Question: Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7

Choices:

(A) 1

(B) 2

(C) 2, 3

(D) 6

Answer:

Question: Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7

Choices:

(A) 1

(B) 2

(C) 2, 3

(D) 6

Answer:

I have no clue…

~~**Question:** Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7~~

Choices:

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Answer:

(C) is the only one with two numbers, so let's go with that

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(D) 6

Answer: (C) ✅

(C) is the only one with two numbers, so let's go with that

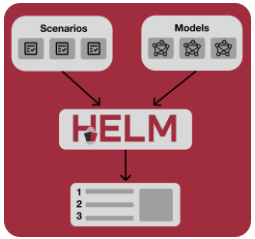
Artifacts or Abduction: How do LLMs answer multiple-choice questions without the question?

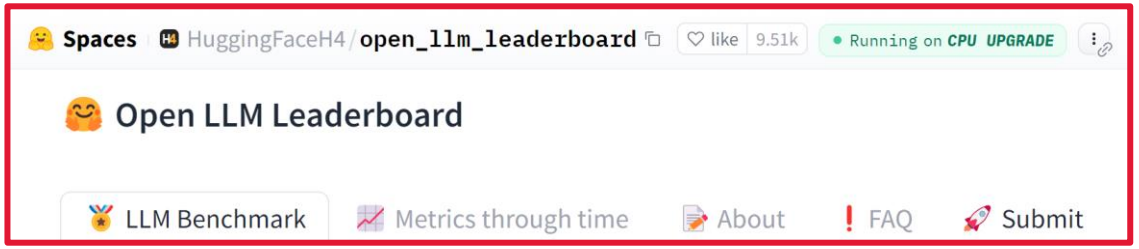
Nishant Balepur, Abhilasha Ravichander, Rachel Rudinger

UNIVERSITY OF MARYLAND

Why is MCQA Important?

- Multiple choice questions are key for LLM evaluations





- We assume MCQA requires reasoning over <u>both</u> the choices + question

But is this assumption true?

How well do LLMs perform *without* the MCQA question?

~~**Question:** Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7~~

Choices:
(A) 1
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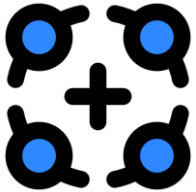
Memorization

Have LLMs already seen the question?

Choice Dynamics



Are LLMs using choices in isolation?

Abductive Question Inference

Can LLMs infer the original question?

How well do LLMs perform *without* the MCQA question?

~~**Question:** Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7~~

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Memorization

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Testing Choices-only Prompts with LLMs

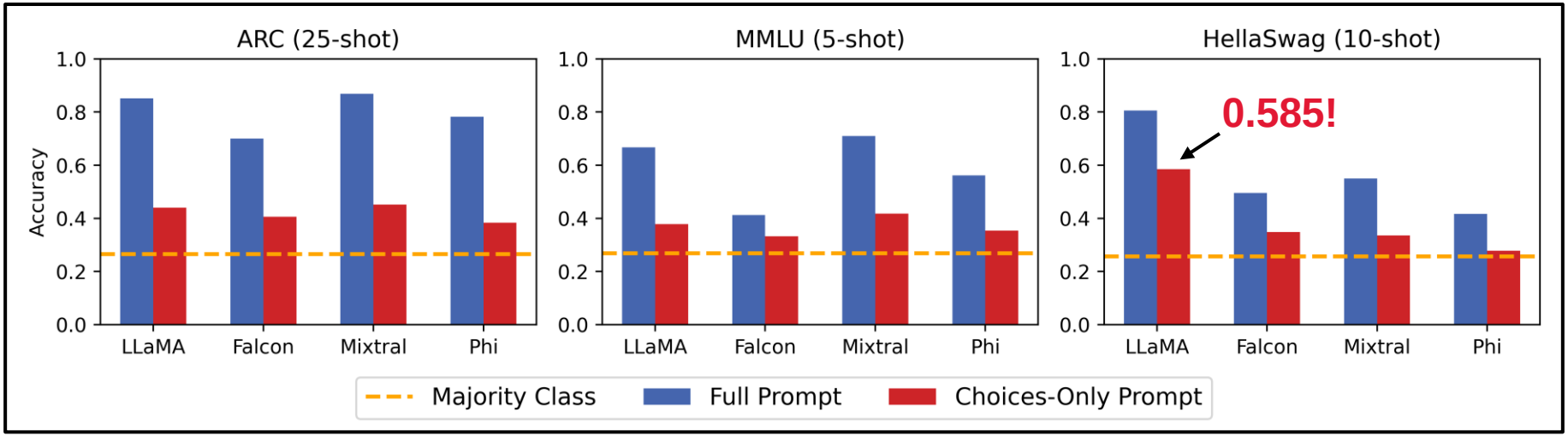
Full Prompt

Question: Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7
Choices:
(A) 1
(B) 2
(C) 2, 3
(D) 6
Answer: (C)

Choices-Only Prompt

Choices:
(A) 1
(B) 2
(C) 2, 3
(D) 6
Answer: (C)

Testing Choices-only Prompts with LLMs



- Our tested LLMs can perform MCQA without the question quite accurately!

