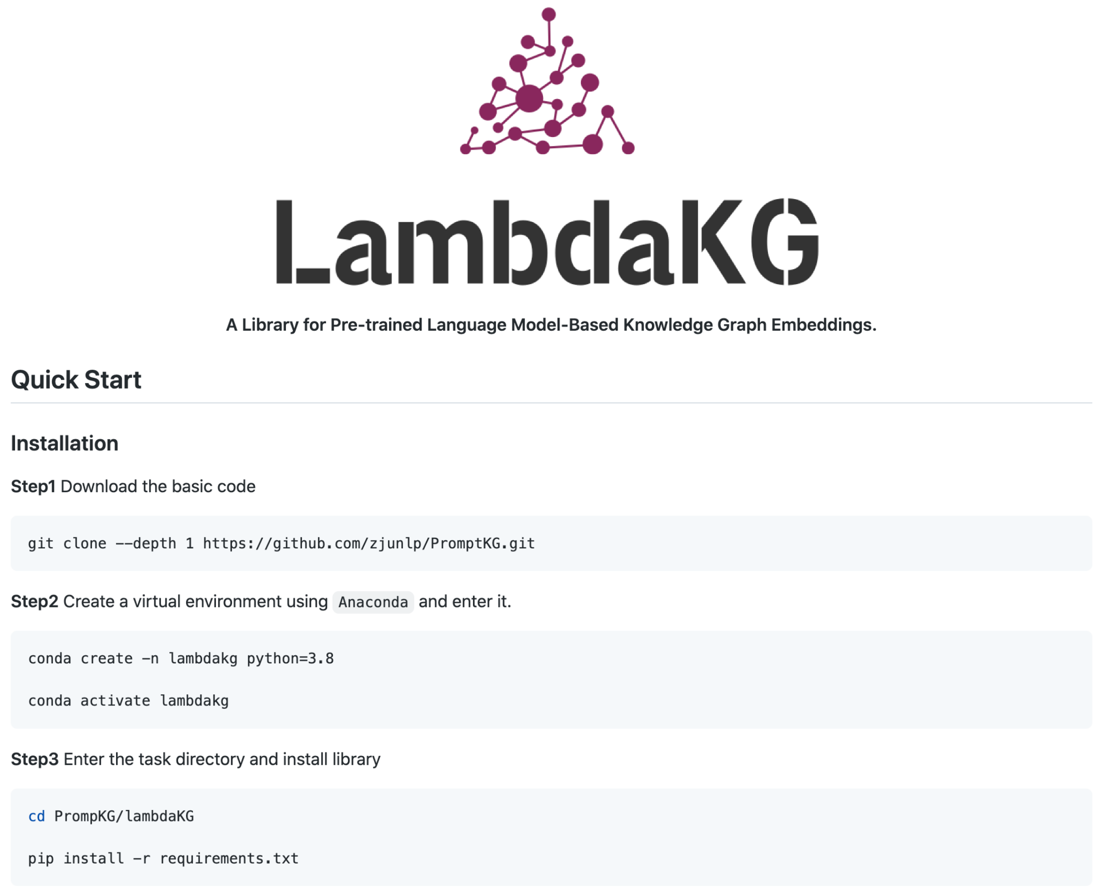


Figure 5: hit@1 of ChatGPT and `text-davinci-003` in FB15k-237.

Open-sourced with an Online System



LambdaKG

A Library for Pre-trained Language Model-Based Knowledge Graph Embeddings.

Quick Start

Installation

Step1 Download the basic code

```
git clone --depth 1 https://github.com/zjunlp/PromptKG.git
```

Step2 Create a virtual environment using `Anaconda` and enter it.

```
conda create -n lambdakg python=3.8

conda activate lambdakg
```

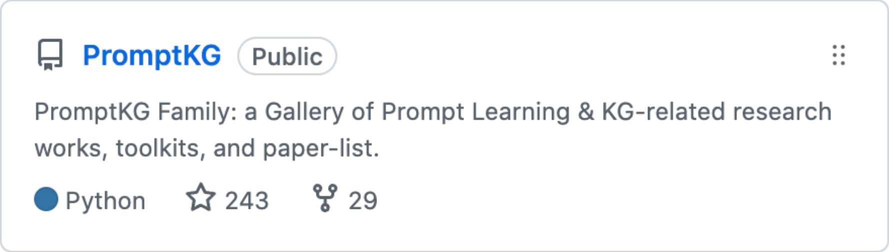
Step3 Enter the task directory and install library

```
cd PrompKG/lambdaKG

pip install -r requirements.txt
```

PyTorch

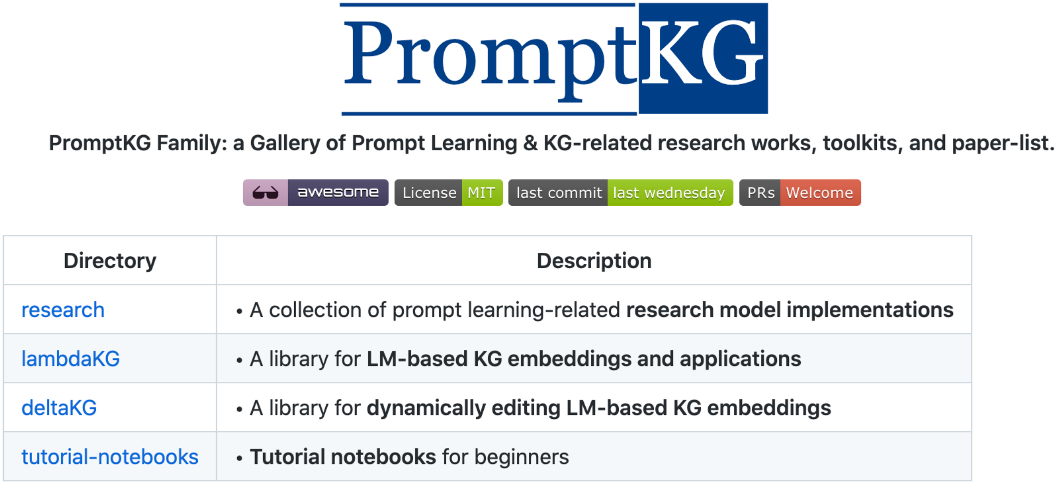
Transformers



PromptKG Public

PromptKG Family: a Gallery of Prompt Learning & KG-related research works, toolkits, and paper-list.

● Python ☆ 243 29



PromptKG

PromptKG Family: a Gallery of Prompt Learning & KG-related research works, toolkits, and paper-list.

Directory	Description
research	• A collection of prompt learning-related **research model implementations**
lambdaKG	• A library for **LM-based KG embeddings and applications**
deltaKG	• A library for **dynamically editing LM-based KG embeddings**
tutorial-notebooks	• **Tutorial notebooks** for beginners

https://zjunlp.github.io/project/promptkg/

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Thank You!

ACCEPT MY ENDLESS GRATITUDE