Introduction to Robotics

The RCX

The RCX is the "brain" of your robot. The RCX runs your robot's program. It reads sensors and controls motors.

 ➢ Motors are connected to output ports **A, B, C**.
 ➢ Sensors are connected to Input ports **1, 2, 3**.

The RCX has 4 buttons:

The **On-Off** button turns the RCX on and off. The RCX will shut itself off after 15 minutes.

The **Run** button runs your program. Pressing the run button again while the program is running will stop the program.

The **PRGM** (program) button selects which program to run. You can store up to 5 different programs on the RCX at one time.

The **View** button lets you view the values of the ports. This is used for seeing the values of sensor readings.
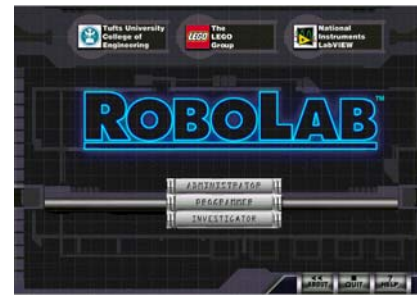
Infrared Receiver

Sensor Ports
(1, 2, 3)

View Button

On-Off Button

Motor Ports
(A, B, C)

Program button

Run button
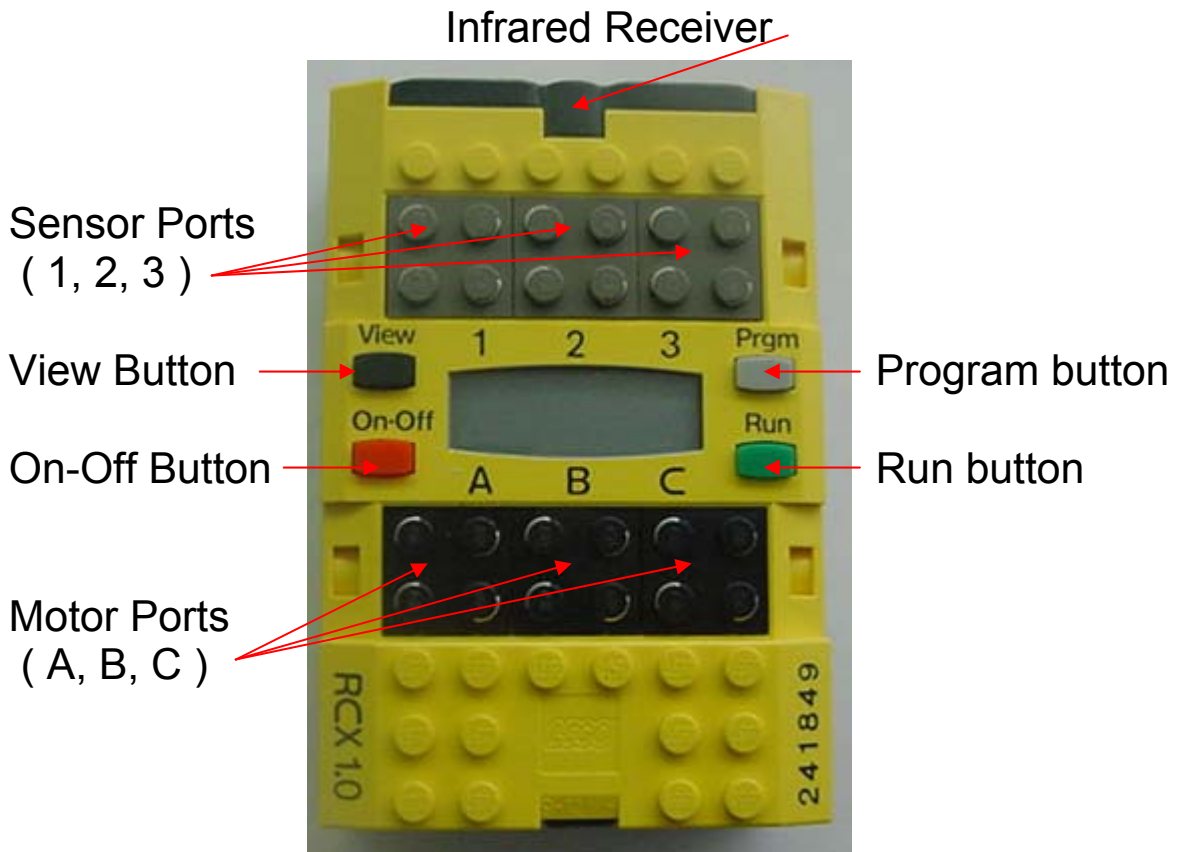
Downloading the Firmware

The firmware is the "operating system" of the RCX. In order for the computer to work with the RCX, you must download the firmware. Downloading the firmware allows communication between the IR Transmitter and the RCX so you can download new programs.

