Explainable Planner Selection

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Workshop on Explainable AI Planning

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Motivation

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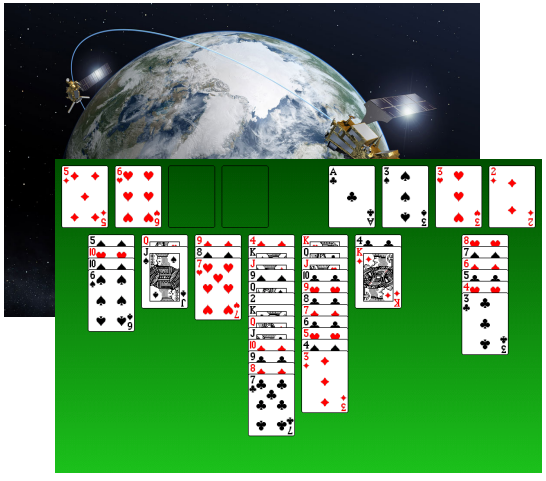

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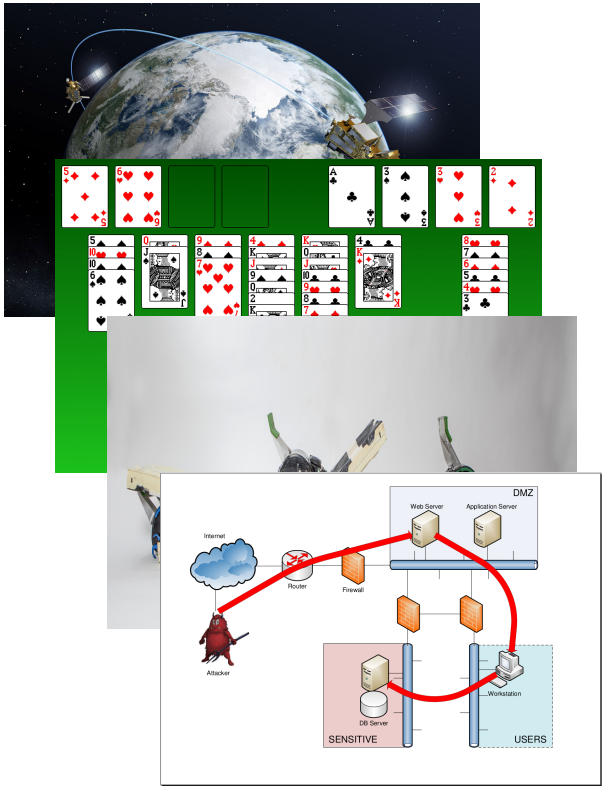

DMZ
Web Server
Application Server
Internet
Router
Firewall
Attacker
DB Server
Workstation
SENSITIVE
USERS

