Action Model Learning based on Grammar Induction

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AI planning

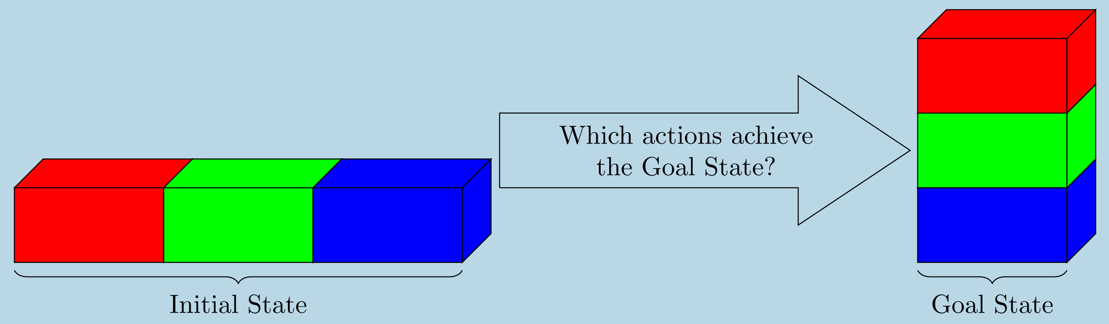

Figure 1: An example of planning problem

To solve a planning problem we need : (1) the declaration of the problem and (2) the PDDL domain containing rules about actions. The declaration of the problem contains an initial state, i.e. a set of properties, called propositions, before the execution of any actions and the goal state, i.e. the configuration of the environment must to be reached, Figure - 1 describes an example of a declaration of a planning problem

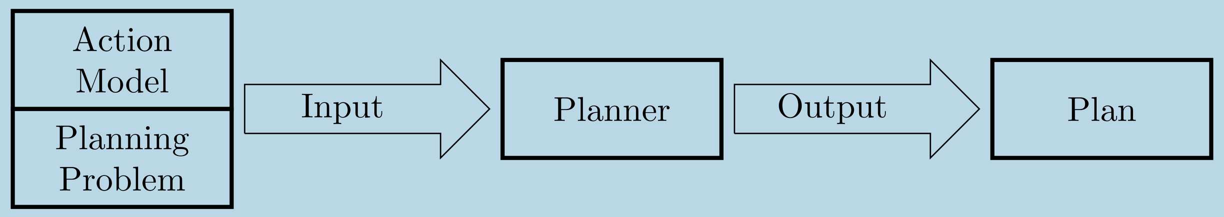

Figure 2: Planning Problem resolution Architecture

Hand-encoding PDDL domains is generally accepted as difficult, tedious and error-prone. The reason is that the experts of the domains to model are not always PDDL experts and vice versa. To overcome this issue, some learning algorithms [1, 2] have been proposed. However, it may be difficult to acquire sufficient data to be able to learn correctly a planning domain or the training data may be noisy or partial. Also, most of the approaches proposed so far in the literature did not allow for the direct use of the domains learned by a robot to solve new problems. To be efficient, a learning approach must tackle the following triple issue:

1. **Output:** AI planning covers a wide range of issue: first-order logic, temporal and hierarchical features, multi-agent etc. Then the learning method have to cover several languages.
2. **Input:** The acquisition of the training dataset must be as simple as possible and requires the least amount of human effort.
3. **Performance:** The learned domain have to be enough accurate to be used "as is" in planner and require the few data as possible.

The AMLSI Approach [9, 10]

We proposed AMLSI (Action Model Learning with State machine Interaction), a learning approach for planning domain acquisition. This approach learns a planning domain from a planning problem. A key idea in AMLSI is that retro-engineering real world state machines is analogous to learning regular grammars: we argue that (1) it is possible to learn a regular grammar [3] by querying a real world state machine, and (2) to induce a PDDL domain from this regular grammar. The contributions of AMLSI are to generate (1) accurate PDDL domains from relatively (2) small datasets with (3) partial observations.

