ACL 2026 SAN DIEGO JULY 2-7

OlymMATH

Challenging the Boundaries of Reasoning: An Olympiad-Level Math Benchmark for LLMs

Haoxiang Sun `hxiang-sun.github.io`

Renmin University of China

with Yingqian Min, Zhipeng Chen, Wayne Xin Zhao, and Ji-Rong Wen

AI Box

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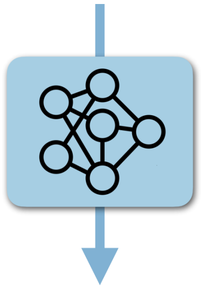

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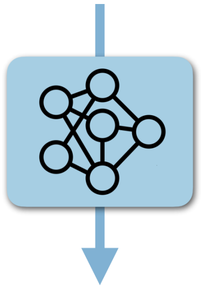

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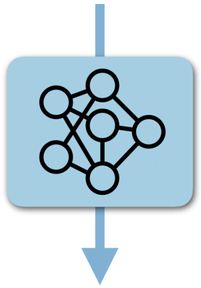

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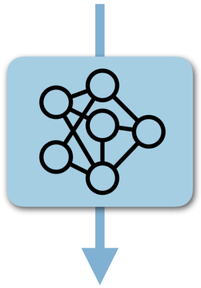

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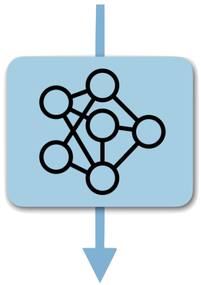

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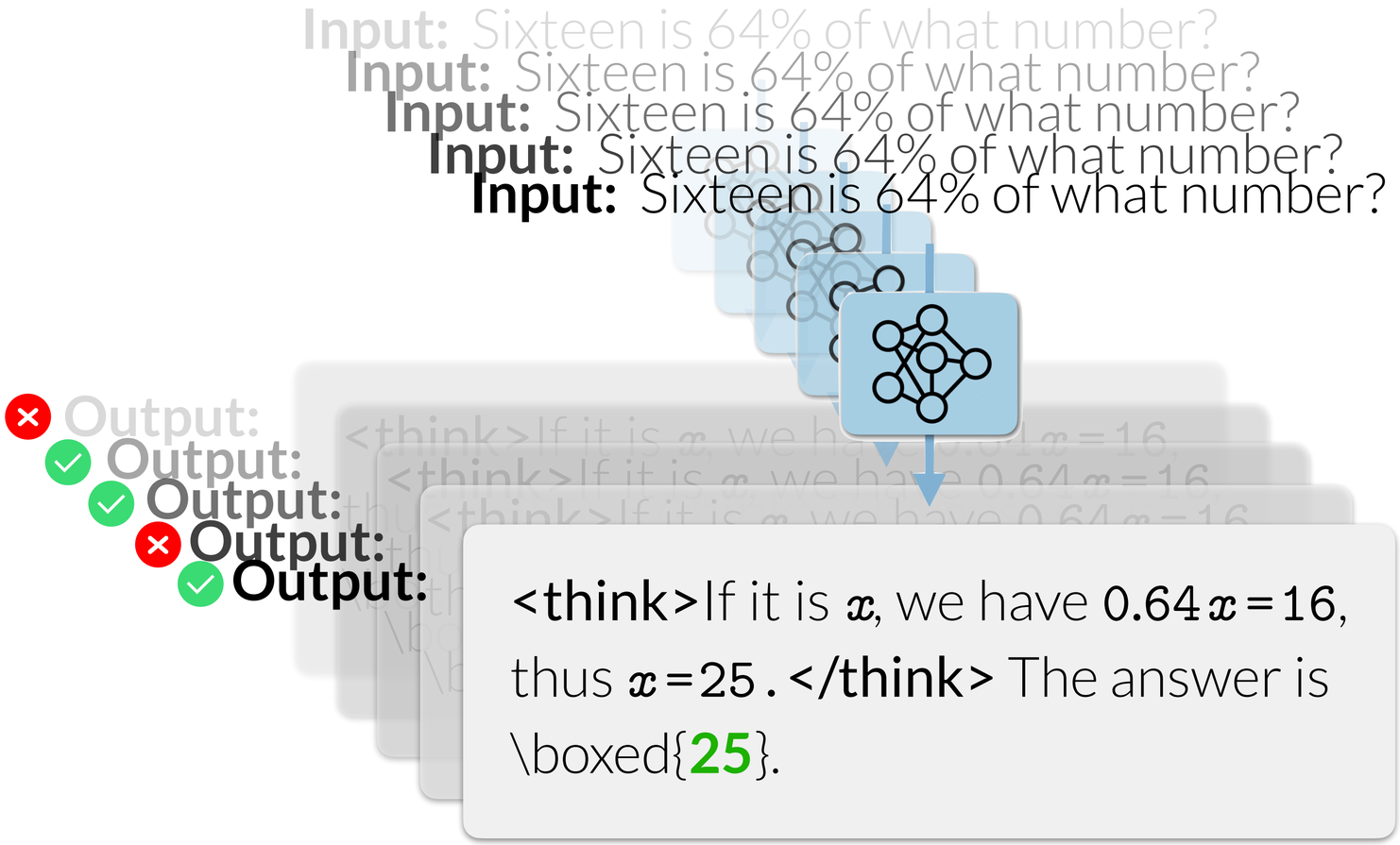

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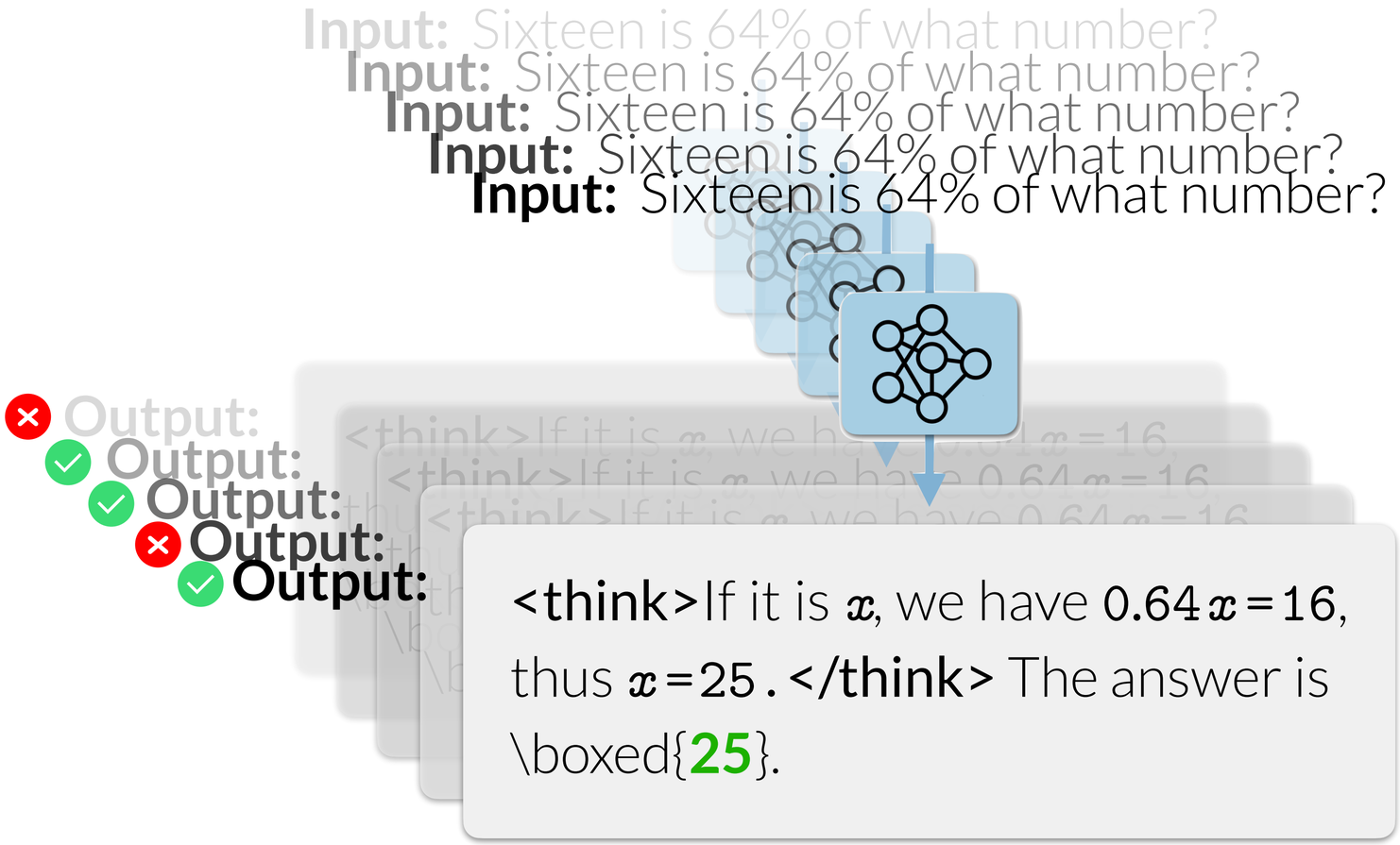

