Planning in the Dark: LLM-Symbolic Planning Pipeline **Without Experts**

Sukai Huang,
Nir Lipovetzky,
and Trevor Cohn

THE UNIVERSITY OF MELBOURNE

1. Limitations in Existing Pipeline

Fragile Pipeline: LLM-generated PDDL fail >99.9% of the time—requires ***expert***!

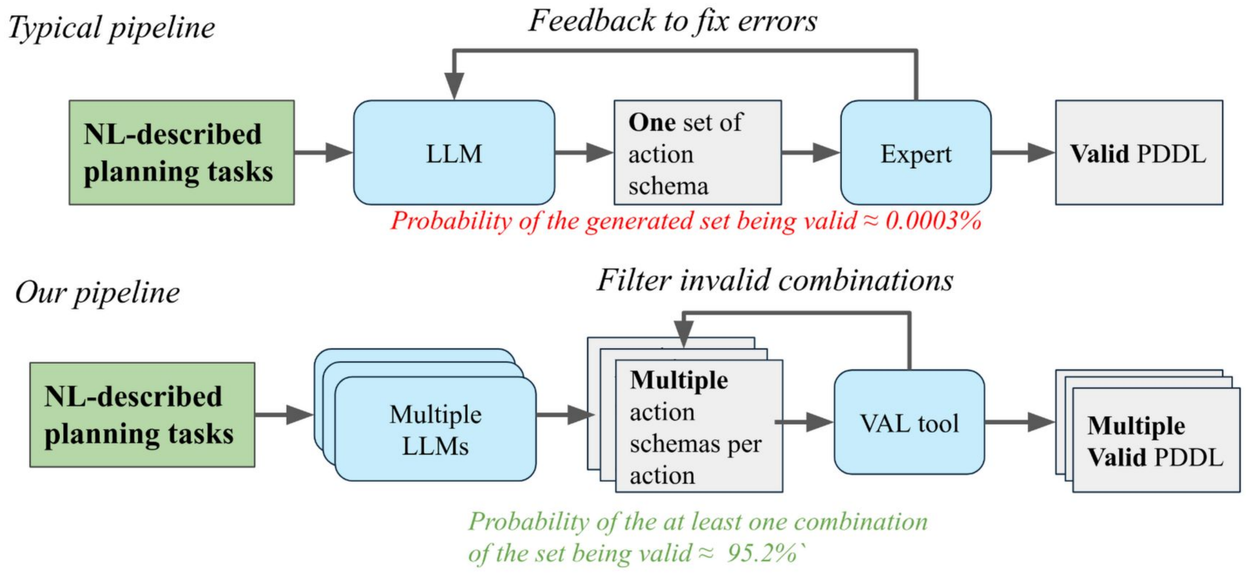
Expert Bottleneck & Bias: Heavy expert refinement (about. ***59 iterations***) + single-perspective bias

2. Solvable Schemas: A Simple Fix!

Multiple LLMs + Inter Schema Set combination: the probability of ***not*** finding a solvable set becomes $(1-p^M)^{N^M} \to 0$ where N is #LLMs, M is #actions, p is the prob. of valid action schema (single LLM)

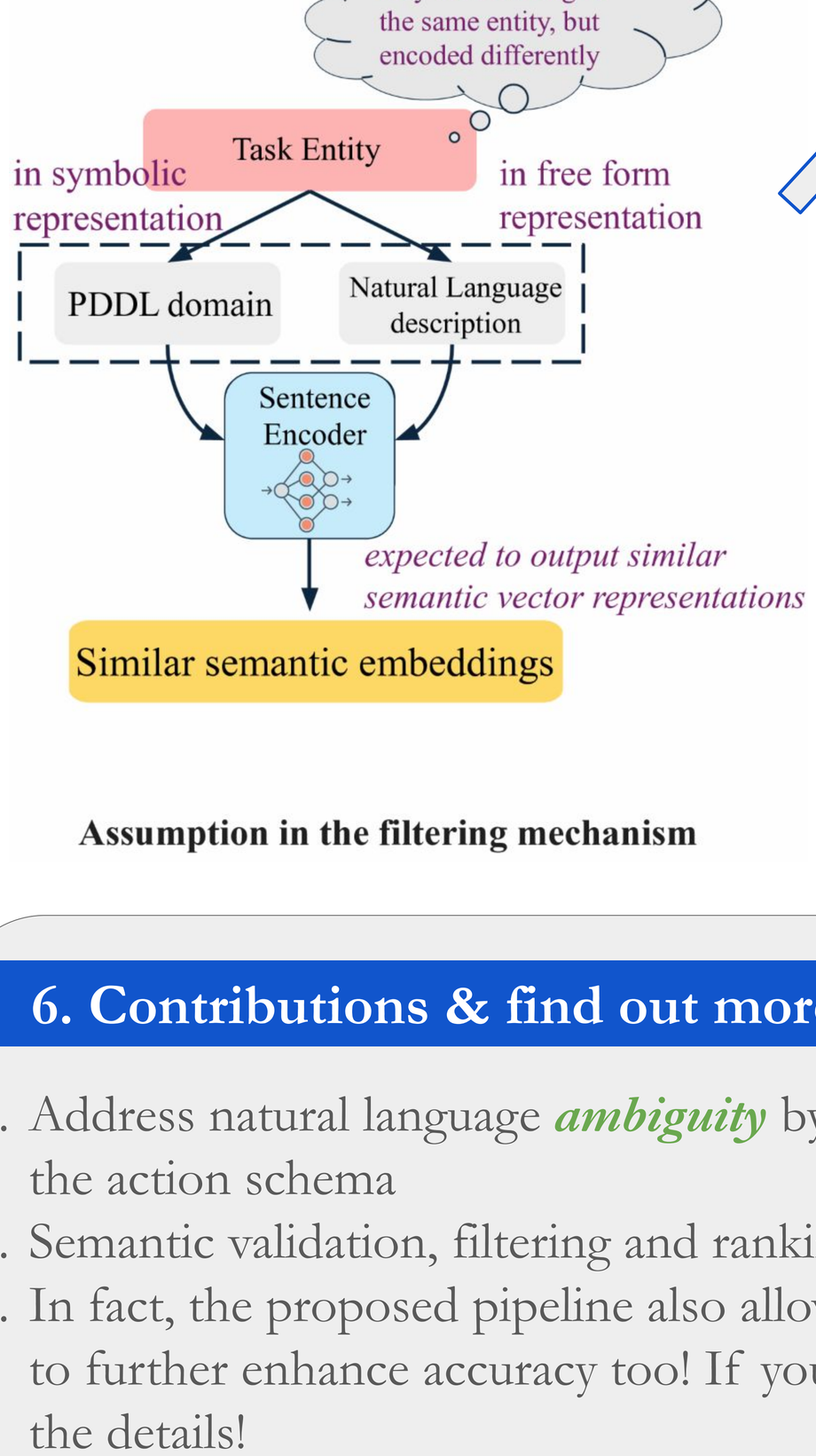
Adv: Solvable Shema Without Experts!

