Java Programming on LEGO EV3 with leJOS using Apache NetBeans

INSTALLATION GUIDE

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Contents

Introduction

leJOS is both an alternative firmware for the EV3 (if you remove the microSD card, the EV3 will boot the standard firmware), and a Java programming library to run Java code on the LEGO EV3.

You will need a microSD card of greater than 2GB, but not larger than 32GB, to install leJOS on your EV3. We have used an 8GB card, as it was reasonably priced and a larger card was not needed in our environment.

If your computer does not have a microSD reader, you will need a USB microSD card reader. There are various readers available. We used a Transcend memory card reader. If you have an SD card reader only, you will need a converter to go from microSD to SD.

Flashing and installing leJOS on the EV3 robot will be done once you have installed the leJOS libraries and tools onto your computer.

API documentation is found here:

https://lejos.sourceforge.io/ev3/docs/

Installing JDKs used for NetBeans and leJOS

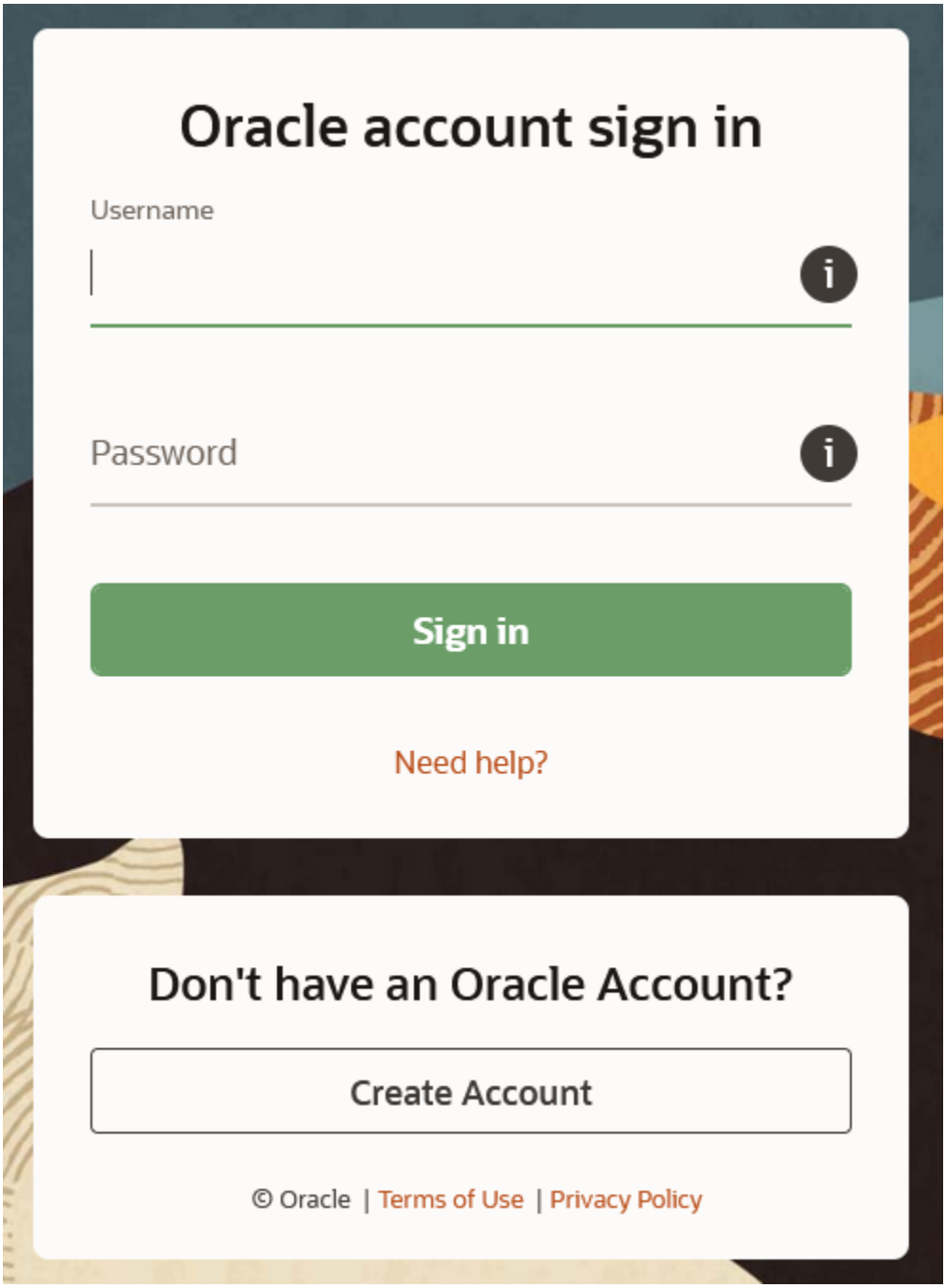
Before installing NetBeans, you must install a Java Development Kit (JDK). Ordinarily, you would use a more modern JDK for regular development, however for leJOS Development, you must additionally install an older edition.

