

## How to get the Thymio II robot to work in the robotlab at the VU

This manual will explain you how to work with the Thymio II robots in the robotlab.

### Getting started

The right equipment before you can start includes:

1. Thymio II robot
2. Raspberry Pi (B+ or 2)
3. Preprogrammed SD card
4. Wifi Dongle
5. Raspberry Pi Camera
6. Battery
7. Cables (Thymio to rasp pi and rasp pi to battery)
8. Scripts to connect with the robot
9. Computer running Linux or Mac OS (Windows needs Cygwin and Xming installed) and wifi (you are supposed to use your own laptop)



**Note:** When connecting all parts, don't turn anything on. When you connected all parts, press the on button of the battery or use a raspberry pi charger to turn the BATTERY on.

### How to work with a Raspberry Pi.

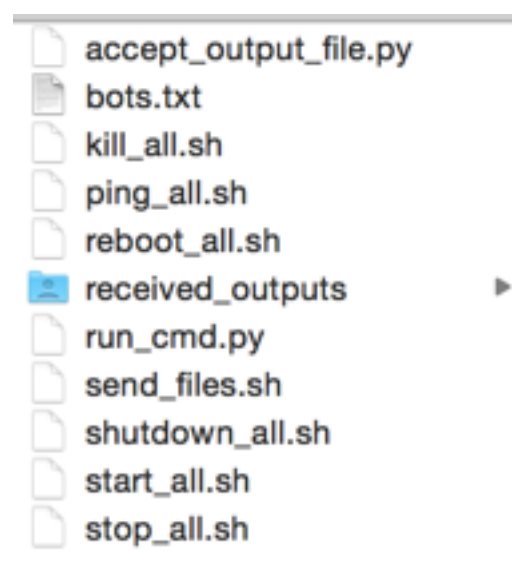
A Raspberry Pi only works with an SD card. You will get a prepared SD card including installation of Aseba (software to control the robot), Python (the used programming language) and open CV (for using the camera. The SD card also includes a script to automatically run an algorithm after rebooting (\_init.sh).

You will be given one advanced script to do a foraging task consisting of 4 files and one folder. There will be also specific example files to control for example the camera (3 example files).

You can check the content of the raspberry pi when connecting it to a monitor with HDMI connection (there is one in the robotlab) or connecting into it using SSH (on Windows you can use WinSCP) You need the login 'pi' and password 'raspberry'.

### Files needed on your laptop

If you use more then one Thymio II robot you can use scripts to control all of them at the same time. These scripts must be on your computer and include the following:



Check the files for the goal of every file.

When you save these files on your computer, you need to modify a couple of them:

- accept\_output\_file**: change N\_THYMIO to number of robots you use (1 or 2)
- bots.txt** is empty when you get it. You need the IP of the raspberries (which is written on the robot), each on an own line. Press enter after the last entered ip.
- send\_files.sh**: change the path into the folder where the files are.
- algorithm.py**: change the port number. There is a table on Google Drive where is written which number you have to use
- config.json**: write here the ip addresses of your Thymio. They can communicate only with this ip.

## Network setup

Your computer needs access to two networks: the VU internet and the Thymio network (password: 172luckytulip75B) at the same time. Because you can only have one wireless, one needs to be connected to the cable. A switch and Ethernet cables are available in the robotlab.

The robot has to recognise your computer IP. You have to fix this IP to set in the python code. You have to ask which one to use, there is a table on Google Drive. (>start at 100)

## Get the files from the Raspberry Pi

In order to run the algorithms on the raspberry pi, we need to modify a file. Therefore we need to have the files. You can get these files by login in to the raspberry and copy all the files:

```
ssh -X pi@<IP_RASPBERRY_PI>  
login: pi  
password: raspberry
```

open a new terminal and enter the command:

```
scp pi@<IP_RASPBERRY_PI>:/home/pi/* ~/<YOUR_PATH>
```

**Note:** You can ssh to the thymio without using a password. To do this, follow the steps on:

<https://www.raspberrypi.org/documentation/remote-access/ssh/passwordless.md>

## Running the example algorithm

Let's try to start the algorithm that is on the robot. First make sure that in the algorithm file (classess.py line 67) you change the IP address to the IP address of your computer (that you should have fixed before following the rules on the table available on Google Drive) and the receiver port. The robot will only listen to messages received from this IP and will only send the result to that port. Make sure that the port is the same written on receive\_output file.

Open a number of terminals equal to the number of robots you are working with. In each terminal, ssh to this raspberry pi (ssh -X pi@<IP\_ADRESS\_PI>).

Open one extra terminal and go to the folder (on your computer) with the files to control all Thymios (on Windows you have to use Cygwin terminal to navigate and send the command ) Send the command to copy all the files (bash ./send\_files.sh), reboot all robots (bash ./reboot\_all.sh) and start all (bash ./start\_all.sh)

You can see fitness functions printed on the terminal screens.

When the experiment is done, the results are automatically copied onto your computer. If for some errors this didn't happen you can use `get_output_files`. Modify this if necessary.

### **Create your own algorithm**

At this moment you are ready to create your own algorithm and to test it on the robot.

**Note:**

1. Keep track of the temperature of the robot. When the robot is restarted often, the temperature can rise and the robot can overheat and break. Make sure that the temperature is around a maximum of 26 degrees. You can do this by using the `airco` and to reduce the maximum speed to 300 instead of 500.
2. Turn the robot off when done using the robot. When the robot is changing, also make sure the robot is off.