C - Underground Exploration

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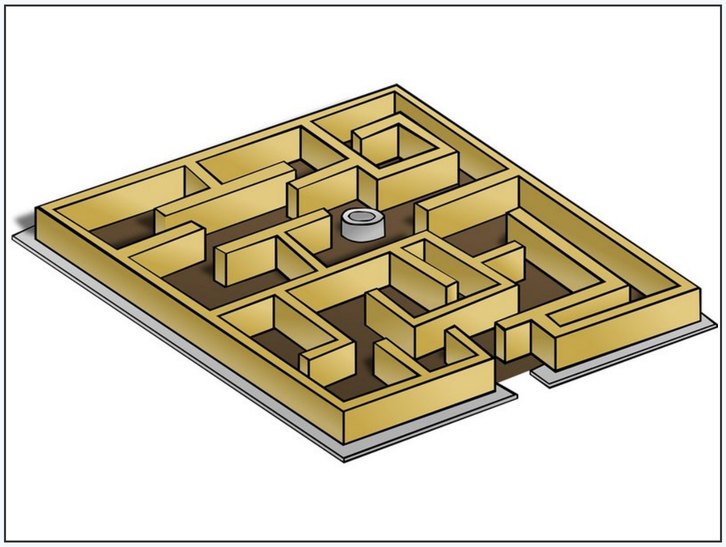
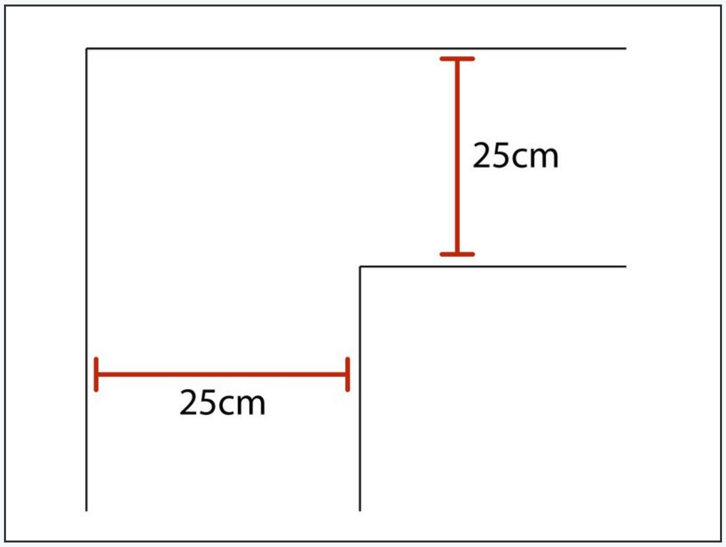
INTRODUCTION

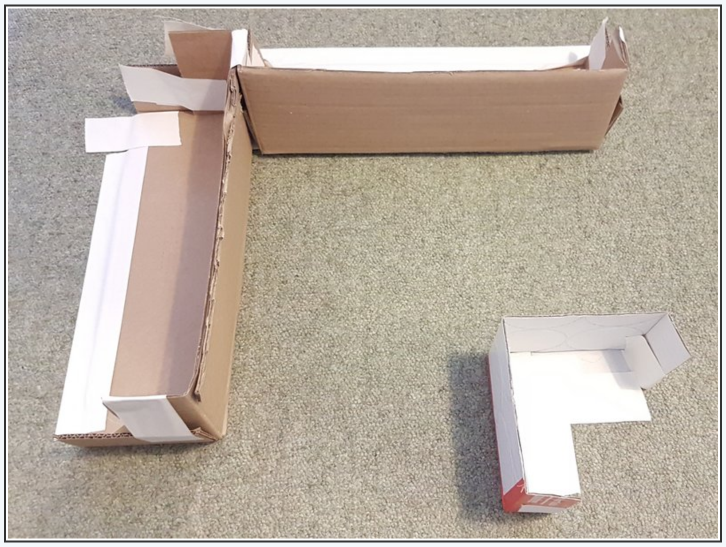
You've discovered an underground system of tunnels under the planet surface, but they are too dangerous to explore! Let's get our robot to explore instead.