Firmware is found in the Administrator section of the RoboLab program.

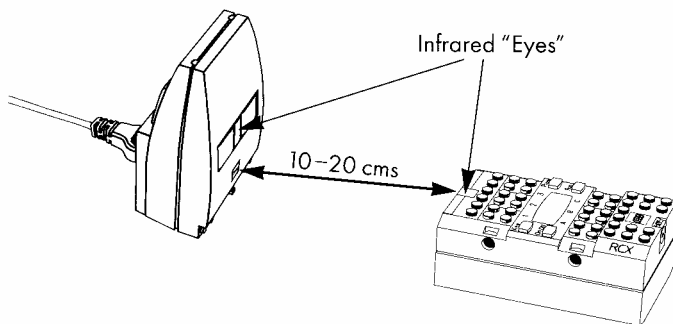Click on the button that says administrator.

Using the IR Transmitter
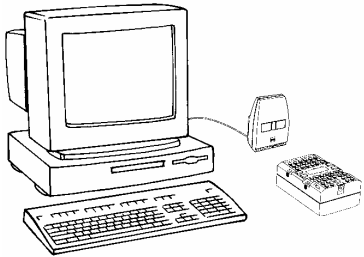
The Infrared Transmitter (IR Transmitter) is used to download programs from the computer to the RCX. The IR Transmitter establishes a wireless link between a computer and the RCX when it is connected to the computer's serial port. Programs can be downloaded from the computer through the IR Transmitter to the RCX. These programs can then be executed by the RCX.

Two ranges of transmission are available and can be selected with the short/long infrared range switch. Always use the short range setting in the classroom so the IR communicator is more focused. That way, there is less chance of confusion when multiple RCX units are transmitting in the classroom.

Position the IR Transmitter so the "eye of the RCX is facing the "eye" of the IR Transmitter. The transmitter and RCX should be about 4 - 8 in. apart. The RCX should be on and program number 3, 4 or 5 should be selected.

Check to make sure that the port that the IR transmitter is connected to matches the number at the top of the select com port icon. If it does not change the port selection by clicking on the icon.
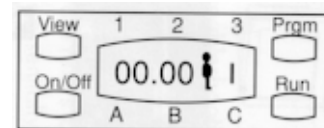
Click on Download the firmware.
Downloading the firmware takes about four minutes.

When the firmware has been downloaded, the display will look like this on the RCX. Check the display on your RCX to make sure that the firmware has been loaded onto that RCX.
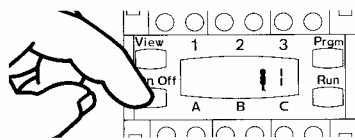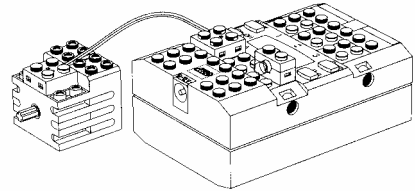Now you are ready to program.
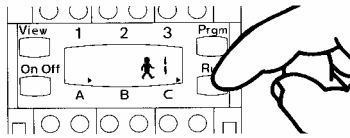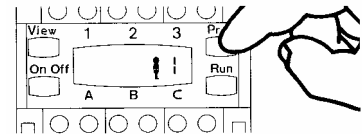
Using Built-in Program 1

The RCX contains five built-in programs (instructions that the robot follows) to control motors and lamps. These programs run without using a computer.

The output ports are black, labeled "A", "B", and "C".

Using a connector lead, connect the motor to Port A and connect the lamp directly to Port C as shown
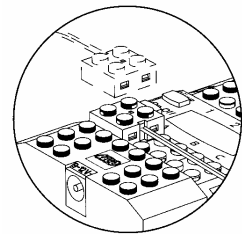
Press the Red On-Off button. The RCX should beep and a little person will appear next to the number "1" (If the number "1" does not appear press the prgm button until it does.)

Press Run to run built-in program 1. What happens?

_____

_____

_____

In what direction does the motor run?

_____

Now with the motor running, turn one end of the wire attached to the motor 180 degrees. What happens?

_____

_____

_____

Press the Run button to stop the output from running.

Summary:
Program 1 provides a constant source of power to two outputs (motors or lamps) connected to Ports A and C when the Run button is pressed. The direction of the motor may be changed by turning one end of the wire attached to the RCX or the motor 180 degrees. The output stays running until the Run button is pressed again.

Using Built-in Program 2

Touch sensors are switches which can be used to turn motors on or off when pressed. The touch sensor is a digital sensor: it can only be pressed or not pressed.

