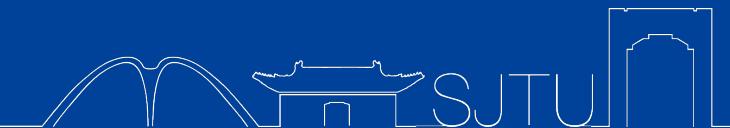


大模型提示学习与思维链



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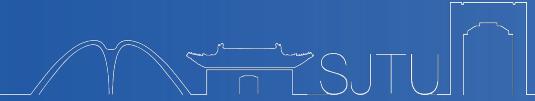
上海交通大学

SHANGHAI JIAO TONG UNIVERSITY





大模型“在线求鼓励”



- 提示学习？思维链推理？
- “一步一步思考” 鼓励大模型实现可解释推理！

「一个玩杂耍的人总共有 16 个球，其中一半是高尔夫球，高尔夫球中又有一半是蓝色的球，请问蓝球总共有多少个？」

对于一个小学生来说，这是一道再简单不过的数学题。但看似无所不能的 GPT-3 却被这道题难住了。

如果你输入这个问题之后，直接向 GPT-3 发问：「问题的答案（阿拉伯数字）是：__？」它会「不假思索」地给出一个错误答案：8。

Q: A juggler can juggle 16 balls. Half of the balls are golf balls, and half of the golf balls are blue. How many blue golf balls are there?

A: The answer (arabic numerals) is

(Output) 8 ✗

GPT-3：你别说准不准，你就说快不快吧。

怎么能让 GPT-3 稍微「动动脑子」呢？想想我们上学的时候老师是怎么做的。

一般来说，优秀的老师会在我们做错题时鼓励我们「再回去想想」，或者帮我们理清解题步骤。同样的，我们也可以这么对 GPT-3。

东京大学和谷歌大脑的一项联合研究表明，只要在答案前加一句「Let's think step by step」，GPT-3 就能给出上述问题的正确答案，而且它还自己理清了解题步骤。

Q: A juggler can juggle 16 balls. Half of the balls are golf balls, and half of the golf balls are blue. How many blue golf balls are there?

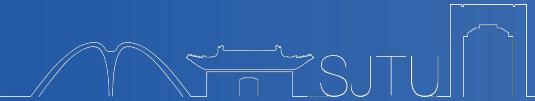
A: **Let's think step by step.**

(Output) There are 16 balls in total. Half of the balls are golf balls. That means that there are 8 golf balls. Half of the golf balls are blue. That means that there are 4 blue golf balls. ✓

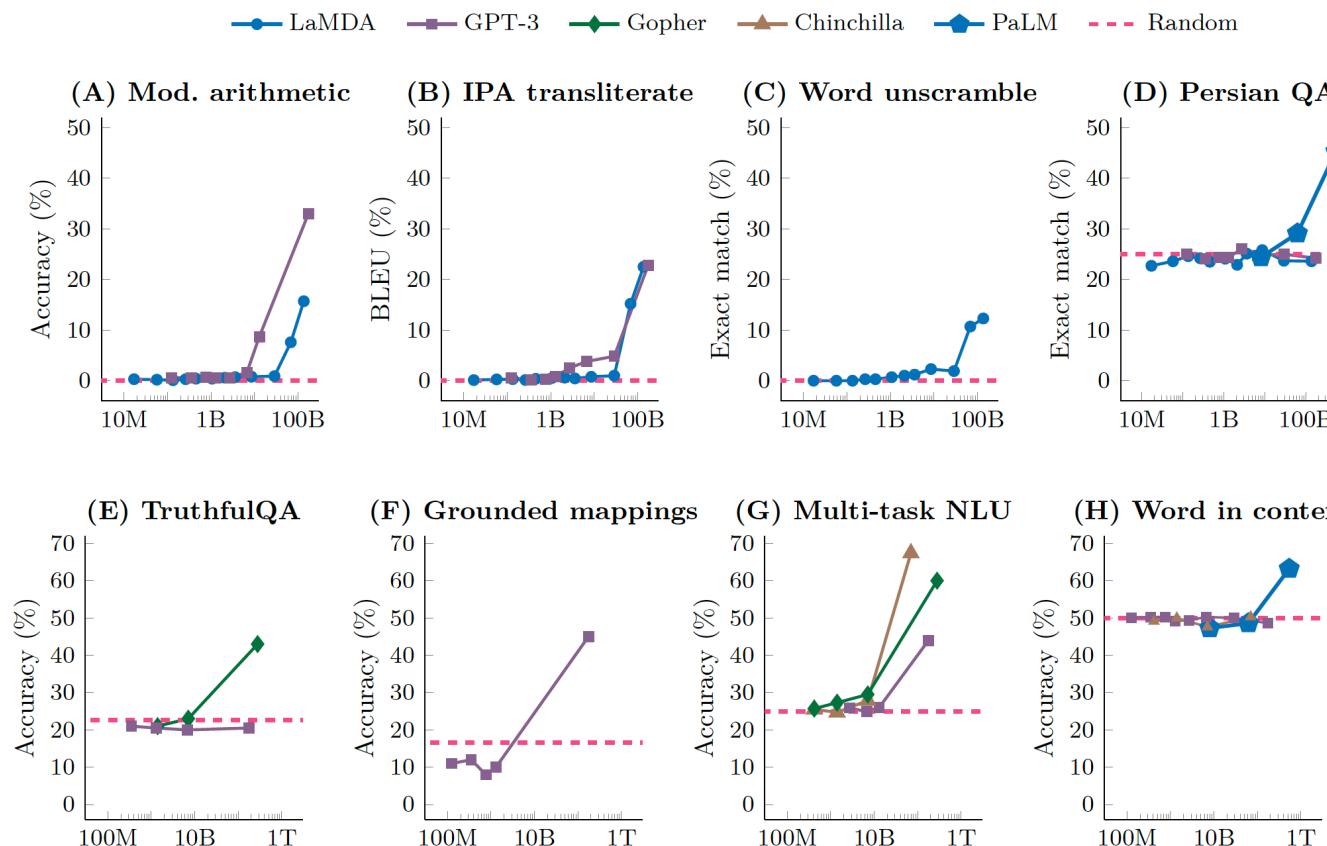
在经典的 MutiArith 数据集上，这句魔法一样的「咒语」将 GPT-3 在零样本场景下解数学题的准确性从 17.7% 提升到了 78.7%。



大模型的“涌现能力”



- 语言模型参数达到一定规模时，某些能力表现（语言推理）会突然大幅提升
- 定义：在小模型中未观察到但在大模型中体现出来的能力
- 示例：5个大模型在8个任务上验证



- 涌现能力的代表

- 提示学习
- 思维链推理

提示学习 (Prompting)



- 上下文学习方式
 - 零样本提示：给出目标指令提示
 - 少样本提示：提供任务范例提示
- 主要功能
 - 针对特定任务的输入-输出格式约束
 - 提供上下文，缩小知识搜索空间
 - 无需梯度更新的知识更新手段

人类友好的交互模式

Translate English to French
cheese =>

(Output) Le fromage

Translate English to French
sea otter => loutre de mer
peppermint => menthe poivrée
plush giraffe => girafe peluche
cheese =>

(Output) Le fromage

零样本提示

少样本提示



思维链推理 (Chain-of-Thought)

- 思维链推理：模拟**人类的思考过程**，将多步骤推理问题分解成一系列中间步骤，进而**实现问题分解和逐步求解**
 - 分配给更多的计算量，生成**更长的上下文**，实现复杂问题的精细求解
 - 提升了模型推理的**可解释性、可控性、灵活性**，有效发挥了大模型在规划、决策、推理等方面潜力
 - 2022年经Google正式提出后，发展成为大模型**最具代表性的技术之一**

Exemplars Question Instruction Rationale Answer

Direct Reasoning

Input
A small sunflower has 3 dozen seeds and a large sunflower has 50% more seeds than a small sunflower. How many sunflower seeds are there altogether?