Disadv: brute force, semantic misalign



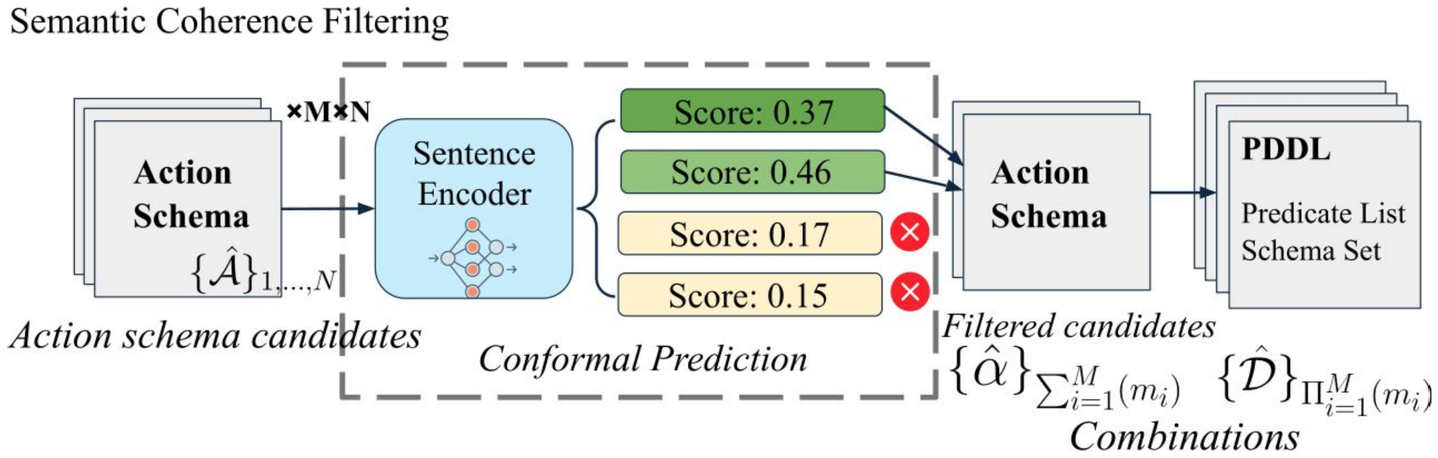
3. Weaver (1952)'s assumption

Like translation, there is a "common base of meaning" between natural language task and symbolic schemas.



Assumption in the filtering mechanism

4. Filtering and Ranking Inspired by Weaver (1952)



Semantic score: **Schema Filter** and ***even*** **Plan ranking!**

5. Fine-tuning the Sentence Encoder is *Convenient*!

Contrastive training with hard negatives synthesized via precon & effect manipulation

Manipulation Type	Description	Example
Swap	Exchanges a predicate between preconditions and effects	Precondition: `(at ?x ?y)` Effect: `(not (at ?x ?z))` → Precondition: `(not (at ?x ?z))` Effect: `(at ?x ?y)`
Negation	Negates a predicate in either preconditions or effects	Precondition: `(clear ?x)` → Precondition: `(not (clear ?x))`
Removal	Removes a predicate from either preconditions or effects	Precondition: `(and (on ?x ?y) (clear ?x))` → Precondition: `(on ?x ?y)`
Addition	Adds mutually exclusive (mutex) predicates to preconditions or effects (Helmert 2009)	Effect: `(on-table ?x)` → Effect: `(and (on-table ?x) (holding ?x))`

6. Contributions & find out more

1. Address natural language ***ambiguity*** by having ***diverse interpretation*** of the action schema
2. Semantic validation, filtering and ranking ***without experts***
3. In fact, the proposed pipeline also allows ***lightweight*** expert intervention to further enhance accuracy too! If you are curious, find our paper to see the details!