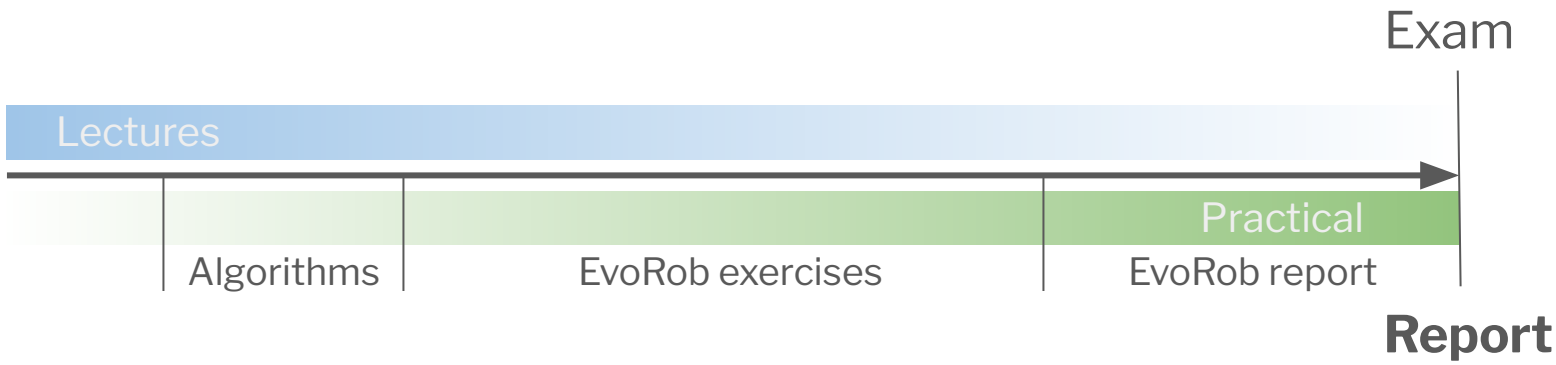
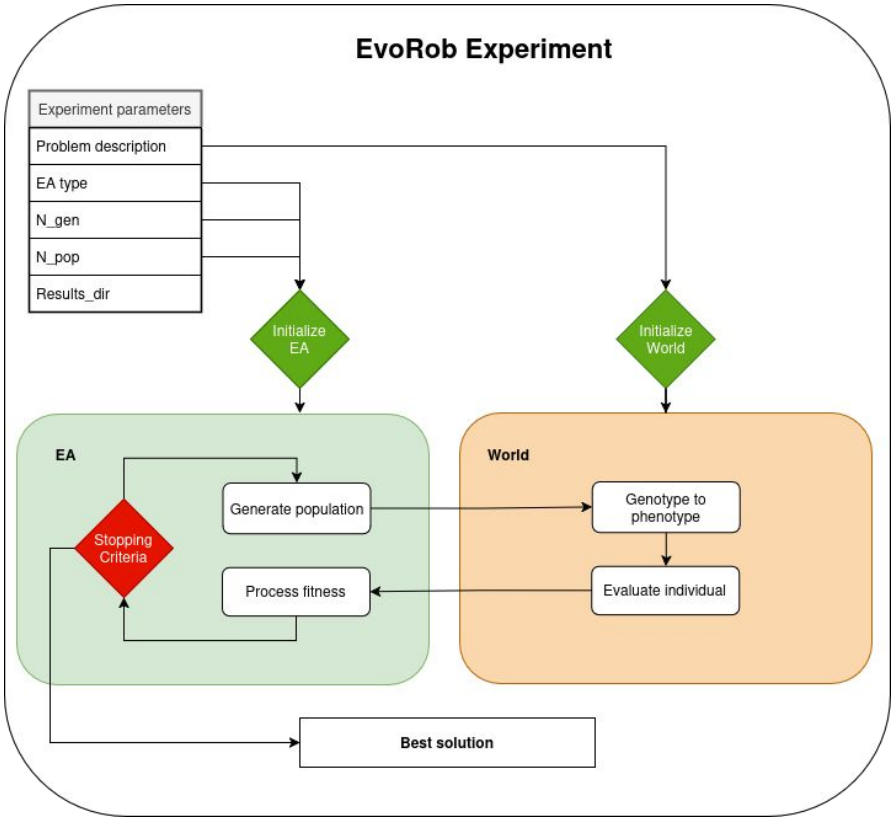
Practical: Overview

All practicals are in Python

- Algorithms (evolutionary algorithms)
- EvoRob exercises (evolutionary robotics experiments)
- **EvoRob report (Final grade)**