Output
The answer is 90. 

Chain-of-Thoughts (Zero-Shot)

Input
A small sunflower has 3 dozen seeds and a large sunflower has 50% more seeds than a small sunflower. How many sunflower seeds are there altogether? Let's think step by step.

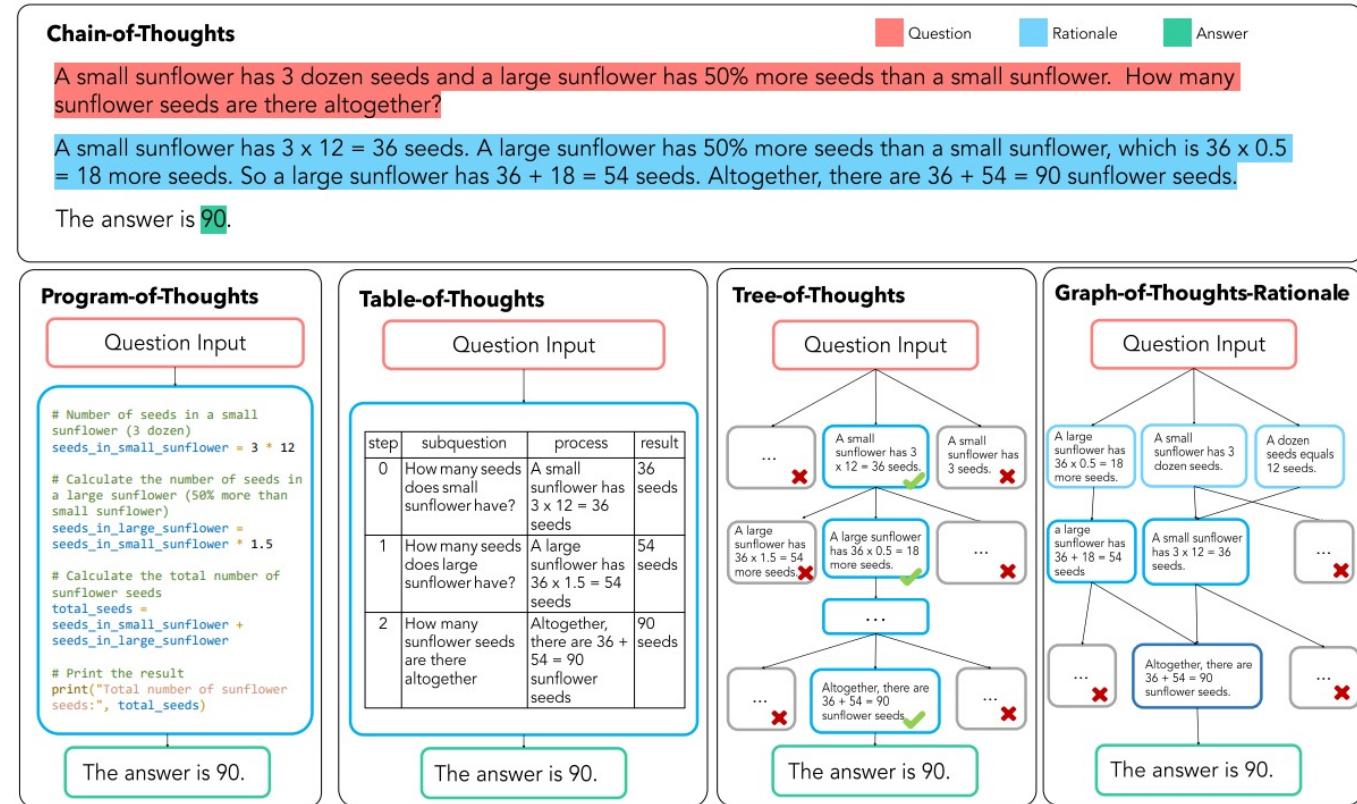
Output
A small sunflower has $3 \times 12 = 36$ seeds. A large sunflower has 50% more seeds than a small sunflower, which is $36 \times 0.5 = 18$ more seeds. So a large sunflower has $36 + 18 = 54$ seeds. Altogether, there are $36 + 54 = 90$ sunflower seeds.
The answer is 90. 

Chain-of-Thoughts (Few-Shot)

Input
Q: There are 15 trees in the grove. Grove workers will plant trees in the grove today. After they are done, there will be 21 trees. How many trees did the grove workers plant today?
A: There are 15 trees originally. Then there were 21 trees after some more were planted. So there must have been $21 - 15 = 6$. The answer is 6.

Input
Q: A small sunflower has 3 dozen seeds and a large sunflower has 50% more seeds than a small sunflower. How many sunflower seeds are there altogether?
A:

Output
A: A small sunflower has $3 \times 12 = 36$ seeds. A large sunflower has 50% more seeds than a small sunflower, which is $36 \times 0.5 = 18$ more seeds. So a large sunflower has $36 + 18 = 54$ seeds. Altogether, there are $36 + 54 = 90$ sunflower seeds.
The answer is 90. 



思维链推理技术 (Chain-of-Thought)



□ 思维链推理：引导模型生成中间思维步骤，进而推导答案

- 无需梯度更新
- 提升推理性能，增强可解释性

□ 任务求解方式的变化

- 常规模式：<问题 → 答案>
- 思维链模式：<问题 → 思维链 → 答案>

Q: There were 10 friends playing a video game online when 7 players quit. If each player left had 8 lives, how many lives did they have total?

A: The answer is

(Output) 80. ✗

常规模式

Q: There were 10 friends playing a video game online when 7 players quit. If each player left had 8 lives, how many lives did they have total?

A: Let's think step by step.

(Output) There were 10 friends playing a video game online. This means that, at the start, there were $10 \times 8 = 80$ lives in total. Then, 7 players quit. This means that $7 \times 8 = 56$ lives were lost. Therefore, the total number of lives remaining is $80 - 56 = 24$. The answer is 24. ✓