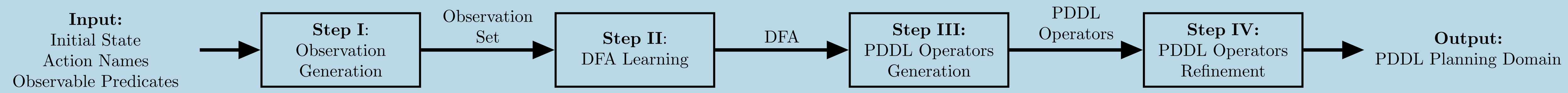

Figure 3: An overview of the AMLSI approach

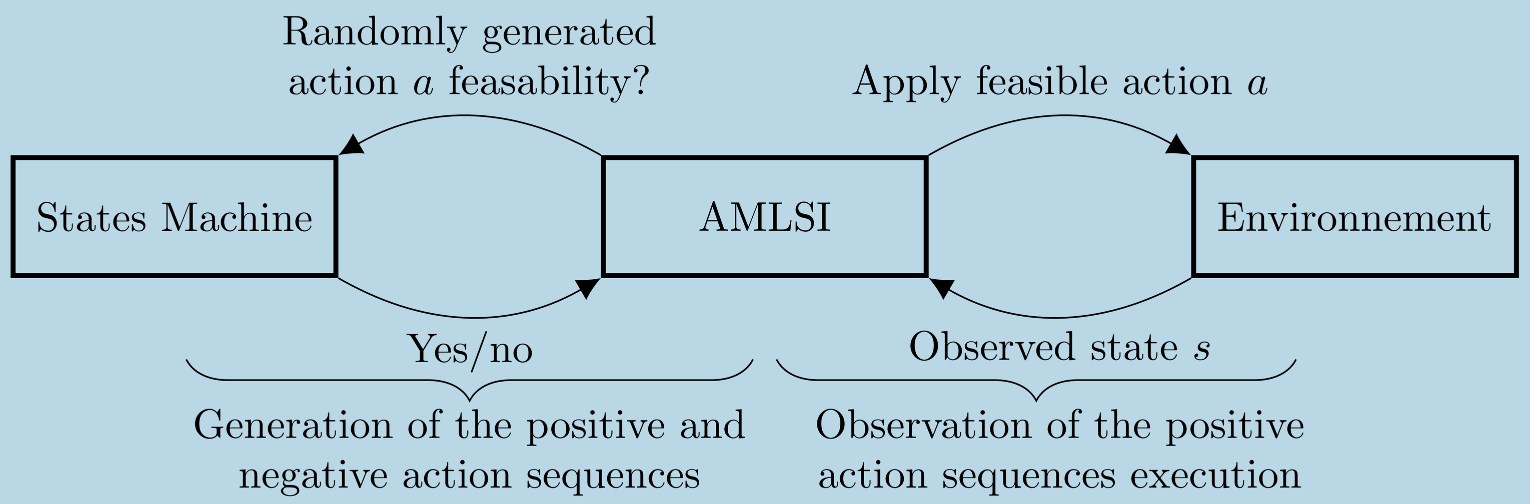

Figure 4: Observation Generation Overview

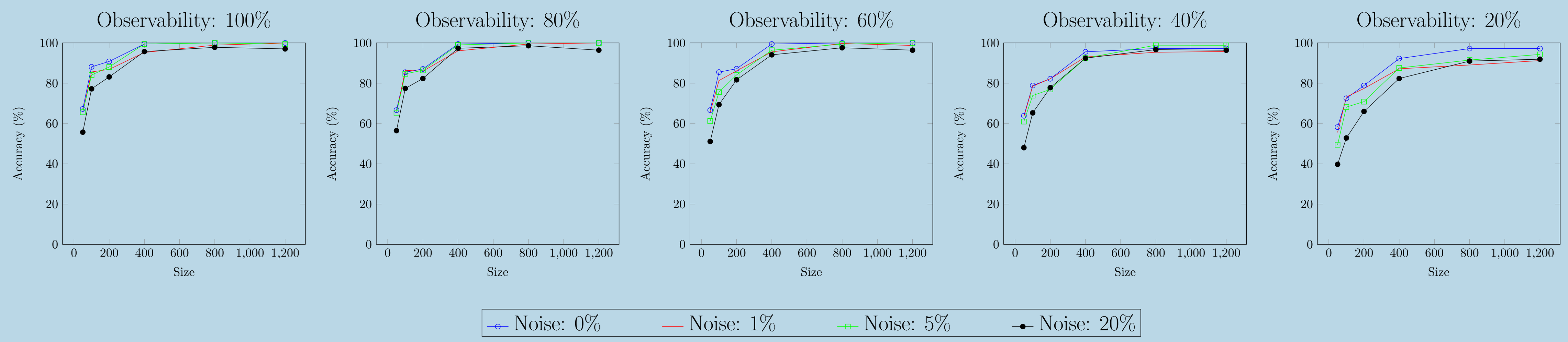

Figure 5: Average Performance of AMLSI in terms of Accuray on 13 IPC Domains when the training data set size increases in number of actions

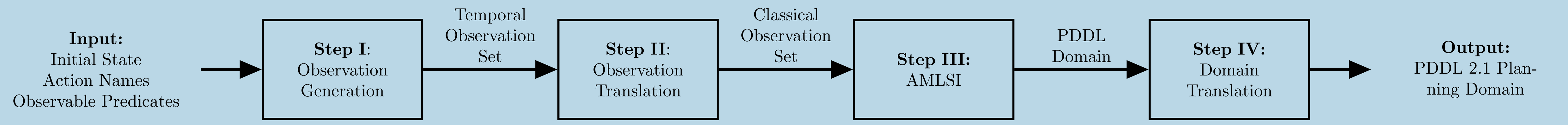

Figure 6: TempAMLSI [4, 5]: An extention to learn PDDL 2.1 [6] Planning Domains

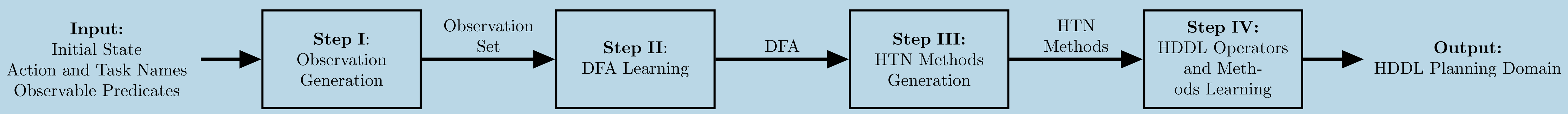

Figure 7: HierAMLSI [7]: An extension to learn HDDL [8] Planning Domains

Acknowledgements

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Conclusion & Futur Work

What has been done:

- Accurate
- Robust to partial and noisy observation
- Requires few data
- Temporal and HTN extensions

What remains to be done:

- Improve Action Model Expreszsivity (ADL)
- Numerical and Probabilistic aspects
- Active Learning

References

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