The minimum JDK version required for NetBeans is 8, however it is recommended to install the latest edition (at the time of this manual it was version 18):

https://www.oracle.com/java/technologies/downloads/

You will also need to install an older JDK version that is compatible with leJOS (Java SE Development Kit 7u80):
https://www.oracle.com/java/technologies/javase/javase7-archive-downloads.html

You will be asked to sign in when you attempt download the older edition:



It’s free to create an account, if you do not have one.

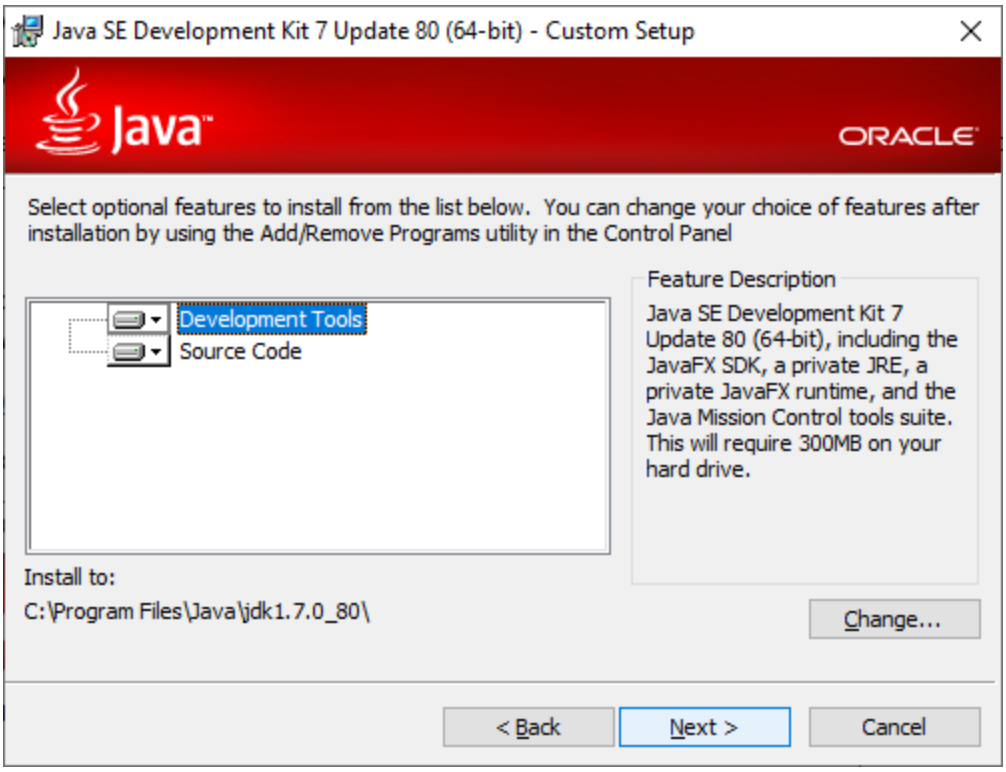
Installing Java SE Development Kit 7u80

You must install Java SE Development Kit 7u80. That JDK is compatible with leJOS.

https://www.oracle.com/java/technologies/javase/javase7-archive-downloads.html

Select the edition that is compatible with your OS.

Press **Next** to proceed.