思维链模式

问题

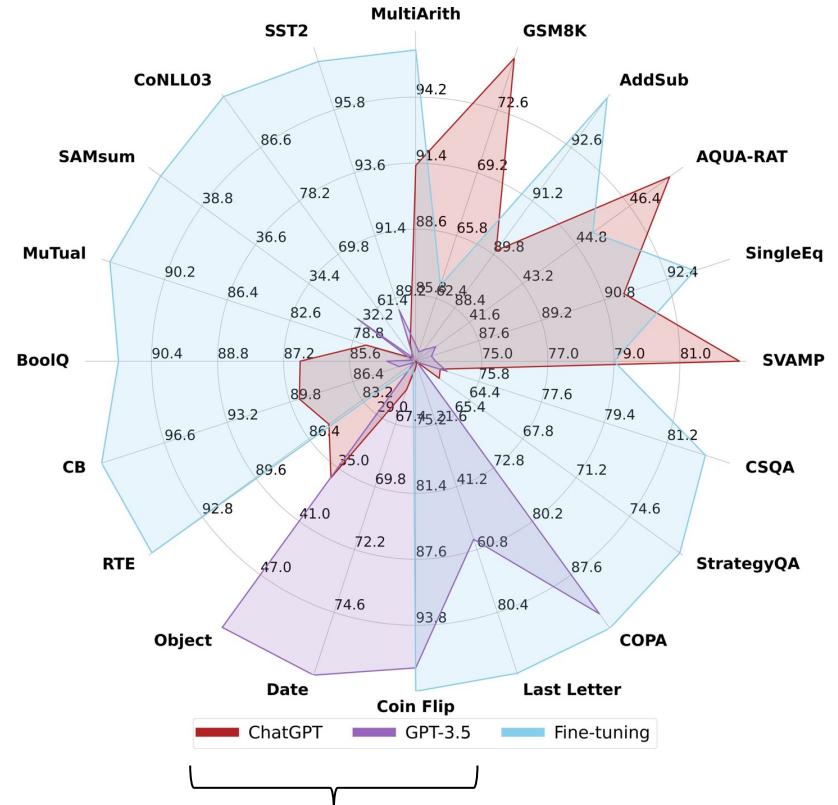
思维链

答案

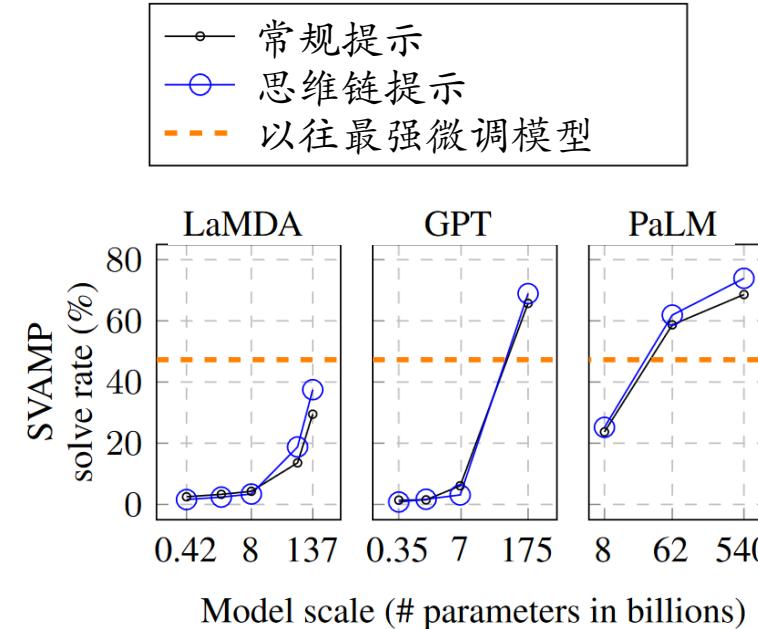


思维链推理技术 (Chain-of-Thought)

- 大模型最具代表性的“涌现能力”
 - 在数学推理、常识推理和逻辑推理复杂任务上的性能超越常规微调模型
 - ChatGPT展现了较强的思维链推理能力



基于思维链提示



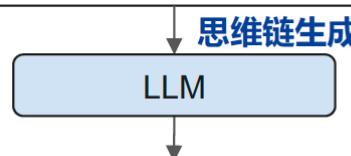
思维链推理技术 (Chain-of-Thought)



□ 思维链推理

- 零样本思维链：在问题后添加特殊提示引导模型逐步推理
- 少样本思维链：使用上下文学习演示样例（问题 + 思维链 + 答案）

Q: A pet store had 64 puppies. In one day they sold 28 of them and put the rest into cages with 4 in each cage. How many cages did they use?
A: Let's think step by step.



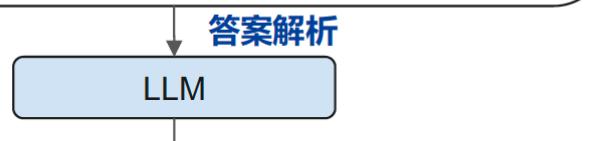
思维链生成

Q: A pet store had 64 puppies. In one day they sold 28 of them and put the rest into cages with 4 in each cage. How many cages did they use?

A: Let's think step by step. There are 64 puppies. 28 of them were sold. This leaves 36 puppies. Each cage has 4 puppies, so we need 9 cages.

生成的思维链

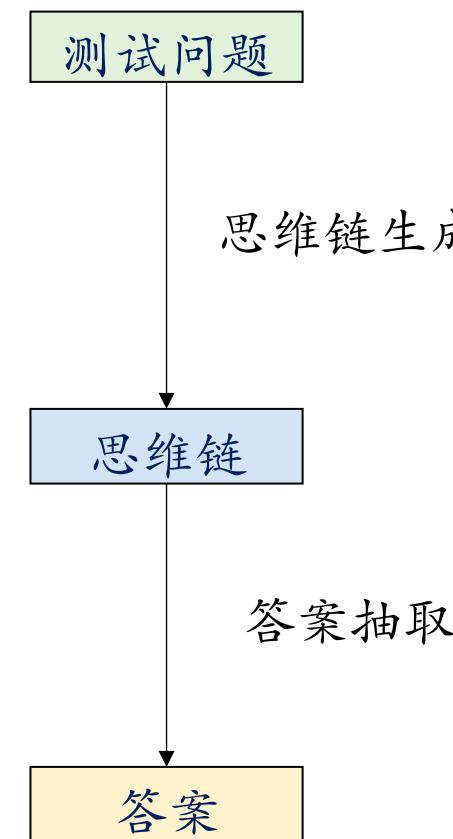
Therefore, the answer (arabic numerals) is



答案解析

LLM

9.



