

PROMPT ENGINEERING AI AS A NOVEL EXPERIENTIAL LEARNING OPPORTUNITY IN CRITICAL THINKING

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CONTEXT

- Major concern: students and knowledge workers using AI will lead to deterioration in their critical thinking skills (Chan 2023, Lee 2025)

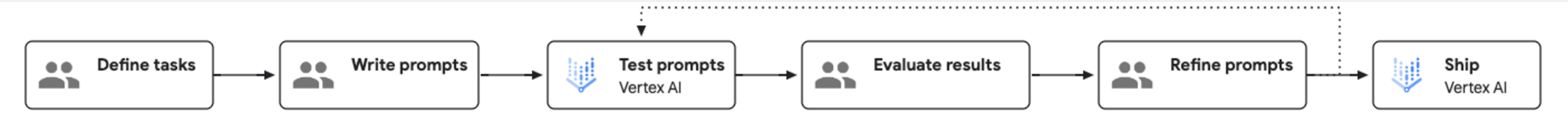
OUR PROPOSAL

- What if structured, iterated, prompt engineering exercises could actually **enhance critical thinking** by providing experiential learning activities for critical thinking?
- Create AI-aware assessments by establishing “bare minimum” standards from AI

METHODOLOGY

Compare:

- Current best practise prompt engineering techniques
 - Chain-of-Thought, Tree-of-Thoughts, zero/one/few-shot learning, debate
 - “give clear and specific instructions”, “add contextual information”, “explain reasoning”, “give constraints”



(e.g., from Google’s [prompting strategies](#))

- Critical thinking pedodogical techniques in higher education
 - Problem-based learning (PBL); collaborative learning; Socratic (open-ended) questioning. (Prakong, 2024)
 - Integrated Cogency Method (ICM; Bates et al., 2024)
 - writing assignments using statistics as evidence, group discussions, and Socratic dialogue led by instructors
 - Dialogue based critical thinking classroom scenario (Archila et al., 2021)
 - argumentation, arguments identification, arguments evaluation, decision-making, and controversial questioning

TERMINOLOGY

- Experiential learning = learning by doing + reflective observation
- Critical Thinking = ability to filter, analyze, evaluate, and synthesize information while considering multiple perspectives and potential outcomes
- Prompt Engineering = process of editing input prompts to AI

EXAMPLE 1

Consider: What does “non-critical thinking” look like?

The Anatomy of an o1 Prompt

I want a list of the best medium-length hikes within two hours of San Francisco.

Each hike should provide a cool and unique adventure, and be lesser known.

For each hike, return the name of the hike as I'd find it on AllTrails, then provide the starting address of the hike, the ending address of the hike, distance, drive time, hike duration, and what makes it a cool and unique adventure.

Return the top 3.

Be careful to make sure that the name of trail is correct, that it actually exists, and that the time is correct.

...

For context: my girlfriend and i hike a ton! we've done pretty much all of the local SF hikes, whether that's presidio or golden gate park. we definitely want to get out of town -- we did mount tam pretty recently, the whole thing from the beginning of the stairs to stinson - it was really long and we are definitely in the mood for something different this weekend! ocean views would still be nice. we love delicious food. one thing i loved about the mt tam hike is that it ends with a celebration (Arriving in town to breakfast!) The old missile silos and stuff near Discovery point is cool but I've just done that hike probably 20x at this point. We won't be seeing eachother for a few weeks (she has to stay in LA for work) so the uniqueness here really counts.

Goal

Return Format

Warnings

Context Dump

Example from https://x.com/daniel_mac8/status/1878283032215408886

To prompt well, student is required to:

- State goal in SMART format
- Have background knowledge on knowing what to ask (e.g., what is AllTrails? Why is it useful? Why did prompter as for variables such as hike distance, drive time, duration, uniqueness etc. required in this context?)
- Provide context needed to operationalise fuzzy variables (e.g., “cool” and “unique” adventure)
- Suited for e.g., business cases, cases requiring complex problem-solving, product development, experimental protocol development

EXAMPLE 2

To prompt well, student is required to:

- Conduct and lead socratic questioning
- Ask open-ended questions
- Identify strong and weak arguments
- Identify and ask controversial questions to uncover potential inconsistencies