Motivation


DMZ
Web Server
Application Server
Internet
Router
Firewall

Motivation

SymBA*

Motivation

SymBA*

Complementary1

Motivation

SymBA*

Complementary1

Symple-1

Motivation

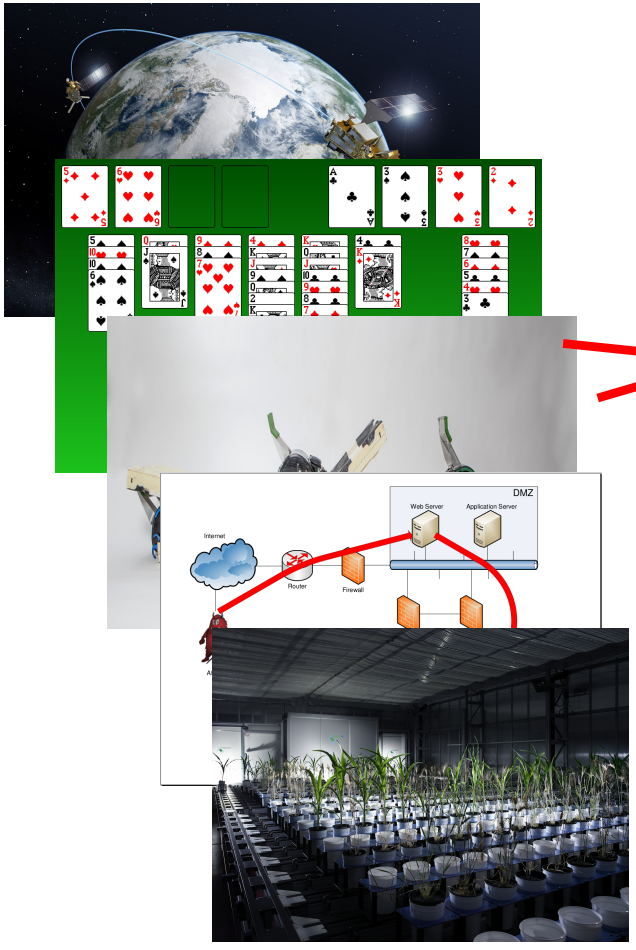
SymBA*

Complementary1

Symple-1

...

Motivation



?

SymBA*

Complementary1

Symple-1

. . .

Setting

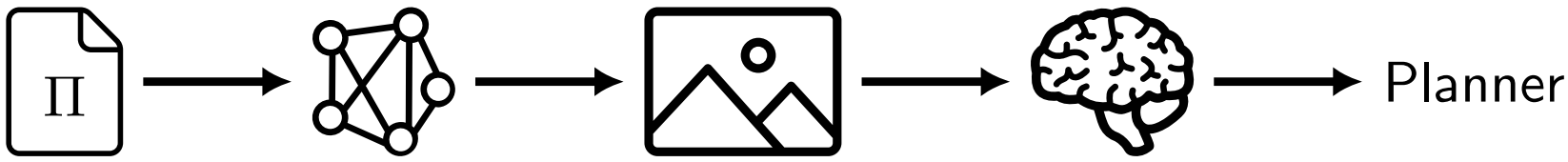
Given:

$P = \{\text{SymBA*}, \text{Complementary1}, \text{Symple-1}, \dots\}$
$T = 1800s$

Portfolio Selector:

$f : \mathit{Tasks} \rightarrow P$

Delfi (Katz et al., 2018)



Images from the Noun Project: RomStu (file), Agni (network), Alfa Design (image), Samuel Dion-Girardeau (brain)

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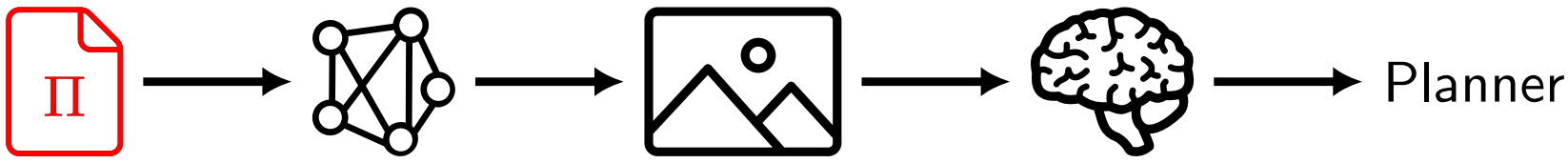

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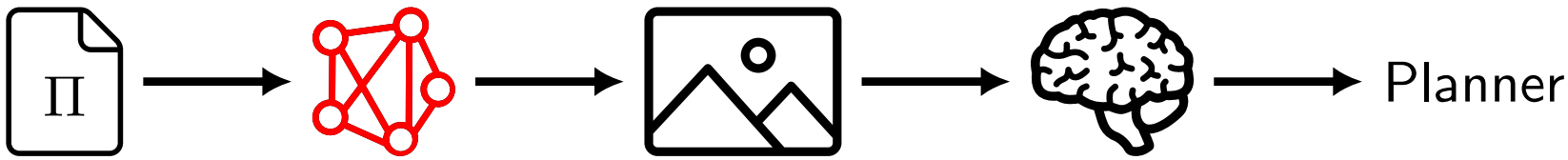

- Problem Description Graph (Pochter, Zohar, and Rosenschein, 2011)
- Abstract Structure Graph (Sievers et al., 2019)

