Bio-Inspired Artificial Intelligence - EMATM00029 Exercises - Evolutionary Robotics

The section ***Digging deeper** is optional. They are for those who want to learn more about the topic.

TED talks

Watch the following video related to evolutionary robotics, reflect on the potential and limitations of the approaches described and the improvements since 2007:
https://youtu.be/lMkHYE9-R0A

Braitenberg vehicles

Braitenberg vehicles are simple robots with two wheels and two light sensors. Motor commands change proportionally to readings on the robot sensors. Depending on the controller, robots will exhibit attraction to the light source, or repulsion.

In a couple of words, describe how you would set the following elements of the algorithm:

- genotype
- phenotype
- fitness for each of desired behaviours (attraction, repulsion)
- initial population
- selection operator
- crossover and mutation probabilities

Evolving cooperation

Modify the Braitenberg experiment above to evolve cooperative behaviours for a team of 10 robots. In the first experiment, robots evolve to aggregate. In the second, they evolve to disperse. Importance is giving to minimising energy usage. Cost is associated with each movement.

How would you change the genome of the robots to favour cooperation? Should you evolve homogeneous or heterogeneous teams? How would you modify the fitness?

Evolving creatures

Use framsticks to evolve creatures that are 1) tall and 2) fast.
You can download the Framsticks Theatre from here:
http://www.framsticks.com/a/al_download.html
Pick menu - select a show - current show - evolution. Use the optimisation criterion to change your fitness. Can you evolve fast/tall creatures?
Change to the show called "evolution demo" and play around with the evolutionary parameters. Do you get different results?

Evolving hardware

Evolve a creature using RoboGen, you can do this online here: http://robogen.org/app/.
Instructions on how to use the app can be found here: http://robogen.org/docs/usage-examples/#RoboGen_Online. Note it may take time to evolve a couple generations.

Read the section "Artificial evolution of robots" to evolve a new robot. In short, click advanced - start an evolution. Here's a possible experimental setup:

Start a new Evolution

Files

Working directory

/localStorage ✔

Configuration file

examples/evolConfObstacleAvoidance.txt ✔

Output directory

test ✔

Options

Seed for the RNG

1 ✔

☑ Overwrite the output directory
☑ Save All

[OK] [Cancel]

Click "render best individual" - "visualise" to see your best individiuals for different generations.

Optional: Online learning

Josh Bongard from the University of Vermont has a really exciting course on Evolutionary Robotics, you can watch the lectures here: https://www.youtube.com/watch?v=ANh_HIGmtRE&list=PLAuiGdPEdwOjySMqCxj2-BQ5QKM9ts8ik