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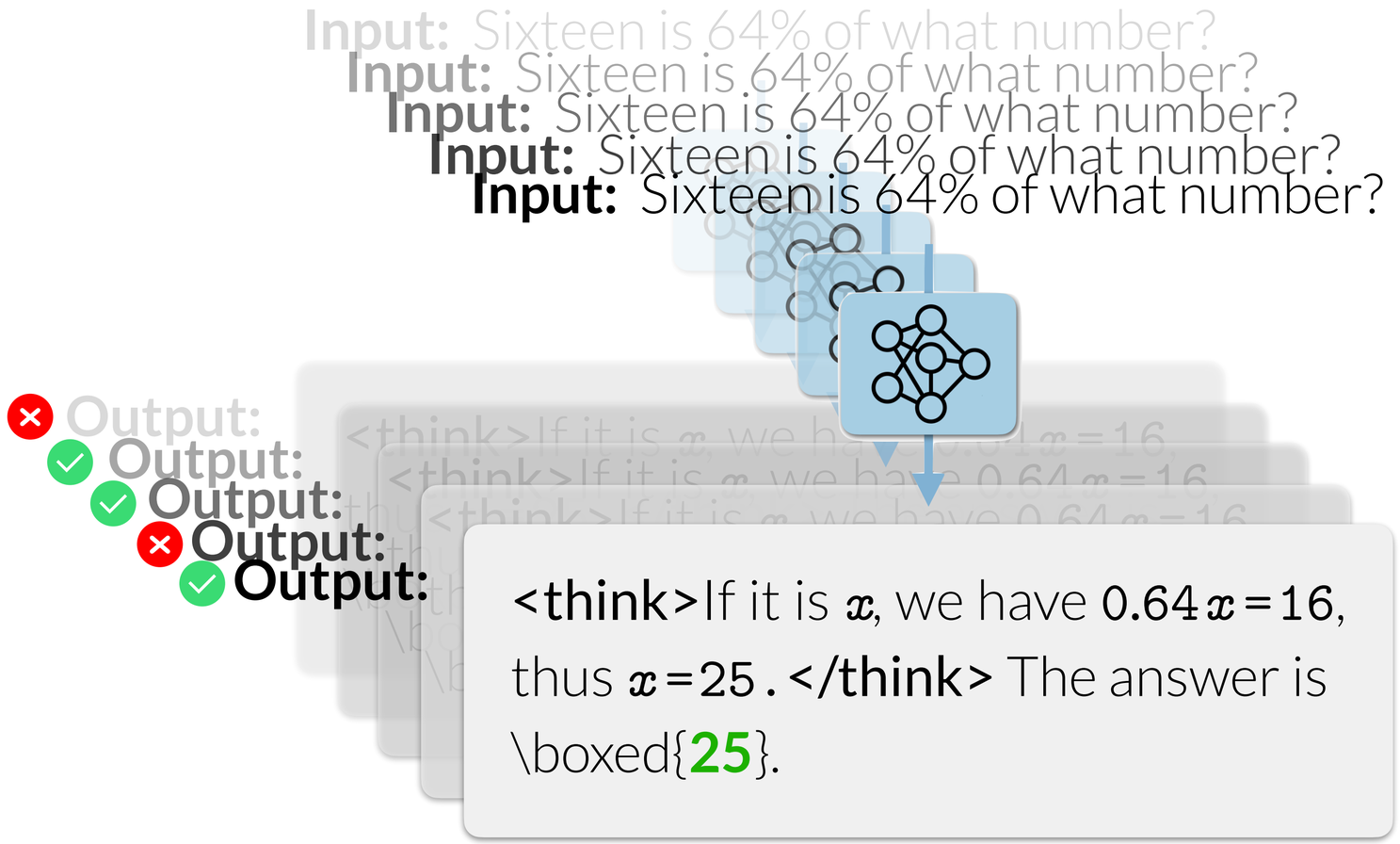

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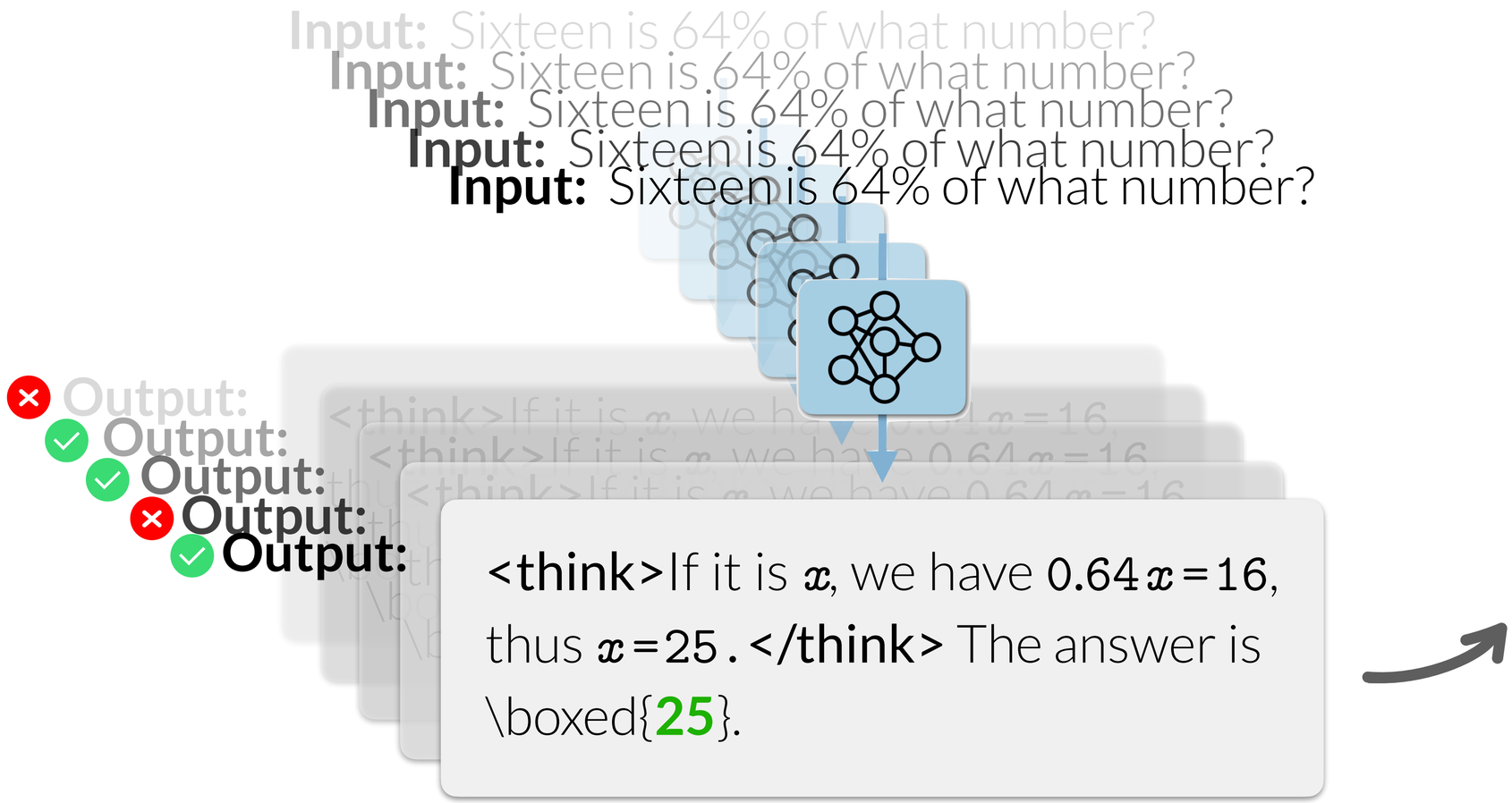

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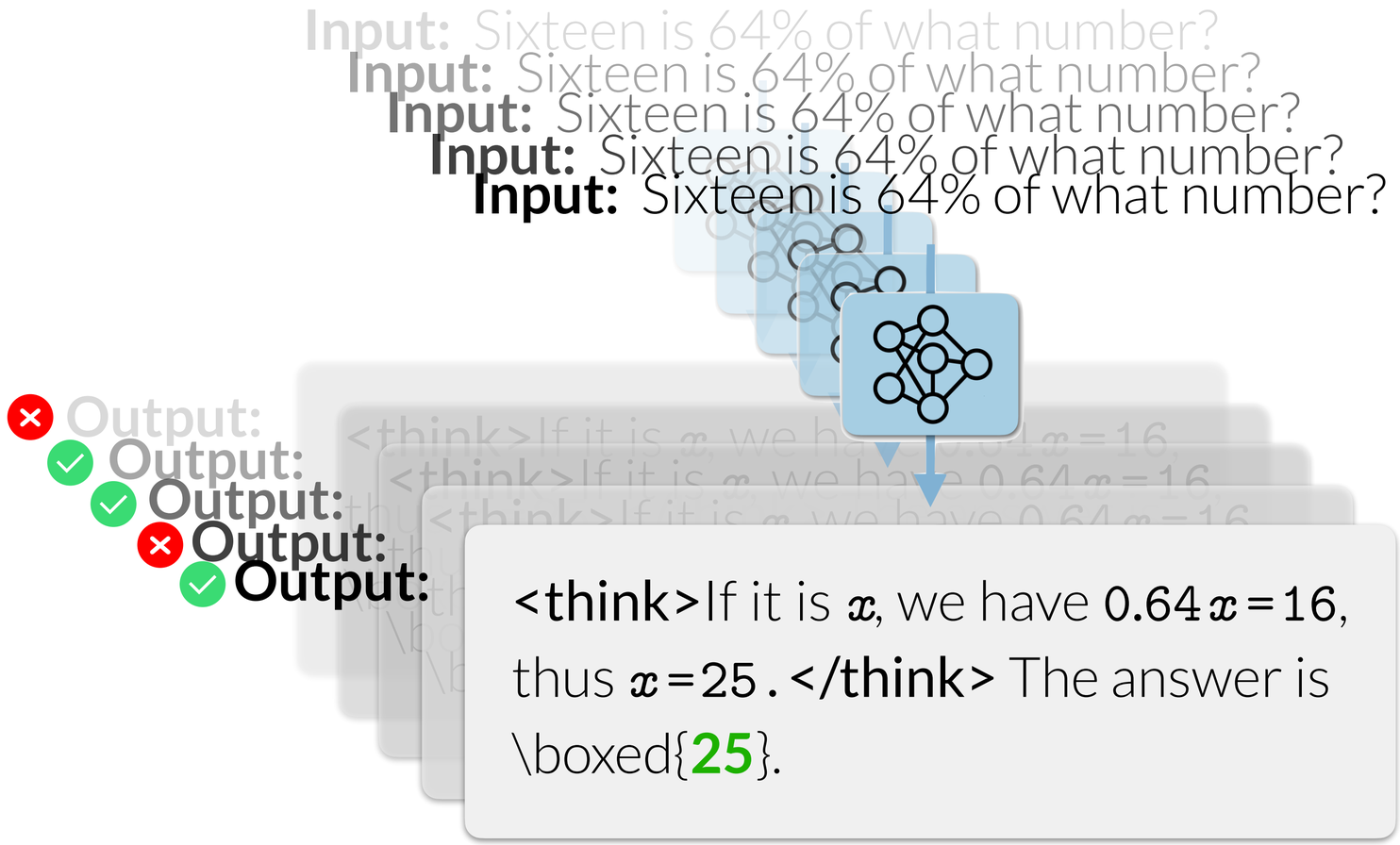

Pass@1: 0.6

Pass@5: 1.0

Cons@5: 1.0

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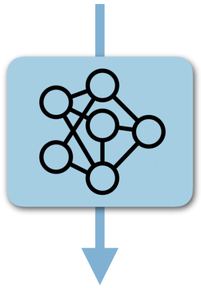

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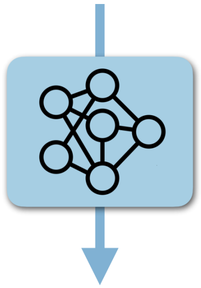