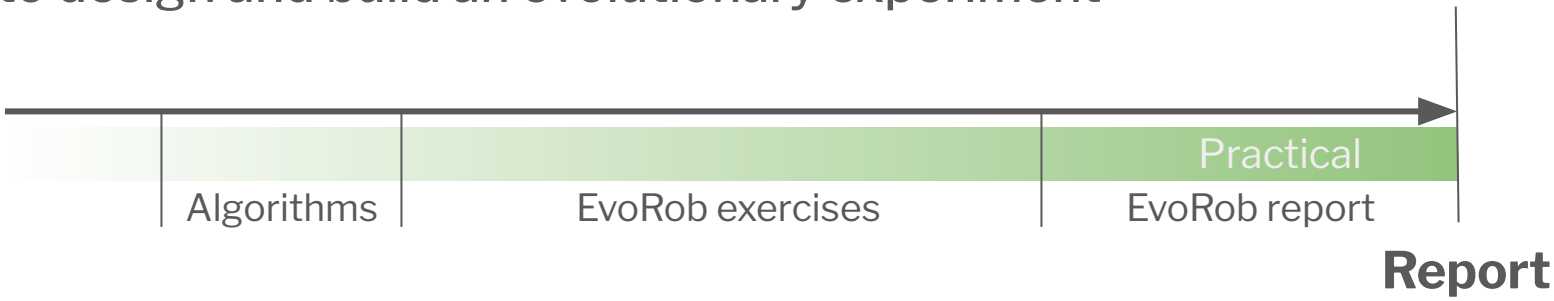


Practical: Overview



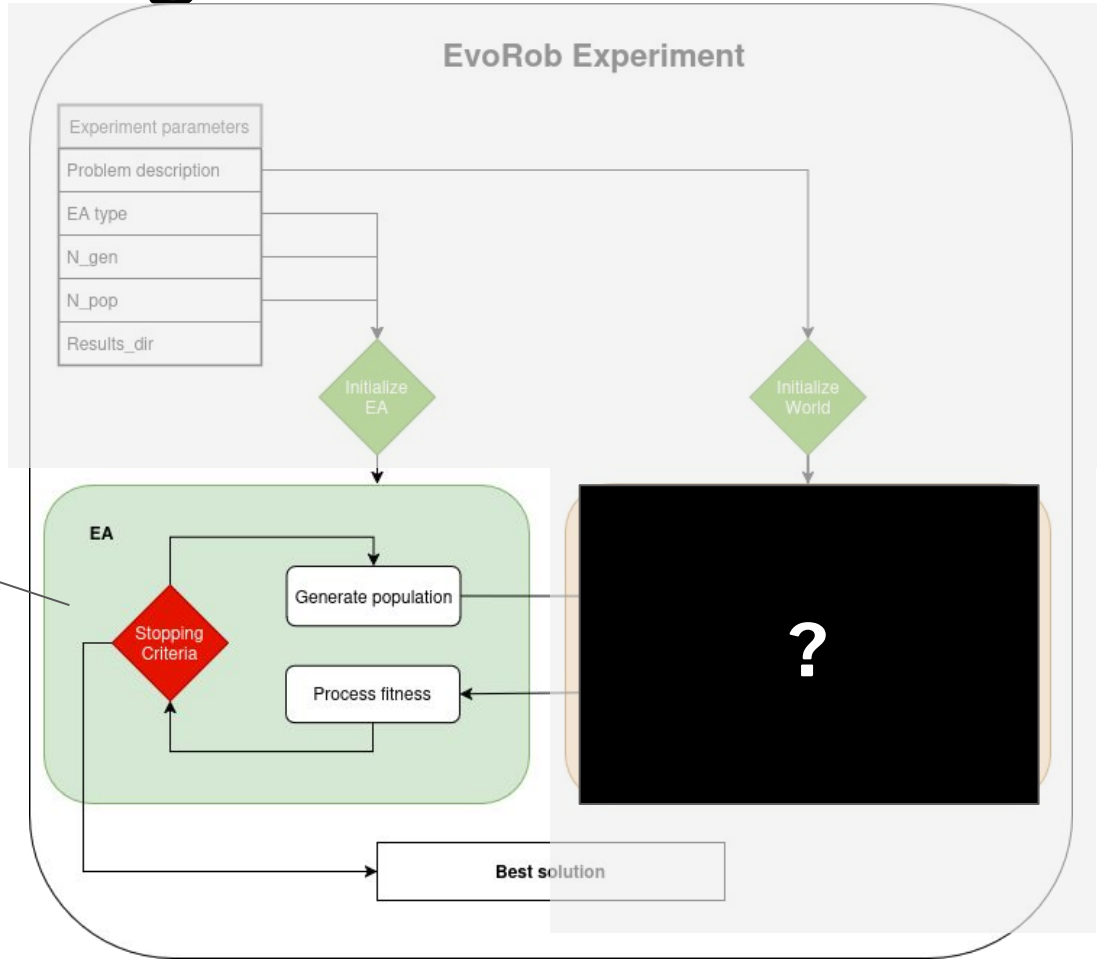
Practical: Learning goals

- Hands-on experience with commonly used evolutionary algorithms and deep reinforcement learning algorithms in robotics.
- Proficiency with state-of-the art software tools like (OpenAI) Gym environments and the MuJoCo physics engine.
- Ability to design and build an evolutionary experiment