The input ports are gray and labeled 1,2, and 3. They allow sensors to control the motors or lamps attached to output Ports A, B and C. Program 2 uses touch sensors to control output Ports A and C.
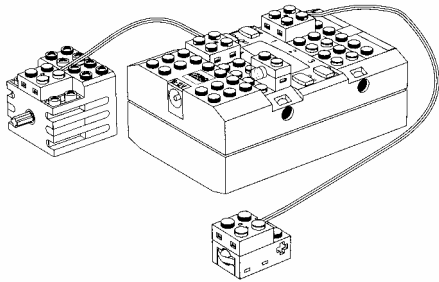
Make sure the motor is connected to port A and the lamp is connected to Port C like they were in the previous exercise.

Find a touch sensor and two wires from your building set. Use one wire to connect the touch sensor to Port 1.
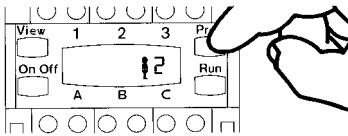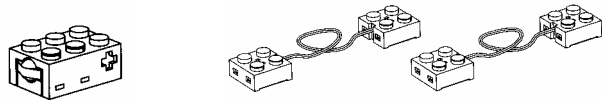
Press On-Off to turn on the RCX.

Press Program (Prgm) button until you see the number 2 on the display.

Press the Run button. What happens?

Find the yellow button on the touch sensor and hold it in with your finger. What happens to the motor?

Release the button and the motor turns back on.

Now move the touch sensor wire connector to Port 3 press the yellow button again. What happens?

Using the other wire, find a way of turning the motor and lamp on and off at the same time. Explain your solution below.


Summary:
Program 2 in the RCX uses two touch sensors to control two motors. This program allows you to move a two-motor model forward and enables it to turn. When one of the touch sensors is pressed, it shuts off one of the motors while keeping the other one running.

Using the RoboLab Program

RoboLab uses icons (pictures) to represent different functions. You string the icons together in a certain order to create the logic of your program. The program is written on your computer and then downloaded to your robot using the infrared tower.
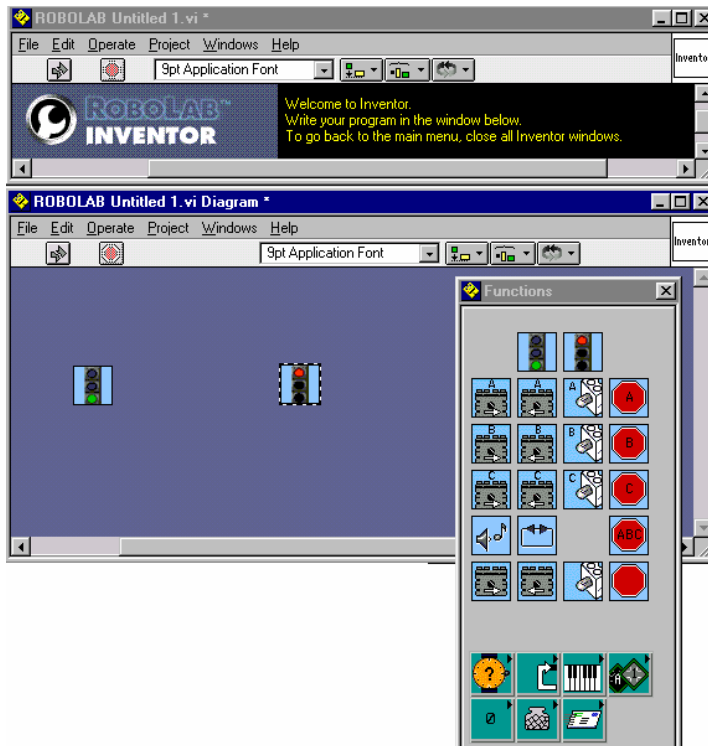
Start the RoboLab program.
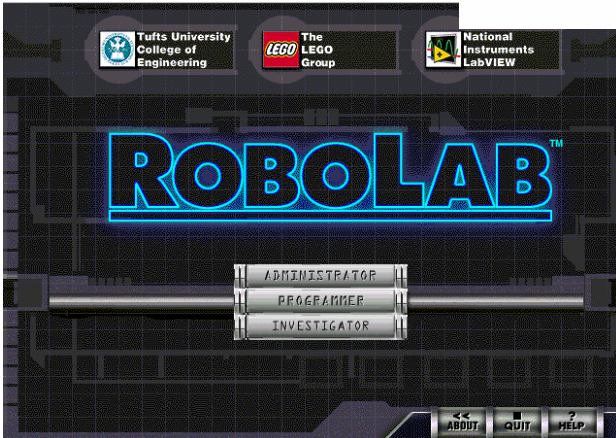
Click on the button that says Programmer.

Double click on the word Inventor 4.

A new program window should appear with a green stoplight and a red stoplight.

Click to maximize the window.

The function palette also opens up. It contains all of the icons that you will use to create your programs.

You can also open the functions palette from the windows menu, show functions palette.

Writing a RoboLab Program

All programs need a green light at the beginning. That is the start of the program. We will write a program to make a motor turn on in the forward direction for 6 seconds and then stop.