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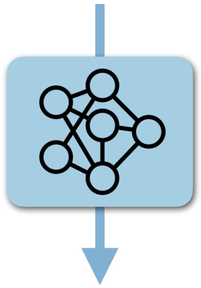

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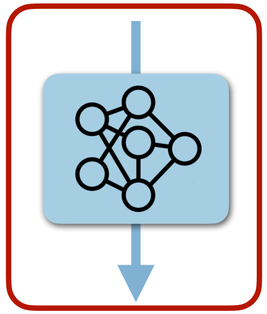

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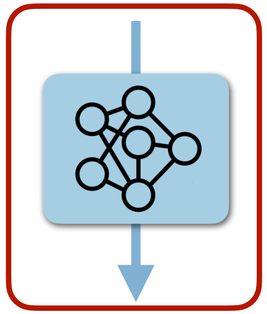

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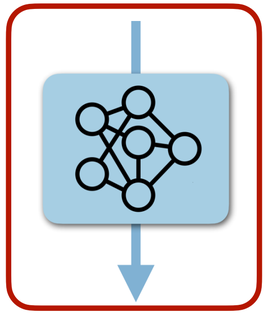

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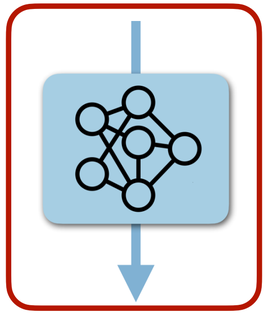

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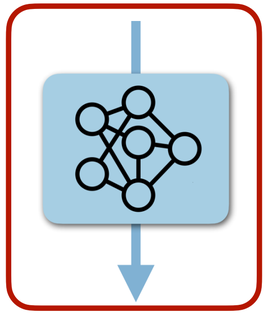

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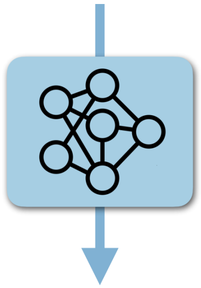

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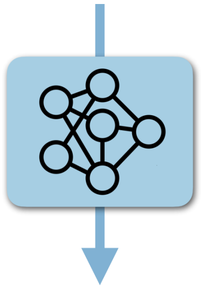

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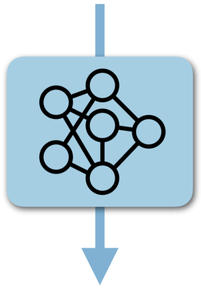

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Please check our paper to see more details on design and evaluation!

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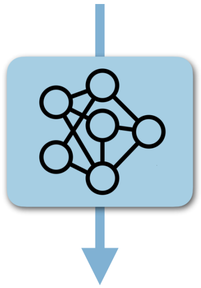

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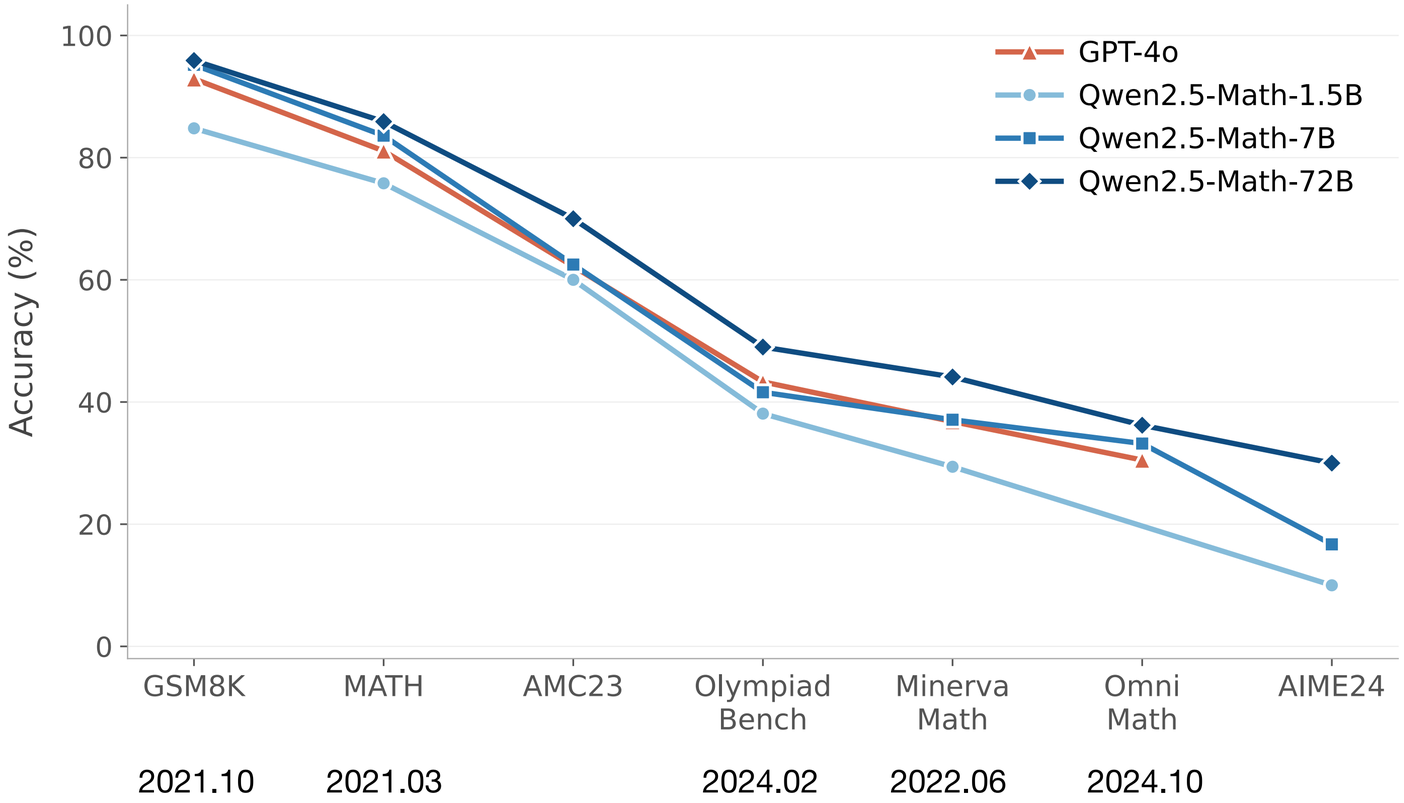

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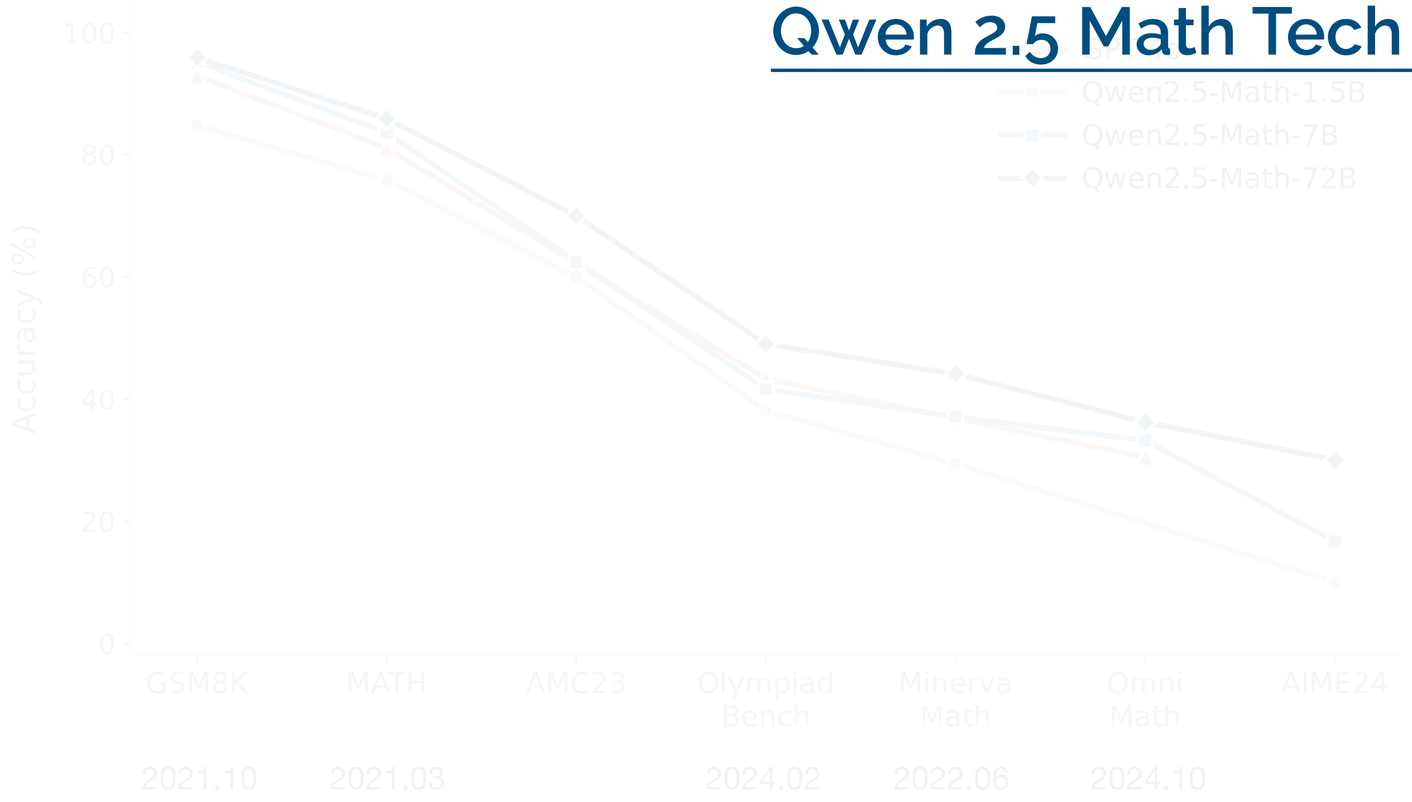
Qwen 2.5 Math Tech Report