Practical: Algorithms

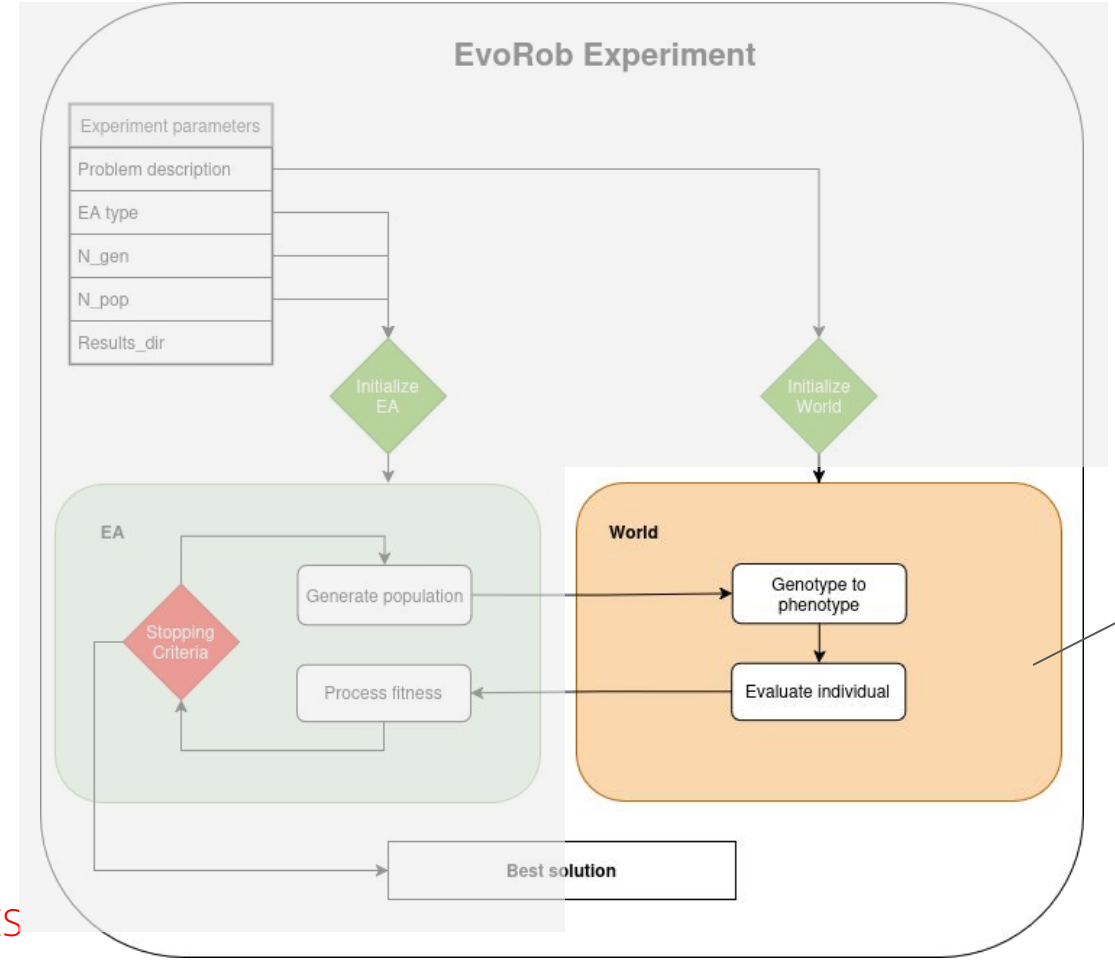
Algorithms



Practical: Algorithms

- Hands-on experience with commonly used evolutionary algorithms
  - GA: combinatorial optimisation
  - ES: real-valued optimisation
  - NSGA-II: multi-objective optimisation
- Will be used for the EvoRob exercises