测试问题

思维链生成

思维链

答案抽取

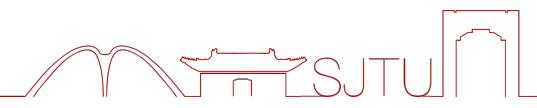
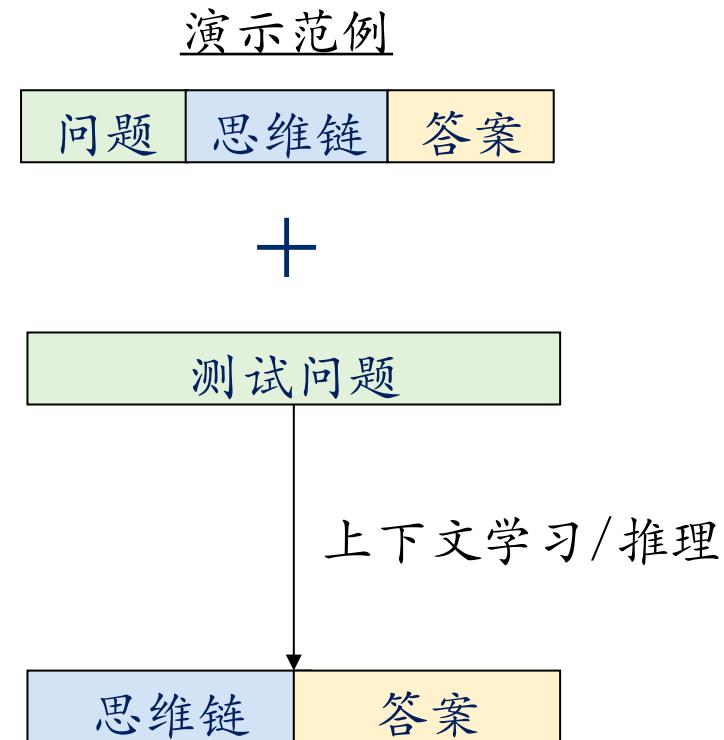
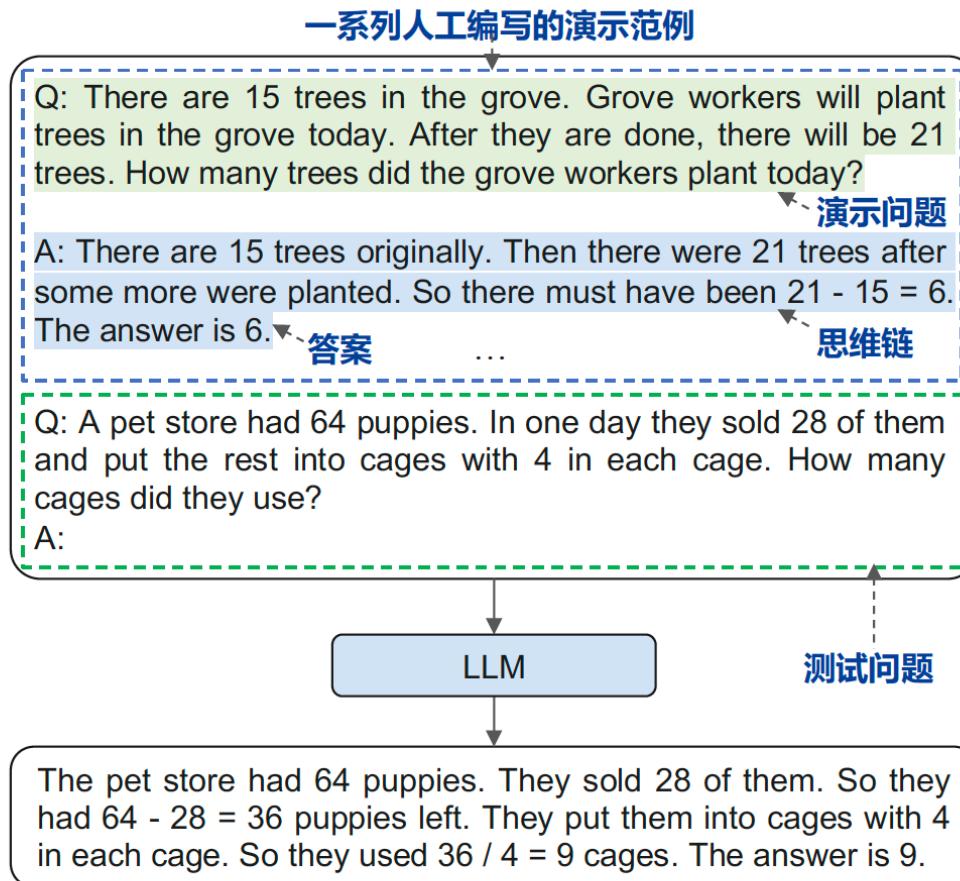
答案



思维链推理技术 (Chain-of-Thought)

□ 思维链推理

- 零样本思维链：在问题后添加特殊提示引导模型逐步推理
- 少样本思维链：使用上下文学习演示样例（问题 + 思维链 + 答案）



练习1: 零样本推理



模型服务累积 / 模型体验中心

模型体验中心 beta

API-KEY | sk-24***8da6

进行模型体验将消耗您的额度 [查看计量计费规则](#)

选择模型

选择模型

通义千问 / qwen-turbo

使用场景

单轮对话

* 输入prompt ②

Q: There were 10 friends playing a video game online when 7 players quit. If each player left had 8 lives, how many lives did they have total?
A: Let's think step by step.

参数设置 [参数说明](#)

enable_search ②:



seed ②: - 1234 +

max_tokens ②:

- 1500 +

top_p ②: 0 1

temperature ②:

0 2

top_k ②: - +

对结果影响较大, 请谨慎调整

repetition_penalty ②:

- 1 +

stop ②: 请选择

请选择, 仅供调试使用

结果

代码

输出

帮助文档

User

Q: There were 10 friends playing a video game online when 7 players quit. If each player left had 8 lives, how many lives did they have total?

A: Let's think step by step.

Assistant

If there were initially 10 friends playing and 7 players quit, that means $10 - 7 = 3$ players remained.

Each of the players who quit had 8 lives. Since these 7 players left, the total number of lives they had together is $7 \text{ players} * 8 \text{ lives/player} = 56 \text{ lives}$.

The answer is 56 lives.



练习2: 少样本推理



模型服务灵积 / 模型体验中心

模型体验中心 beta

API-KEY | sk-24***8da6

进行模型体验将消耗您的额度 [查看计量计费规则](#)

选择模型

选择模型

通义千问 / qwen-turbo

使用场景

单轮对话

* 输入prompt ②

A: Originally, Leah had 32 chocolates. Her sister had 42. So in total they had $32 + 42 = 74$. After eating 35, they had $74 - 35 = 39$. The answer is 39.
Q: Jason had 20 lollipops. He gave Denny some lollipops. Now Jason has 12 lollipops. How many lollipops did Jason give to Denny?
A: Jason started with 20 lollipops. Then he had 12 after giving some to Denny. So he gave Denny $20 - 12 = 8$. The answer is 8.
Q: There were 10 friends playing a video game online when 7 players quit. If each player left had 8 lives, how many lives did they have total?
A:

参数设置 参数说明

enable_search ②:



seed ②:

- 1234 +

max_tokens ②:

- 1500 +

top_p ②:

0 1

temperature ②:

0 2

top_k ②:

- +

对结果影响较大, 请谨慎调整

repetition_penalty ②:

- 1 +

stop ②: 请先选择stop类型

结果

代码

输出

帮助文档

User



Q: There are 15 trees in the grove. Grove workers will plant trees in the grove today. After they are done, there will be 21 trees. How many trees did the grove workers plant today?
A:

There are 15 trees originally. Then there were 21 trees after some more were planted. So there must have been $21 - 15 = 6$. The answer is 6.

Q: If there are 3 cars in the parking lot and 2 more cars arrive, how many cars are in the parking lot?

A: There are originally 3 cars. 2 more cars arrive. $3 + 2 = 5$. The answer is 5.

Q: Leah had 32 chocolates and her sister had 42. If they ate 35, how many pieces do they have left in total?

A: Originally, Leah had 32 chocolates. Her sister had 42. So in total they had $32 + 42 = 74$. After eating 35, they had $74 - 35 = 39$. The answer is 39.

Q: Jason had 20 lollipops. He gave Denny some lollipops. Now Jason has 12 lollipops. How many lollipops did Jason give to Denny?

A: Jason started with 20 lollipops. Then he had 12 after giving some to Denny. So he gave Denny $20 - 12 = 8$. The answer is 8.

Q: There were 10 friends playing a video game online when 7 players quit. If each player left had 8 lives, how many lives did they have total?

A:

Assistant

There were $10 - 7 = 3$ players left. The total number of lives left is $3 * 8 = 24$ lives. The answer is 24.





练习3: PoT少样本编程 (TMLR)

Question: In Fibonacci sequence, it follows the rule that each number is equal to the sum of the preceding two numbers. Assuming the first two numbers are 0 and 1, what is the 50th number in Fibonacci sequence?

The first number is 0, the second number is 1, therefore, the third number is $0+1=1$. The fourth number is $1+1=2$. The fifth number is $1+2=3$. The sixth number is $2+3=5$. The seventh number is $3+5=8$. The eighth number is $5+8=13$.
..... (Skip 1000 tokens)

The 50th number is 32,432,268,459.

