Constructive Artificial Intelligence Practical session 9

by Lola Cañamero and Matthew Lewis
m.lewis4@herts.ac.uk

In this practical, you will learn one way to log and analyse data from a robot in the Webots simulator. This can be used to do the type of quantitative analysis seen in lecture 9, and can be used in coursework CW2.

This practical assumes you have read through and worked on the document from practical sessions 6 to 8. If you have questions from the previous Webots practical sessions, you are free to ask them during this session.

Exercise 1: Logging Data

This exercise should be done in pairs.

Start with a Webots robot controller in which the robot has a physiological variable (e.g. the controller from practical session 8). We will add some logging to record the value of the variable.

1. In the initialisation code, open a file for writing, name it "log.csv" (CSV stands for "Comma-Separated Values"). In Python you can use the function `open(name, mode)`, in C you can use the function `fopen(name, mode)`. In both cases *mode* is a string, e.g "w" for write, and the function returns a file object/structure pointer that can be used for writing to the file.

2. Add code to close the file (call the standard functions `close()` in Python, and `fclose()` in C) to your cleanup code (e.g. when the robot dies and the main loop is exited).

3. Add a function to write to the value of the physiological variable(s) plus a newline to the logfile (if you have more than one physiological variable, separate them with suitable character, e.g. comma, space, tab). The function could use the standard `write()` function in Python or `fprintf()` in C.

   Add a call to your logging function in the main loop of the controller.

4. Run the simulator for a while (the robot should find a resource and consume it a few times during the run). The log file will be created in the folder where your controller code is located. Open the log file (the .csv extension will mean that by default it opens in Excel).

5. In Excel (or another spreadsheet program, or using another method such as using R or processing the file in Python):

i. Plot a graph of the values of the physiological variable over time.

ii. Calculate the difference between the physiological variable and its fatal limit at each time step.

iii. Calculate the mean difference between the physiological variable and its fatal limit across the whole run.

iv. (If you have more than one physiological variable, you can also calculate the wellbeing at each time step and the overall wellbeing across the whole run.)

Exercise 2: (advanced, optional)

If you finish exercise 1, you can either:

1. Do Exercise 2 from Practical Session 8.

2. Run your simulation multiple times, collecting data each time.
   Change the conditions of the run (e.g. change the controller in some way) and run the simulator multiple times again, collecting data each time.
   Calculate some metrics for each run, and use a t-test (e.g. in Excel) to test whether there is a significant statistical difference between the metrics in each condition (use a significance threshold of 0.05, so accept the hypothesis if $p < 0.05$).