Efficient RL for Large Language Models
with Intrinsic Exploration (PREPO)

GitHub

Paper

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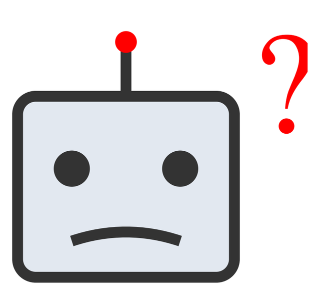
TL;DR

PREPO reduces Reinforcement Learning (RLVR) training costs by **3x**. It uses "intrinsic" metrics—Prompt Perplexity & Rollout Entropy—to filter data, guiding exploration.

1. The Problem



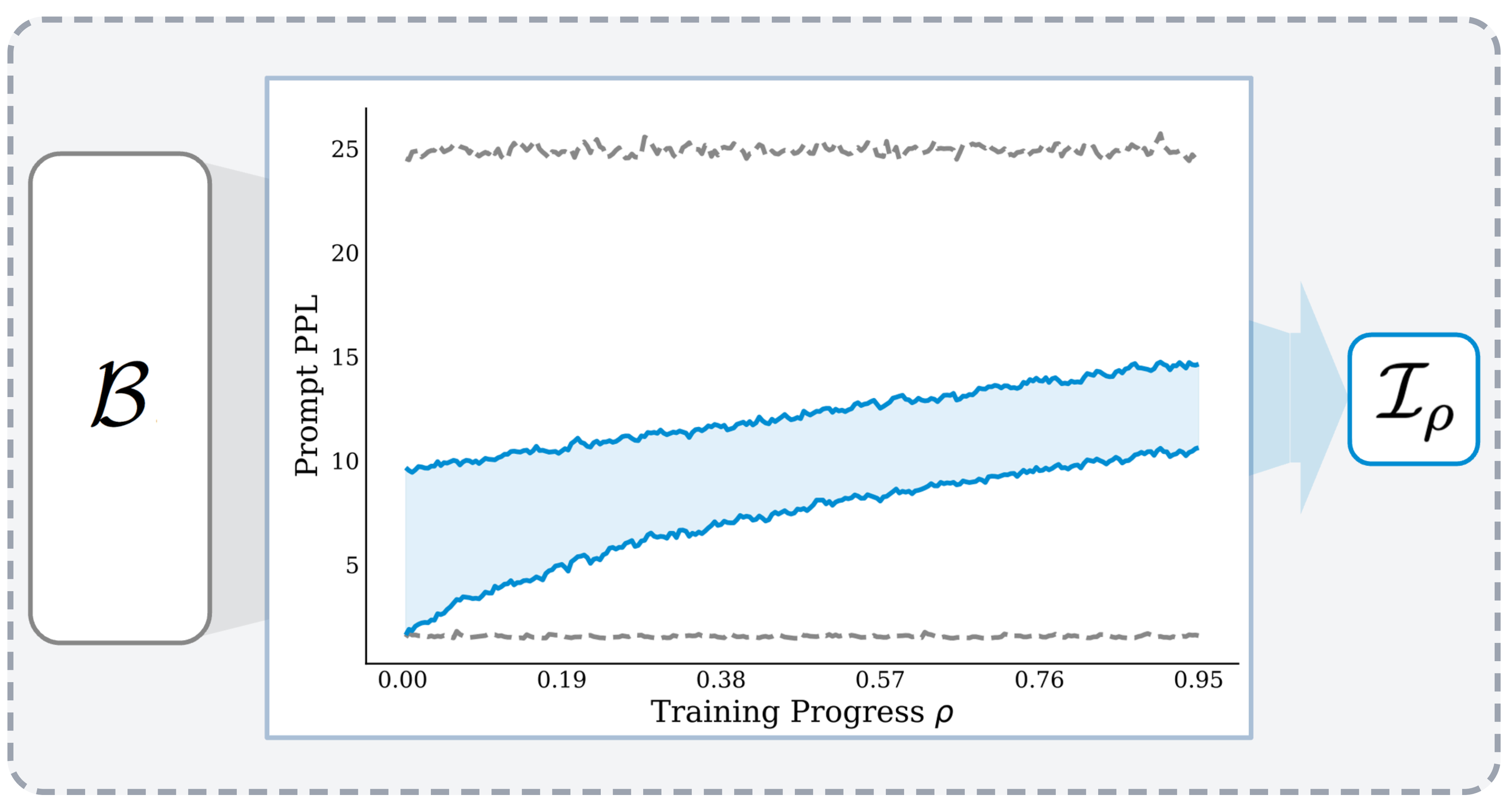
- **Costly:** Standard RLVR generates thousands of rollouts.
- **Inefficient:** Many samples are too easy or too hard (zero advantage).
- **Goal:** Data-efficient RLVR training using data intrinsic properties.