CoT

32,432,268,459



```
length_of_fibonacci_sequence = 50
fibonacci_sequence = np.zeros(length_of_)
fibonacci_sequence[0] = 0
fibonacci_sequence[1] = 1
for i in range(3, length_of_fibonacci_sequence):
    fibonacci_sequence[i] = fibonacci_sequence[i-1] +
    fibonacci_sequence[i-2]
ans = fibonacci_sequence[-1]
```

PoT



12,586,269,025



Question: Ketty saves 20000 dollars to the bank. After three years, the sum with compound interest rate is 1000 dollars more than the sum with simple interest rate. What is the interest rate of the bank?

Assuming the interest rate is x . The sum after two years with simple interest rate is $20000 + x * 20000 * 3 = 20000 + 60000x$. The sum after two years with compound interest rate is $20000 * (1 + x)^3 = 200000 + 60000 * x + 60000x^2 + 20000x^3$. The difference can be written as $60000x^2 + 20000x^3 = 1000$. In order to solve x , we can use the quadratic formula. $x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$, ..., $x = (-20000 \pm 6160) / 120000$, $x = -0.051333$.

CoT

-0.051333



```
interest_rate = Symbol('x')
sum_in_two_years_with_simple_interest = 20000 +
interest_rate * 20000 * 3
sum_in_two_years_with_compound_interest = 20000 * (1 +
interest_rate)**3
# Since compound interest is 1000 more than simple interest.
ans = solve(sum_after_in_yeras_with_compound_interest -
sum_after_two_years_in_compound_interest - 1000,
interest_rate)
```

PoT



x = 0.24814

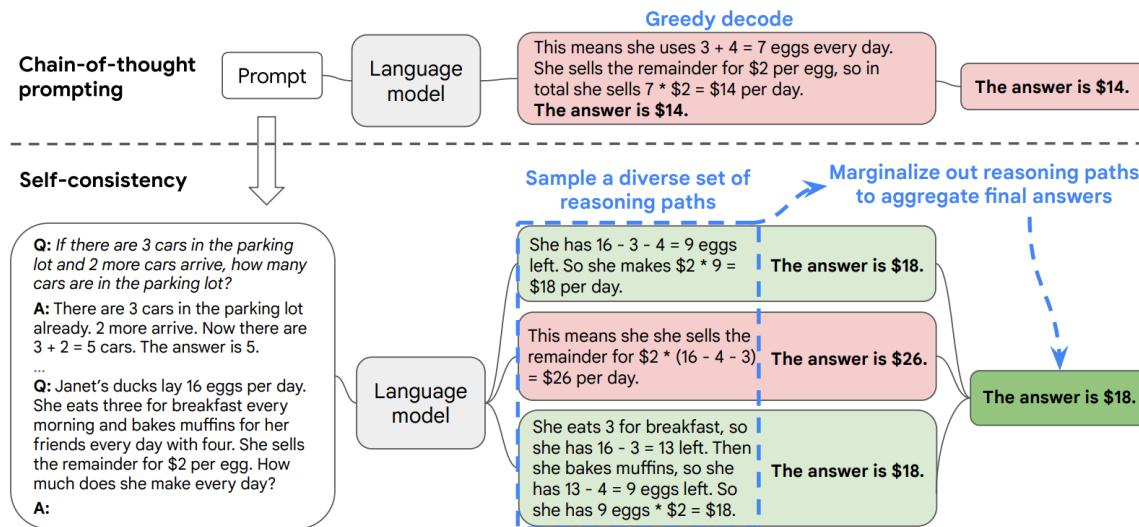


观察&思考

- 错误范例的影响：把少样本学习中的例子改成错误的答案，结果会发生变化吗？

Invalid Reasoning	Originally, Leah had 32 chocolates and her sister had 42. So her sister had $42 - 32 = 10$ chocolates more than Leah has. After eating 35, since $10 + 35 = 45$, they had $45 - 6 = 39$ pieces left in total. The answer is 39.	Yesterday, Julie read 12 pages. Today, she read $12 * 2 = 24$ pages. So she read a total of $12 + 24 = 36$ pages. Now she needs to read $120 - 36 = 84$ more pages. She wants to read half of the remaining pages tomorrow, so she needs to read $84 / 2 = 42$ pages tomorrow. The answer is 42. ✓
--------------------------	--	--

- 自治性提升推理结果：设置temperature大于0（如0.7），保持同样的输入，多次采样，生成多个推理路径和答案，最终选择答案出现最多的作为最终答案输出。

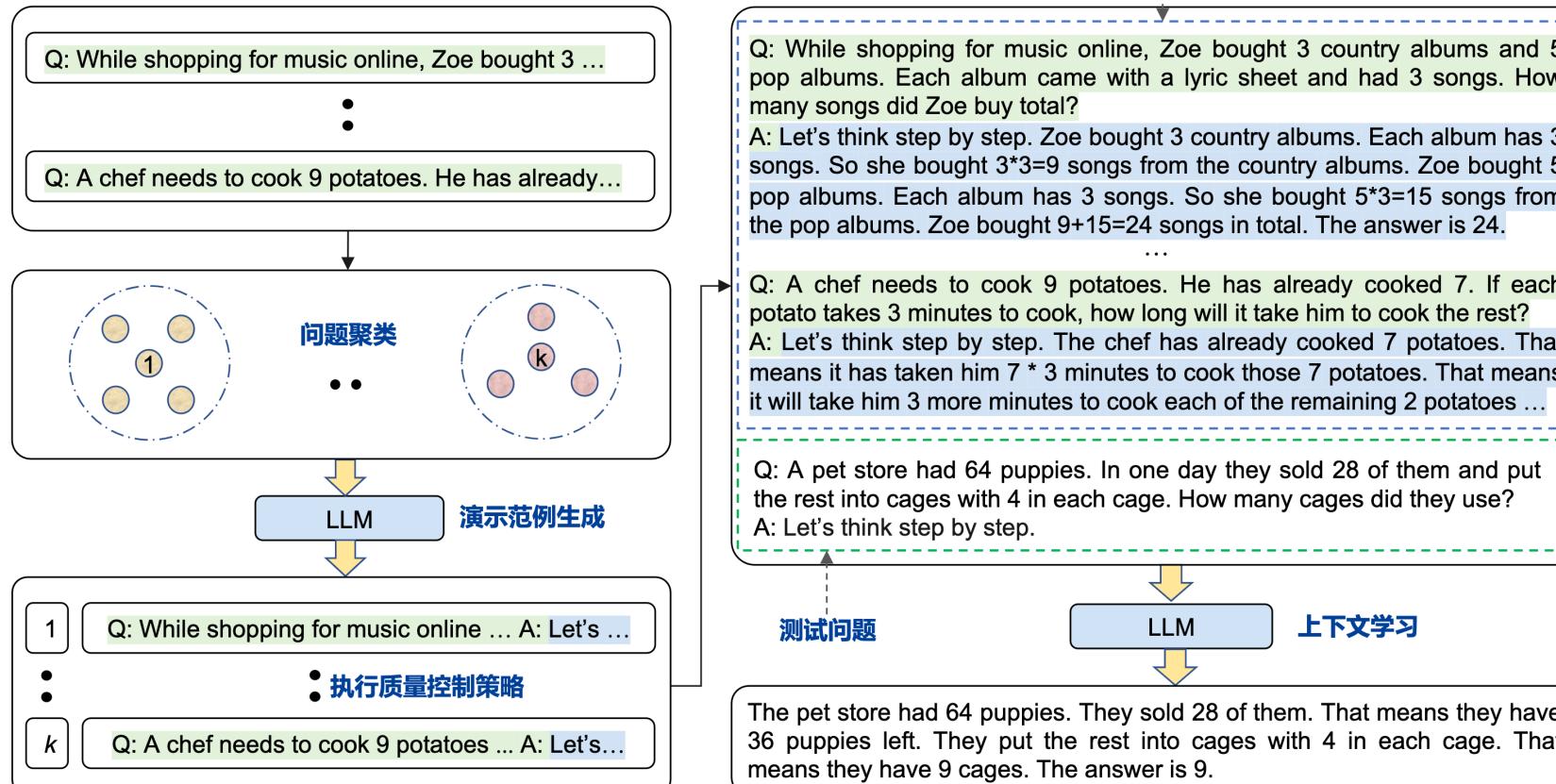


高阶: Auto-CoT自动思维链 (ICLR 2023)