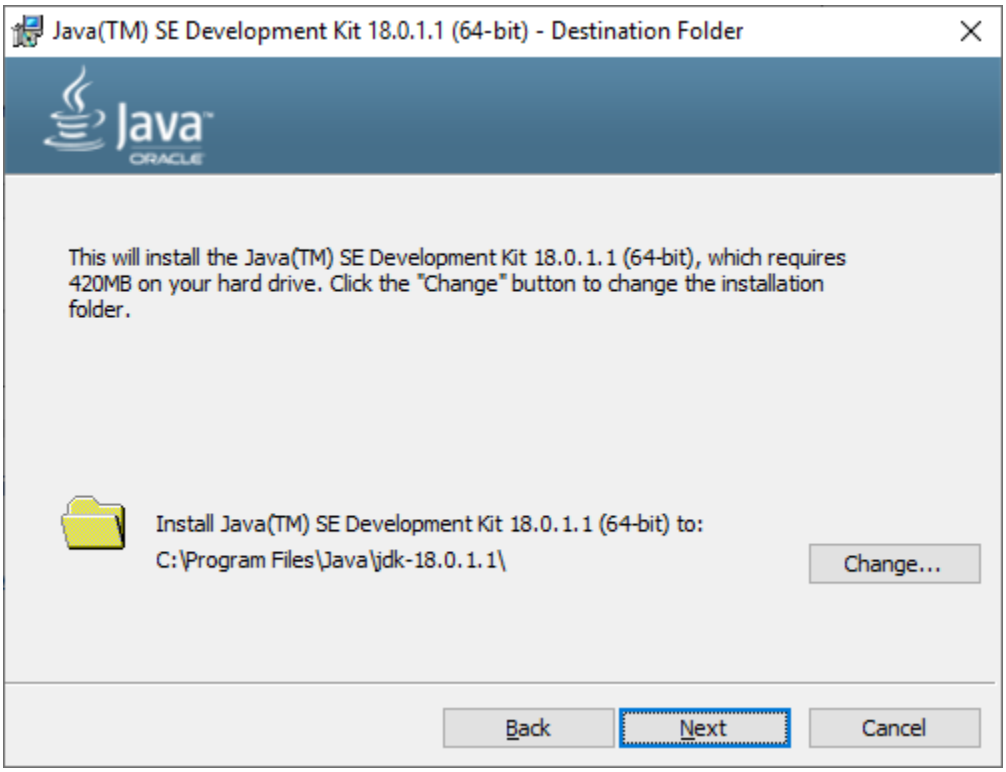
Press **Next** to proceed.

Press **Close** to end the install.

Installing Java SE Development Kit 18

This version of JDK is used to comply with NetBeans requiring JDK 8 or later. It is also used when you are developing programs for other devices (other than the EV3).

https://www.oracle.com/java/technologies/downloads/



Press **Next** to install with the default installation location.

Press **Close** now that the install is complete.

Installing leJOS

You need to download and install leJOS EV3:

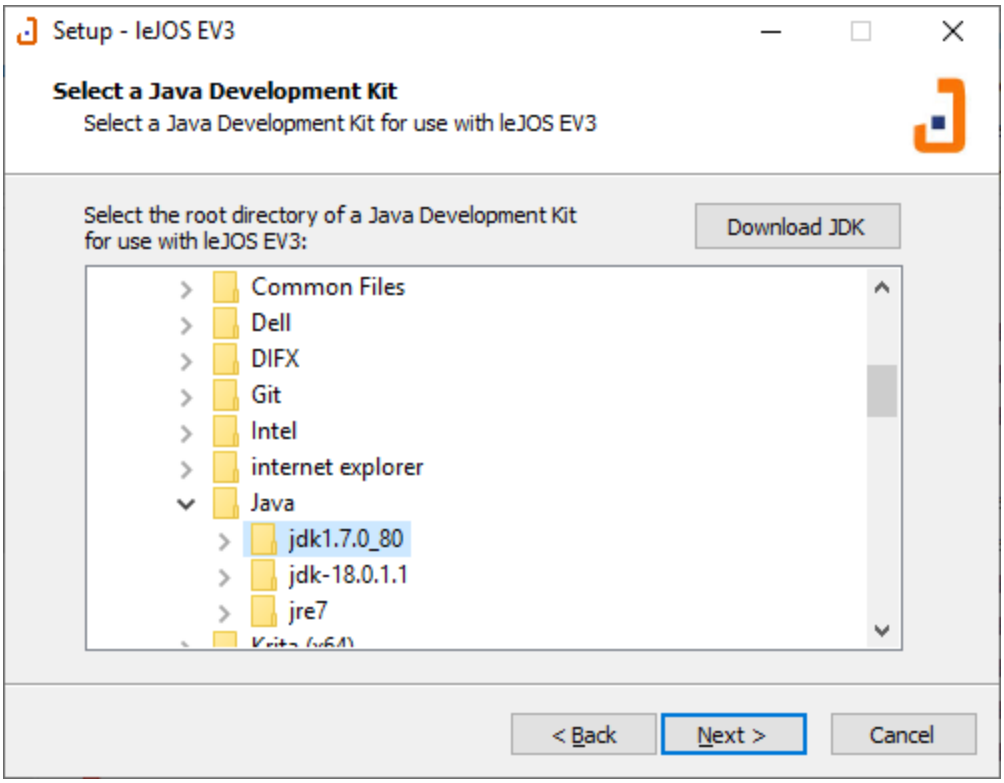
https://sourceforge.net/projects/ev3.lejos.p/files/0.9.1-beta/

