

# Towards Scalable Reliable Automated Evaluation via LLMs

*LLMs judge each other — Elo-ranked, expert-level evaluations at a fraction of the cost*

Bertil Braun, Martin Forell

## Why This Matters - LLM outputs are hard to score:

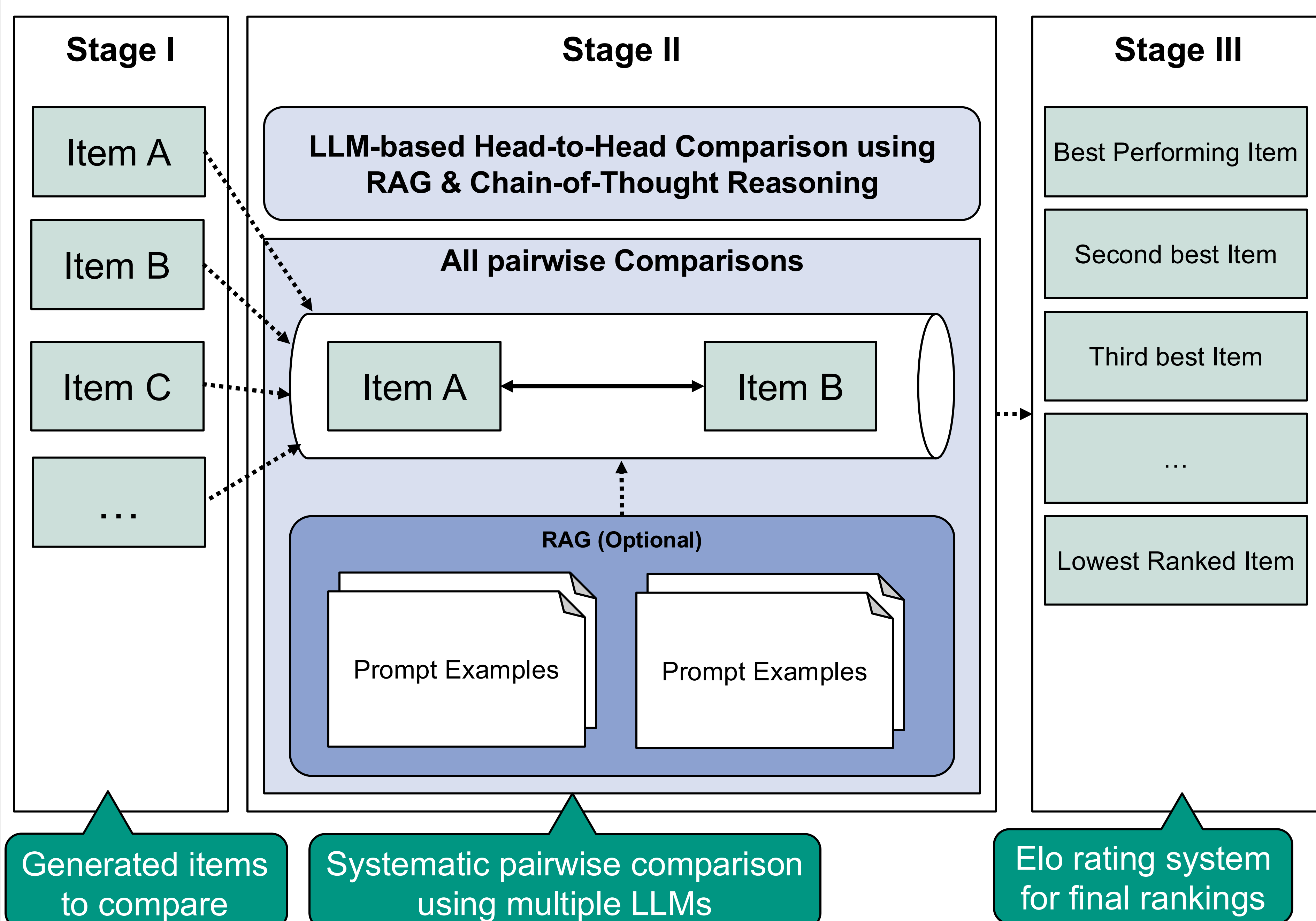
- **Resource-intensive:** Human evaluation doesn't scale
- **Inconsistent:** Traditional metrics miss nuanced quality
- **Biased:** Single-LLM judgments suffer from positional/verbosity biases

We show that a **crowd of LLMs**, voting pair-wise and aggregated with Elo, reproduce expert rankings while reducing manual effort.

## Key Contributions: Multi-LLM Pairwise Comparison + Elo Rating

- **Multiple LLMs** evaluate pairs **bidirectionally**
- **Elo system aggregates** judgments into stable, interpretable rankings ( $\Delta 100$  pts  $\approx 64\%$  win-prob)
- Adjustable **agreement thresholds** (majority  $\rightarrow$  consensus)

## Solution: Multi-LLM Pairwise Evaluation with Elo Rankings



## Method

- **Prompt engineering:** Role prompt  $\rightarrow$  RAG few-shots  $\rightarrow$  Chain-of-Thought  $\rightarrow$  structured-JSON verdict
- **Bias shields:** Bidirectional evaluation (A vs B, B vs. A) + 5 diverse LLMs
- **Agreement:** Threshold (1.0–0.5) decides draw vs. Elo update; majority (0.5) best
- **Elo system:** Updated after each decision:  

$$R_{new} = R + K(\text{Score} - E),$$
 E = expected win probability

## Limitations

- **Computational overhead:**  $O(n^2)$  comparisons become costly at scale
- **Draw sensitivity:** High thresholds ( $>0.75$ ) produce excessive draws
- **Similar items:** LLMs struggle with subtle quality differences
- **Domain dependency:** Requires task-specific prompt engineering

## Results at a Glance

- **Strong correlation** with expert rankings (Spearman's  $\rho$ ): Multi-LLM = 0,83 vs. Single-LLM = 0,85
- **Multi-LLM** approach demonstrates improved robustness to conflicting judgments.
- **Majority threshold (0,5)** most effective for result aggregation
- Validation: **20 domain experts** ranked generated competency profiles

## Key Finding:

Multiple LLMs + Elo rankings achieve expert-level assessment quality while **maintaining scalability**.