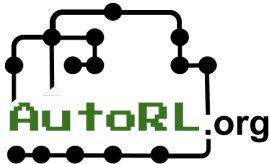
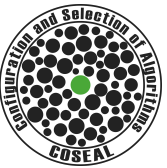


AutoML & Contextual RL

André Biedenkapp



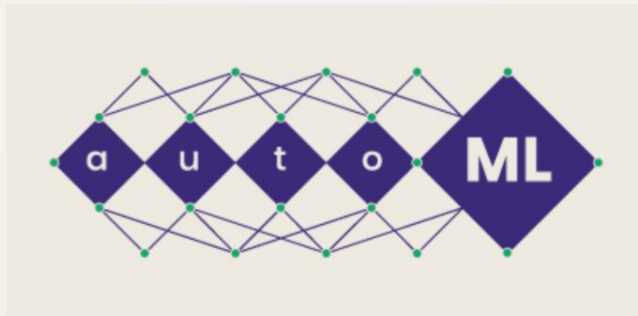
What is Automated Machine Learning?

Learn how to speed up your AI development.

A free, cookie-based open course on **Automated Machine Learning**.
Work through short video lectures, readings, and hands-on quizzes.
No sign-up; your progress stays with you.

▶ Start learning

Resume progress



10

Modules

210

Learning units

65

Video lectures

130

Self-checks

automlmooc.org

Let's take a look at an excerpt

Algorithm Configuration