□ Auto-CoT: 自动思维链提示学习

- 引导大模型**自主编写**与任务有关的推理论例，**克服对人类标注提示范例的依赖性**
- 有效推动思维链技术的**规模化、实用化**



<https://github.com/amazon-science/auto-cot>

□ 范例构造

- **问题:** 覆盖数据集的基本特征 -> 通过聚类得到最具代表性的问题
- **思维链:** 反映一步一步的推理过程, 导向最终答案 -> 通过零样本提示来生成推理链条

模型	数学推理							常识推理		符号推理	
	MultiArith	GSM	AddSub	AQuA	SingleEq	SVAMP	CSQA	Strategy	Letter	Coin	
Zero-Shot	22.7	12.5	77.0	22.4	78.7	58.8	72.6	54.3	0.2	53.8	
Zero-Shot-CoT	78.7	40.7	74.7	33.5	78.7	63.7	64.6	54.8	57.6	91.4	
Few-Shot	33.8	15.6	83.3	24.8	82.7	65.7	79.5	65.9	0.2	57.2	
Manual-CoT	91.7	46.9	81.3	35.8	86.6	68.9	73.5	65.4	59.0	97.2	
Random-Q-CoT	$87.1_{\pm 1.8}$	$40.4_{\pm 0.4}$	$82.7_{\pm 1.3}$	$31.5_{\pm 1.1}$	$81.5_{\pm 0.3}$	$66.7_{\pm 1.8}$	$71.9_{\pm 0.2}$	$58.0_{\pm 0.1}$	$58.2_{\pm 0.3}$	$95.9_{\pm 0.1}$	
Auto-CoT	$92.0_{\pm 1.7}^{\dagger}$	$47.9_{\pm 3.7}^{\dagger}$	$84.8_{\pm 2.9}^{\dagger}$	$36.5_{\pm 2.2}^{\dagger}$	$87.0_{\pm 1.2}^{\dagger}$	$69.5_{\pm 2.2}^{\dagger}$	$74.4_{\pm 2.5}^{\dagger}$	$65.4_{\pm 0.4}^{\dagger}$	$59.7_{\pm 3.2}^{\dagger}$	$99.9_{\pm 0.1}^{\dagger}$	



高阶: Sum-CoT摘要思维链 (ACL 2023)

- “让我们一步一步思考，来提炼复杂摘要”
- 在SumCoT技术的加持下，GPT-3.5仅通过零样本学习，远超精调后的BART、T5等常用模型

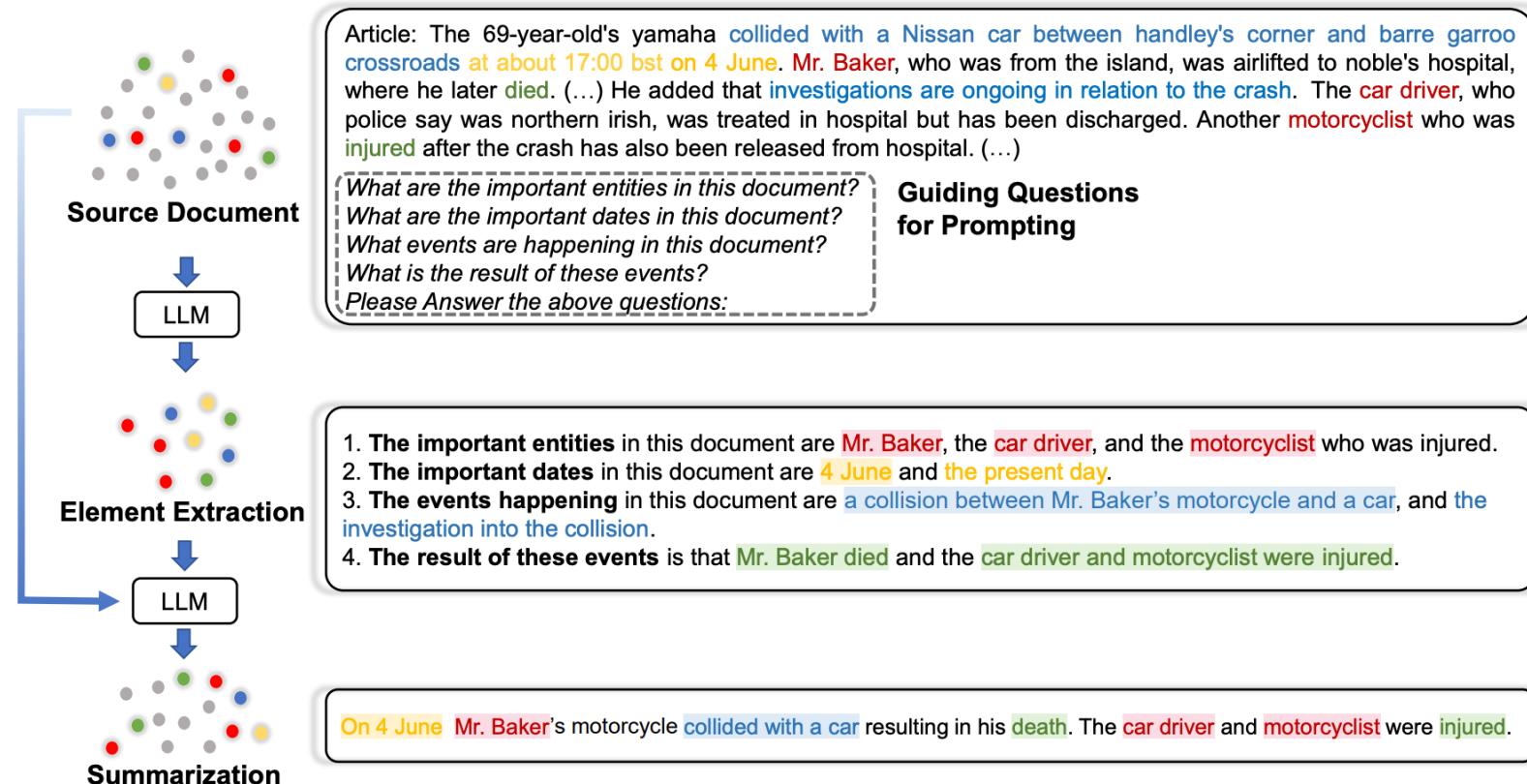


Figure 2: Full pipeline and example of our **Summary Chain-of-Thought** method.

<https://github.com/Alsace08/SumCoT>



高阶: Critic结合工具使用 (ICLR 2024)

Question Answering

Question: Who won the 2016 Russian national silver medal with another Russian ice dancer born 29 April 1995?

Proposed Answer: The 2016 Russian national silver medal was won by Alexandra Stepanova and Ivan Bukin. Alexandra Stepanova was born 29 April 1995. Ivan Bukin was born 10 April 1993. So the answer is: Ivan Bukin.

