

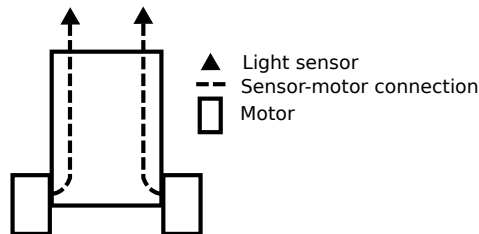
## Assignment: Braitenberg Robot 2

During this practical session you will expand your robot so that it exhibits a variety of light seeking/avoiding behavior. Before beginning the practical it is advised to read the material provided on Braitenberg Vehicles. This will help you understand the behaviors you are trying to produce.

Your robot needs to be able to perform four behaviors when presented with a strong light.

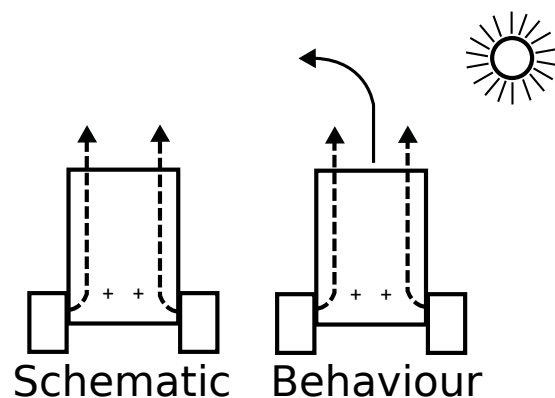
1. Fear (robot drives away from the light)
2. Aggression (robot drives towards the light)
3. Love (robot slowly approaches and rests near light)
4. Exploration (robot slowly avoids the light and rests away from the light)

To produce these behaviors some modification of your robot is needed. Specifically, you need to attach two light sensors to your robot and be able to return values from them. You need to then use the sensors to alter the input to the motors.



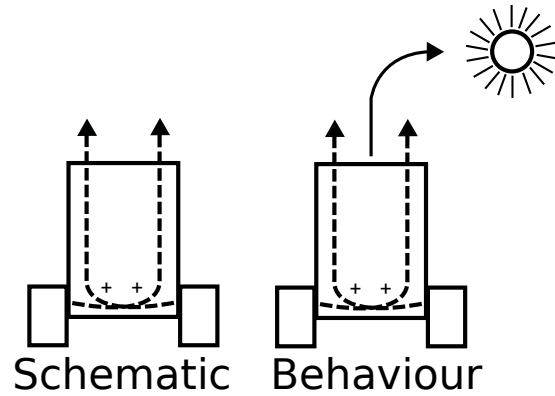
### Exercise 1: Fear

Your first task is to make the robot drive away from the light. This can be done by making an excitatory connection between the light sensor reading and the motor on the same side.



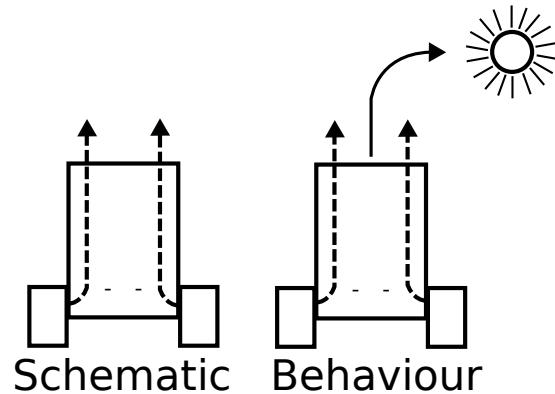
### Exercise 2: Aggression

By swapping the connection between the sensors and motors (the sensor affects the motor on the opposite side) we can make the robot to drive towards the light. Connection swapping can be done physically or in software.



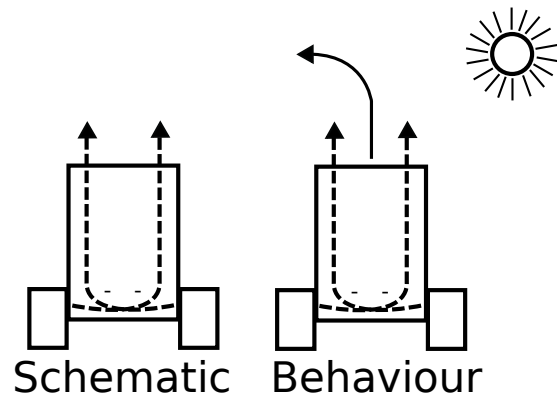
### Exercise 3: Love

Interestingly, we can modify this light seeking behavior to make the robot stop near the light as well. This can be done by making an inhibitory connection between the light sensor reading and the motor on the same side.