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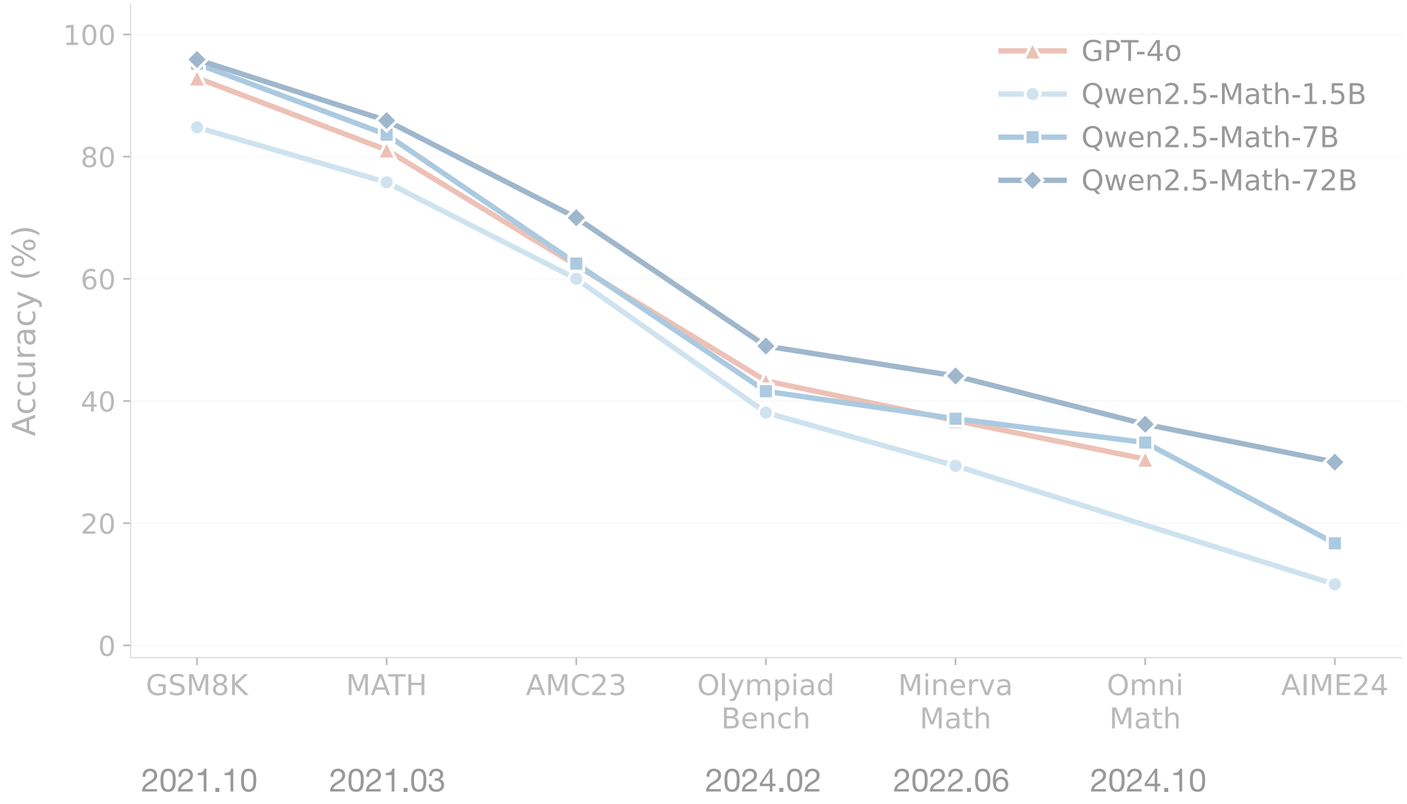

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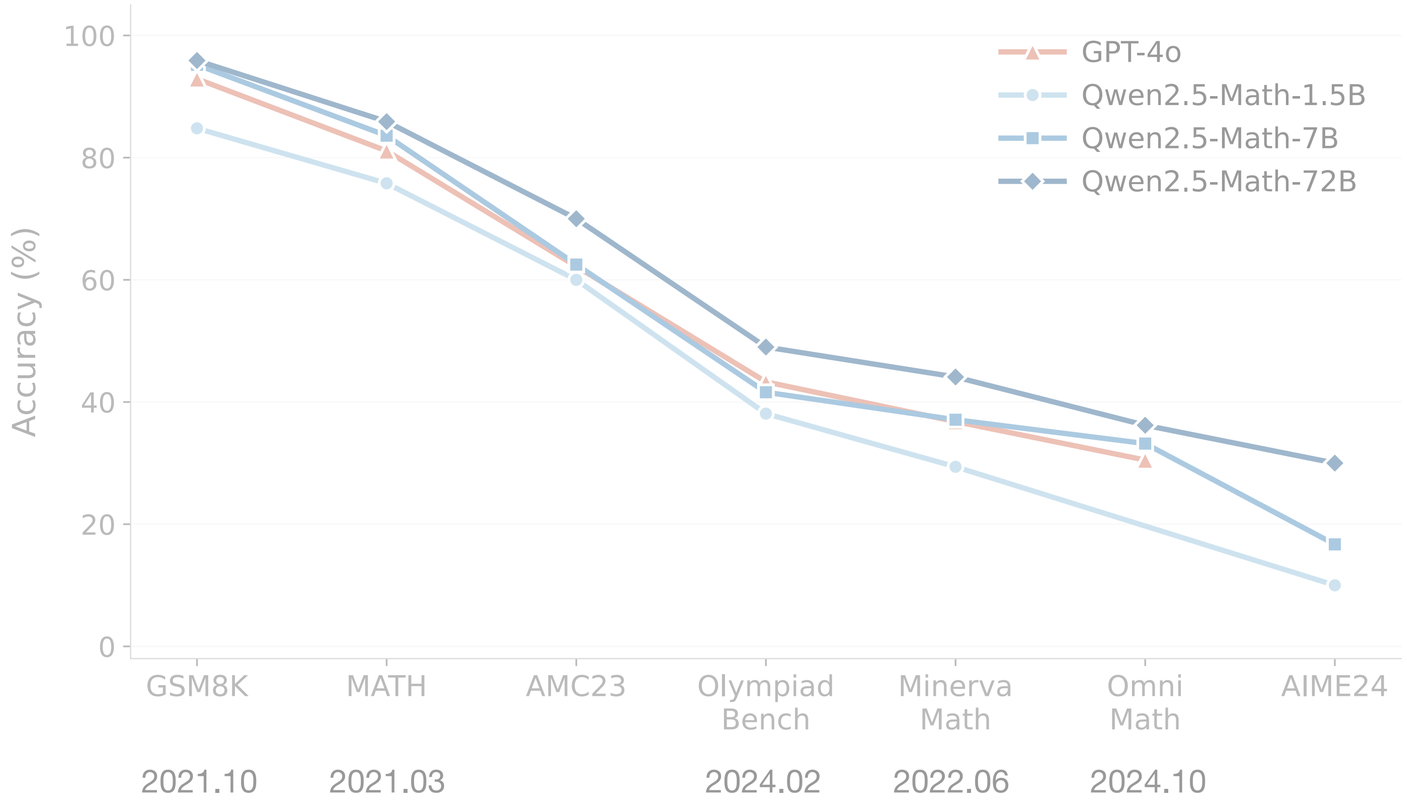

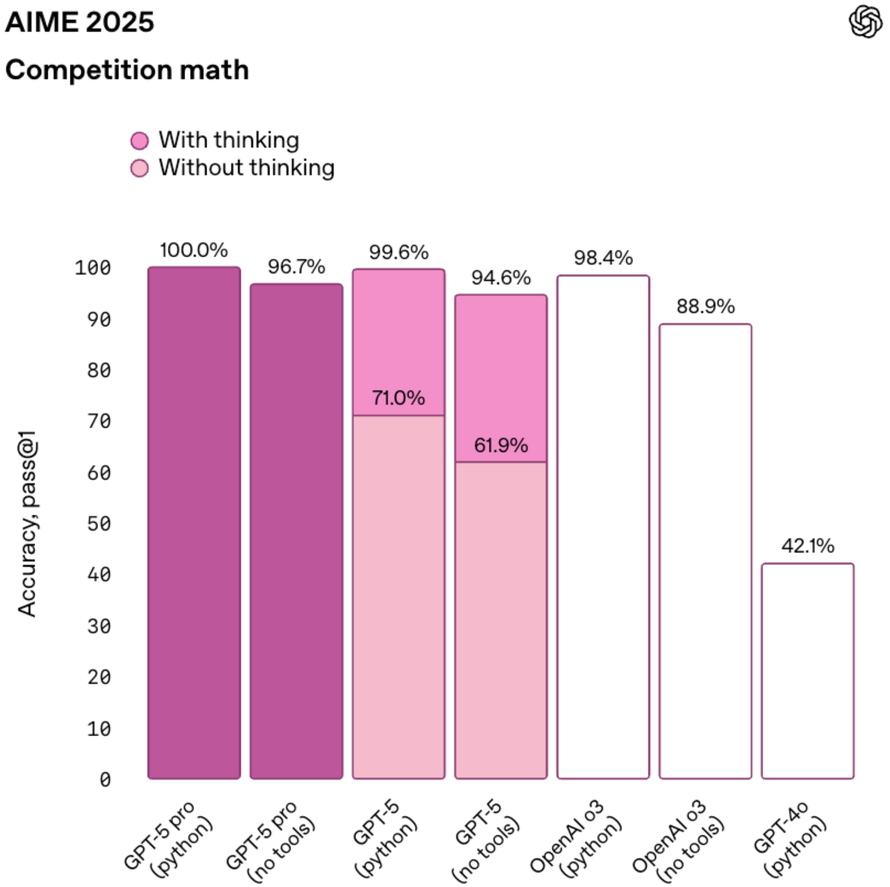

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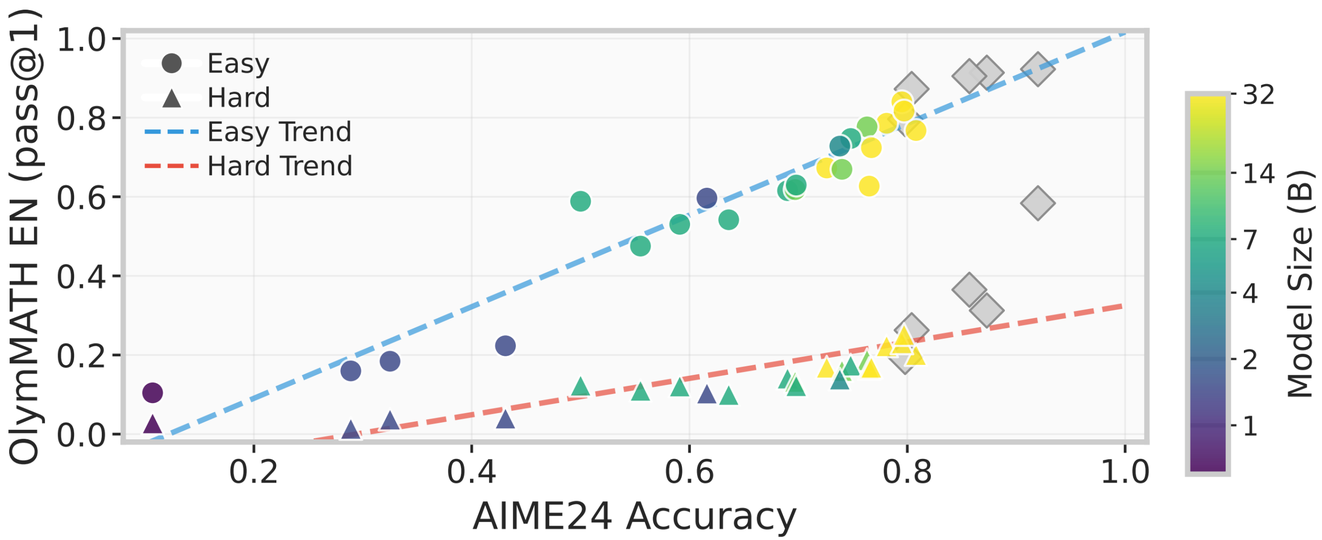