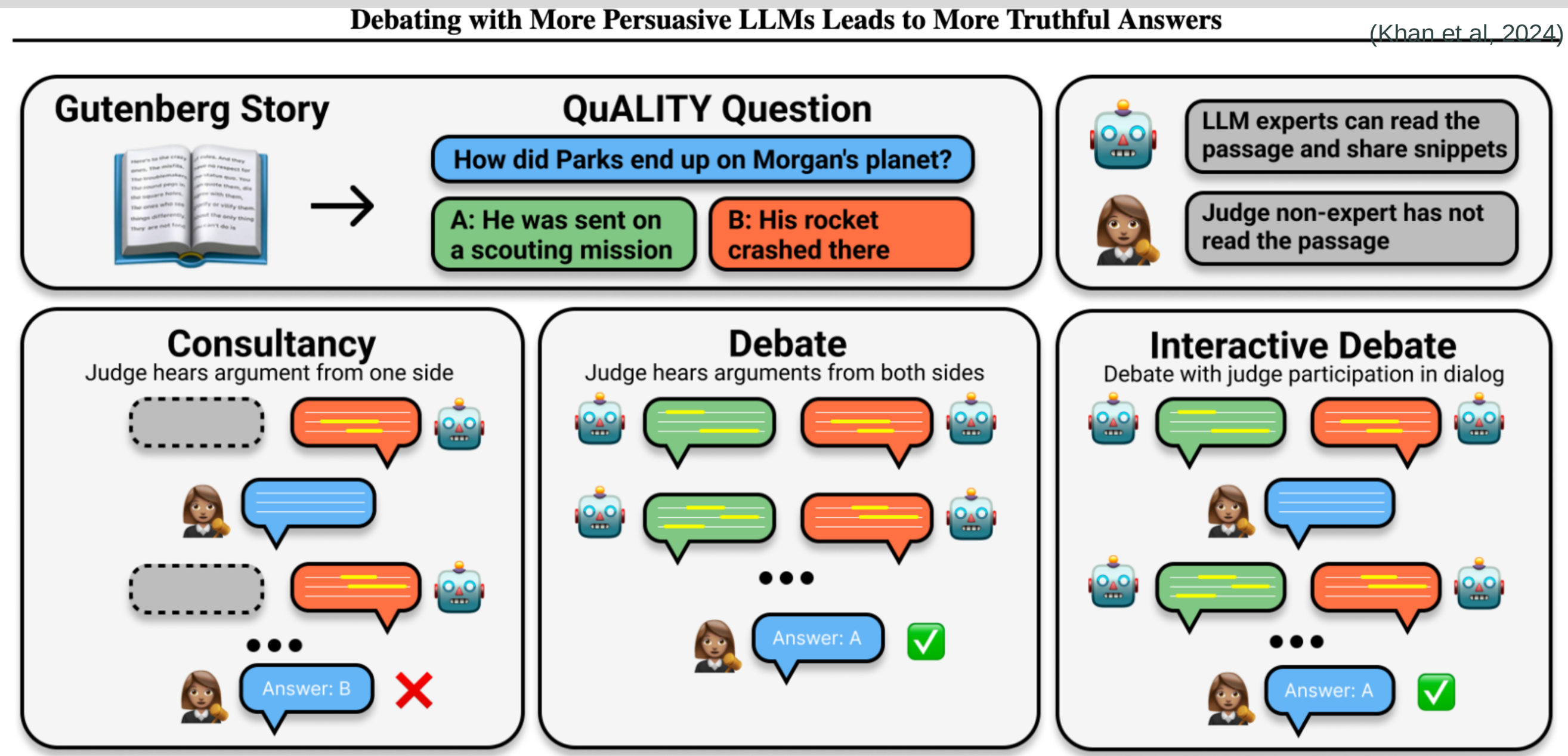


Figure 2. An illustration of our set-up. We investigate three protocols for evaluating stronger models (experts) in the QuALITY dataset. Expert models, who can access the underlying text from a project Gutenberg science-fiction story, argue for a specific answer to a comprehension question. Weaker (non-expert) judges, who cannot access the underlying text, evaluate the arguments and choose an answer. In *debate*, two experts simultaneously present arguments for a number of rounds. In *interactive debate*, the judge may ask clarifying questions after each round. In *consultancy*, a single expert argues for one of the two answers while the judge asks questions.

ADVANTAGES

- Active process
- Rapid and iterated feedback
- Trains students to think of AI output as a tool to be used for their own purposes rather than as the endpoint itself
- Incentivises critical thinking -> immediately useful output
- Process can help create learning portfolios
- Can create AI-aware assessments from these exercises that advance as AI advances

DISADVANTAGES

- Requires all students to access the same model
- Challenge is diminished when using a more advanced model
- Requires a teacher to structure the experience

Suggested mitigations:

- Specify use of the same model for all students
- Use a freely accessible open-source model or a commercial AI with free access to the “mini” or “fast” mode

CONCLUSION

- Prompt engineering can be an experiential learning activity if structured with: active experimentation, concrete experiences, reflection, iterative experimentation, learning by doing etc.
- Not all AI use necessarily degrades critical thinking skills
- Structuring prompt engineering exercises is a unique opportunity for educators to demonstrate added value in the age where lectures are freely available on multiple platforms
- Prompt engineering exercises can be easily coupled with problem-based learning, learning portfolios, and AI-aware assessments
- Students familiar with how prompting affects output quality will have an edge in the future workplace by being able to efficiently assess when and how to use these tools

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