

	<p>Department of Computer and Mathematical Sciences</p>	<p>CS 1305 Intro to Computer Technology</p>	<p>8</p>
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Module 8: Introduction to LEGO MINDSTORMS

Objectives:

The main objective of this module is to become familiar with a LEGO MINDSTORMS kit and learn how to construct a robot using LEGO MINDSTORMS kit.

Introduction

LEGO MINDSTORMS kit comes with everything is needed to learn how to build a functional robot. The reverse side of the cover label has a chart of each piece that should be included in the set as well as the amount of each. Pieces are lost easily so every piece may not be accounted for or may have not been included in the set. Familiarize with the pieces listed on the chart as well as try and locate some of pieces in the set.

Specialty pieces:

Locate and familiarize with the special pieces that perform actions and will be used by a constructed robot. In Figure 1, it illustrates a LEGO MINDSTORMS microcomputer with accessories such as sensors and motors as follows:

- 1) LEGO MINDSTORMS microcomputer (**Brick**)
- 2) Motors
- 3) Touch Sensors
- 4) Light Sensors
- 5) Wires
- 6) Infrared (IR) Tower



Figure 1: LEGO MINDSTORMS Microcomputer and Accessories

LEGO MINDSTORMS Microcomputer

Locate a LEGO MINDSTORMS microcomputer or **Brick**, which is how it will be referenced from now on. The middle part of **Brick** as shown in Figure 1 has:

- Four buttons:
 1. **View**: Used to change the view of the display screen
 2. **Prgm**: Cycles threw the stored programs on the brick
 3. **On – Off**: Turns the brick on and off
 4. **Run**: Runs the current program
- **Program Status** is a figure on the display that is still when nothing is happening or will appear to be running when the selected program is set to **Run**.
- **Program Number** is the current program that the brick is set to. The brick can store up to 5 programs.

- The numbers **1**, **2**, and **3** refer to the three **input** slots above the respective numbers. This is where input devices will be connected to.
- The letters **A**, **B**, and **C** refer to the three **output** slots below the respective letters. This is where output devices will be connected to.

Motors

The motors are high efficient motors that run using the power from **Brick**.

Touch Sensors

Touch sensors are sensors that act like a switch or a button switch. They inform **Brick** if the switch is:

- Pressed
- Not pressed
- Held down

Light Sensors

The light sensors are light sensitive sensors that can detect:

- Light and dark areas of a room
- Difference in some shades of color such as red, green, and shades of grey
- Infrared light

Wires

The wires that come with the set are cables used to connect the sensors and motors to the **Brick**.