X

What's the problem with the above answer?

- Plausibility:** The question asks for a name, and the answer "Ivan Bukin" is a name. So it's plausible.

Google

2. Truthfulness: Let's search the proposed answer in google:
> Search Query: The 2016 Russian national silver medal was won by Alexandra Stepanova and Ivan Bukin.
> Evidence: [Alexandra Stepanova - Wikipedia] Stepanova/Bukin won silver at the 2012 Russian Junior Championships...
From the evidence, Stepanova/Bukin won silver at the 2012 Russian Junior Championships, **not 2016**.

Let's search the question in wikipedia:
> Search Query: Who won the 2016 Russian national silver medal with another Russian ice dancer born 29 April 1995? site: wikipedia.org
> Evidence: [Victoria Siniatsina - Wikipedia] Victoria Alexandrovna Siniatsina is a Russian ice dancer .

The evidence suggests that Victoria Siniatsina is a Russian ice dancer born 29 April 1995. We need to find out who won the 2016 Russian national silver medal with Victoria Siniatsina.

Google

> Search Query: Who won the 2016 Russian national silver medal with Victoria Siniatsina?
> Evidence: [Nikita Katsalapov - Wikipedia] In December, Siniatsina/Katsalapov won the silver medal behind Bobrova/Soloviev at the 2016 Russian Championships.

The evidence suggests that Nikita Katsalapov won the 2016 Russian national silver medal with Victoria Siniatsina, not Alexandra Stepanova and Ivan Bukin. The answer is **incorrect**.

Here's the most possible answer: The 2016 Russian national silver medal in ice dancing was won by Victoria Siniatsina and Nikita Katsalapov. Victoria Siniatsina was born on April 29, 1995. So the answer is: Nikita Katsalapov.

✓

Program Synthesis

Question: Ann, Bill, Cate, and Dale each buy personal pan pizzas cut into 4 pieces. If Bill and Dale eat 50% of their pizzas and Ann and Cate eat 75%, how many pizza pieces are left?

Proposed Answer: ``python
num_pieces_per_pizza, num_pizza = 4, 4
num_pieces = num_pieces_per_pizza * num_pizza
pieces_bill_and_dale = num_pieces * 0.5
pieces_ann_and_cate = num_pieces * 0.75
answer = num_pieces - pieces_bill_dale - pieces_ann_cate``

X

Execution: No runtime error
Output: answer = -4.0

Python logo

What's the problem with the above code?

- Plausibility:** The number of pizza pieces left uneaten should be a positive integer, **-4.0 < 0**, so the answer is **not reasonable**.

2. Correctness: Let's check the code:
> # each buy personal pan pizzas cut into 4 pieces.
> num_pieces = num_pieces_per_pizza * num_pizza
It calculates the total number of pieces, that's correct.

> pieces_bill_dale = num_pieces * 0.5
> pieces_ann_cate = num_pieces * 0.75
Each person only eats their own personal pan pizza,
'num_pieces * 0.5' means 50% of the total pieces, this is **wrong**.

Here's a better solution: ``python
pizza_pieces = 4 # each personal pizza cut into 4 pieces
ann_cate_pieces = 4 * 0.75 * 2 # Ann, Cate eats 75%
bill_dale_pieces = 4 * 0.5 * 2 # Bill, Dale eats 50%
total_eaten = ann_cate_pieces + bill_dale_pieces
answer = pizza_pieces * 4 - total_eaten # pieces left``

✓

Toxicity Reduction

Previous toxic text: ... last year before hanging himself.

Perspective X

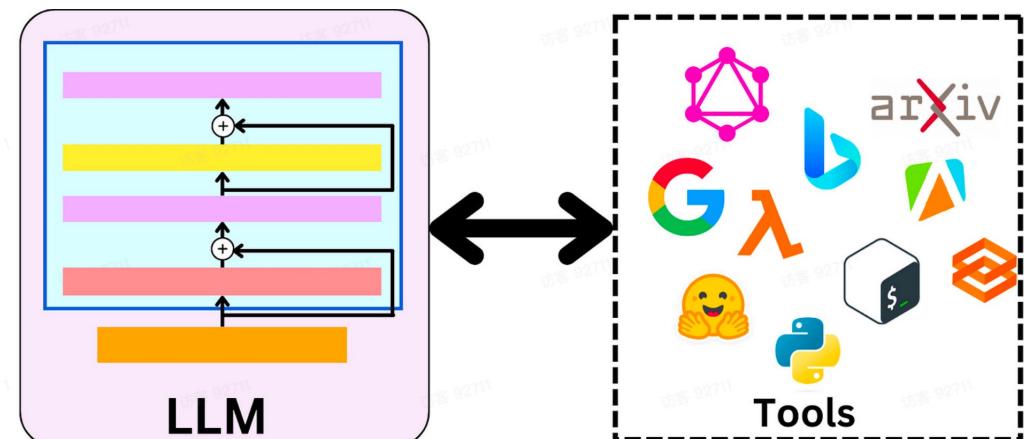
The text has **53%** toxicity of threat. To improve content safety while ensuring fluency, here's a **non-toxic continuation** after '\':

Jason Conroy, 19, strangled fellow resident Melissa Matheson at Alexandra House in Bristol \ in November 11 2014. It serves as a reminder of the importance of mental health support to...

✓

思维链结合工具使用

- 规划&求解：对问题求解过程进行规划，结合外部工具进行交互
- 克服大模型在部分任务上的能力缺陷，如计算、搜索等，对接符号化系统



高阶: ReAct机器人操控 (ICLR 2023)



Obs t

You are cooking a dish and seeing salt is out...

Reasoning

“The dish should be savory, and since salt is out, I should find the soy sauce instead. It is in the cabinet to my right...”

Act t

Turn right

Obs t+1

You see a cabinet and a table...

Act t+1

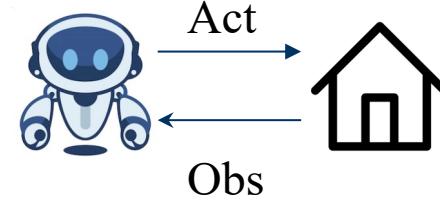
Open cabinet

.....

“Verbal Reasoning” as Augmented Action Space!

<https://react-lm.github.io/>

<https://zhuanlan.zhihu.com/p/659102403>



Question: Aside from the Apple Remote, what other device can control the program Apple Remote was originally designed to interact with?

Answer: iPod

Thought: Let's think step by step. Apple Remote was originally designed to interact with Apple TV. Apple TV can be controlled by iPhone, iPad, and iPod Touch. So the answer is iPhone, iPad, and iPod Touch.

Answer: iPhone, iPad, iPod Touch

Act only

Act 1: Search[Apple Remote]
Obs 1: The Apple Remote is a remote control introduced...
Act 2: Search[Front Row]
Obs 2: Could not find [Front Row]. Similar: ...
Act 3: Search[Front Row (software)]
Obs 3: Front Row is a discontinued media center software ...
Act 4: Finish[yes]

Thought 1: I need to search Apple Remote and find the program it was originally designed to interact with.
Act 1: Search[Apple Remote]
Obs 1: The Apple Remote is a remote control introduced in October 2005 by Apple ... originally designed to control the Front Row media center program ...

Thought 2: Apple Remote was originally designed to control the Front Row media center program. I need to search Front Row next and find what other device can control it.

Act 2: Search[Front Row]
Obs 2: Could not find [Front Row]. Similar: ['Front Row Seat to Earth', 'Front Row Motorsports', 'Front Row (software)', ...]
Thought 3: Front Row is not found. I need to search Front Row (software).
Act 3: Search[Front Row (software)]
Obs 3: Front Row is a discontinued media center software ...

