MICRO-515
Evolutionary Robotics
Prof. Dario Floreano

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ROBOGEN CHALLENGE 2024:
Evolve a legged robot solving your self-designed task

The evolved robot must be wheel-less and capable of locomotion using legs, as well as performing tasks identified by groups. Your task should be interesting yet simple enough to be evolved in RoboGen. The movement has to avoid jittery behavior.

Submission and grading:

- Submission deadline: **Wednesday, 29-May-2024 23:59**
- Every team should **submit the following files in a zip file on Moodle**:
    1. Their best robot (.txt file)
    2. All evolution files (scenario.js, configuration files, arenas, etc)
    3. Their presentation (PDF and pptx)
- **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, 30-May-2024**.
- The presentation will be graded on the scientific approach, clarity and completeness.

Additional key information:

1. Discuss the project with your group members and ask the TAs questions at the lab session on the 2nd and 16th of May.
2. You will need access to the DLL prototyping facilities to build the robot you evolve. You will need to complete the online training before you use DLL:
    - General safety: go.epfl.ch/moodle-training (only the DLL Prototyping part)
    - Rules for using a prototyping space (you will need to choose the name of the course): go.epfl.ch/prototyping-training (choose: CREDITED-MICRO-515)

- To receive access to the 3D prints, you must register and attend the course. Registration are on this link: https://doodle.com/meeting/participate/id/dRlDJRwa/vote

Please complete this before you use DLL.

3. Start planning and evolving your robot on RoboGen as soon as possible as **you will need to leave enough time to build your robot** before the project deadline on 29st May at 23:59.
4. Each group will be provided with hardware, including electronics and 3D printed parts, which you will use to assemble and test your robot. You will need to do some electronics, 3D print extra parts, then assemble and test your evolved robot. You will likely need to use the DLL facilities in your own time.
5. Future lab sessions will be split between room BS160 and DLL. The TAs will be at the following locations:
    a. 2nd May:
        i. **BS160** (10:30am – 12:00am) – Hardware handout, finishing previous exercises
    b. 16th May:
        i. **DLL** (9:15am – 12:00am) – Project Coaching
    c. 23rd May:
        i. **BS160** (9:15am – 10:00am) - Lecture by Prof. Floreano
        ii. **DLL** (10:15am – 12:00am) – Project Coaching
    d. 30th May:
        i. **BS160** (9:15am – midday) **– Final graded presentations**

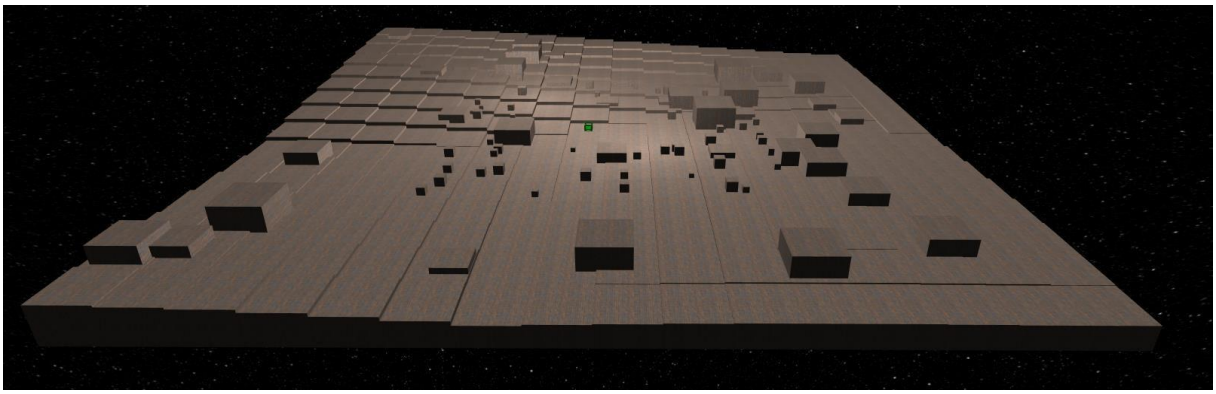
Hardware

- 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.
- Hardware will be returned to TA during the final graded presentation

Rules

- Evolve a morphology with no more than **6 servos**.
- Teams evolving their robot with initial morphologies must justify the reason in the presentation.
- Design your own arena
- Avoid jittery behavior.
- Use legged locomotion
- Allow **25 components** max in your body morphology (option in simulation config file).
- Use only IMU and IR sensors (do **not** light sensors).
- **Add noise to the servos and sensors** not higher than 0.1 and not lower than 0.02

Example of arena design:



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).
- Try to not run too many evolutions/visualizations of the robots (better if only one). This can lead to a crash of your web browser and therefore the end of your evolution.
- Sometime the RoboGen app seem to have a problem saving the files of the evolution. You can always try to refresh the page before you start an evolution.

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.

Important

- If you have any issue with hardware (missing components, broken electronics, etc) write email to your TA.

Good luck with your evolution!