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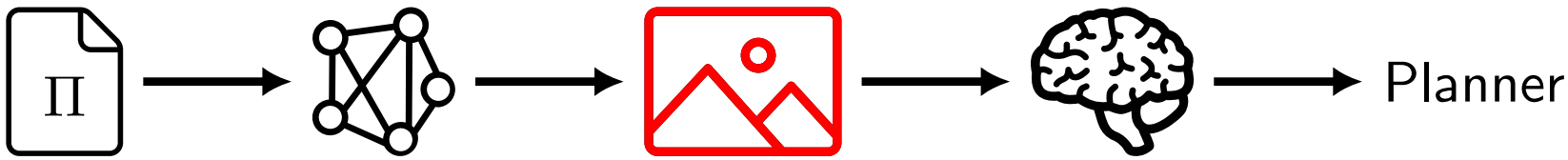
Delfi (Katz et al., 2018)



- 128x128 pixels

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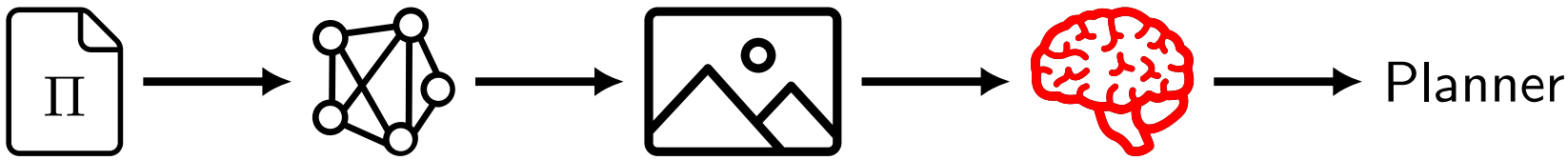

- Convolutional Neural Network (CNN)

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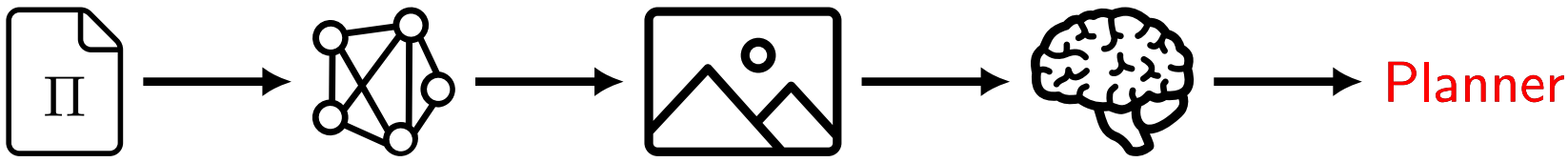
Delfi (Katz et al., 2018)



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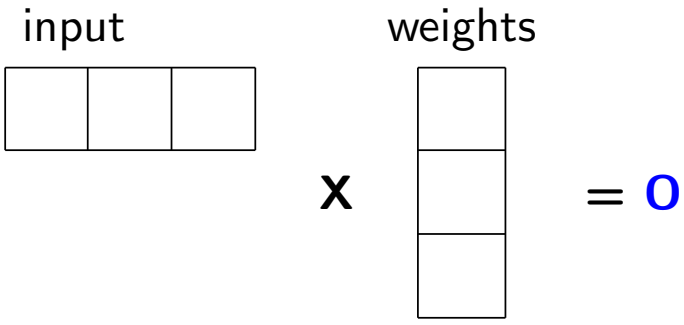
Contributions

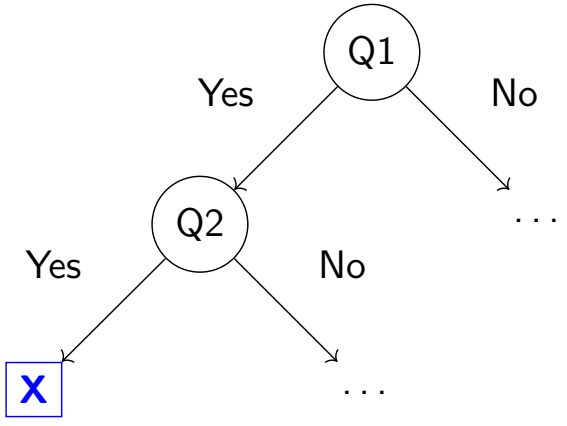
- **Explainable techniques** and **understandable features**
- identify **important features**
- investigate **which planners** are selected