Algorithm



Parameter



Instances

1 Gold
1 Silver
0 Bronze

Objective

Image sources given at the end of the presentation

Per Instance Algorithm Configuration

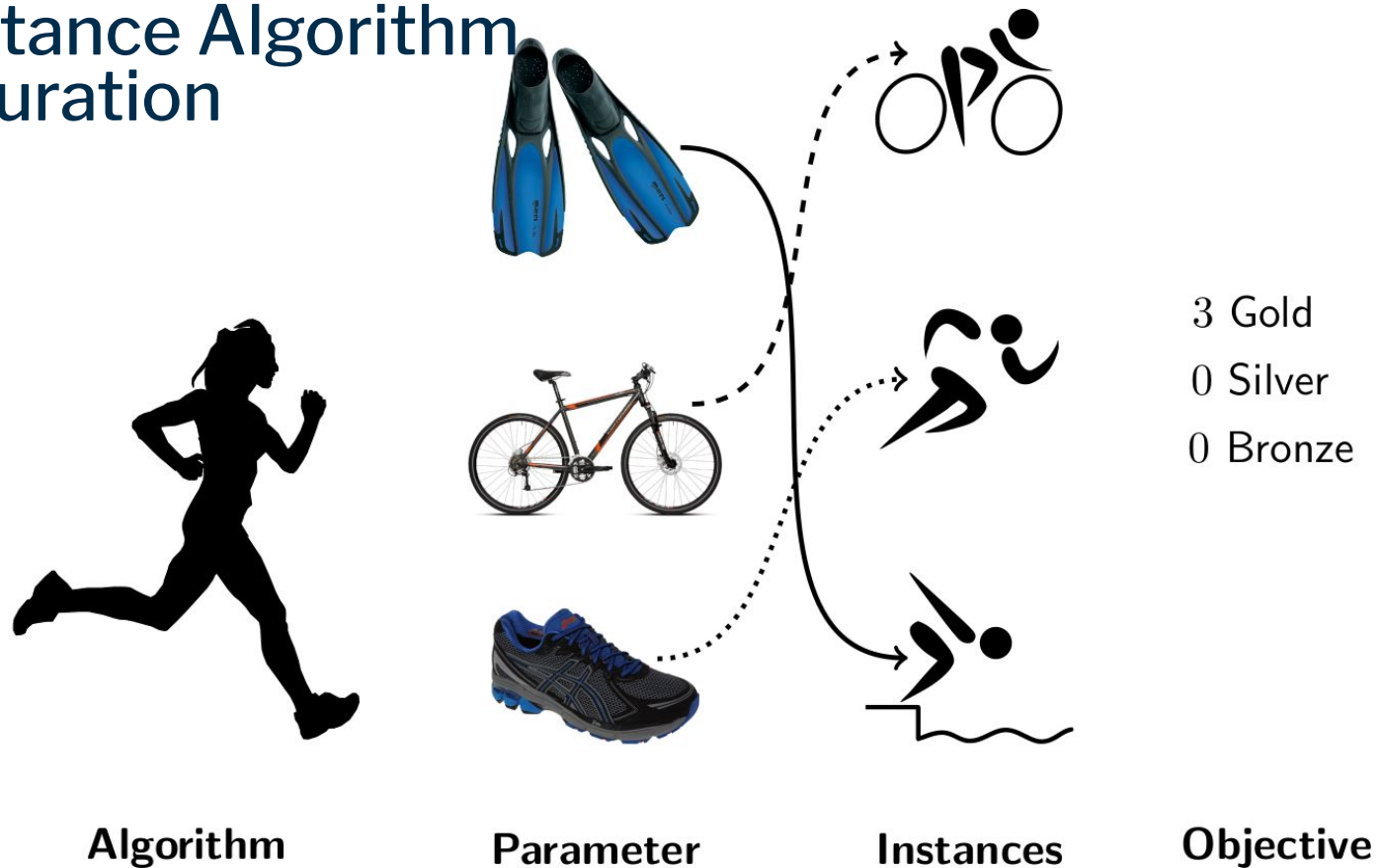
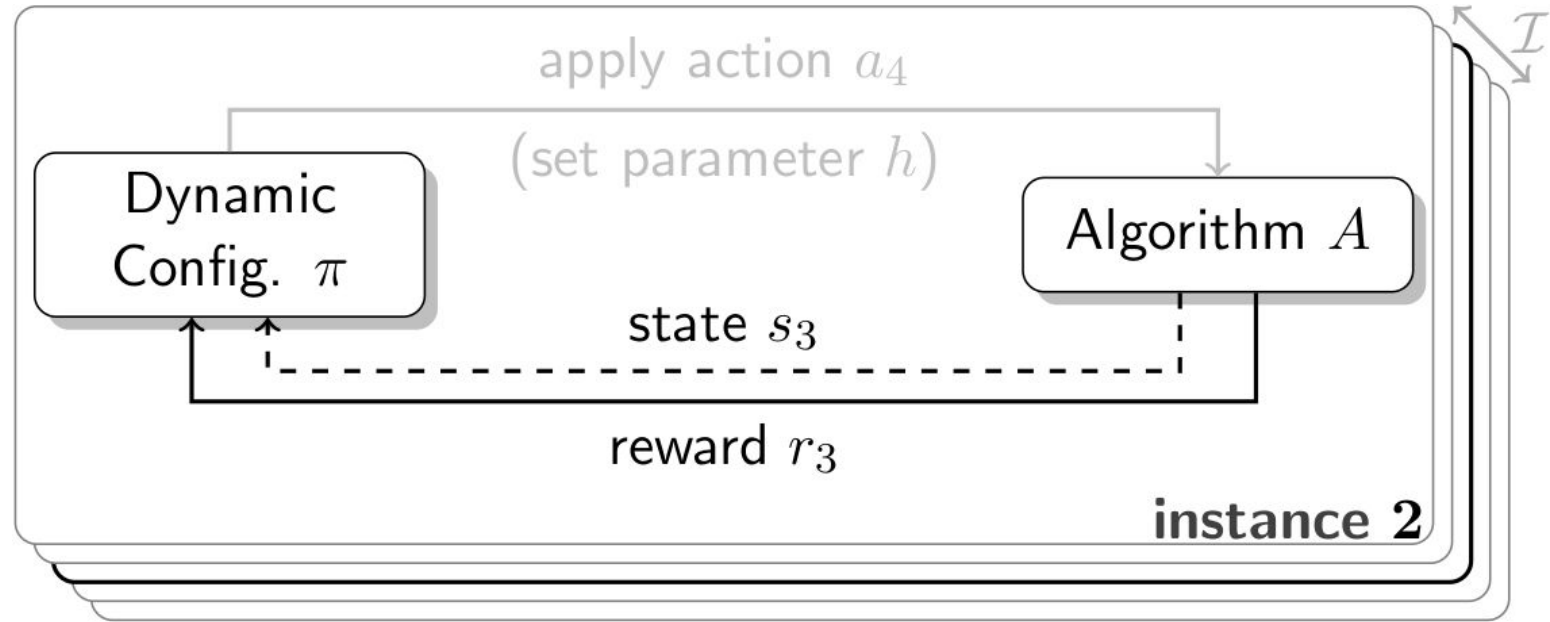
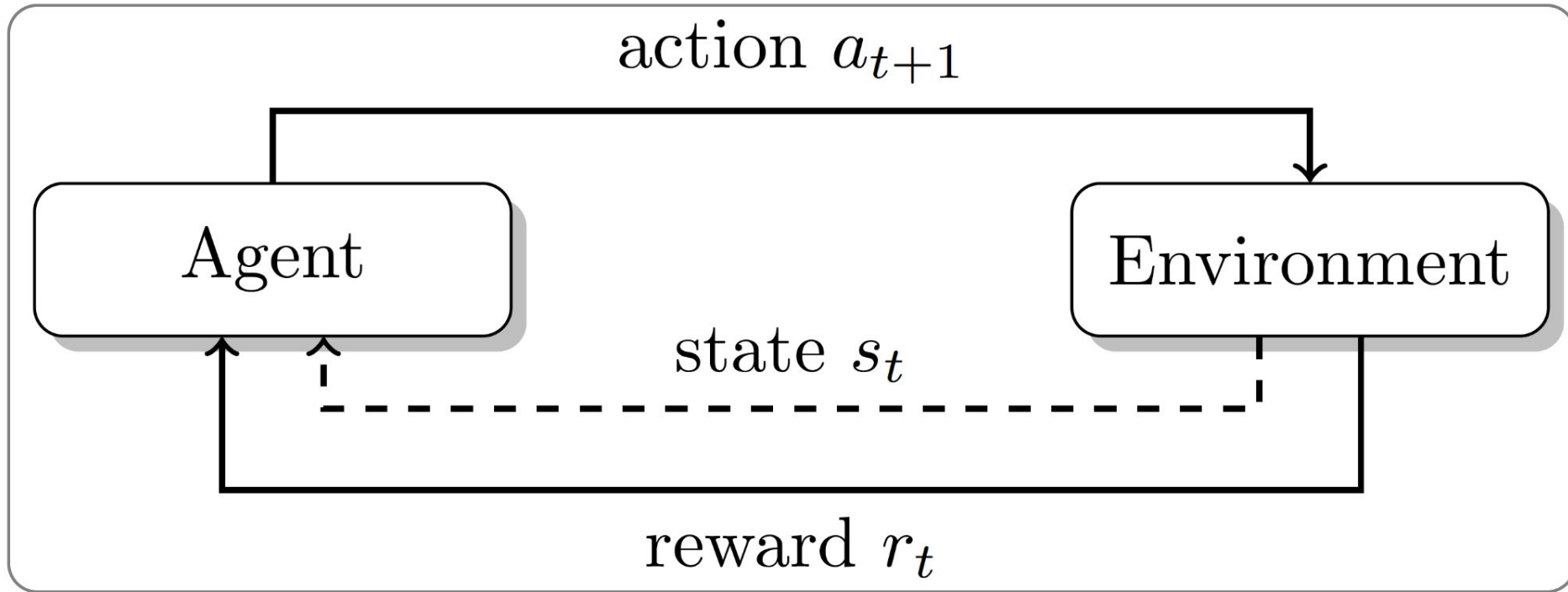