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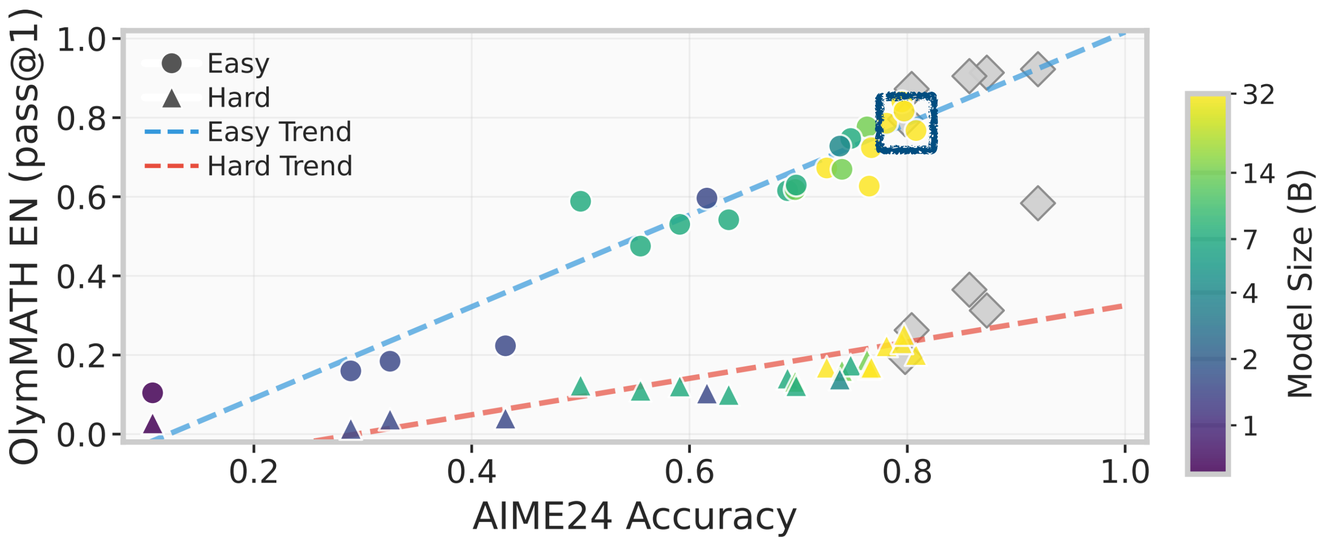

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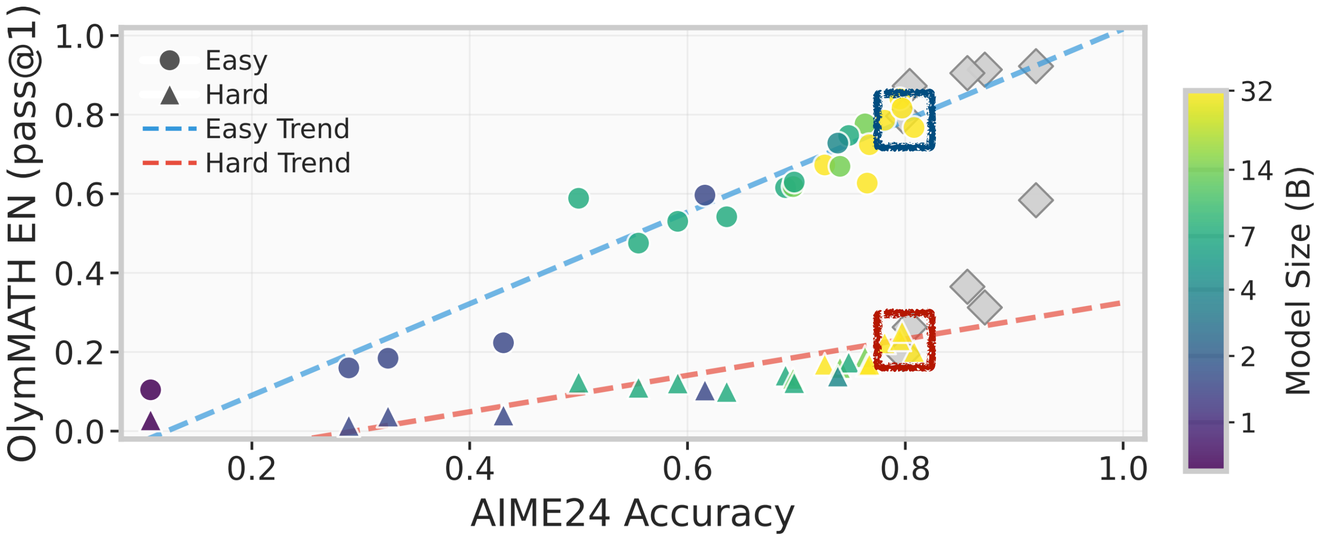

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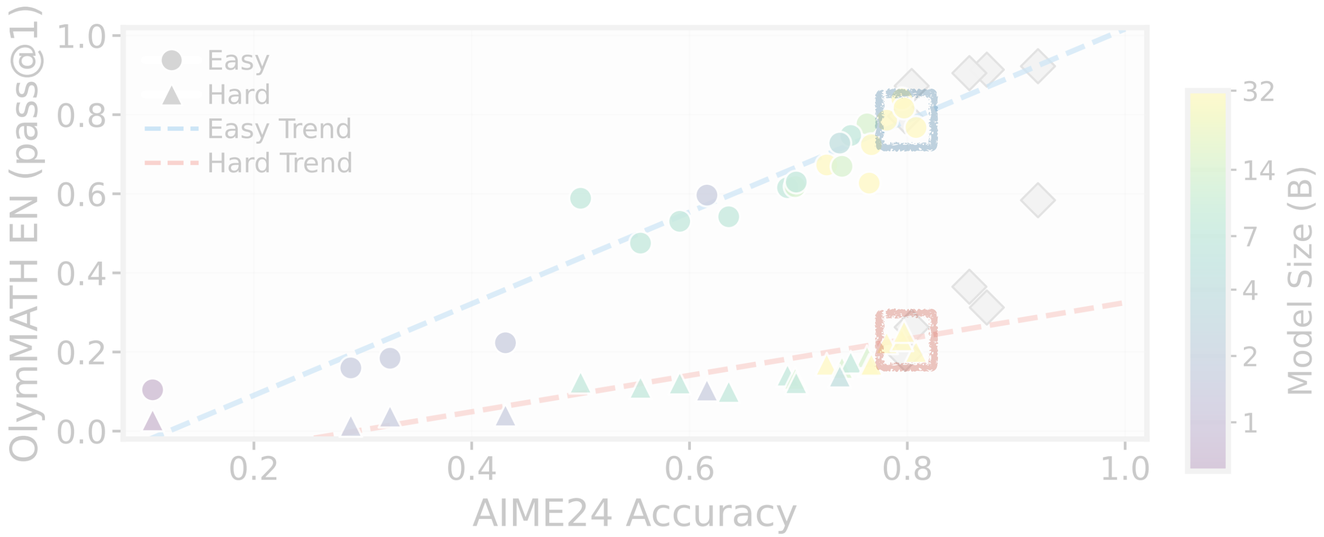