Machine Learning Techniques

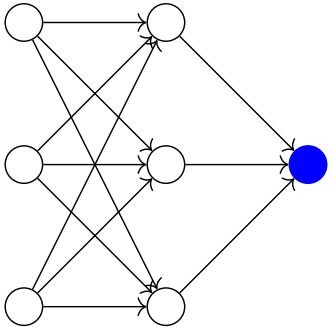
Linear Regression



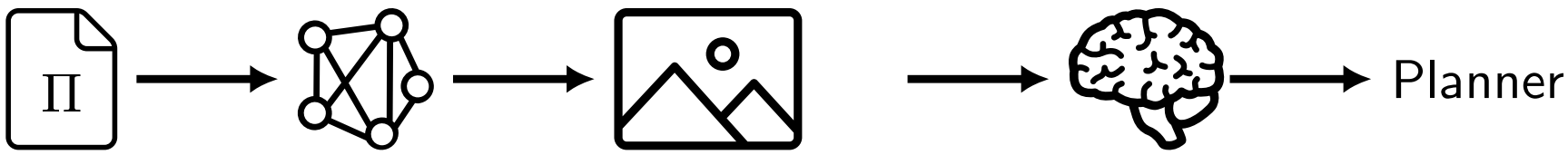
DecisionTree



Multi-Layer Perceptron



Training



- data set of Ferber et al. (2019)
  - tasks, runtimes
- extract features
- train **one** model per planner
- labels: time, logtime, coverage
- 10 repetitions

Images from the Noun Project: RomStu (file), Agni (network),Alfa Design (image), Becris (Linear Regression), Knut Synstad (Decision Tree), Samuel Dion-Girardeau (brain)

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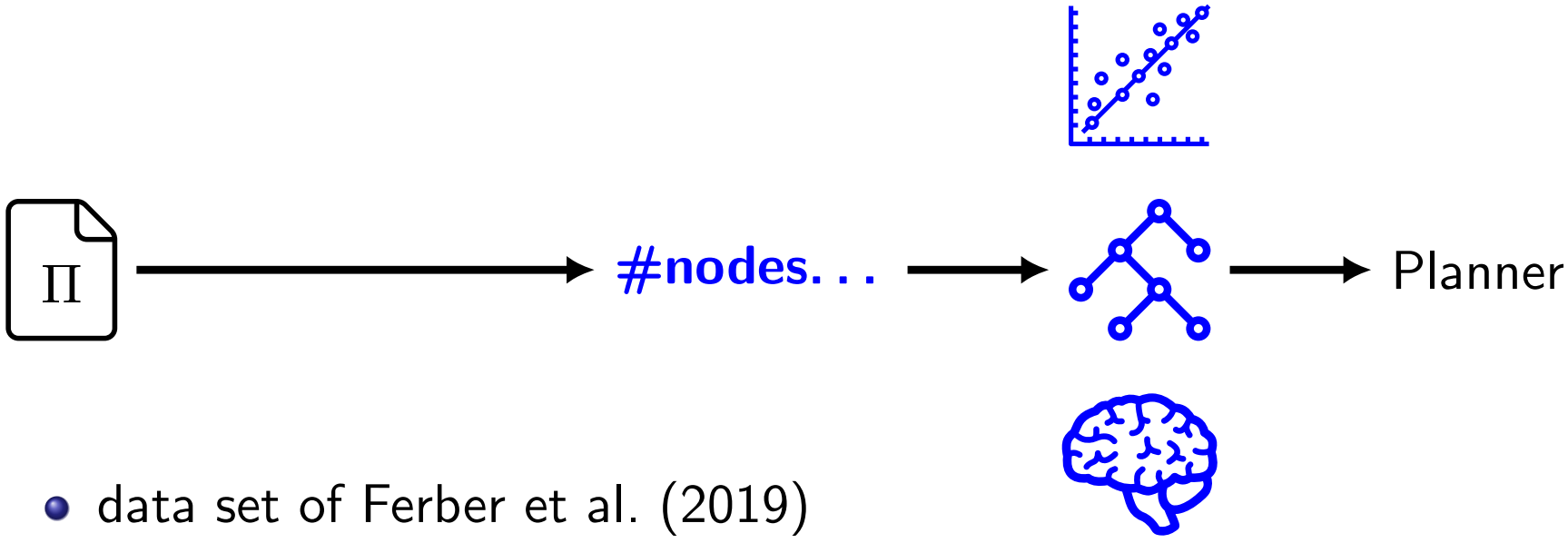

