

Classical Planning with LLM-Generated Heuristics: Challenging the State of the Art with Python Code

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@NeurIPS'25



Source: NASA

```
1 (:action sample_soil
2 :parameters (?x - rover
3              ?s - store
4              ?p - waypoint)
5 :precondition (and (at ?x ?p)
6                   (at_soil_sample ?p)
7                   (equipped_for_soil_analysis ?x)
8                   (store_of ?s ?x)
9                   (empty ?s)
10                  )
11 :effect (and (not (empty ?s))
12             (full ?s)
13             (have_soil_analysis ?x ?p)
14             (not (at_soil_sample ?p))
15            )
16 )
```

Solving Planning Tasks

Common approach: heuristic search

Domain-independent heuristics:
good & reusable

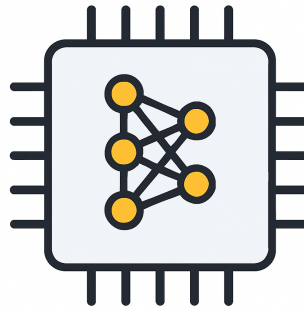
Can we use LLMs to create heuristics?



Domain



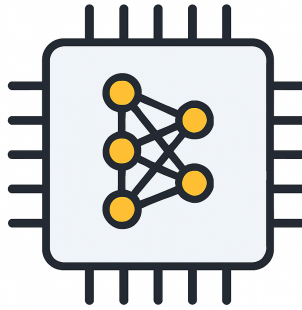
Domain



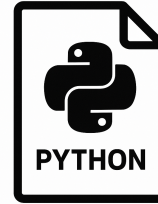
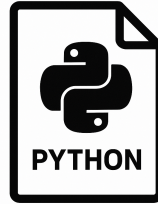
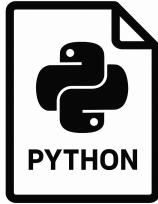
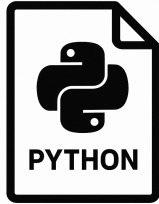
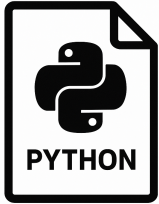
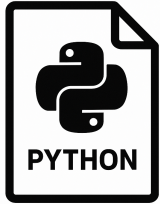
LLM



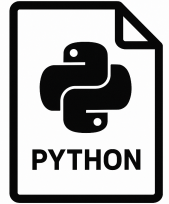
Domain



LLM



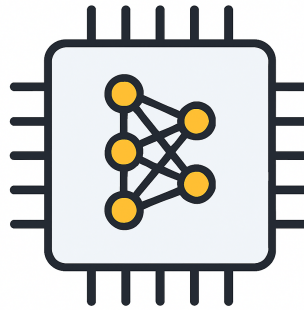
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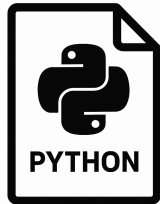
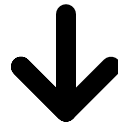
25 Heuristics



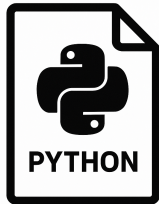
Domain



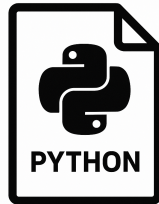
LLM



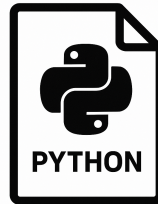
PYTHON



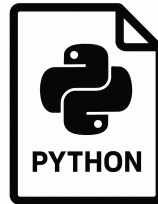
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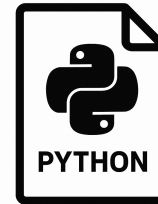
PYTHON



PYTHON

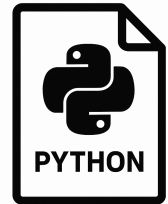


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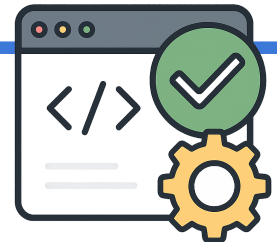
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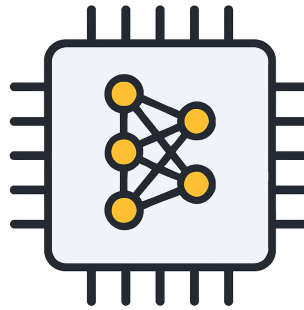
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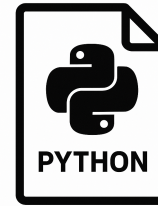
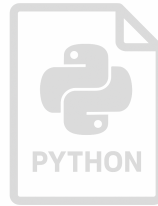
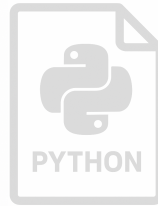
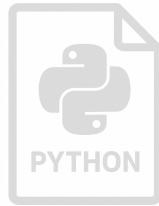
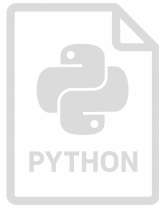
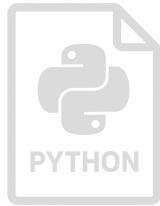
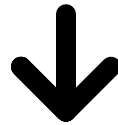




Domain



LLM



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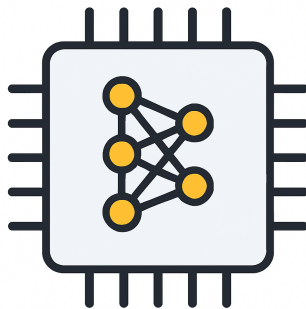


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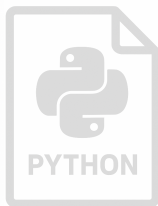




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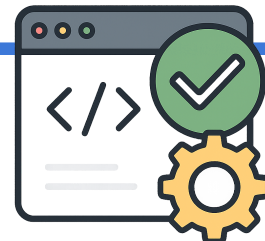
LLM



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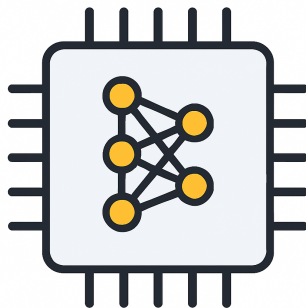


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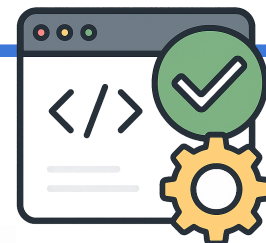
LLM



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25 Heuristics



Test!

Experiments

Eight domains and 720 tasks:

International Planning Competition 2023

Much **harder** than domains usually tested

Plans with **hundreds of steps**

Heuristics from **DeepSeek R1** on **Pyperplan**

Our Method	373
C++ Baseline	295
Python Baseline	243
Gemini 2.0 Pro	202
DeepSeek R1	174
DeepSeek V3	48

Conclusion

LLMs create **good heuristics** for planning

Not only memorization

Can we do the same with **smaller models**?