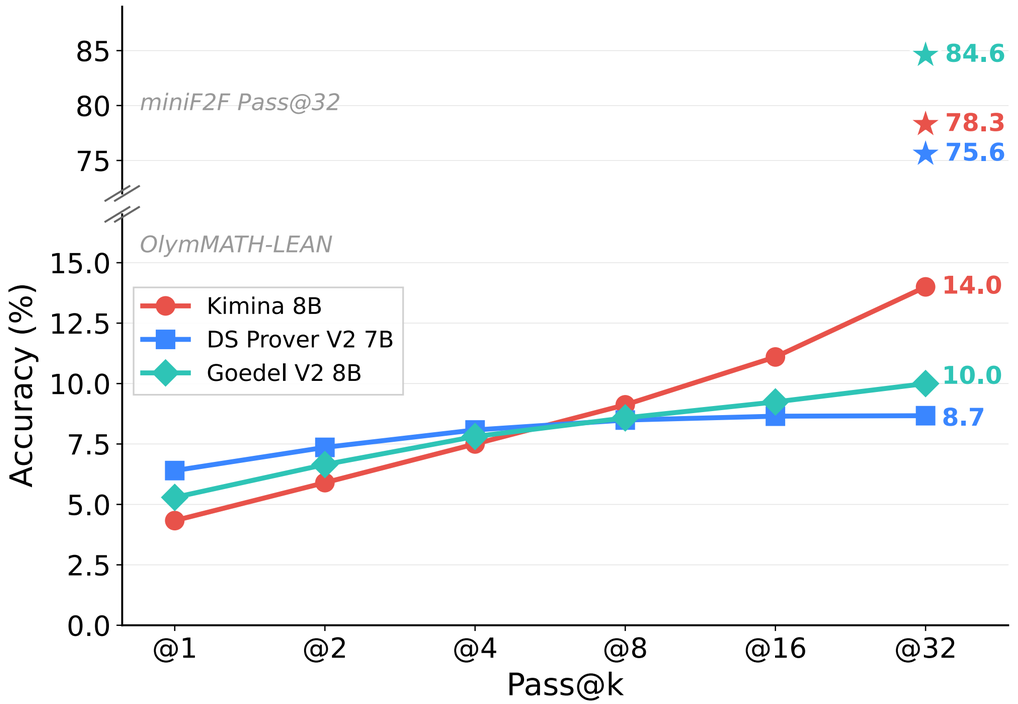

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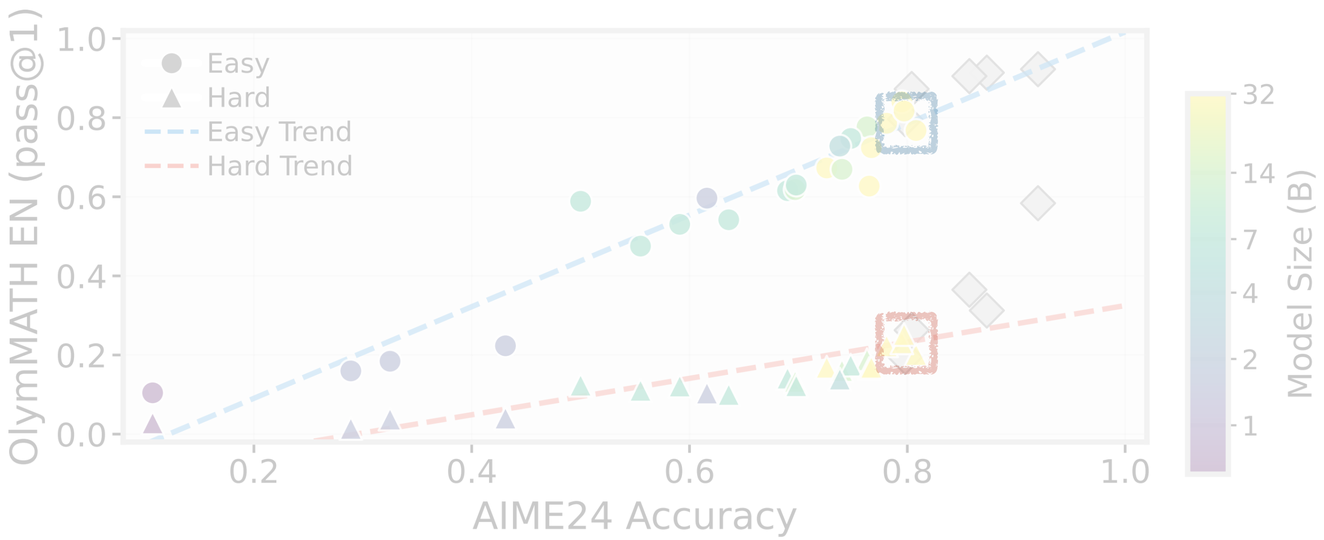

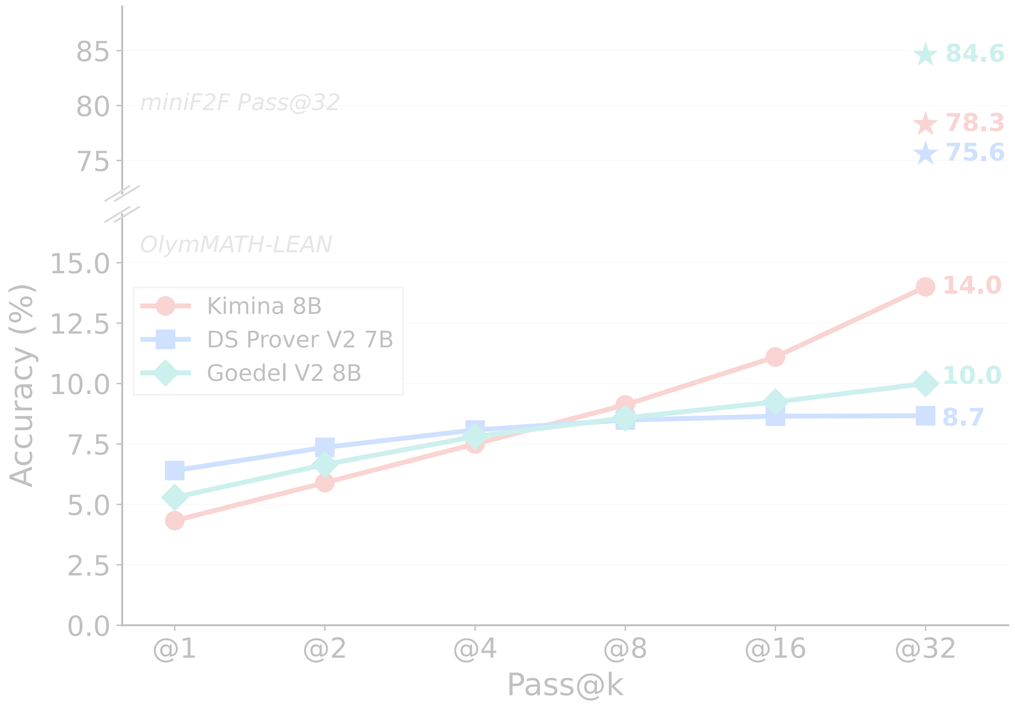

Motivation

Challenging Enough? **Reliable Enough?** Rigorous Enough?

Motivation

Challenging Enough? | Reliable Enough? | Rigorous Enough?

- Data Leakage
- Multilingual
- Statistical Stability

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MMLU	1000	13.20	28.40	13.50	9.00	12.10	11.50	11.70	9.20
MMLU-Pro	1000	5.50	16.20	7.10	5.40	6.00	6.30	7.40	6.90
AIME-2024	30	0.00	0.00	10.00	3.30	6.70	40.00	40.00	13.30
GSM8K	1000	0.00	5.00	5.00	0.80	6.90	0.70	74.20	7.30
MATH-500	500	0.60	3.20	0.60	7.80	0.80	0.80	0.80	8.20
MGSM	250	0.00	0.00	5.60	1.60	35.60	0.80	72.80	6.00

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Example from MATH-500

Problem: For how many positive integers $n > 1$ is it true that 2^{24} is a perfect n^{th} power?
Answer: $\boxed{7}$

Partial Prompt

Prompt: For how many positive integers $n > 1$ is

Qwen2.5-7B Output

it true that 2^{24} is a perfect n^{th} power?
To determine for how many positive integers $n > 1$ the number 2^{24} is a perfect n-th power...
Let's count these values. There are 7 such values...
The final answer is $\boxed{7}$.

Llama3.1-8B Output

the set of positive divisors of n (including 1 and n) less than 50 ?
(A) 15 **(B)** 16 **(C)** 17 ...
The number of positive divisors of n is given by...
The number of factors of each of these numbers is...
The answer is $\boxed{\textbf{(B)}\ 16}$

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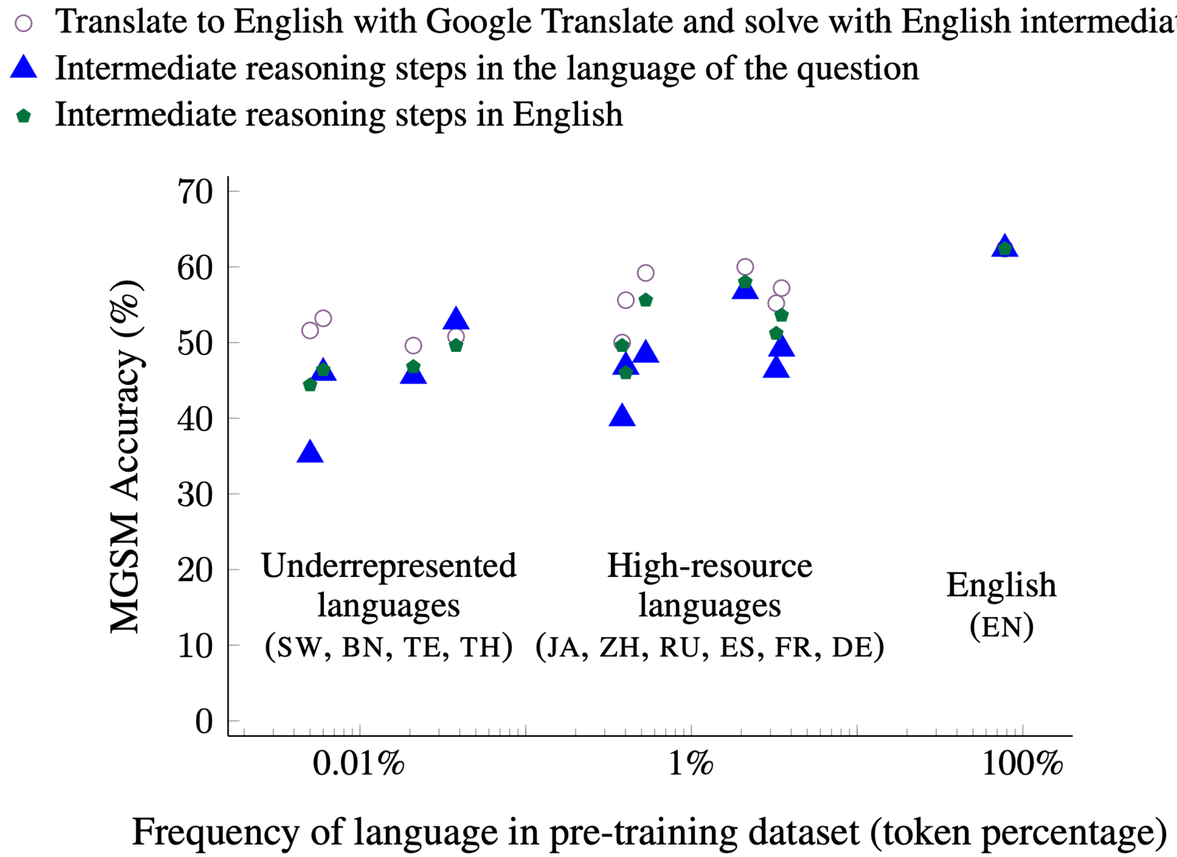