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Features

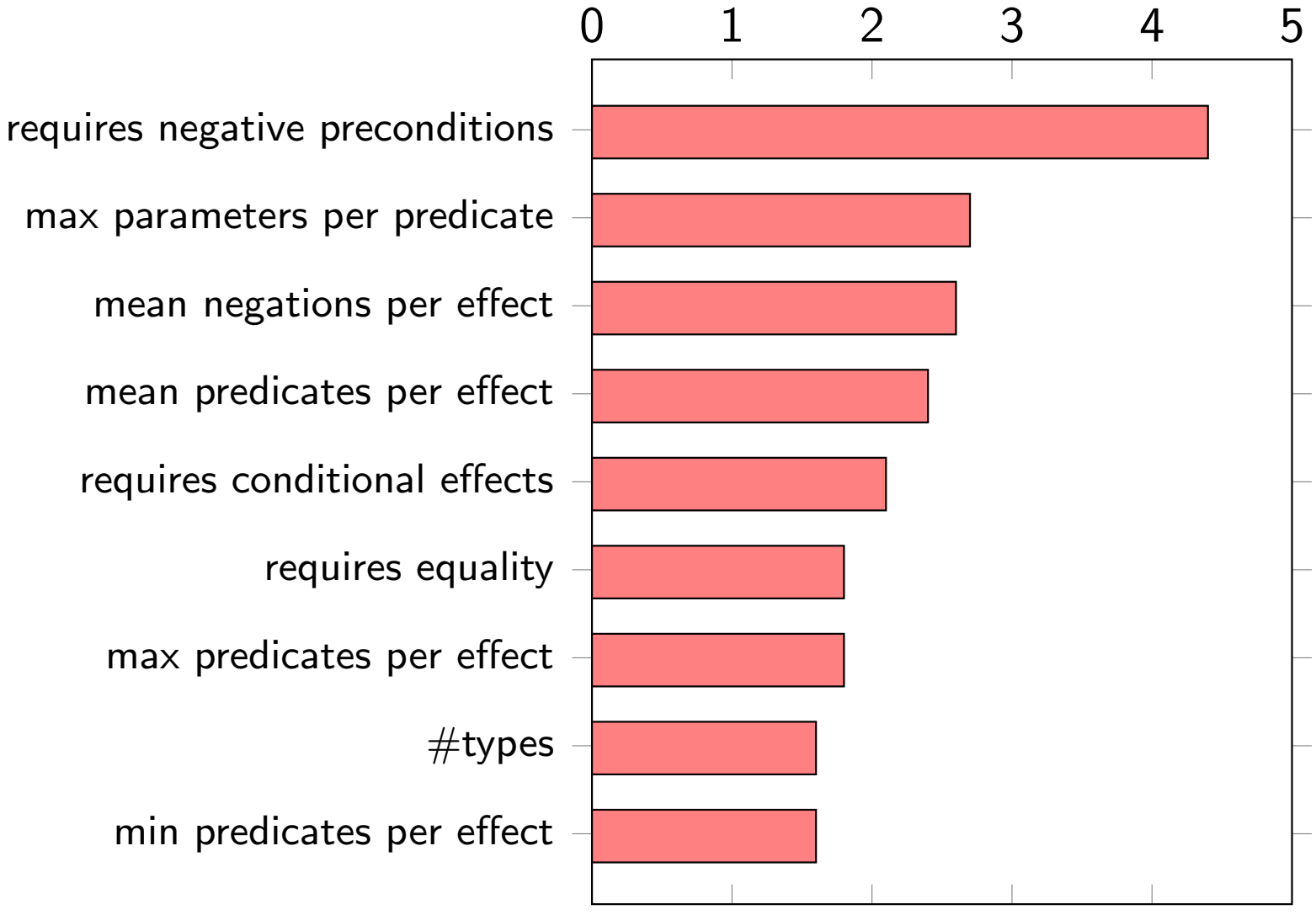
$$\text{FPDDL} \subset \begin{matrix}\text{Fawcett} \\ \text{PDDL}\end{matrix} \subset \text{Union}$$