2. Method: Online Prompt Selection

Strategy: Prompt Perplexity

Use perplexity as a proxy for adaptability. Train on **Low PPL** to **High PPL** prompts.

$$P(\rho) = \exp\left(-\frac{1}{N}\sum_{t=1}^{N}\log p(x_t|x_{prev})\right)$$

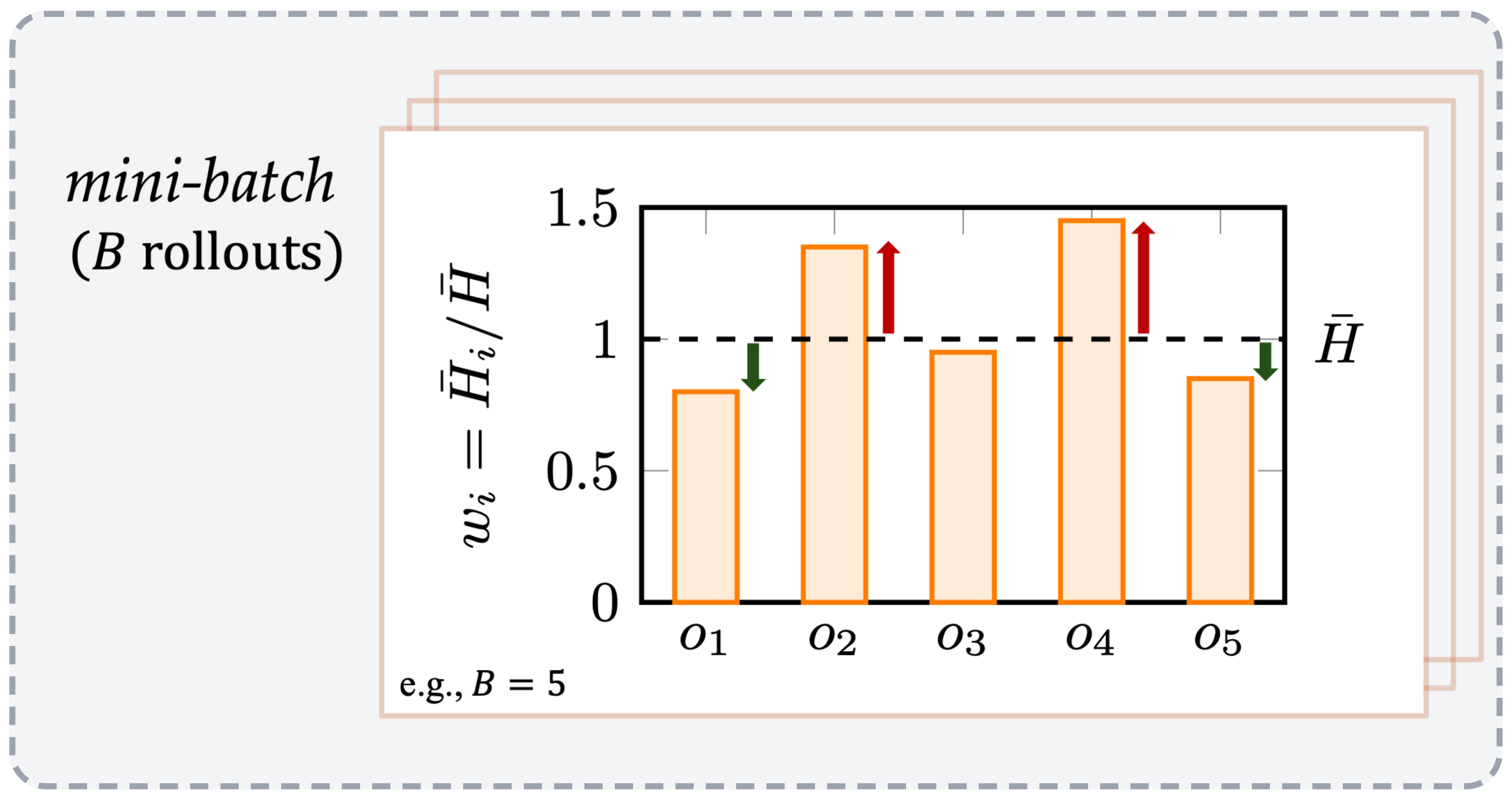


3. Method: Rollout Weighting

Strategy: Relative Entropy

Prioritize diverse reasoning paths. Weight rollouts by their average token-level entropy.

$$w_i = \frac{\bar{H}_i}{\bar{H}}, \quad \bar{H}_i = -\frac{1}{|o_i|}\sum_{t=1}^{|o_i|}\sum_{v\in V} p(v|x_t)\log p(v|x_t)$$



4. Results

Tested on **Qwen** & **Llama** (MATH500, AIME, Olympiad).