How well do LLMs perform *without* the MCQA question?

~~**Question:** Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7~~

Choices:
(A) 1
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(D) 6

Memorization

Have LLMs already seen the question?

Choice Dynamics

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Abductive Question Inference

Can LLMs infer the original question?

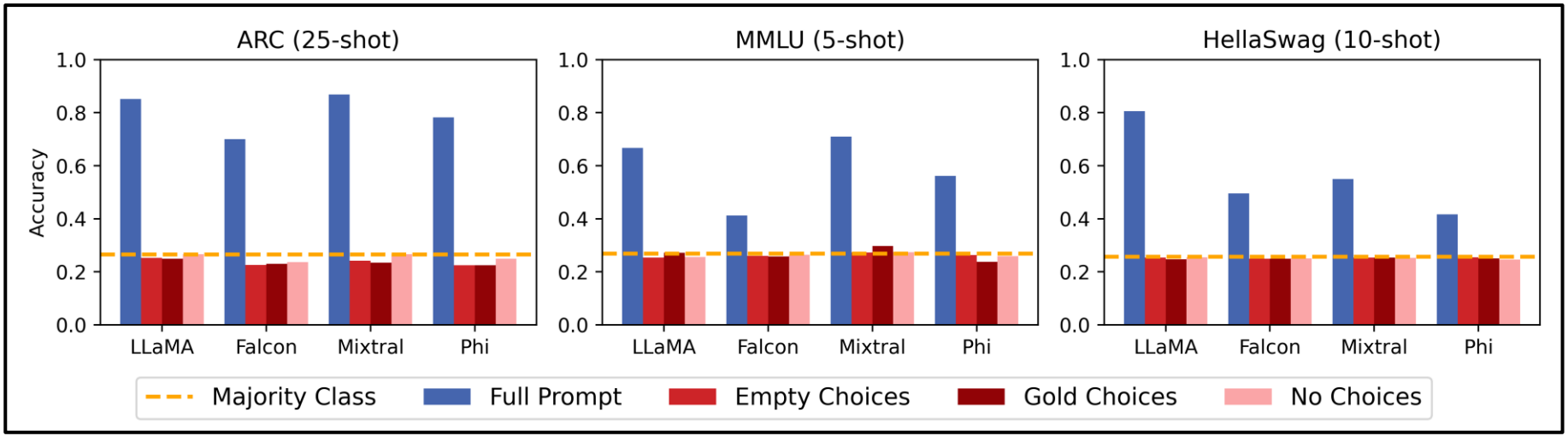
Is this just Memorization?

- Let's design some prompts only answerable through memorization:

No Choices Prompt

Question: Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7
Answer: (C)

Is this just Memorization?



- No strong evidence of memorization

How well do LLMs perform *without* the MCQA question?

~~Question: Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7~~

Choices:
(A) 1
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(C) 2, 3
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Memorization

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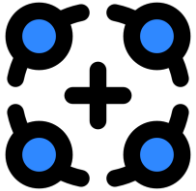
Choice Dynamics



Are LLMs using choices in isolation?

Abductive Question Inference

Can LLMs infer the original question?

Properties of Answer Choices

Two exploitable properties of answer choices:

1. **Individual Priors:** *this choice contains "not", so it's right* (artifacts)
2. **Group Dynamics:** *this choice is the only one with two numbers, so it's right* (reasoning)

To disentangle these, we ask the LLM to classify each choice in isolation:

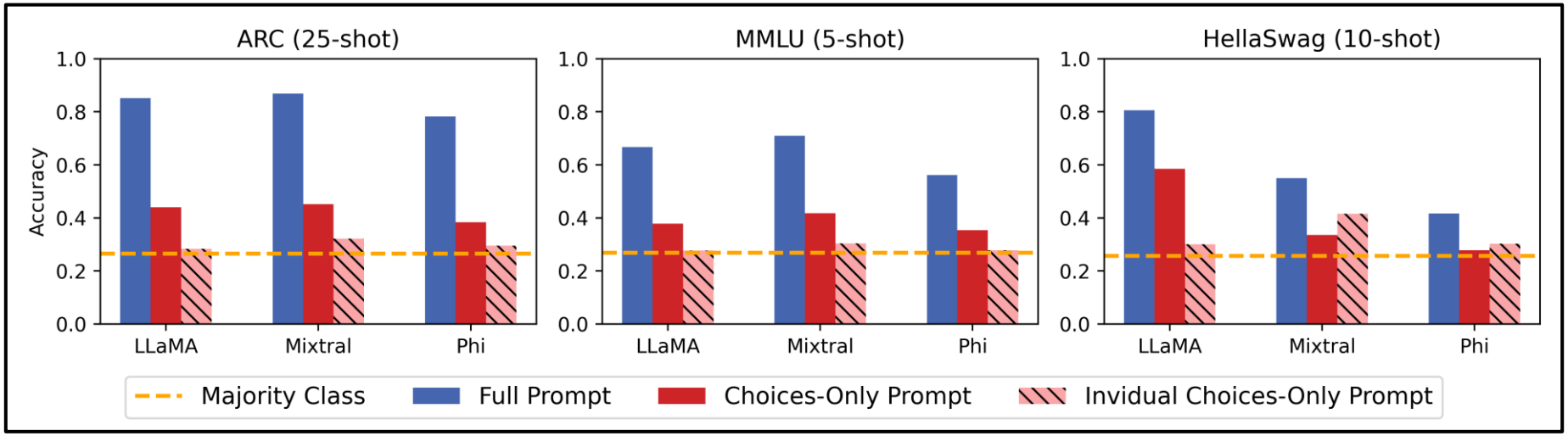
Choices:
(A) 1
Answer: False

Choices:
(B) 2
Answer: False

Choices:
(C) 2, 3
Answer: True

Choices:
(D) 6
Answer: False

Properties of Answer Choices



- Individual priors cannot fully explain choices-only accuracy
- LLMs may engage in reasoning over all choices!

How well do LLMs perform *without* the MCQA question?

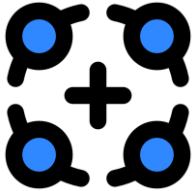
Question: Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7

Choices:
(A) 1
(B) 2
(C) 2.3
(D) 6

Memorization

Have LLMs already seen the question?

Choice Dynamics



Are LLMs using choices in isolation?

Abductive Question Inference

Can LLMs infer the original question?

How well do LLMs perform *without* the MCQA question?

Question: Find all zeros in the indicated finite field of the given polynomial with coefficients in that field. $x^3 + 2x + 2$ in Z_7

Choices:
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Memorization

Have LLMs already seen the question?

Choice Dynamics

Are LLMs using choices in isolation?

Abductive Question Inference

Can LLMs infer the original question?

Can LLMs Infer the Original Question?

- Let's try one of these advanced reasoning strategies!

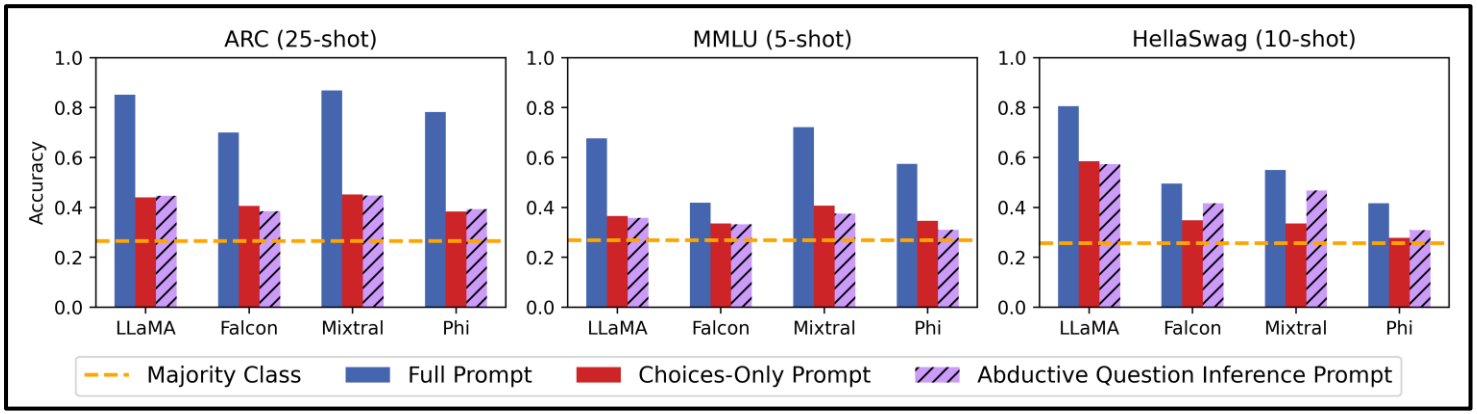
Step 1: Abductive question inference

Choices:
(A) 1
(B) 2
(C) 2, 3
(D) 6
Question: Identify the answer(s) that solve the equation $x^2 - 5x + 6 = 0$

Step 2: Answer the inferred question

Question: Identify the answer(s) that solve the equation $x^2 - 5x + 6 = 0$
Choices:
(A) 1
(B) 2
(C) 2, 3
(D) 6
Answer: (C)

Can LLMs Infer the Original Question?



Dataset	LLaMA	Falcon	Mistral	Phi
ARC	0.380	0.370	0.300	0.280
MMLU	0.190	0.150	0.250	0.210
HellaSwag	0.330	0.440	0.420	0.460

AQI vs Choices-Only Cohen's Kappa

- Abductive question inference explains *some*, but *not all* of choices-only accuracy

Summary + Takeaways

We now know that:

- LLMs can perform well in MCQA *without the question*
- This may *not* just be due to *memorization*
- LLMs may employ reasoning strategies *over all choices*
- *Abductive question inference* may be one such strategy

Choices-Only LLMs can be stronger than we think

Abductive question inference is an impressive strategy!

Impressive strategies like AQI can't fully explain choices-only accuracy

We still need to work towards building better benchmarks