Feature augmentations: normalize

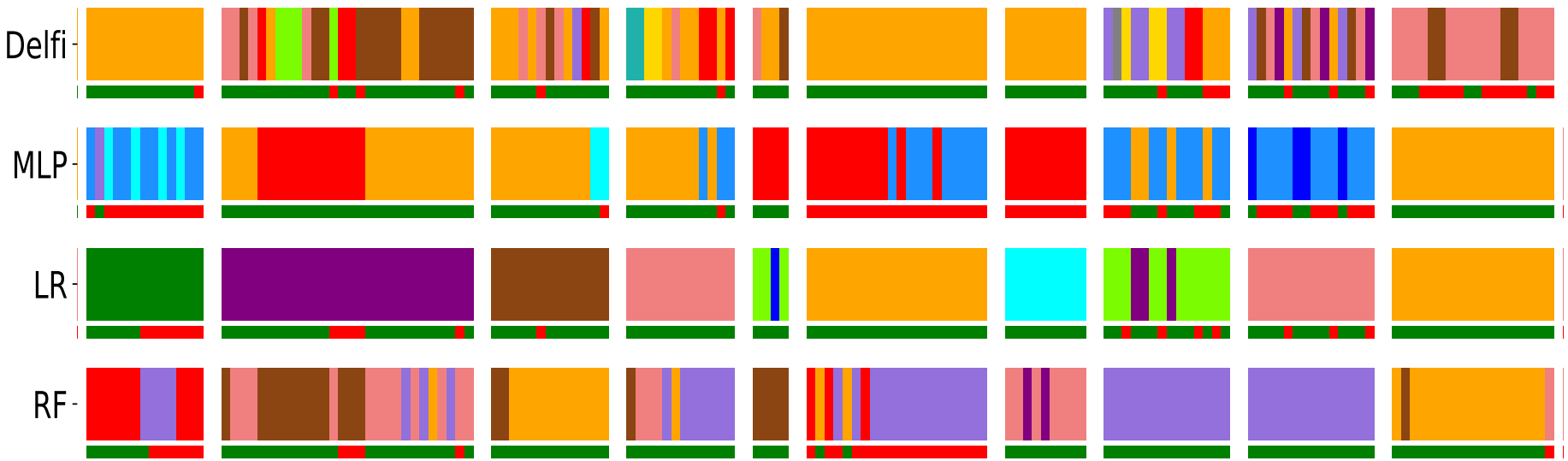
Performance

		Linear Regression					MLP		RF
		0.0	0.1	1.0	2.0	5.0	3	5	50
FAWCETT	binary	78.6	77.2	82.1	82.4	80.9	**87.1**	78.2	**84.8**
	logtime	79.3	79.0	81.5	81.7	83.6	82.2	82.2	84.1
	time	78.6	81.8	80.5	80.4	80.3	82.2	**85.3**	81.8
FPDDL	binary	**87.7**	74.3	72.7	74.3	71.4	81.0	81.5	77.5
	logtime	82.5	84.0	78.5	77.7	80.3	78.2	79.7	82.0
	time	86.5	**86.5**	**86.5**	**86.6**	**86.6**	80.2	81.9	78.8