Practical: EvoRob Exercises



EvoRob exercises

Practical: EvoRob Exercises

- Hands-on experience with commonly used evolutionary algorithms and deep reinforcement learning algorithms in robotics.
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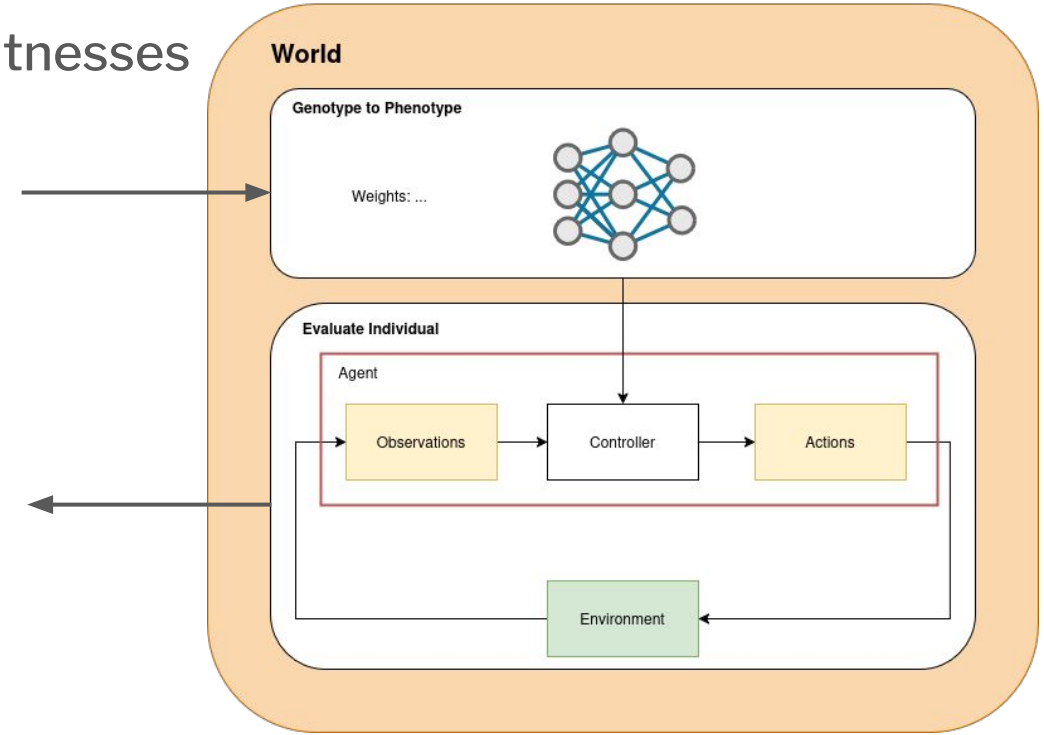
Practical: EvoRob Exercises

Translate genomes → robots → fitnesses

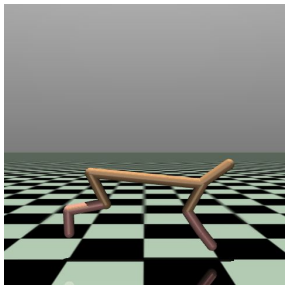
We need:

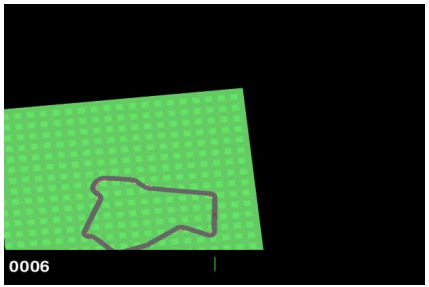
- Simulation environment
- Physics engine