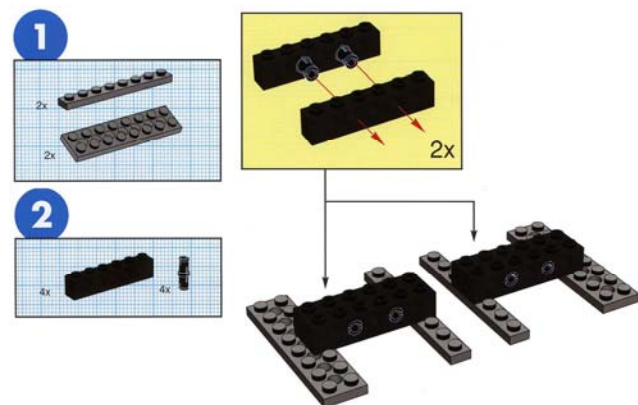
Infrared (IR) Tower

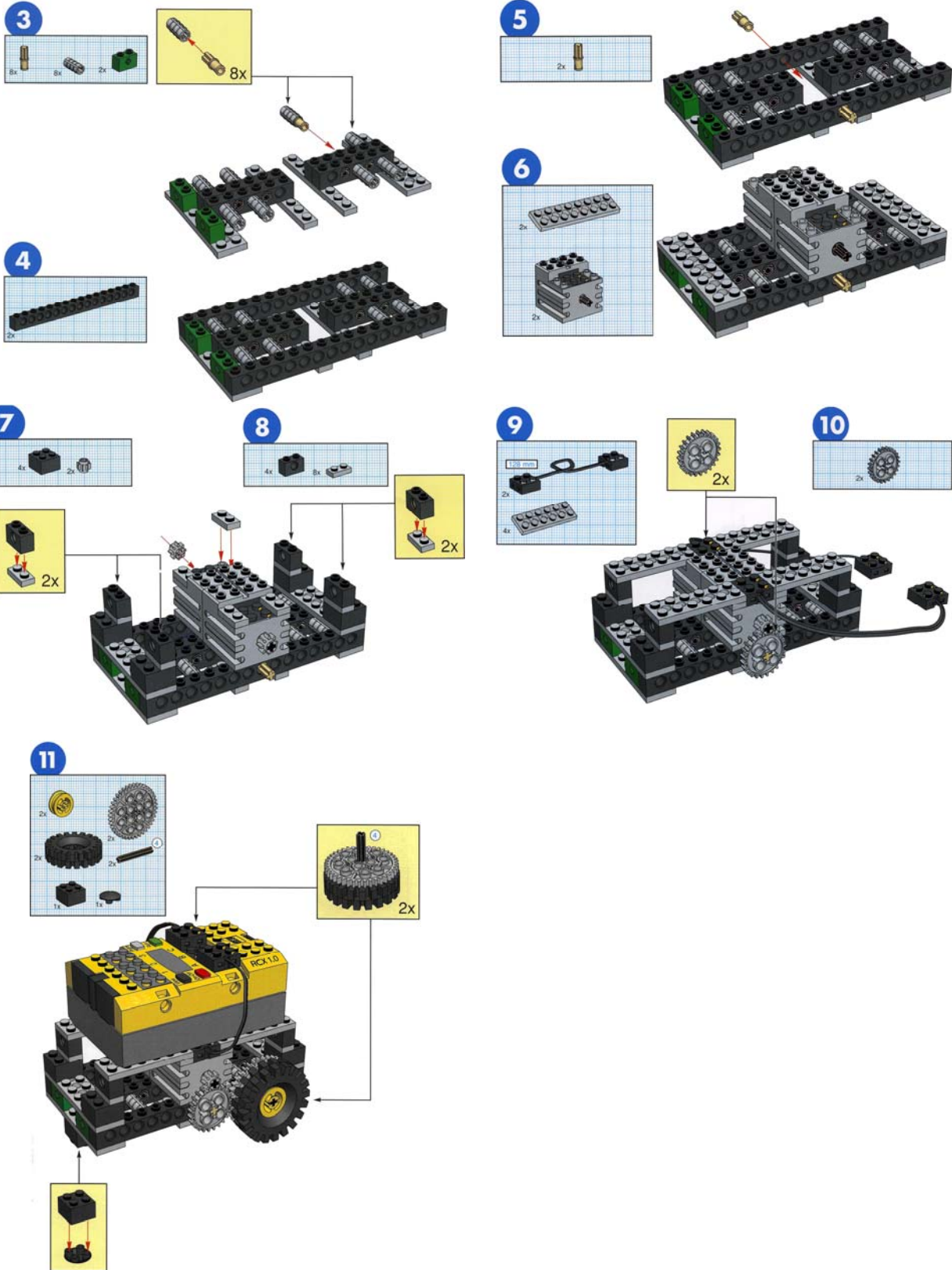
This is used to upload a program from the computer to **Brick**.

Task 1: Building a Robot

In this task, you will learn LEGO basic building techniques to build a robot called **MyRobot**.

Activity 1.1: In this activity, we will build a frame with wheels for simple robot that LEGO MINDSTORMS microcomputer (**Brick**) can be attached. This is the main body (frame) of the robot.





Task 2: ROBOLAB Software

In this task, you will learn how to use **ROBOLAB** Software to program your robot.

Activity 2.1: LEGO MINDSTORMS ROBOLAB software

Follow these steps to open **ROBOLAB** software:





- 1) From the **All Programs** command, click on **Start** button  and then select **All Programs** command  from the **Start** menu.
- 2) Choose  **ROBOLAB 2.5.4** from **ROBOLAB 2.5.4** menu, the **ROBOLAB** start screen should appear as follows:
- 3) Click on  button from **ROBOLAB** menu as shown in Figure 2.
- 4) Double click on **Inventor 4** from the **Inventor** menu as shown in Figure 3. A blank workspace similar to **Figure 4** will appear and you are ready to program.