Step 1

Make the Underground Tunnels







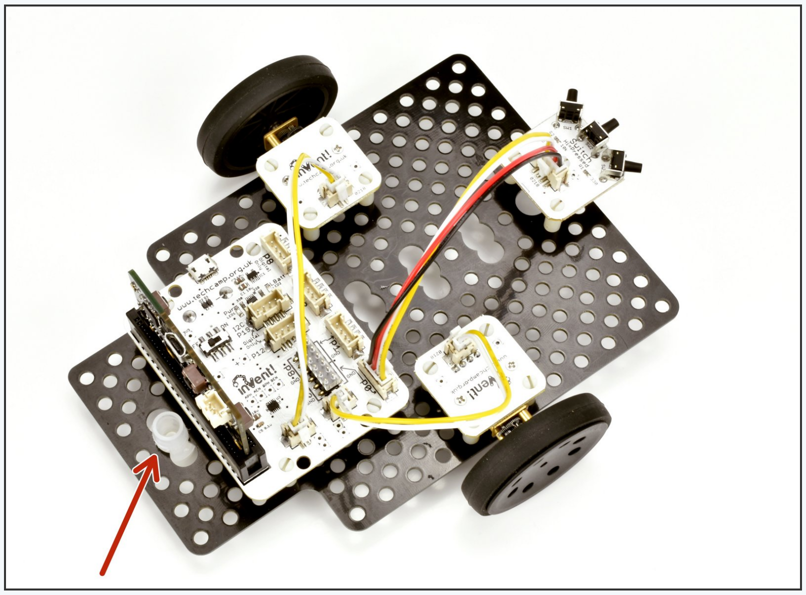
- First, we need to make a system of tunnels to **test** the robot exploration program with. You can do this **individually**, or in **groups.**
- The tunnel system under the planet is made of **straight walls** all at **90 degrees** to each other, like the maze in the picture.
- For now, make a **small section** of maze like the second picture - just a **simple right turn.**
- You can use books, cardboard and tape or anything else sensible you can think of! **Make sure the walls are taller than your robot.**

⚠ The walls must be **at least 25cm apart** so your robot has room to turn - this is **very important!**

Step 2

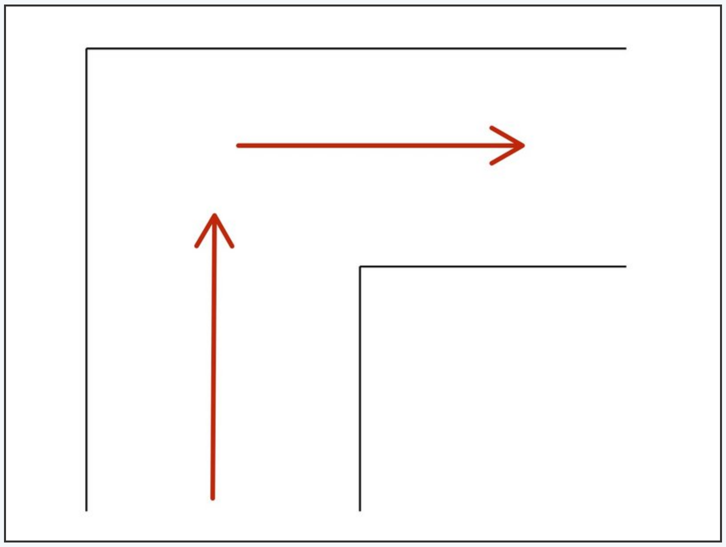
Setup the Robot

- Setup your robot like the picture - make sure everything is in **exactly the right place** or your robot won't **balance properly.**
- The left motor should be in **M1**, the right motor in **M2,** and the switch in **P0**.
- The **trackball** goes at the back to keep the robot stable.



