Evolutionary Robotics
Prof. Dario Floreano

Teaching assistants:
Euan Judd (euan.judd@epfl.ch)
Krishna Manaswi Digumarti (krishna.digumarti@epfl.ch)

The goal of the grand challenge is to evolve a robot for the next Mars exploration rover

The evolved robot must be wheelless and should be capable of locomoting as quick as possible on rough terrain while avoiding obstacles. Additionally, the robot must stabilize its core components as much as possible while locomoting as it could be used to carry delicate scientific equipment in the future.

Assignments

- Carefully read the instructions and rules in this document.
- Every team should submit the best robot (txt file), their presentation (PDF and pptx) and all evolution files (scenario, configuration files, arenas, etc) on **Moodle** before **Tuesday, 31-May-2022 23:59**.
- All teams will receive a kit of components so that they can build their robot and access to the DLL building where they use the facilities such as 3D prints and soldering irons.
- **The performances of the robot will not be graded.** However, you need to give a presentation, which will be graded, on the procedure used to evolve the final robot. A template of the presentation will be provided on Moodle.
- The presentations will be on **Thursday, 2-June-2022**.
- The presentation will be graded on the scientific approach, clarity and completeness.

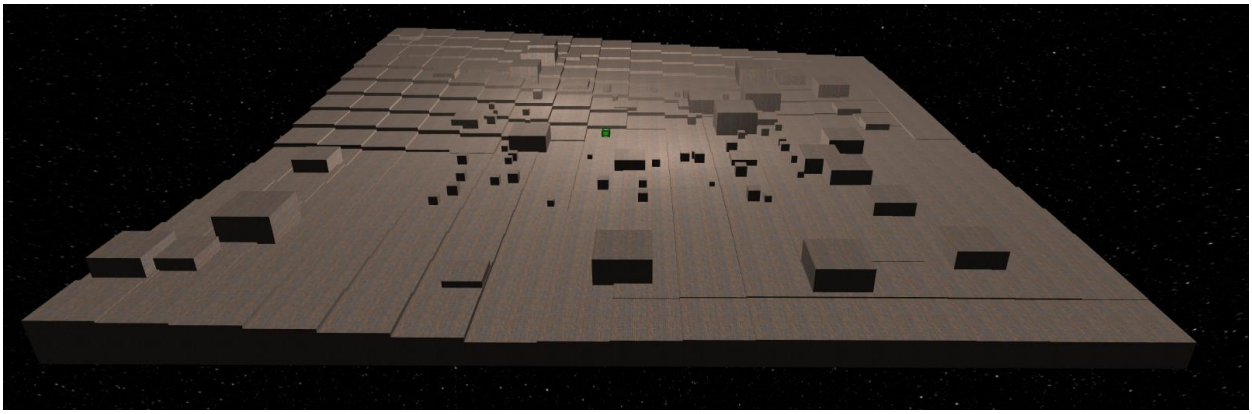
Rules

- Evolve a morphology with no more than **8 servos**.
- Teams evolving their robot with initial morphologies must justify the reason in the presentation.
- We will upload an arena (pictured below) to moodle for you to use in addition to any arenas that you make yourself.
- The submitted robot will be tested in an arena that is very similar to the one provided to you. Your robot will be built so you should use **earth's gravity**. However, as a fun task,

you could check how your robot will behave on mars (gravity of mars = 3.711 m/s^2).

- Avoid jittery behaviours by uncommenting the option in the simulation config file.
- Allow **25 components** max in your body morphology (option in simulation config file).
- Use only IMU and IR sensors (not light sensors).
- **Add noise to the servos and sensors** not higher than 0.1 and not lower than 0.02

The arena:



Reminders and tips

- Remember that you can split your evolution into several steps that each evolve for one distinct behaviour, e.g. first locomotion, then obstacle avoidance and finally stabilization.
- You should be scientific in your approach so make sure you only change a few parameters in each evolution and justify your choices.
- Some IMU values should be minimized in the fitness function to stabilize the core of the robot (modify your scenario file appropriately).

You may see the fitness plateau after a certain number of generations. If this happens, try the following:

- Keep the evolution running for more generations. Big improvements can sometimes happen after 50-100 generations, even after the fitness seems to have plateaued already.
- Explore more the fitness landscape, i.e. increase the population size, mutation rate, crossover rate, or make the tournament size smaller.
- Improve the fitness function. For instance, modify the equation by changing some of the terms or give weights to different terms in the existing fitness function to change their relative importance.

Timeline

14-Apr-2022	Introduction to Grand Challenge
31-May-2022	Deadline for final robot submission
02-June-2022	Presentations

Write to your teaching assistants if you have any questions or issues!

Good luck with your evolution!