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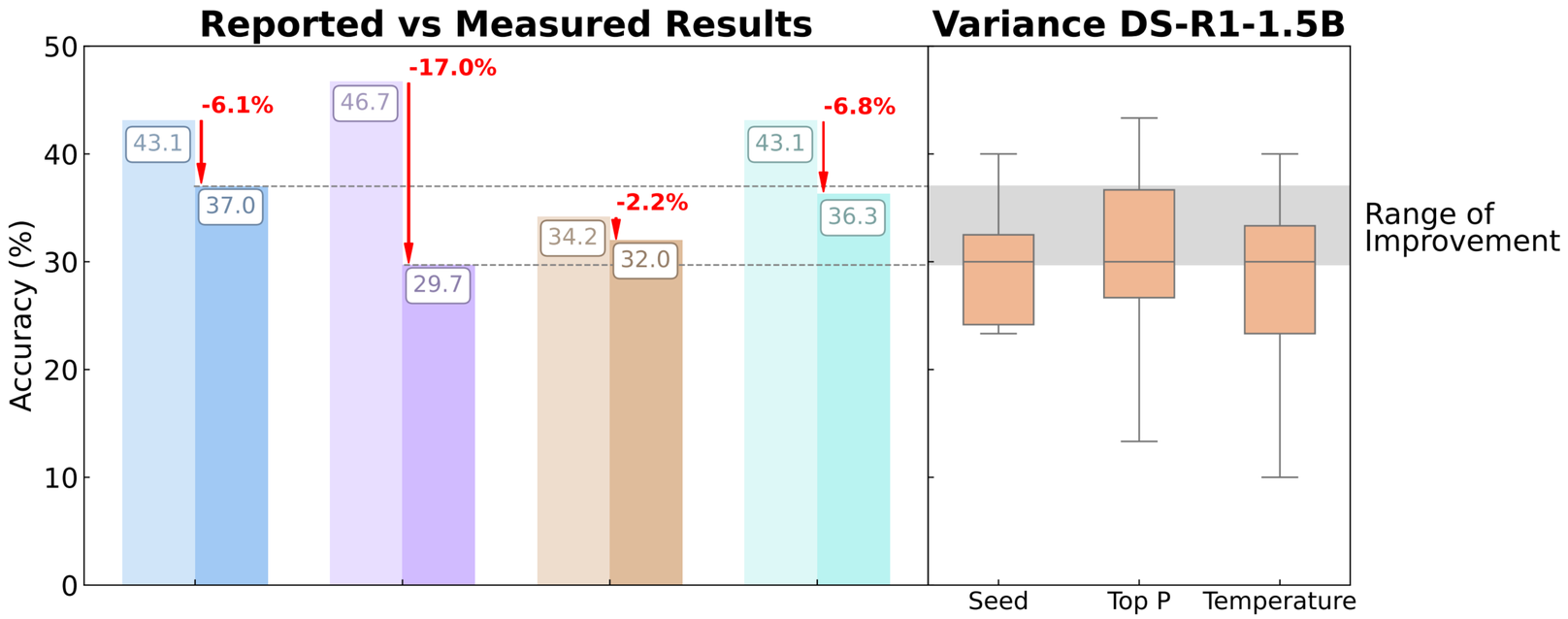

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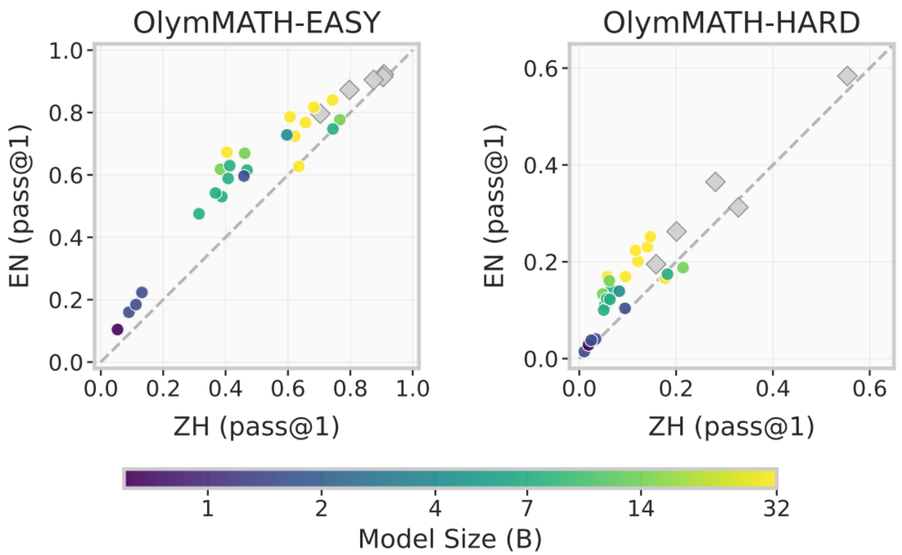

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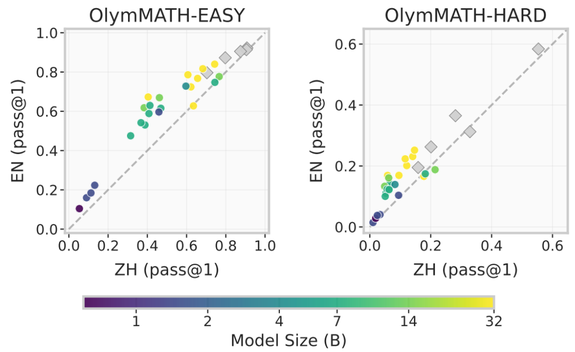

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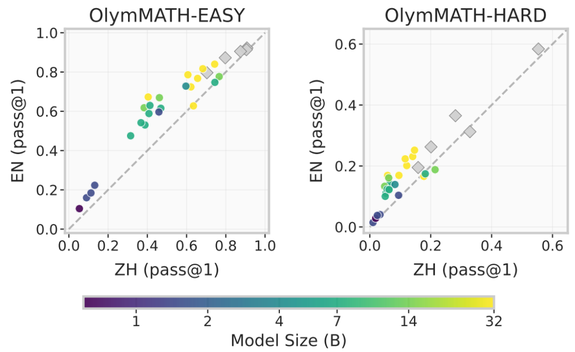

- **Statistical Stability**
  - We have significant more problems than concurrent works (w/ same difficulty)

Motivation

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Motivation

Challenging Enough? Reliable Enough? Rigorous Enough?

Problem: In the triangle $\triangle ABC$, the lengths of the three sides are a, b, c, satisfying the condition $2a^2 + b^2 + c^2 = 4$. Find the maximum value of the area of $\triangle ABC$.

Answer: $\frac{\sqrt{5}}{5}$. (When $a = \frac{2}{\sqrt{5}}, b = c = \sqrt{\frac{6}{5}}$)

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The problem involves maximizing the area of an isosceles triangle with sides a, b, b under the constraint $2a^2 + b^2 + c^2 = 4$. By assuming $b = c$, we derive a formula for the area in terms of b and find the maximum area by expressing it as a function of $u = b^2$. We then determine the critical points of this quadratic function, identify the maximum area, and finally recover the side lengths to verify that they satisfy the original constraints. The maximum area achieved is $\frac{\sqrt{5}}{5}$.

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Let's detect the keywords! (WLOG, etc.)

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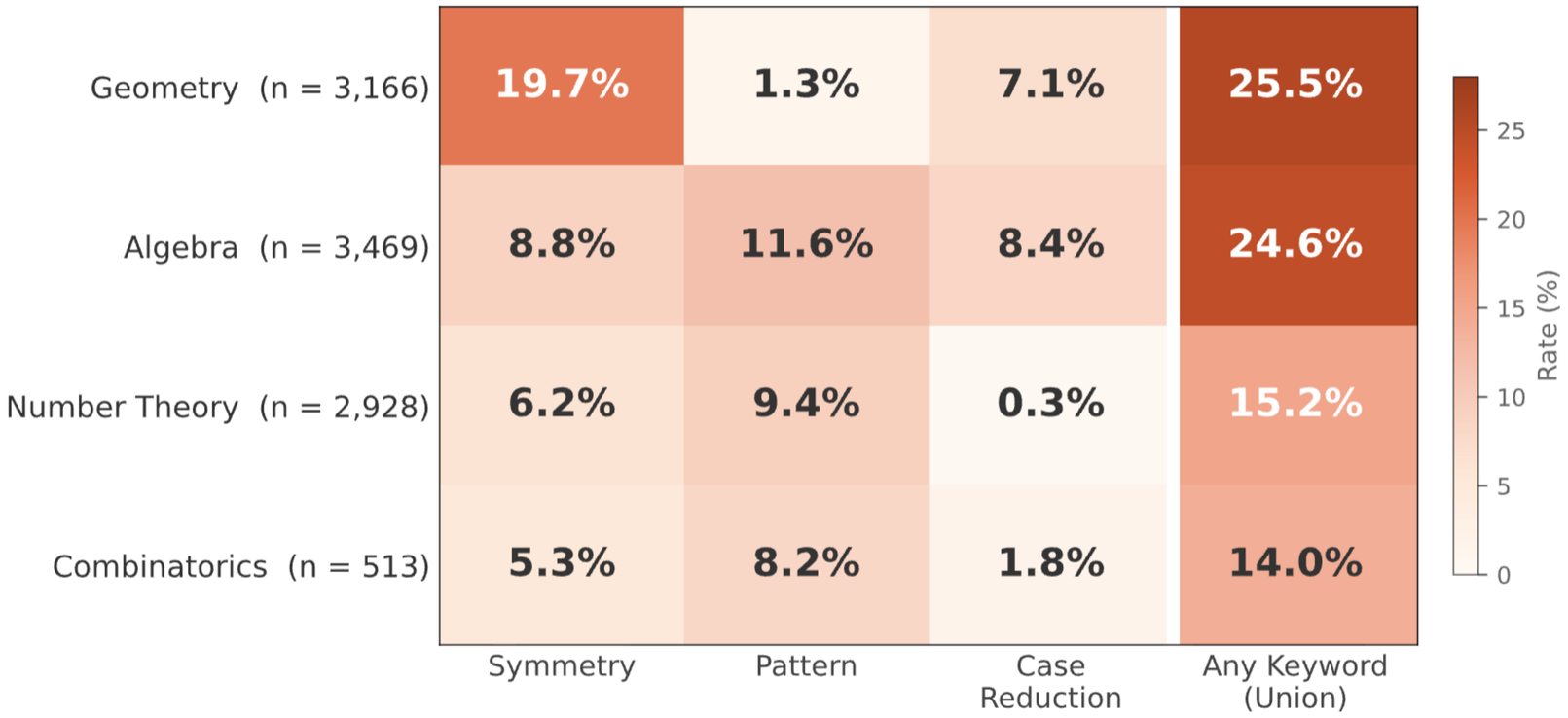