Image sources given at the end of the presentation

Dynamic Algorithm Configuration



What is Reinforcement Learning?



Agents learn by *interacting* with their world

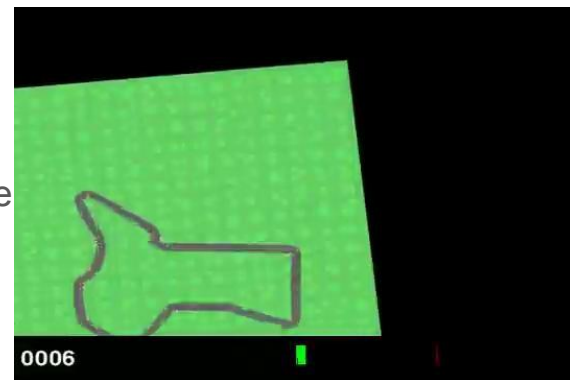
(How) Does RL Generalize?

Mediocre Generalizability!

Training

Race Car
w/o Trailer

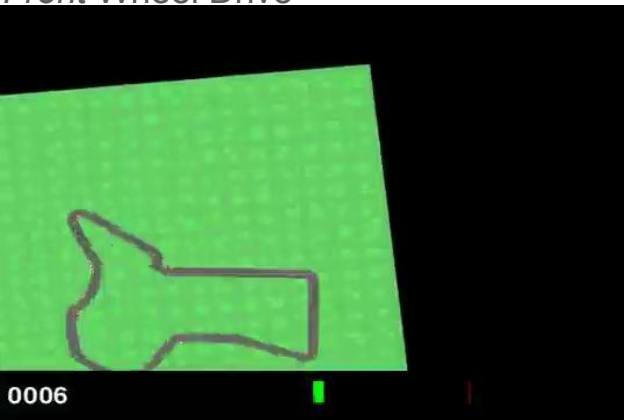
Rear Wheel Drive



Testing

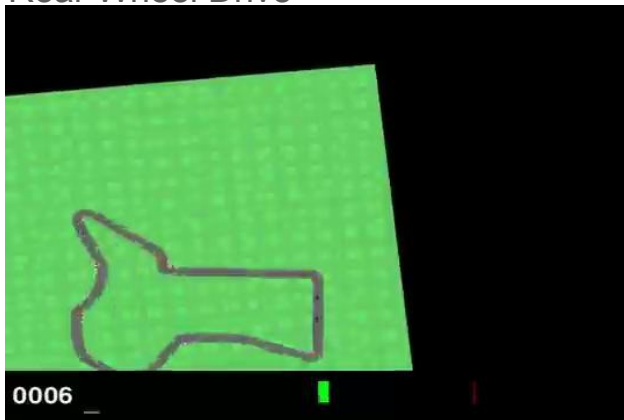
Race Car w/o Trailer

Front Wheel Drive



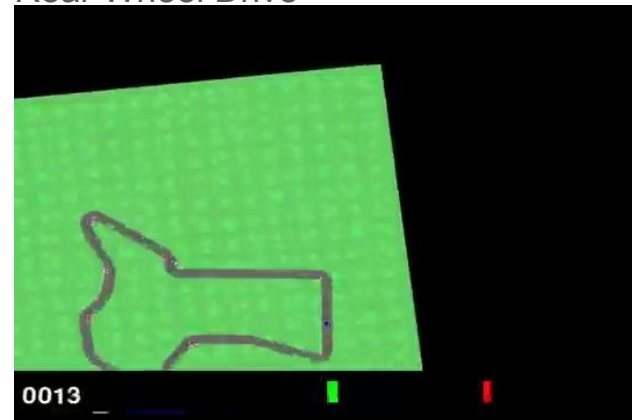
Race Car + Small Trailer

Rear Wheel Drive