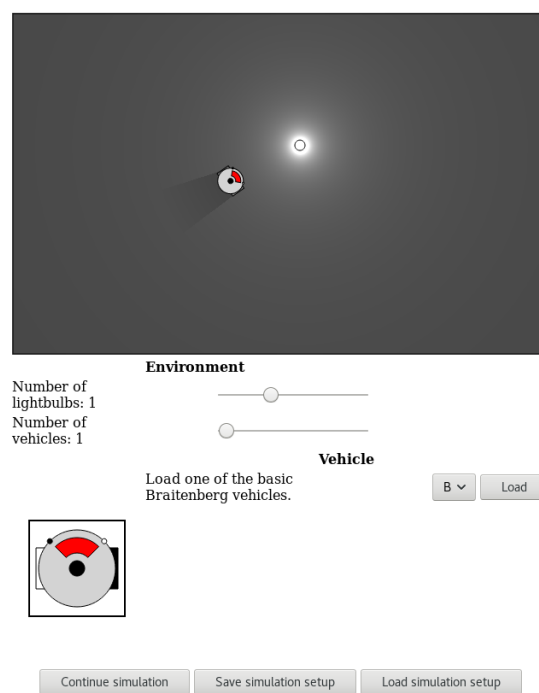
### Exercise 4: Exploration

Finally, we can make the robot avoid light but also stop close to it. This can be done by using an inhibitory connection and swapping the connection between the sensors and motors.



### Braitenberg Simulation

In addition to implementing the 4 behaviors described above we also want you to see the behaviors in virtual agents. On Blackboard you will find a zip file (**BraitenbergSim.zip**) containing a Javascript simulation of a robot capable of performing the different Braitenberg behaviors. In order to run this simulation you need to simply load the HTML file (**BraitenbergABCD.html**) in your favorite modern browser (Chrome, Safari, Firefox, ...), with JavaScript enabled (it is unless you've disabled it). You should be able to see the simulation environment like in this screenshot:



The robot will start to simulate one of the behaviors described above. Each of the settings (A, B, C, D) implements a different Braitenberg behavior (love, fear, exploration, and aggression). Your task is to determine which configuration corresponds to each behavior. Note that you can drag the robot and light source(s) with the mouse.

## Report

It is mandatory to hand in a report for this assignment (on time!), but it will be worth less than the other practicals. This presents an opportunity to get feedback without undue influence on your final grade: do what you think is good work, and we will give feedback for improvement. Your report should consist of 4 sections: introduction, methods, results and discussion. Below is a breakdown of the type of information we would like in each section.

### Introduction

- What are Braitenberg vehicles?
- Why should we study Braitenberg vehicles?

### Methods

- How and why you designed your robot like you did.
- How you implemented the algorithms (for example how exactly did you pass the light values to the motors). Did you consider or try another way that you decided was worse?

### Results

- Describe the behavior of your robot with respect to the different algorithms.
- Indicate which of the simulation settings you think represents each algorithm. Did you find a particular experimental setup useful to differentiate them?

### Discussion

- What are the behavioral differences (if any) between your robot and the simulation.
- What could have caused these differences?

## Deliverables

With your report please include the following in a single zip file.

- A photo of your robot (as a Figure in your Methods section).
- All code files.
- A set of brief videos (<20s each) showing your robot performing the different behaviors (label them appropriately, quality is not important but file size is, please keep them small).

## References

- Rolf Pfeifer and Christian Scheir, “Braitenberg Vehicles.” Understanding Intelligence (Cambridge, MA: MIT Press, 1999), 181-198.
- Valentino Braitenberg, Vehicles 1-7, Vehicles: Experiments in Synthetic Psychology (Cambridge, MA: MIT Press, 1984).
- <https://www.youtube.com/watch?v=yUVcI5Pw2o4>
- <http://users.sussex.ac.uk/~christ/crs/kr-ist/lec1a.html>
- <http://www.bcp.psych.ualberta.ca/~mike/BricksToBrains/>