Figure 2: ROBOLAB Menu

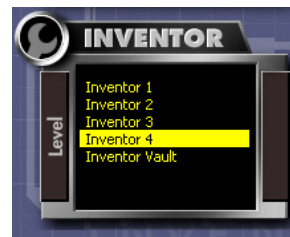


Figure 3: Inventor Menu

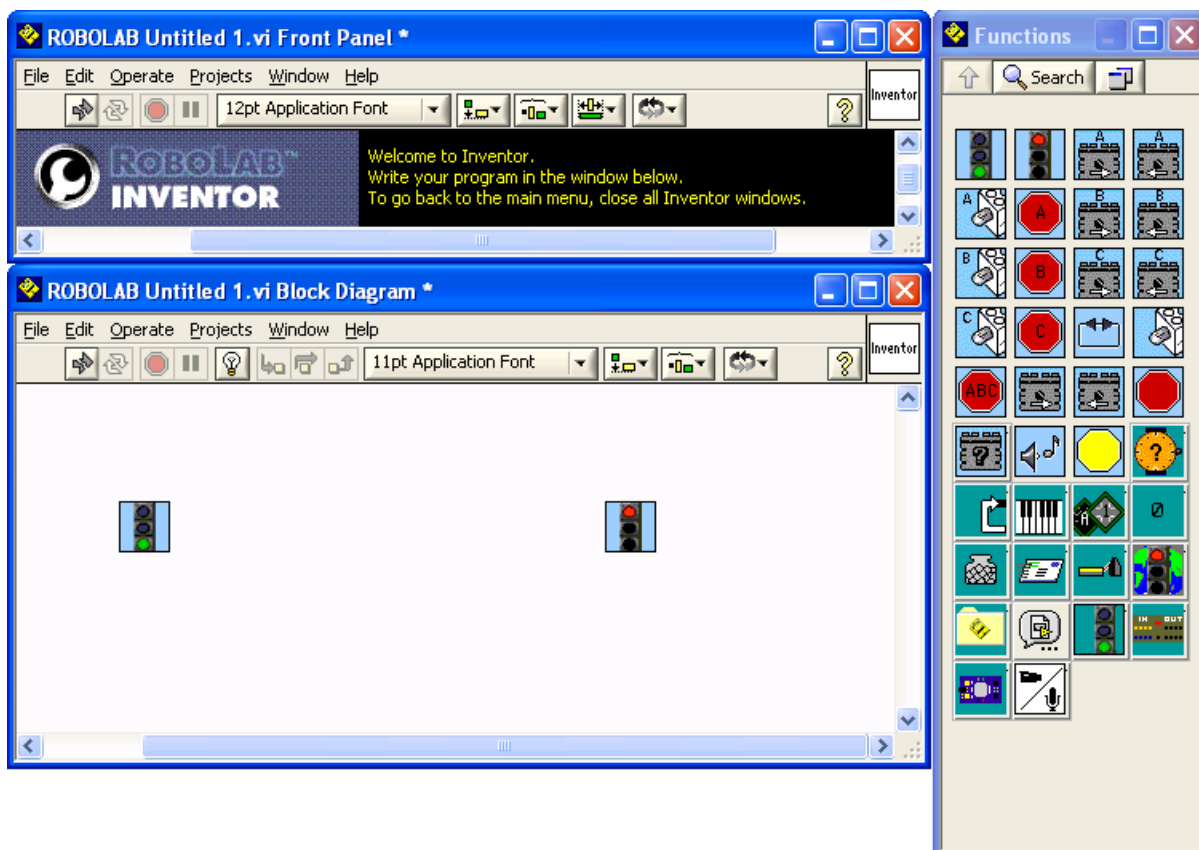


Figure 4: Programming Workspace

Task 3: The First Program

In this task you will learn how to write the first inventor program for **MyRobot** that was built in Task 1 to move forward.

Activity 3.1: The Tools Pallet

Open **Tools pallet** as follows::

1. Select **Window** from the menu bar as shown in Figure 5.
2. Choose **Show Tools Palette** from drop-down menu as shown in Figure 5.