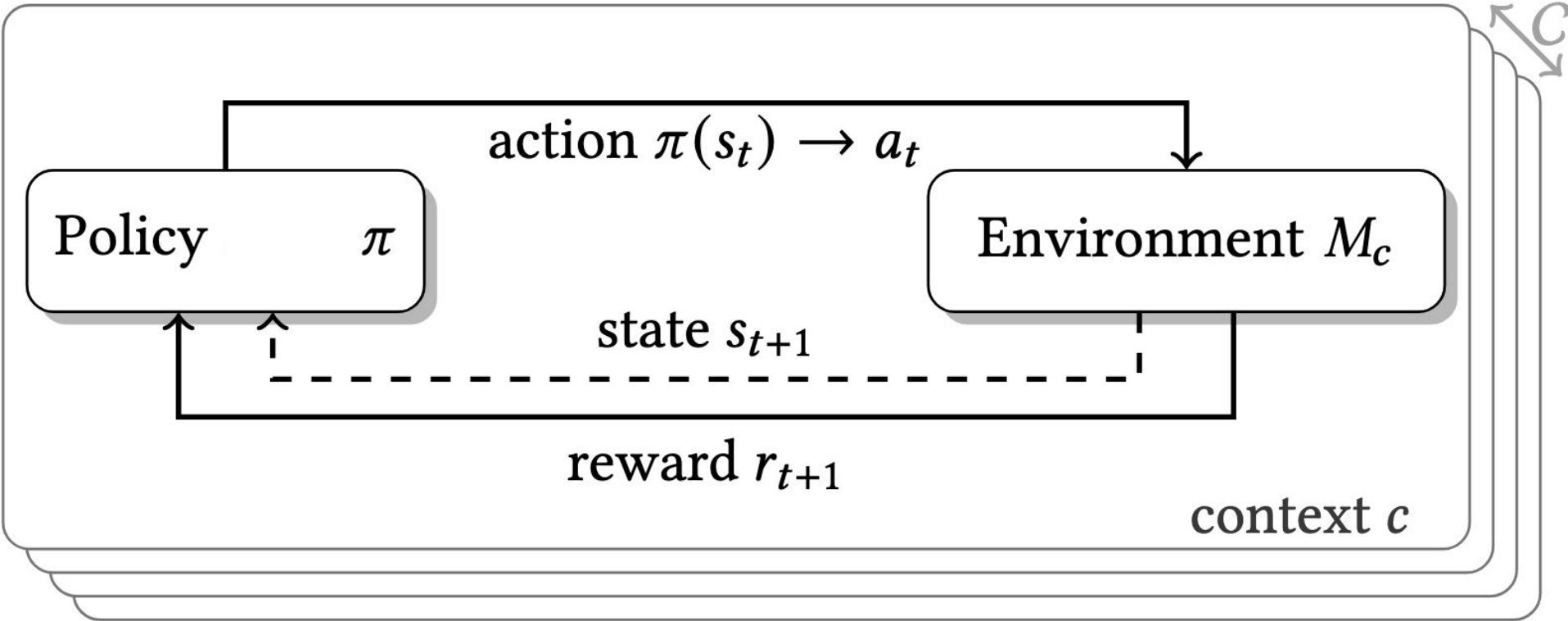


Race Car + Large Trailer

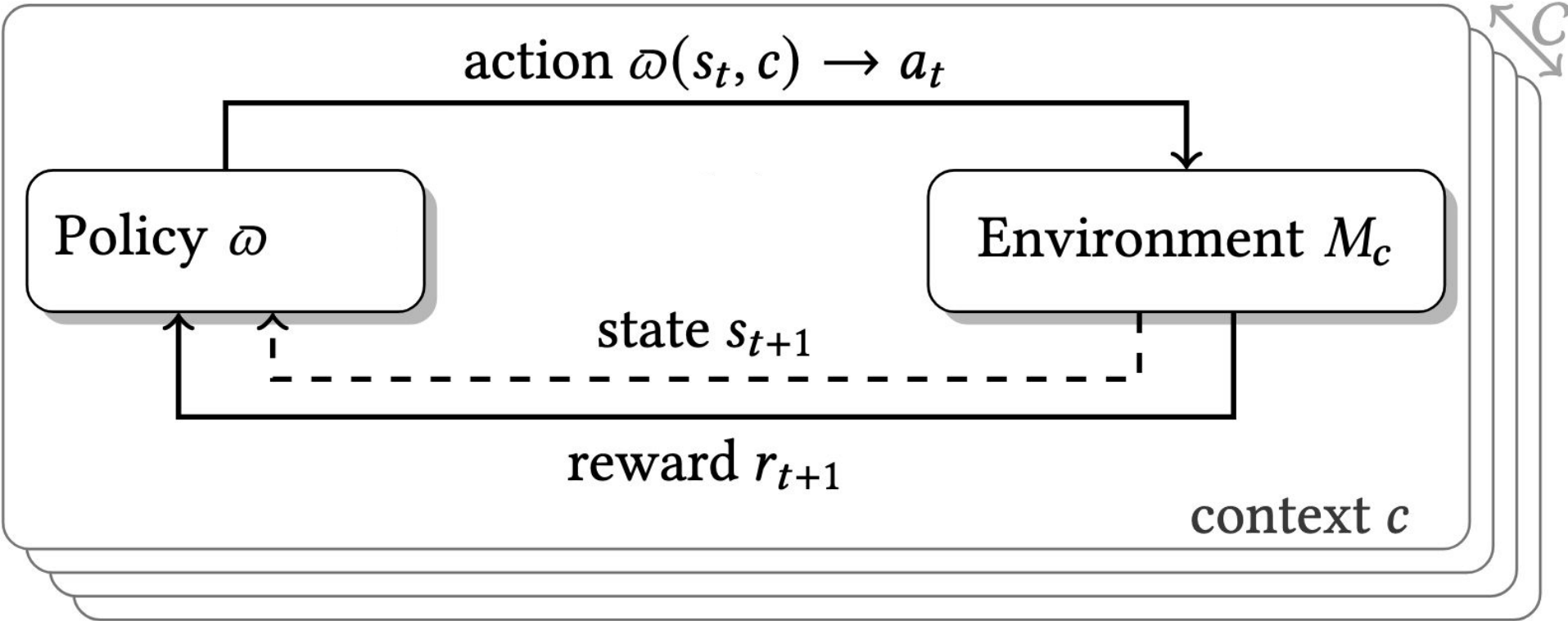
Rear Wheel Drive



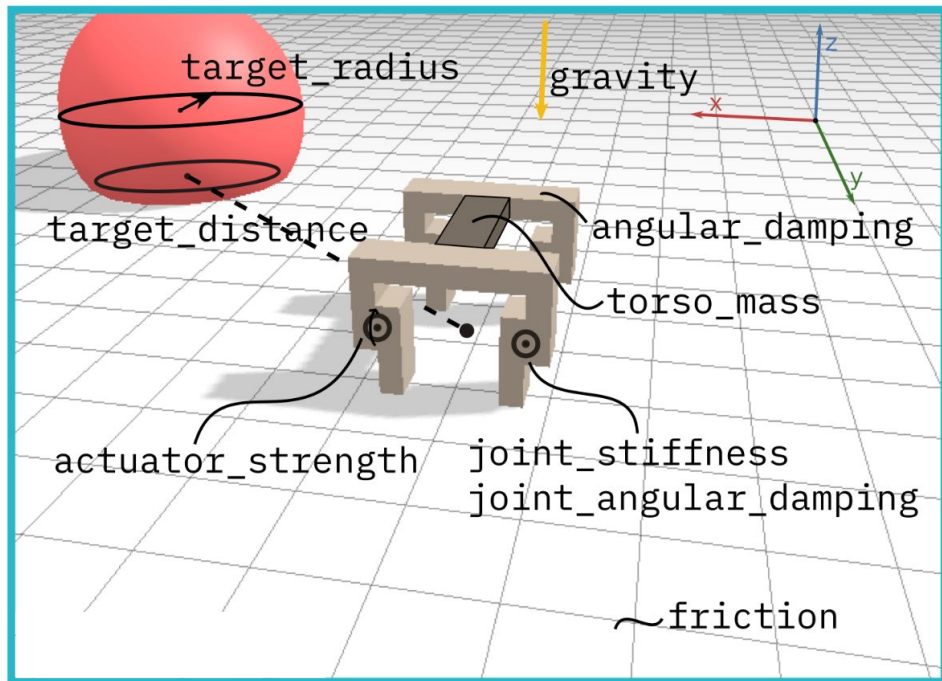
What is **Contextual** Reinforcement Learning?



What is **Contextual** Reinforcement Learning?