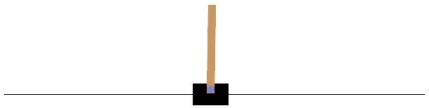


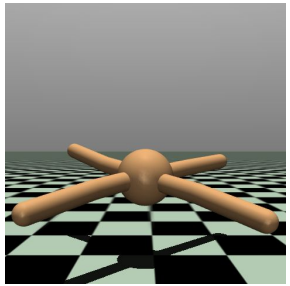
Practical: EvoRob Exercises

(OpenAI) Gym: simulation environment







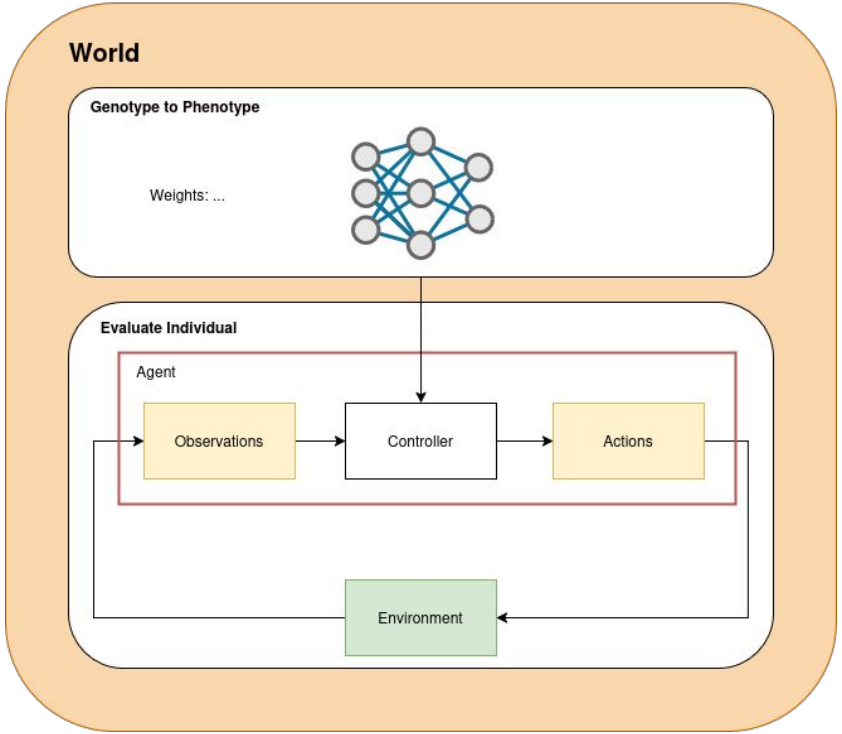


Practical: EvoRob Exercises

Translate genomes → robots → fitnesses

We need:

- Simulation environment
- Physics engine

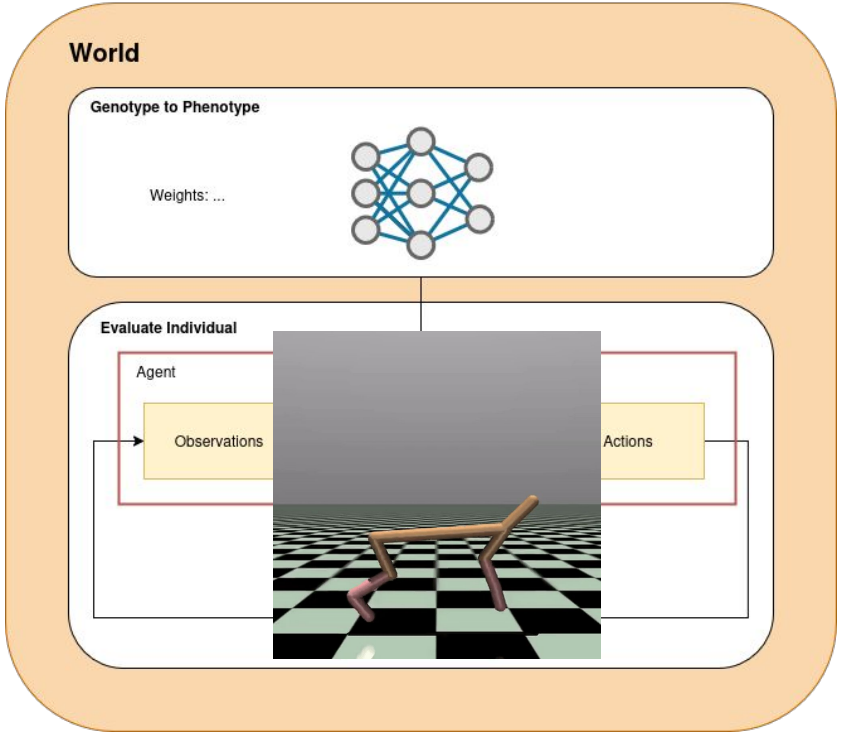


Practical: EvoRob Exercises

Translate genomes → robots → fitnesses

We need:

- Simulation environment (gym)
- Physics engine

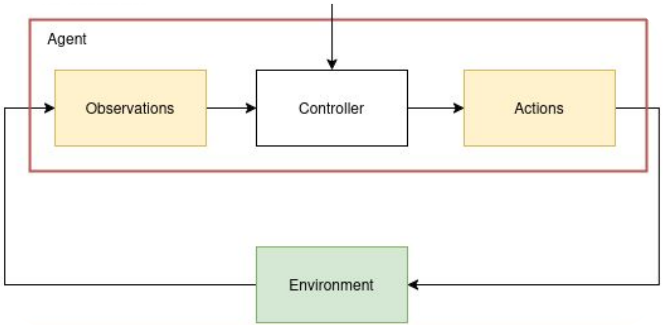


Practical: EvoRob Exercises

Robot simulation with: Gym interface

```
observations, _ = gym.reset()
For n_time_steps:

actions = controller(observations)
observations, _ = gym.step(actions)
```