Thought 4: Front Row (software) is controlled by an Apple Remote or the keyboard function keys. So the answer is keyboard function keys.
Act 4: Finish[keyboard function keys]

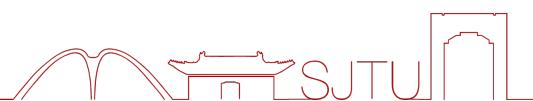


小结

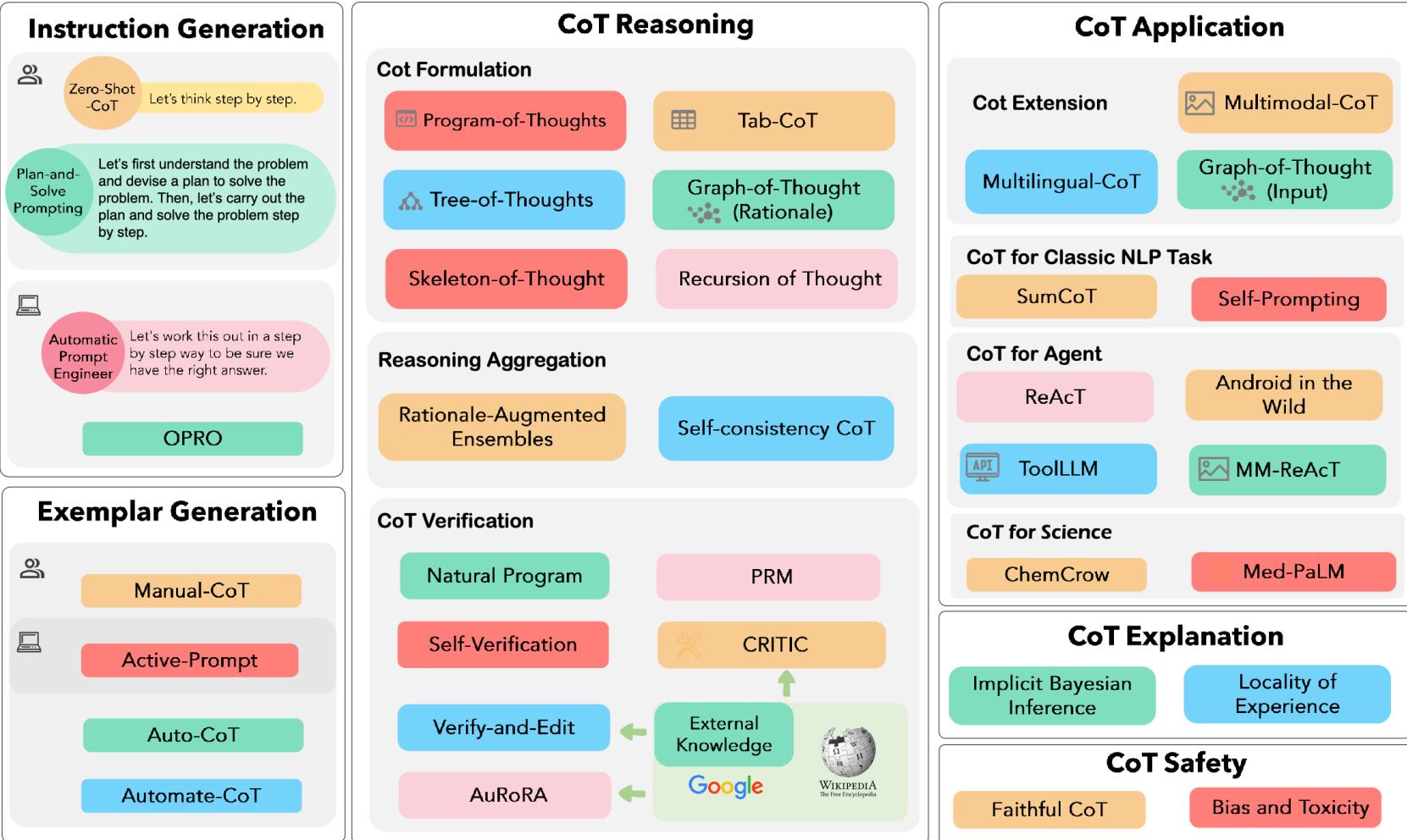


通过Prompting我们可以：

- 1. 获得可解释的过程
- 2. 控制输出的格式
- 3. 融入上下文知识
- 4. ...



思维链推理的前沿发展



- 从人工编写提示到自动提示构造
- 从自然语言思维链到结构化思维链
- 从自我校验到结合外部工具校验
- 从常规语言任务到更广泛的任务
 - 多模态
 - 多语言
 - 智能体
 - 科学领域
 - 安全领域

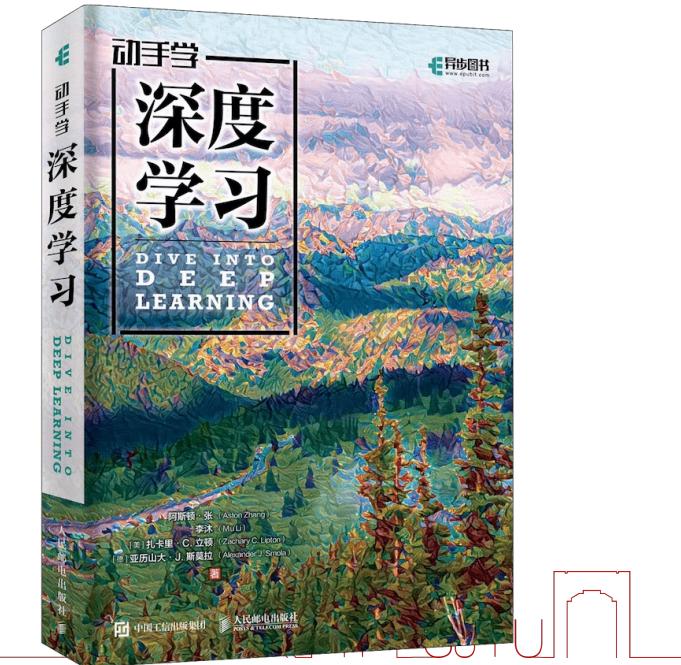
相关材料与工具



- 实验文档: <https://sjtullm.gitbook.io/dive-into-langs/2.tuning>
- LLaMa: <https://github.com/Meta-Llama/llama>
- 智谱AI: <https://open.bigmodel.cn/>
- 通义千问: <https://help.aliyun.com/zh/dashscope/developer-reference/quick-start>
- Openai: <https://platform.openai.com/playground>
- Langchain: https://python.langchain.com/docs/get_started/introduction
- 其他: 文心一言、百川等



The screenshot shows a Bilibili video player interface. The video title is "Chain of Thought论文、代码和资源【论文精读·43】". The video has 7.7万 views and was uploaded on 2022-10-24 at 09:00:00. The video content is a presentation slide titled "Chain of Thought Prompting Elicits Reasoning in Large Language Models" by Jason Wei¹, Xuezhi Wang², Dale Schuurmans¹, Maarten Bosma¹, Ed Chi¹, Quoc Le¹, Denny Zhou¹. The slide includes an abstract and a figure showing a chain of thought process. The video player interface shows the video duration as 6 Apr 2022, 6人正在看, 已装填 221 条弹幕, 2358 likes, 1342 comments, 1187 shares, and 601 views.



谢谢大家

תודה לך