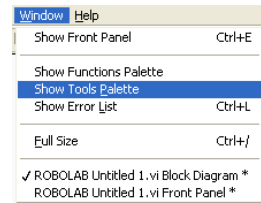




Figure 5: Window Menu

The **Tools Pallet** will appear as shown in Figure 6.





Figure 6: Tools Pallet




Activity 3.2: Creating a Program



In the workspace, there are two traffic-light objects  . The **green** light represents, **Starting Program Object**, the starting point of program and the **red** light represents, **Ending Program Object**, the ending point of program. On the right side of workspace there is a window labeled **Functions** as shown in Figure 4 that contains all the functions that will be used to create a program to control a robot as we desire.

Now we ready to create a program to control **MyRobot** built in Task1.



MyRobot has two motors attached to **Brick**. One is connected to port A . To control this motor through the program, you need to insert **Motor A Forward Object**  from the **Functions** window to the workspace by dragging and place it in between the two lights on your workspace. Then connect or link **Starting Program Object** to **Motor A Forward Object**.

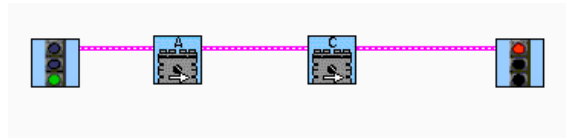
There are two ways to create a connection:

- If you place icon close to **Starting Program Object**, it will automatically create a wire connection between the **Starting Program Object** and the **Motor A Forward Object** that looks like this . The pink line is a “wire” that connects **Starting Program Object** to the first action of your program is supposed to start doing.
- If you place the icon anywhere on the workspace you will have to create the connection yourself. This can be done as follows:
 1. Select the connect wire icon  from the tool pallet. Your mouse pointer will now appear like a spool of wire.
 2. Move the pointer towards **Starting Program Object**. As the pointer gets near the top right corner of the object it will begin flashing a black square.  Click once on the flashing black square to establish a connection of a wire to the object.

3. Move the pointer towards **Motor A Forward Object**. As the pointer gets near the top right corner of the object, it will begin flashing a black square.  Click once on the flashing black square to establish a connection of a wire to the object. You should now have a completed connection between **Starting Program Object** and **Motor A Forward Object** that looks something like this 

Activity 3.3: Create another Connection





There are two motors on **MyRobot**. You programmed a forward movement to motor A in the previous activity. In order **MyRobot** to move properly, you need to program a forward movement to another motor that attached to the **Robot**. The second motor is attached to port C  on the **Brick**. Repeat the steps described in Activity 3.2 to insert **Motor C Forward Object**  between **Motor A Forward Object** and **Ending Program Object** in the program. Also connect **Motor C Forward Object** to **Motor A Forward Object** and **Ending Program Object**. Your complete program should look like this.



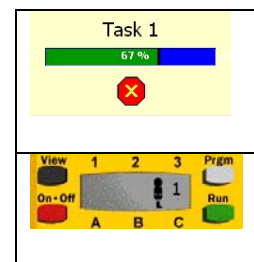
Task 4: Downloading Your Program

In this task, you will learn how to upload/send a program to **Brick** and run it.



Activity 4.1: Follow the steps below to upload the program that you created in Activity 3.3 to **Brick**.

1. Place your completed **MyRobot** in front of the IR tower. Make sure that the **Communications Port** is facing the tower. 
2. Turn on **Brick** by pressing the  button.
3. Locate and click on the **Run** button  underneath the **Edit** tab on the menu bar. The button will change into , which means it is trying to establish a communication with **Brick**.

The **Robolab** software will then connect to **Brick** and will display a new window that shows the progress of uploading the program. When uploading is complete, **Brick** will play a tune. A new window will then flash on the screen showing you a picture of **Brick** and what program number the program was uploaded to.



Activity 4.2: Run your program

Make sure you place your robot on a flat surface where it will not fall. To run your program, press the  button on **Brick**. **MyRobot** should immediately begin to turn its wheels and move forward. To stop **MyRobot**, press the  button. You have now successfully programmed your first robot.