Practical: EvoRob Exercises

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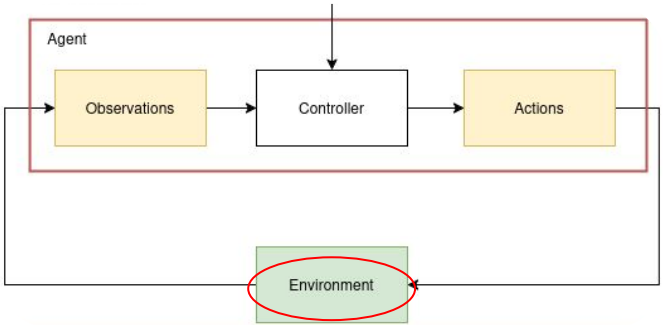
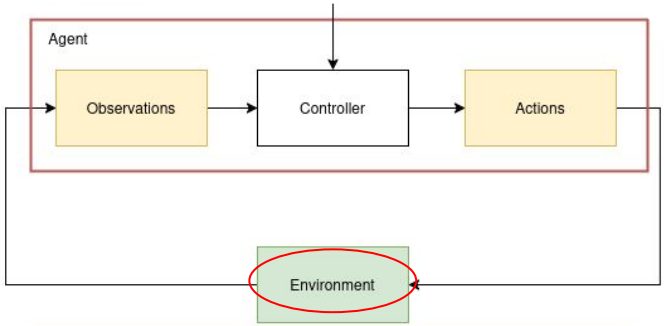


Practical: EvoRob Exercises

Translate genomes → robots → fitnesses



We need:

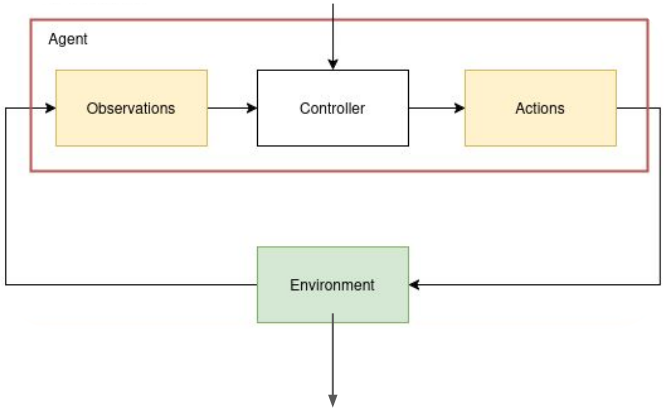
- Simulation environment (gym)
- Physics engine

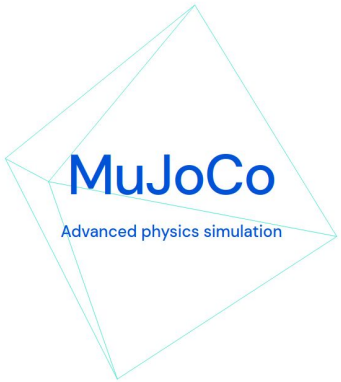
Practical: EvoRob Exercises

Translate genomes → robots → fitnesses

We need:

- Simulation environment (gym)
- Physics engine (MuJoCo)





Practical: EvoRob Exercises

IMPERIAL

Adaptive & Intelligent Robotics Lab

PhD applicants

We are seeking highly motivated and talented PhD students to help us research using learning algorithms (deep reinforcement learning, quality diversity optimization, evolutionary algorithms and others) to improve the adaptivity, versatility and autonomy of physical robots. This objective encapsulates several major research directions, including:

DEEPMIND IS HIRING A

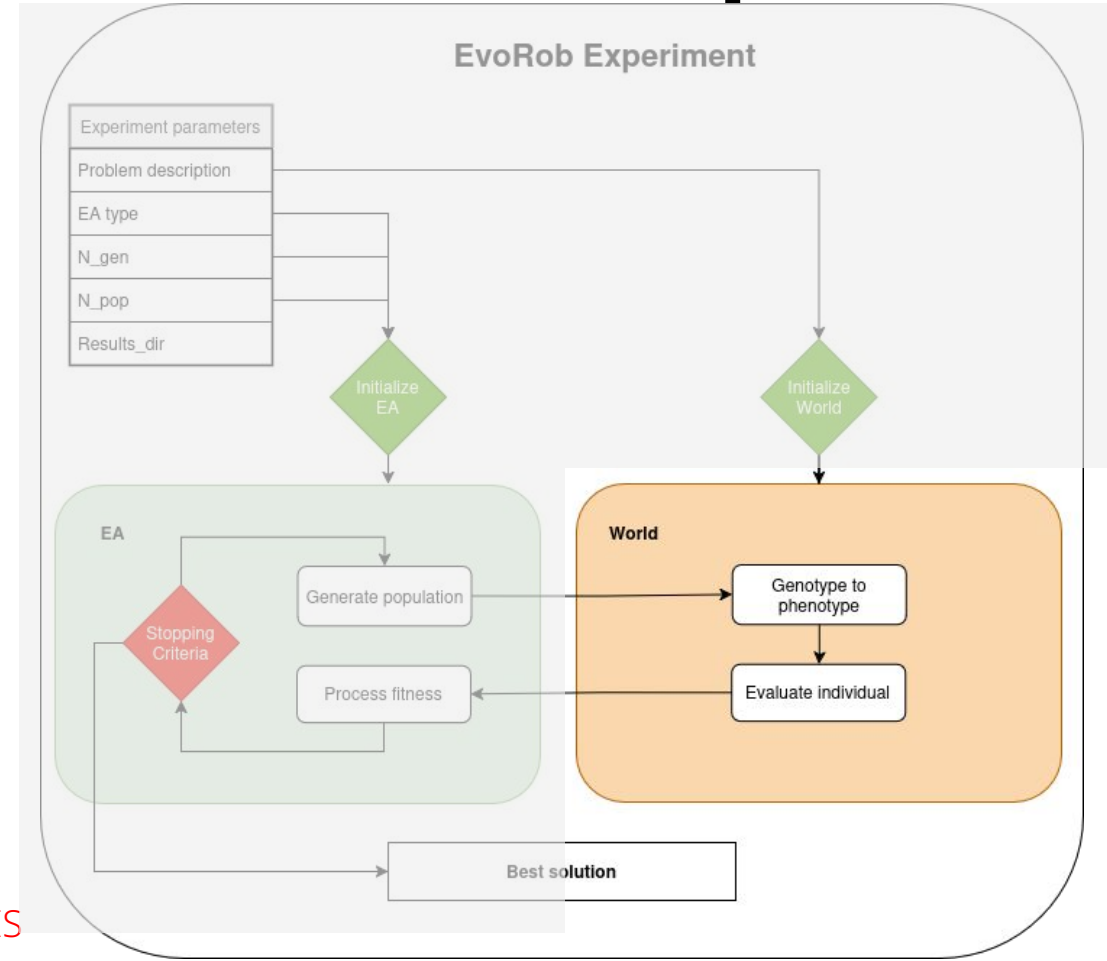
Software Engineer, Robotics Simulation (MuJoCo)

Senior Robotics Manipulation Engineer

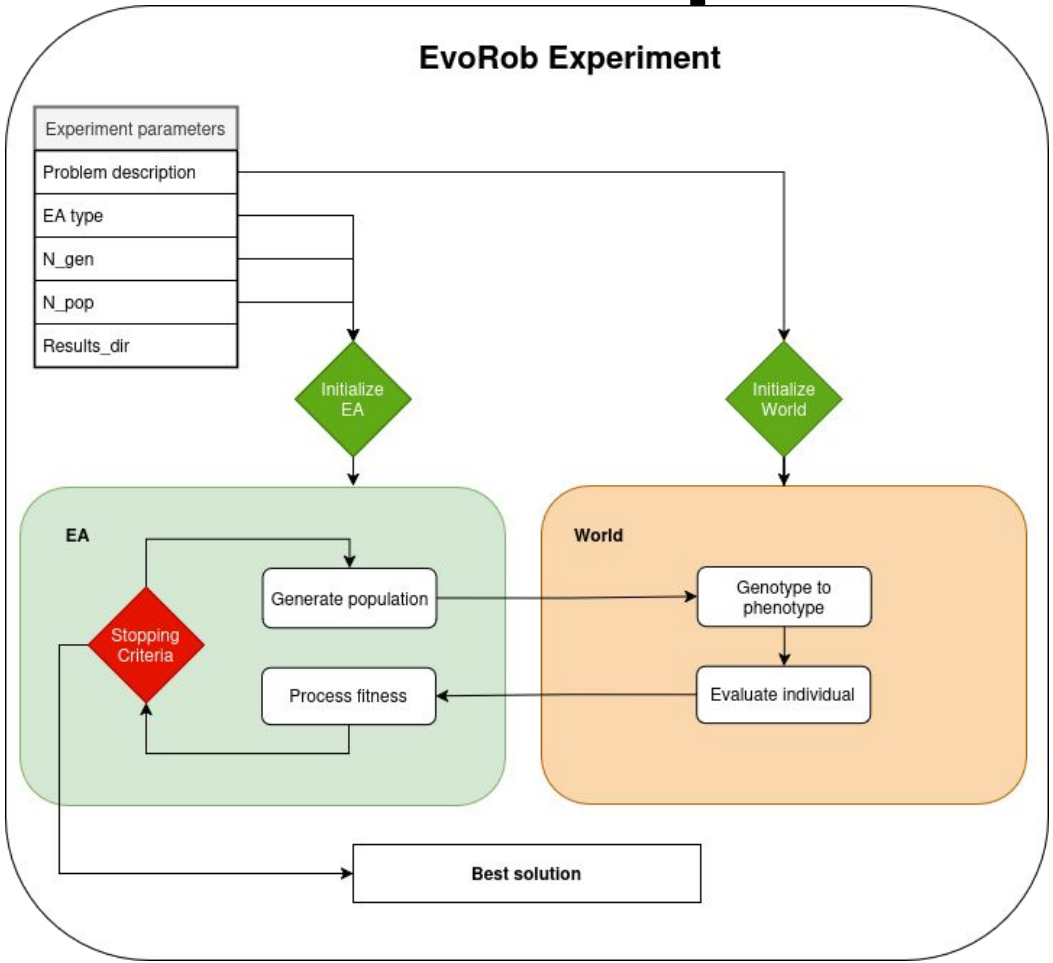
Qualifications:

- Solid understanding of control theory, with a focus on manipulation and locomotion tasks.
- Proficiency in Python/C++ and deep learning frameworks like PyTorch.
- Extensive experience with GPU programming, including CUDA and GPU-accelerated libraries.
- Experience with robotics simulation frameworks (e.g., OpenAI Gym) is a plus.
- Experience working with physical robots is beneficial.
- Thrives in a fast-paced, dynamic environment and possesses the ability to contribute to all stages of product development.

Practical: EvoRob Report



Practical: EvoRob Report



Practical: EvoRob Report

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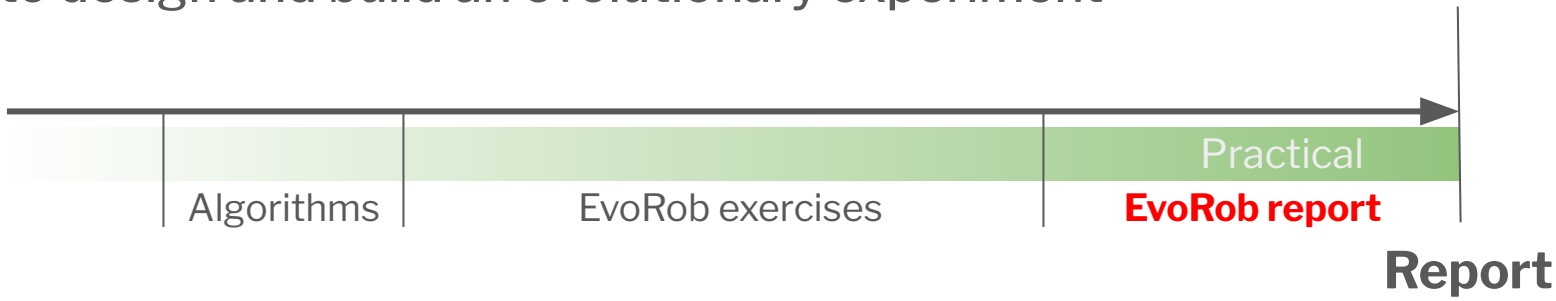
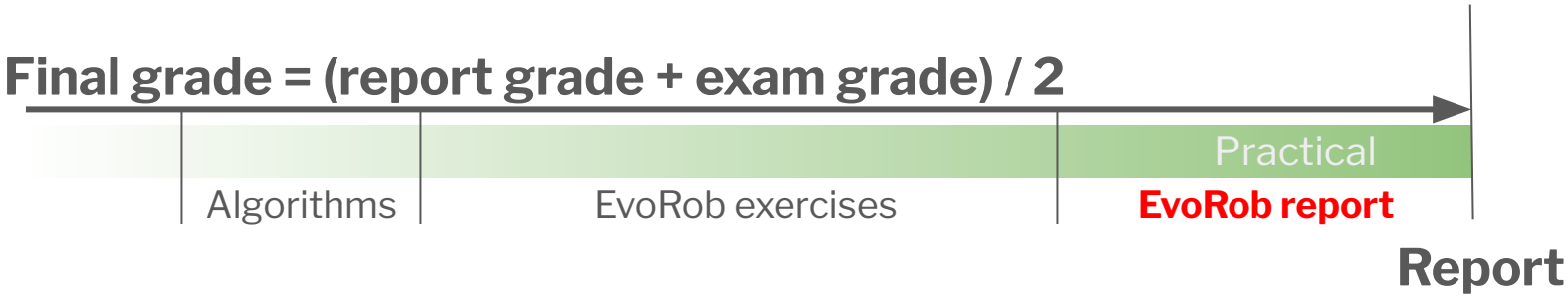


Practical: EvoRob Report

- Start on time (multiple experiments can take long)
  - We expect you to understand the EvoRob exercises here
- Groups of 2 student
- Max 2 pages
- Follow the Word template



Practical: EvoRob Report

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- Max 2 pages
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Title

1. Introduction

Provide a brief introduction to the topic or purpose of your evolutionary experiment. Include a short overview of the objectives, environment, robot design.

EA: Short description of EA
World: Short description of your world

2. Methods

Describe the geno2pheno type (and reason why you choose this representation), fitness function, what do you measure/why, and describe your statistical method.

Questions?

For questions outside of lectures/practical:

- **Moodle**