If on Windows download leJOS_EV3_0.9.1-beta_win32_setup.exe

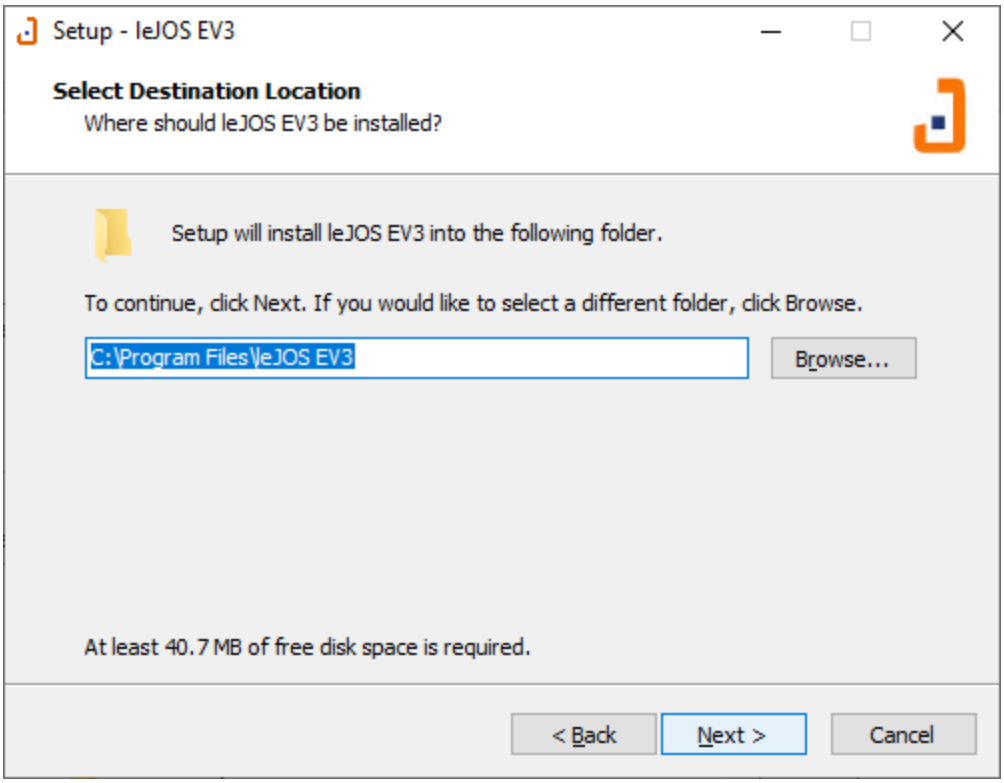
If on Linux/Mac download leJOS_EV3_0.9.1-beta.tar.gz

On windows run the setup.exe file to install the leJOS libraries and to also flash the microSD card for the EV3. On Linux/Mac, just uncompress the file to access the libraries and utilities.

