# AI4Games 2021
## Exercise 2
## Mars Lander

10 points
Deadline: 08.11

Your task in this exercise is to write an evolutionary-based controller for a Mars Lander[1] optimization puzzle.

For inspiration, you can take a look at the Tech.io playground about Genetic Algorithms[2] with accompanying online visualization[3] and the blog post about GAs usage for Mars Lander[4].

## Simulator [2p.]

Implement a forward model that allows you to simulate the course of the game for the given map, initial position, and a sequence of actions. In your report, write the number of fully random simulations your agent can perform in the first round of the *Easy on the right* test.

Please note that underlying physics engine works on doubles, but every turn player inputs are rounded to integers. Thus, to be consistent with the true state of the game you should simulate its course from the beginning and discard inputs from later rounds.

## RHEA [4p.]

Implement RHEA, so that your program passes all the test cases and validators (they are the same as for the medium puzzle Mars Lander – Episode 2[5]). (Attach proof of this.) You can apply any operators that work for you for selection, crossover, mutation, and replacement. You can use the ones provided in the lecture, search the web, or encode your own ideas. Briefly describe in your report what did you try and what were the results.

For the best version you have found, visualize an example of the evolutionary run, showing best and average fitness per generation.

## Fitness implementation [2p.]

For this kind of problem, a proper formulation of a fitness function crucial. Think about how it can be done.

Note that most of the simulations will end with crashes sooner or later. But, some crashes should be considered better than others to push the evolution in the right direction. Obtaining any path that will lead to a safe landing is the first priority, so we can optimize such more promising paths.

Formulate a few functions and try them in your algorithm. Write a discussion in the report describing what worked and what didn't work and what you suppose were the reasons for this.

## Final challenge [2p.]

Upgrade your algorithm to be able to pass the third episode of the Mars Lander puzzle[6].

Describe the changes you had to made (if this is a different version than the one used for Episode 2) and the final set of operators, fitness formulation, and other important parameters.

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[1]https://www.codingame.com/ide/puzzle/mars-lander
[2]https://tech.io/playgrounds/334/genetic-algorithms/
[3]https://fafl.github.io/genetic-lander/
[4]https://www.codingame.com/blog/genetic-algorithm-mars-lander/
[5]https://www.codingame.com/training/medium/mars-lander-episode-2
[6]https://www.codingame.com/training/expert/mars-lander-episode-3

## Bonus score [+1p.]

Add to your report your nickname on CodinGame and a screen with best score obtained by any version of your program. The bonus will be given to anyone reaching a certain (hidden so far) threshold.

## Late days [-3p.]

You can still send your solution one week after the main deadline, but the number of received points will be reduced by 3.