Step one: Click and drag an icon that looks like motor A with the forward direction arrow and place it next to the green light. (The white arrow shows the direction of the motor and the letter shows which motor will be turned on.)
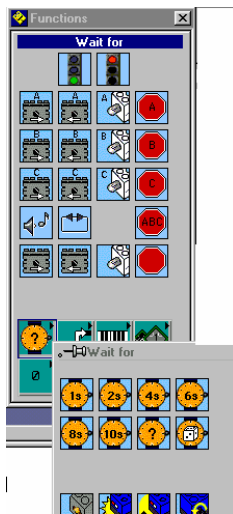
Step Two: We need a way to turn on the motor for 6 seconds. In the Functions Palette, click on the icon that looks like a watch. The Wait for sub-palette appears. Click on the watch icon that says 6s and drag it next to the Motor A icon. This means, "wait for 6 seconds".

Your program should look like this:

Step Three: Finally, we need to turn off the motor after waiting for 6 seconds. Click on the icon that looks like a stop sign with the letters ABC and drag it next to the 6s watch icon. This means stop all motors connected to ports A, B, C. The red stoplight ends the program.
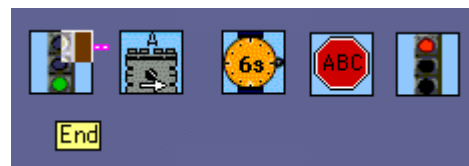
Your program should look like this now.

Step Four: The icons need to be wired together. To do this you will use the wire tool found in the tools palette. The tools palette is in the windows menu.
Wire Tool

Move the wire tool to the upper right corner of the green light icon. It should begin to blink. You will see the word "End". Click the mouse once.

Now move the cursor to the upper left corner of the Motor A icon. It will blink Begin. Click the mouse and a solid pink wire should appear between the two icons
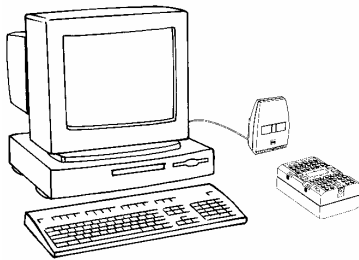
Good wire   **Bad wire**

If you wire up the ions incorrectly, a black and white striped wire will appear. This is a bad wire. To remove bad wires, go to the Edit menu and select Remove Bad wires or type CTRL + B.
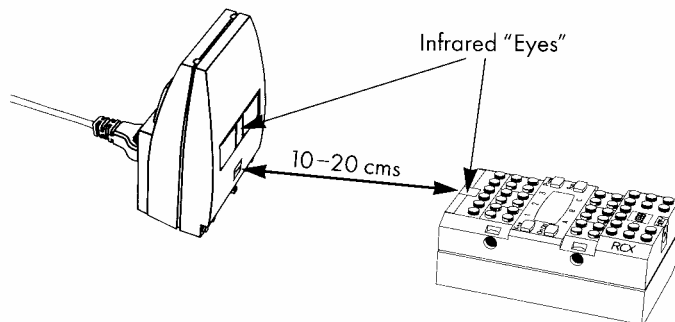

Select tool

If you need to delete an icon use the select tool in the tools palette. Click on the icon you want to delete and press the delete key on your keyboard. You can also remove bad wires using the tool.

Using the IR Transmitter

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Infrared "Eyes"

10–20 cms

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Downloading the Program

Begin the downloading process by clicking the arrow button.
When the download is complete, the RCX will play a rising sweep sound. If the arrow is broken, that means you have a problem with your program.

To run the program, press the Run button on the RCX. To stop the program, press the run button again.
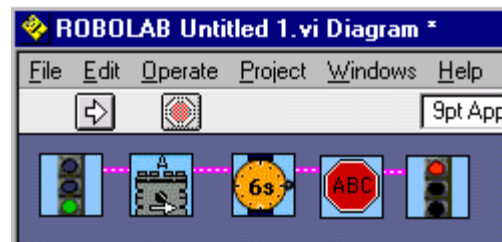
Debugging Tips

Nobody writes perfect programs for the first time. Even though they may download successfully to the RCX, they still may not do what you think they should do. If this happens, then you need to debug your program.

One strategy that is very helpful is to have your program play a sound when it reaches a certain point, like when it makes a branch or a fork. That way, you know if your program has gotten to that point.

Another good tip is to slow down the actions of your robot by adding time delays. That way, you have some time to stop and think if your robot is doing the right thing.

For large programs, it is a good idea to break them down into smaller functional blocks and test each one separately to make to make sure they are doing what you think they should.

One common mistake is mixing up the branches on a fork. Using sounds or beeps can quickly diagnose this problem.

Above all, don't give up. Keep trying until your program is working exactly the way you want it to.