Let’s get {cyber}physical, physical!

So, you want to play Tic Tac Toe with a robotic arm? You’ve come to the right place.

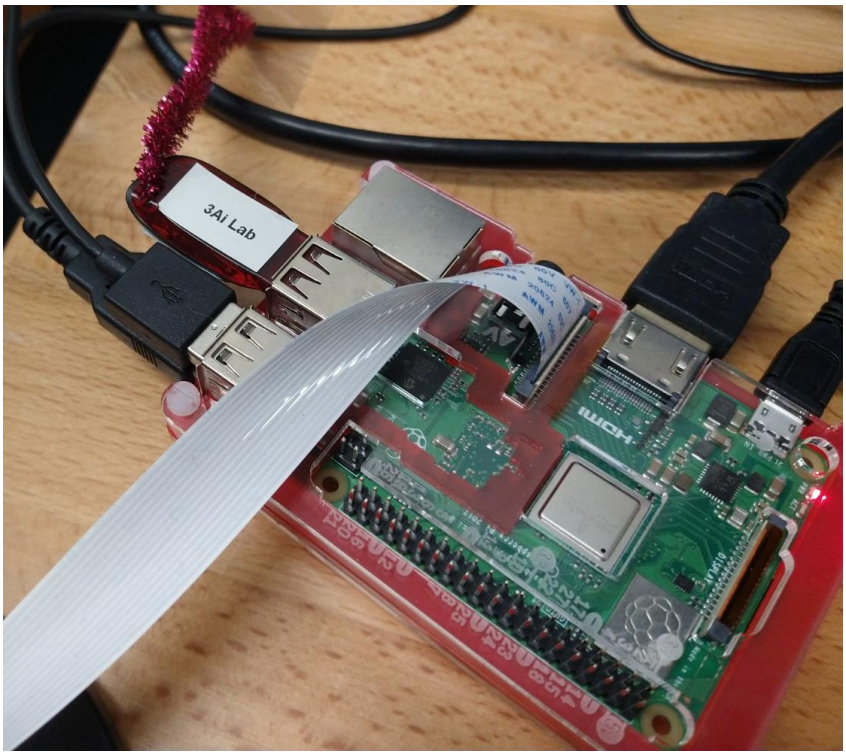
Agent Validity

First: Make sure your agent is valid – it must make only valid moves.

Ask a tutor for help if you are unsure about your agent validity.

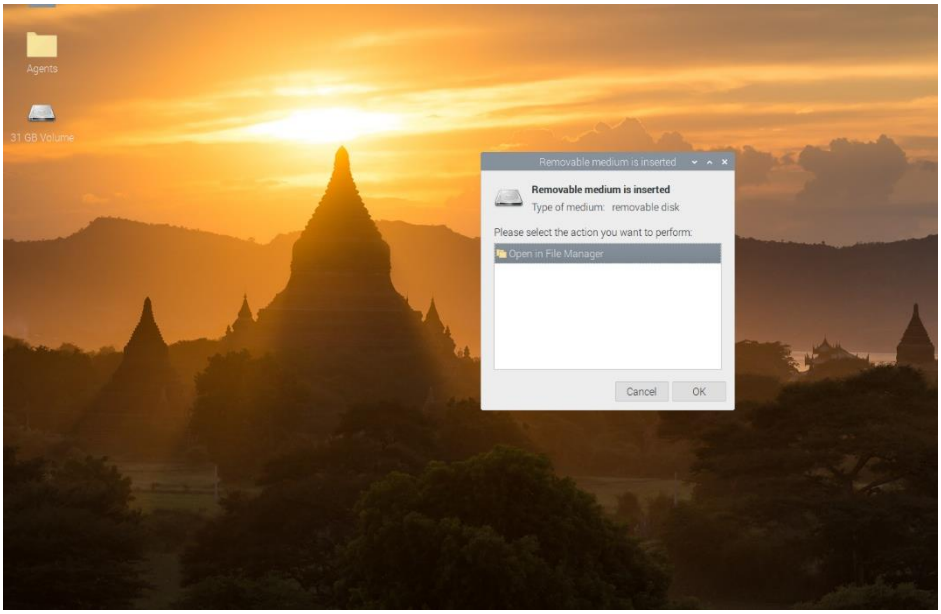
Copy agent code to the Raspberry Pi

The Raspberry Pi computer is adjacent to the AxiDraw V3/A3.