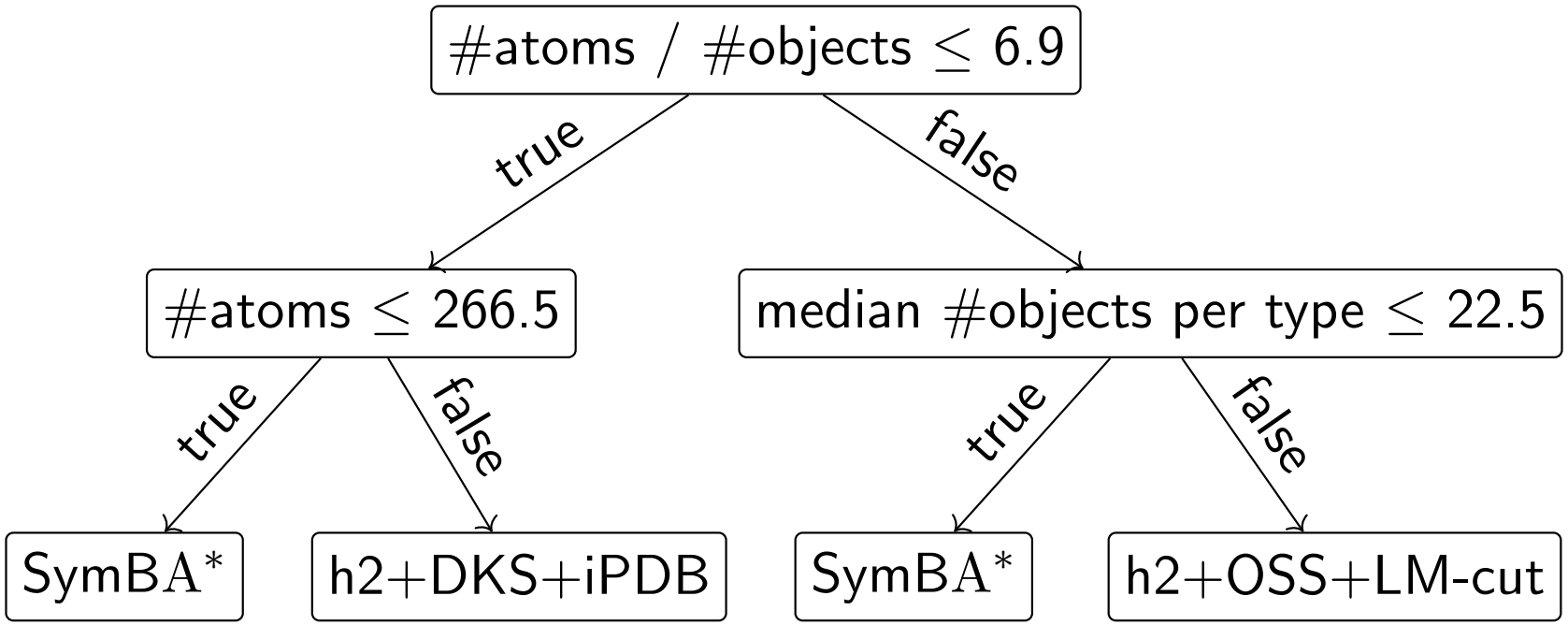
Feature Importance



Planner Choices



Single Decision Tree



Summary

Explainable planner selection ...

- is possible
- let's us identify important features
- learns the right planner for a domain
- can be as simple as a single decision tree

References

Ferber, P.; Mai, T.; Huo, S.; Chen, J.; and Katz, M. 2019. IPC: A Benchmark Data Set for Learning with Graph- Structured Data. In *In Proceedings of the ICML-2019 Workshop on Learning and Reasoning with Graph-Structured Representations*.

Katz, M.; Sohrabi, S.; Samulowitz, H.; and Sievers, S. 2018. Delfi: Online Planner Selection for Cost-Optimal Planning. In *Ninth International Planning Competition (IPC-9): planner abstracts*, 57–64.

Pochter, N.; Zohar, A.; and Rosenschein, J. S. 2011. Exploiting Problem Symmetries in State-Based Planners. In Burgard, W.; and Roth, D., eds., *Proceedings of the Twenty-Fifth AAAI Conference on Artificial Intelligence (AAAI 2011)*, 1004–1009. AAAI Press.

Sievers, S.; Röger, G.; Wehrle, M.; and Katz, M. 2019. Theoretical Foundations for Structural Symmetries of Lifted PDDL Tasks. In Lipovetzky, N.; Onaindia, E.; and Smith, D. E., eds., *Proceedings of the Twenty-Ninth International Conference on Automated Planning and Scheduling (ICAPS 2019)*, 446–454. AAAI Press.