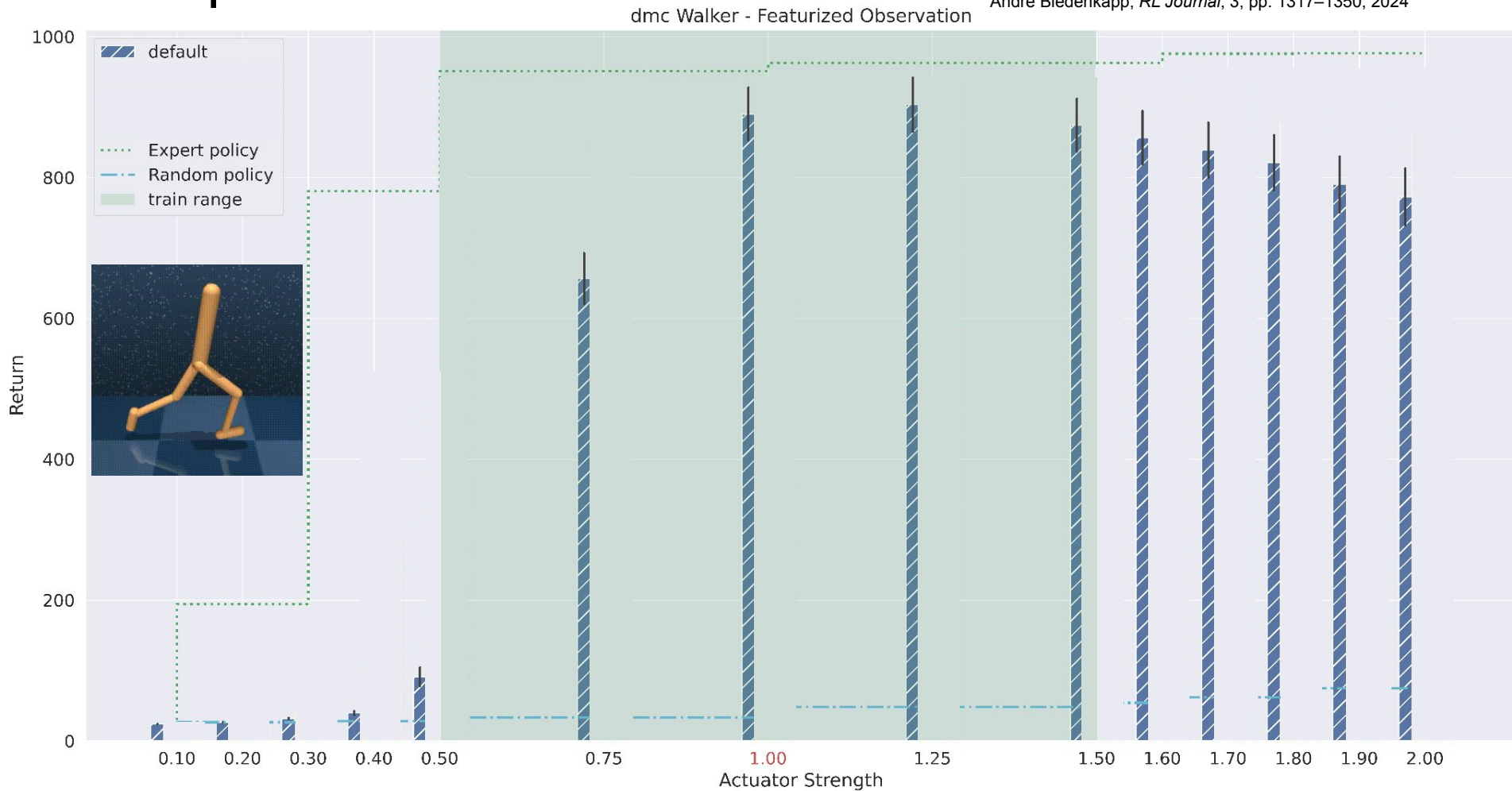
What is Context?