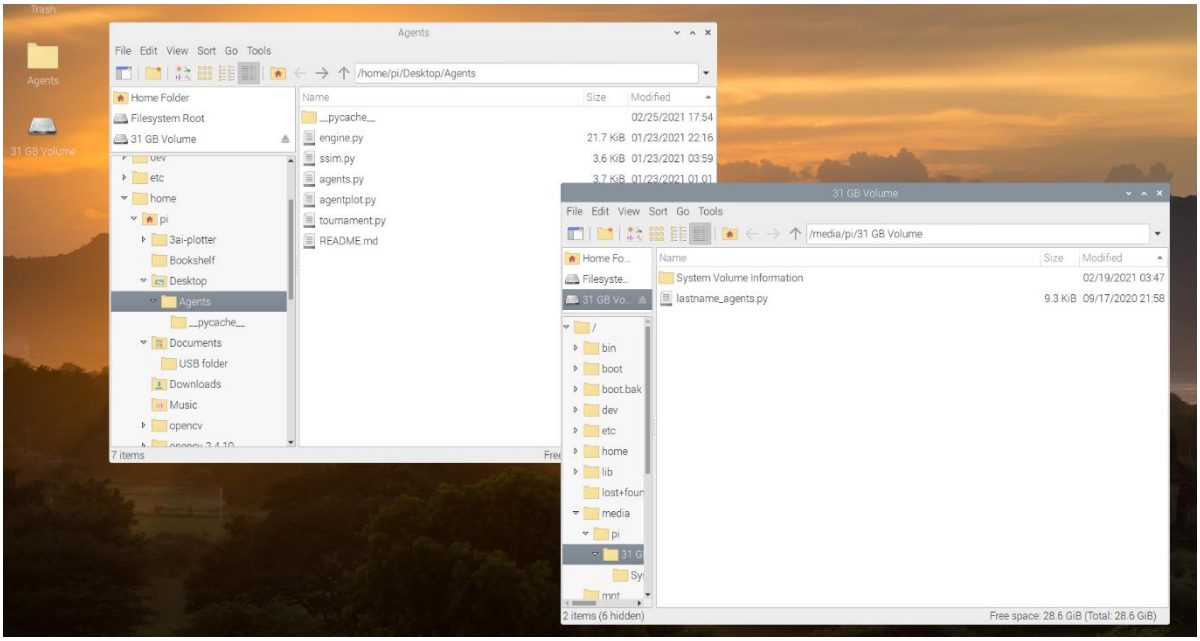


It is a small box with an exposed board, USB keyboard and mouse connections, and an HDMI monitor connected. The ribbon cable connects the Raspberry Pi to a camera input. The micro-usb port provides electrical power to the Raspberry Pi.

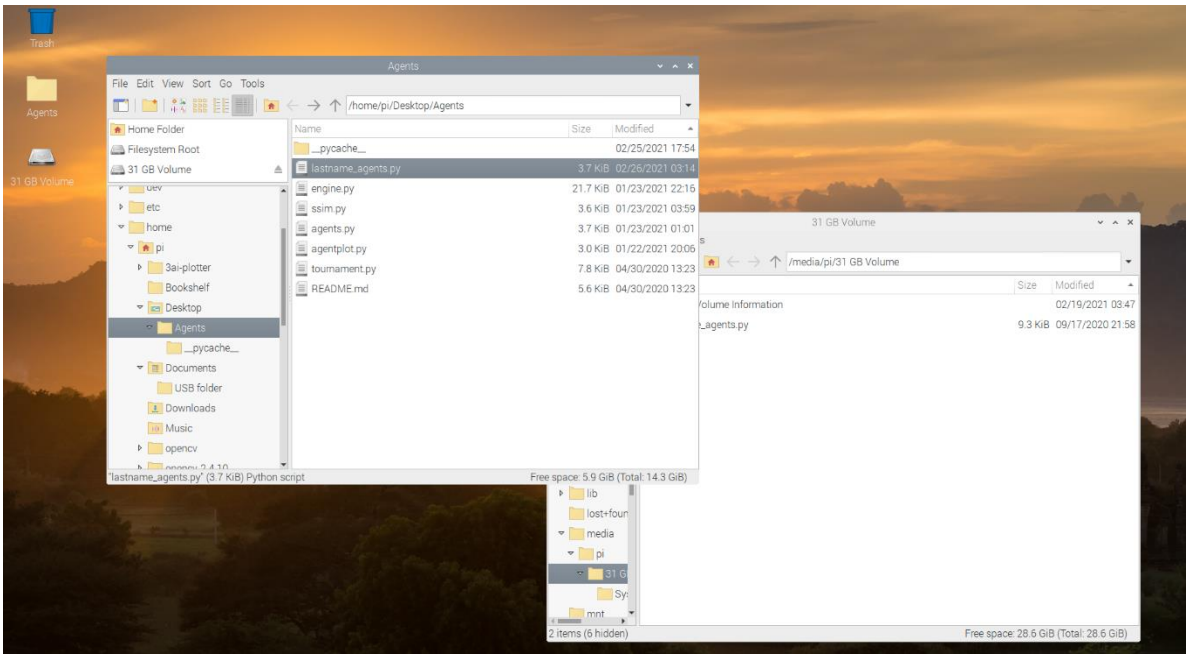
1. NAME your agent file as lastname_agent.py through copying or renaming the file
2. COPY the agent to a USB flash drive
3. PLUG the USB flash drive into one of the the Raspberry Pi’s USB ports