Step 3

Right Turn



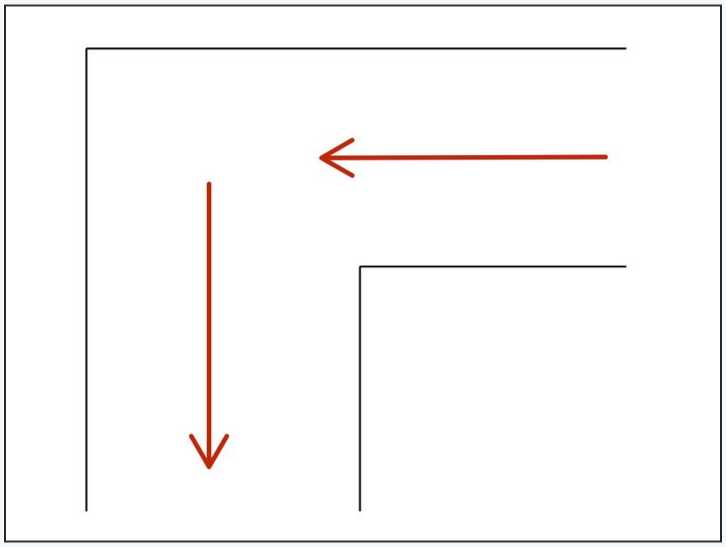
- Let's write a simple program to make the robot navigate the **right turn.** Your program should:
    - Drive **forwards**
    - **If** the switch is pressed, **reverse slightly,** then **turn right 90 degrees**
    - Drive **forwards** again
- You should just need **1** IF statement to complete this - your code should be quite similar to the obstacle avoider in the last lesson!

Be sure to **test it properly** on your maze section until it works reliably!

If you are having trouble getting your turns to be accurate, you can always try **slowing down your motors.**

Step 4

Left Turn

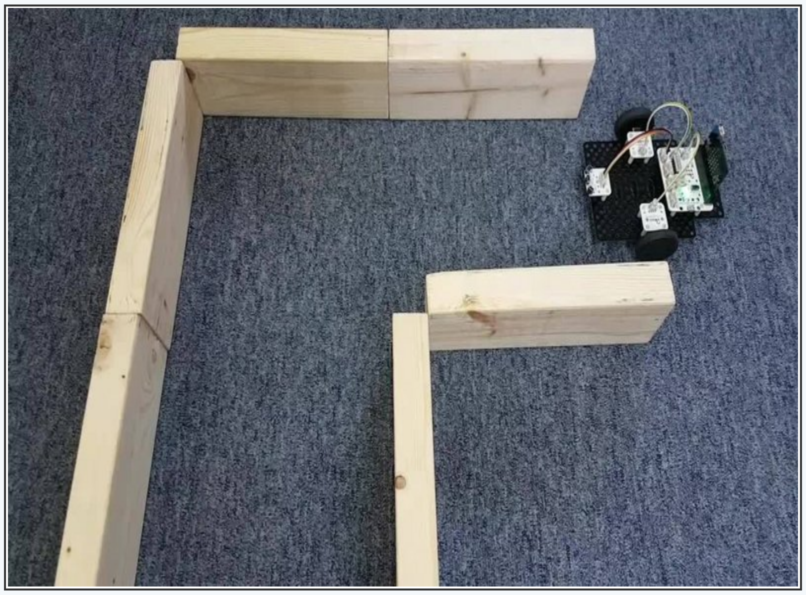


- When your robot is able to make the right turn correctly, try running it through the maze section from the **other direction**, to try a **left turn.**
- Did it behave how you expected?
- Your robot probably **turned right** 90 degrees, **hit** the other wall, **turned right** 90 degrees again and went **back** where it came from!
- This is no good - the robot will never make it through the tunnels! **Can you think how to fix it?** Have a think then move on to the next step.