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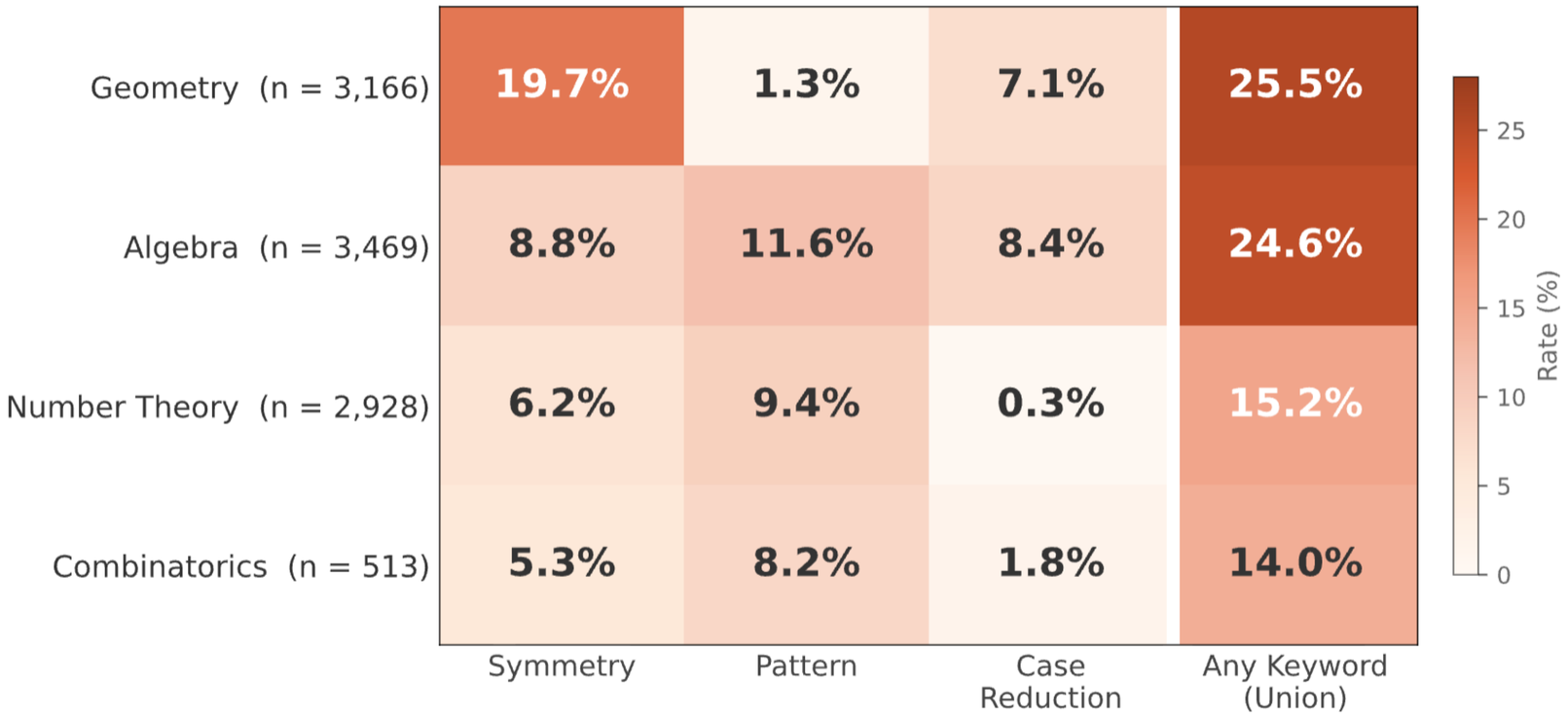

Stronger models even have higher keyword rate!

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Let's do LLM-as-Judge?

Design

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LLM Evaluators Recognize and Favor Their Own Generations, …

Design

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Let's do LLM-as-Judge?

Let's create a Lean subset!

Design

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Lean encodes proofs as programs, so proof correctness reduces to type-checking.

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- **Iterative Refine w/ environment**: Claude Opus 4.5 is prompted to interact with Lean REPL server and iteratively refine (Can be parallelized using Claude Code subagent)
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Please see more details in our paper!

Conclusion:

Conclusion: OlymMATH

Problem-EN: Find the remainder of $\sum_{k=0}^{1234} \binom{2016 \times 1234}{2016k}$ modulo 2017^2 (provide the value in the range $[0, 2017^2)$).
Answer: 1581330. **Subject:** Number Theory.

Subject: Number Theory. **Formal Statement:**

```
theorem to_prove
  (n : Nat) (p : Nat) (hp : p.Prime)
  (hdiv : p | 2^n + 1) : p % 8 != 7 := by sorry
```

OlymMATH-EASY

100 Problems

AIME Level

EN / CH

OlymMATH-HARD

100 Problems

More Challenging

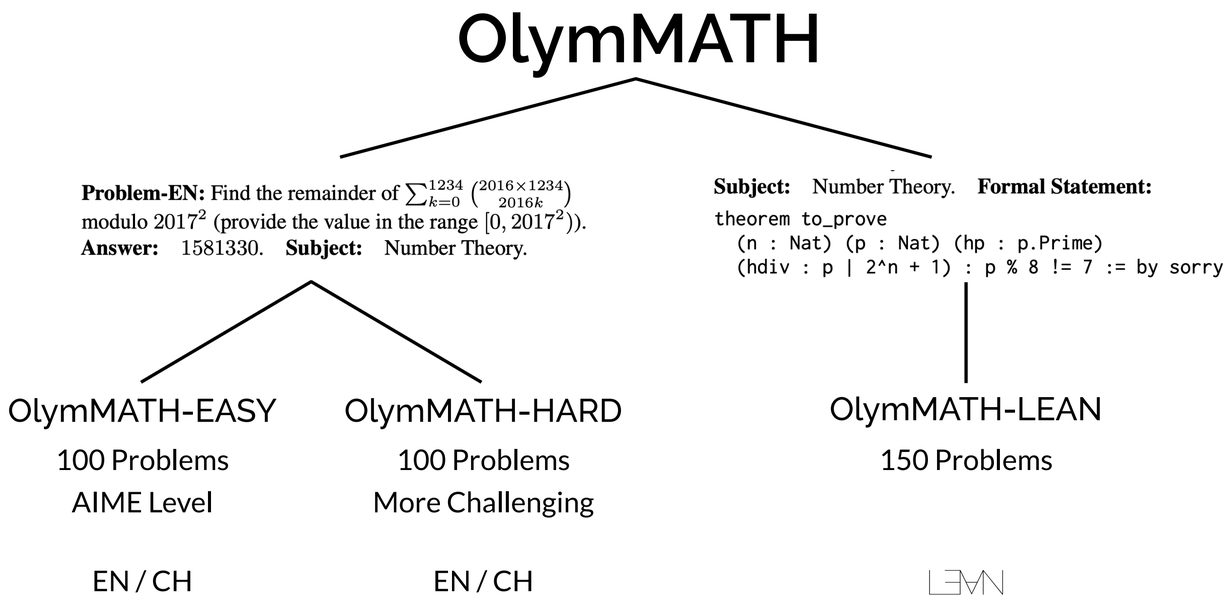
EN / CH

OlymMATH-LEAN

150 Problems

LEAN

Conclusion: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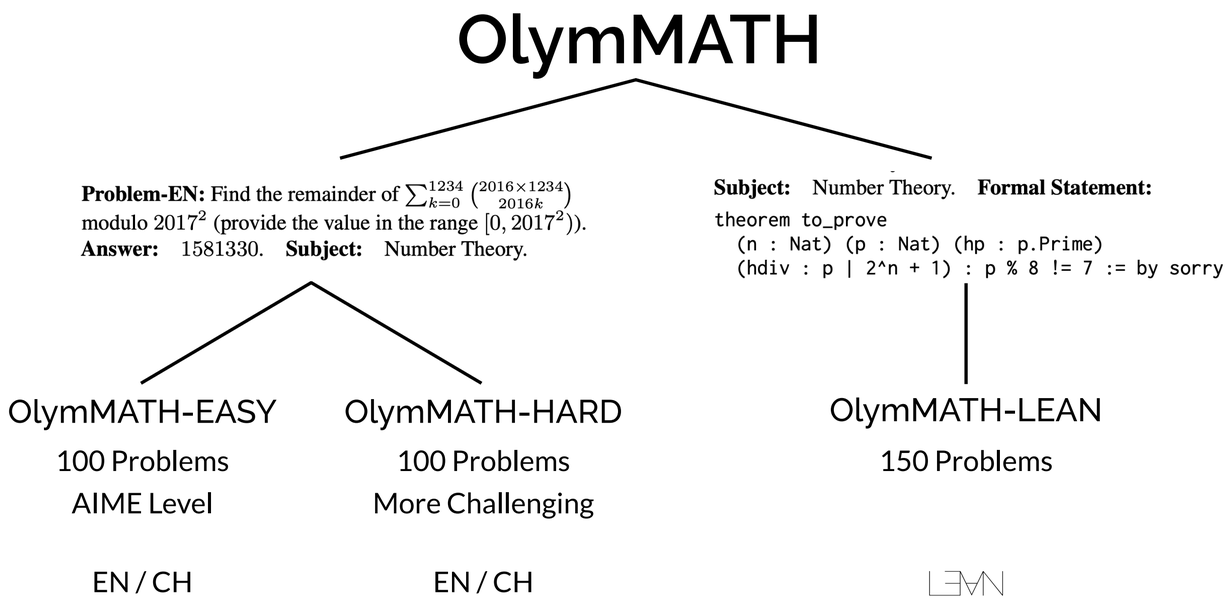

- **Challenging**: Our EASY subset aligns AIME difficulty (to provide more robust evaluation of weaker LLMs); HARD and LEAN are even more challenging
- **Reliable**: Expert manual verification; Bilingual evaluation reveals EN-ZH gap; More statistically stable evaluation
- **Rigorous**: More fine-grained process-level verfication with Lean
- **Open-source**: Releasing 582k+ reasoning trajectories, a visualization tool, expert solutions, and Lean synthesis multi-agent pipeline

OlymMATH in the Wild

- **RL Training & Optimization**: Pass@k Training, Beyond Pass@1 (SvS), TreeAdv, R^2VPO, GeoRA, Adaptive Ability Decomposing (A^2D), …
- **Distillation & Data Selection**: Agent Distillation, From Correction to Mastery (SCoRe), Unified Data Selection (HES), …
- **Reasoning & Tool Use**: Code-Integrated Reasoning (CIR), Sticker-TTS, Agentic RL Scaling Law (ZeroTIR), …
- **Multi-agent Systems**: AgentDropoutV2, HSM3K-CN, …

Towards Better Evaluation of LLMs

- **Contamination Resistance**: Live & Dynamic Benchmarks

  MathArena SciDA MathDuels

- **Extended Difficulty**: Scaling from competition-level to research-level

  REALMATH CompMath-MCQ Proof2Hybrid Re^{2}Math

- **Beyond Final-answer Accuracy**: Evaluating diversity, proof rigor, …

  RIMO PROOFGRID Think360°

- **Multilingual & Multimodal**: Evaluating more languages & modalities

  MATHNET IRLBench GEOGRAMBENCH OMIBench

- **More Domains**: Evaluating reasoning on more domains

  PHYBench CMedCalc-Bench ModelingBench HumorBench

Thanks for listening!

Paper
https://arxiv.org/abs/2503.21380

GitHub
https://github.com/RUCAIBox/OlymMATH

Hugging Face
https://huggingface.co/datasets/RUC-AIBOX/OlymMATH

Have any questions? Please send an email to `hxiang.sun@gmail.com`

X: @CoderBak Personal Website: `hxiang-sun.github.io`