4. Copy the file to the “Agents” folder on the desktop



5. This step is now complete

- 

Setup AxiDraw for printing

1. Unplug the printer and move the print head to the home position
2. Use/load A3 size paper or the small A4-sized whiteboard (the more sustainable choice) – ensure holding clips are close to the edge of the board

   TIP: Don't move or adjust the position of the board
3. Load your chosen pen into the AxiDraw pen holder for this Tic Tac Toe match – the pen should be in the Pen Up position.
4. Check home position and orientation
5. Plug the USB cable for the printer into one of the Raspberry Pi's USB ports
6. Plug in the AxiDraw to electric power
7. Check the position of the Raspberry Pi camera. It should, as much as is possible, be centred over the A3 paper, and be oriented "square" to the paper.

   TIP: Don't adjust the position of the camera. If the camera is moved, it needs to be **recalibrated.**

Setup Code for the AxiDraw

1. Open the file lastname_agent.py in an editor
   a. You can right click and open in Thonny Python,
   b. or open a terminal and try

```
cd ~/Desktop/Agents

nano lastname_agent.py

# ask a tutor for help if you are unfamiliar with nano as a text editor
```

2. On line 11, change "`from engine import engine`" to "`from engine import axi_engine`" (this imports the engine code that will interface with the AxiDraw plotter)
3. Where you call engine for your agent at the end of the file, change this to "`axi_engine(your_agent)`"
4. Save your changes

Ready, Player One - Run your code

Open a terminal

```
cd ~/Desktop/Agents
```

```
python3 lastname_agent.py
```

If it all runs successfully, the AxiDraw should draw the Tic Tac Toe board, and run the first move for your agent as the first player – that is: it will draw an "X" in one of the squares. It will then stop and wait.

Grab your own pen – make SURE it is a high contrast pen which is not too fine. A dark colour Sharpie marker is great. I used a green 0.4mm lumocolour marker and that worked 😊

Draw an "O": in a free square to make your move.

Look at the Raspberry Pi – it is waiting for you to press enter. Press enter to continue the game.

Continue the game until the game is over.

Congratulations – you just played a game against your own agent. Who won? How did it feel? What could be changed/improved? What questions arise for you?

Troubleshooting tips

Raspberry Pi Cannot Detect Your Move?

Sometimes the plotter may not be able to detect your move, this can be corrected by one or more of the following:

- Ensure your move isn't too close to the gridline.
- Ensure your move is not too tiny. It should fill most of the grid cell.
- Ensure the move is visible and thick lined.
- If you're using chisel tip marker, you can try changing to bullet shaped tip marker – for thicker lines.
- Ensure the light in the room is bright – and there isn't much changes in the lighting condition before and after you make your move.

Afterwards, try making your move again in the same box.

- Your move doesn't have to be a perfect 'O'.
- If the vision system still doesn't see it, try shading the whole centre of your 'O'.