Step 5

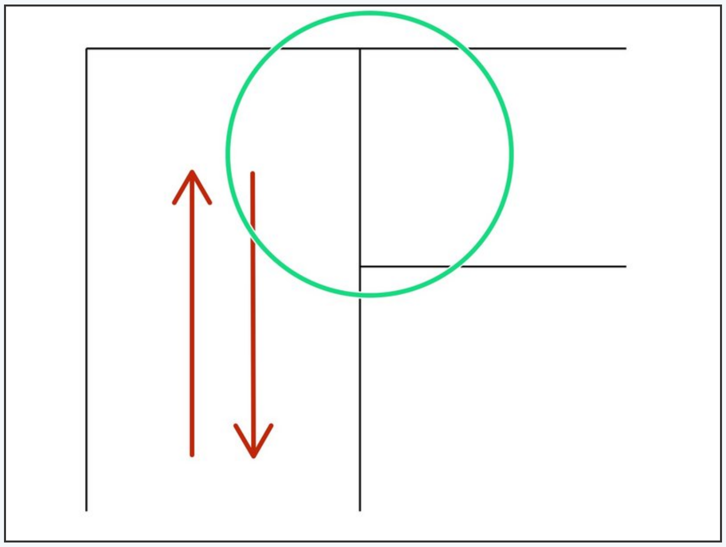
Fixing the Left Turn

- To fix this, we need to write a program that can **work out** whether we need to turn **left** or **right.**
- If you think you know how to do this, great - **try it out!** If not, here is a way that might work:
  - If the switch is pressed, **always turn right 90 degrees.**
  - Move forward a **small amount**, and if the switch is pressed **again,** we must be at a **left turn!**
  - **Spin 180 degrees**, then continue driving forwards
- **Check out the video** for how your robot should handle the left turn if you're still not sure!
- Here's a hint - you will need to put an If statement **<u>inside</u> another IF statement.**



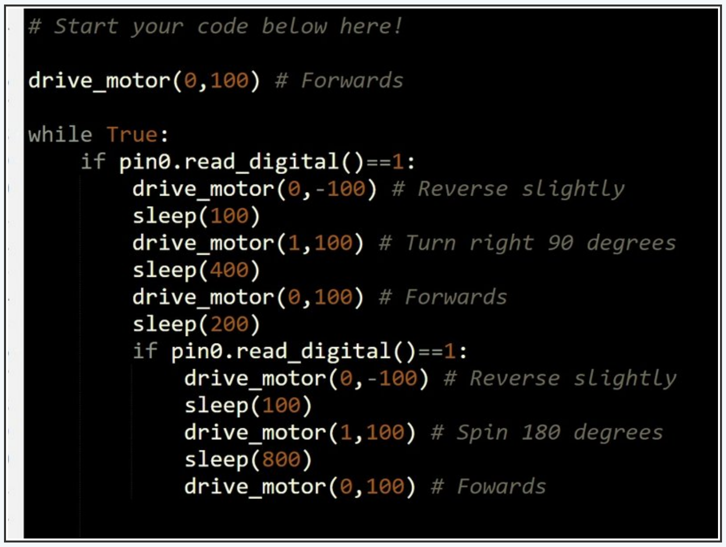
Step 6

Dead Ends



- Now our robot can handle almost anything underground, but what about a **dead end?**
- **Add another IF statement** to your program to check if the switch is being pressed after the 180 degree turn, and if it is, **turn back!**
- There's some **example code** for a program that can deal with left and right turns in the second image if you are stuck.
- **Add another wall** to your test maze so you can properly test your code!

⚠ Now things are getting complicated, don't forget to **comment** your code properly.



```
# Start your code below here!

drive_motor(0,100) # Forwards

while True:
    if pin0.read_digital()==1:
        drive_motor(0,-100) # Reverse slightly
        sleep(100)
        drive_motor(1,100) # Turn right 90 degrees
        sleep(400)
        drive_motor(0,100) # Forwards
        sleep(200)
        if pin0.read_digital()==1:
            drive_motor(0,-100) # Reverse slightly
            sleep(100)
            drive_motor(1,100) # Spin 180 degrees
            sleep(800)
            drive_motor(0,100) # Fowards
```

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Step 7

Test the Full Maze!

- Time for a real test of your program!
- As a group, **combine** all the small maze pieces into **one large maze,** with at least one left turn, one right turn and a dead end. The bigger the better!
- **Time** each other's robots and see who can get through the maze the fastest.
- You will probably want to do some **test runs** first so you can adjust your program so it is as fast as possible.

Step 8

Two Switch Sensors

- For the super advanced explorers, you could try using **two switch modules** like in the obstacle avoidance challenge, to see if you can do the maze any faster.
- You could also experiment with the **positioning** of the wheels, switches and trackball on your robot to see which positions work the best.
- In short, try experimenting with **anything** you think might **improve the performance** of you robot!