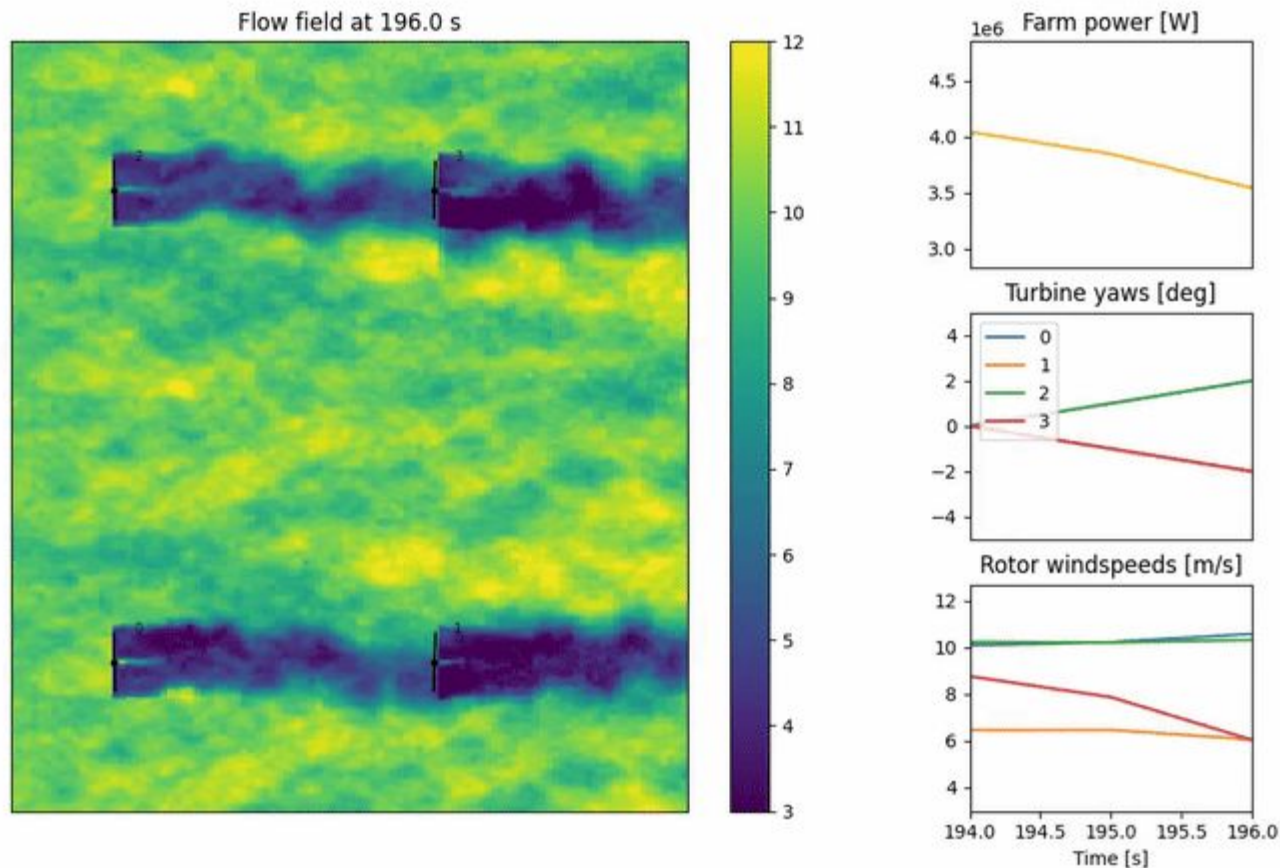
Contextualize Me – The Case for Context in Reinforcement Learning
Carolin Benjamins, Theresa Eimer, Frederik Schubert, Aditya Mohan, Sebastian Döhler, André Biedenkapp, Bodo Rosenhahn, Frank Hutter, and Marius Lindauer; *TMLR*, 2023

Example: Context in MBRL

Dreaming of Many Worlds: Learning Contextual World Models Aids Zero-Shot Generalization; Sai Prasanna*, Karim Farid*, Raghu Rajan, André Biedenkapp; *RL Journal*, 3, pp. 1317–1350, 2024



Potential Outlook of the Emmy-Noether Group



Nilsen et al. (2026). WindGym: A Reinforcement Learning Environment for Wind Farm Control. Journal of Open Source Software, 11(120), 9946. <https://doi.org/10.21105/joss.09946>

Potential for Collaborations in PEARLS

Any setting in which AutoML could be used:

- Multi-objective optimization (maximizing performance while minimizing CO2 footprint)
- Which tools to use and why (not every AutoML tool is created equal)
- Assessing if AutoML could be helpful at all (Human-Expertise can avoid large AutoML overheads!)
- Setting up appropriate evaluation pipelines
- ...

Tackling real world data:

- My Emmy-Noether Group focuses on generalizability!
- Sim-to-real transfer
- Few-Shot Adaptation
- Fine-tuning
- ...

Image Sources

- [Female Runner](#) (by algoTruneman under CC0 1.0)
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- [Bike](#) (under CC BY-NC 4.0)
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These images were flipped/rotated or scaled and used to depict abstract representations of Algorithm Configuration