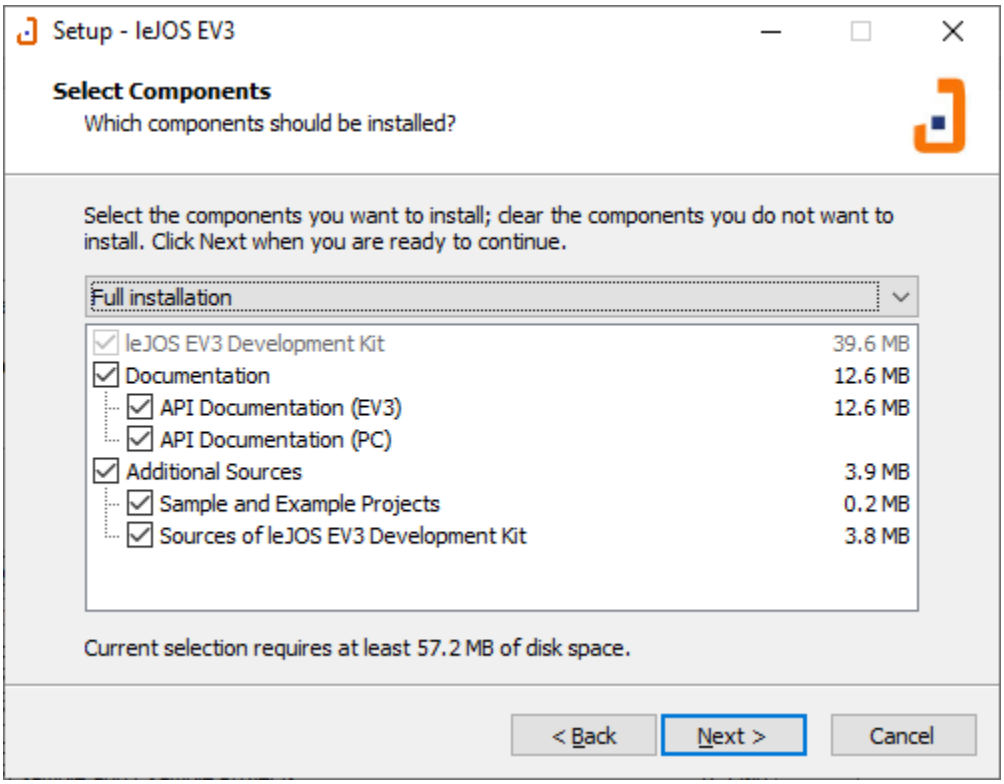
Press **Next** to begin.



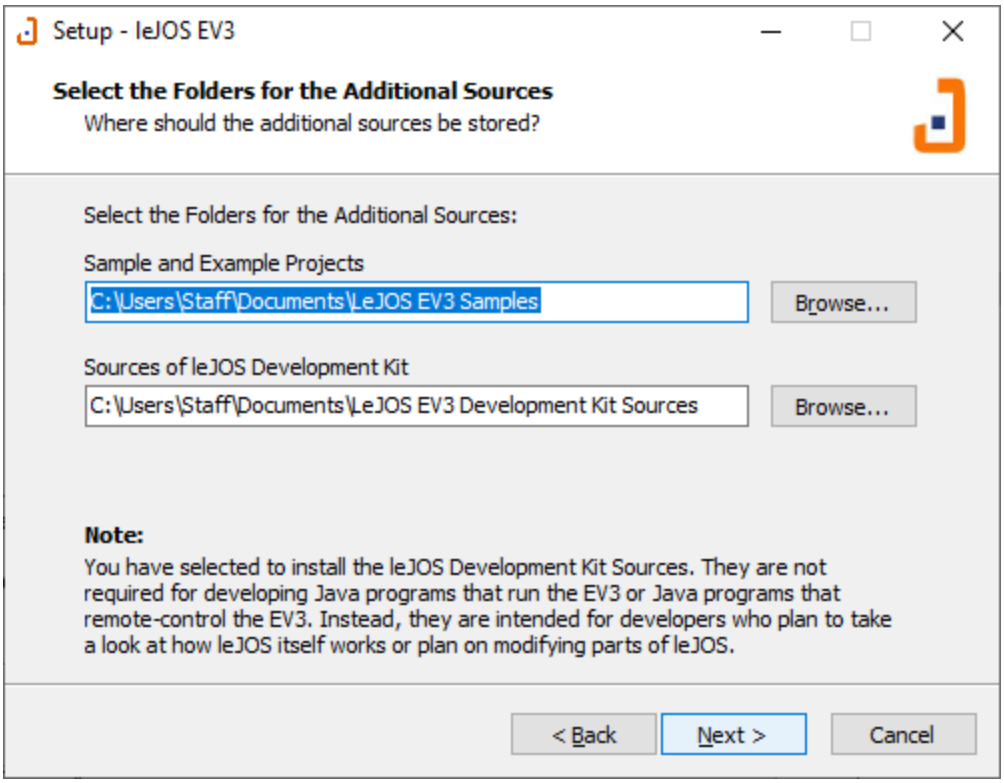
Select the **1.7.0_80** edition of Java (which was previously installed), as it is compatible with leJOS. Then press **Next**.



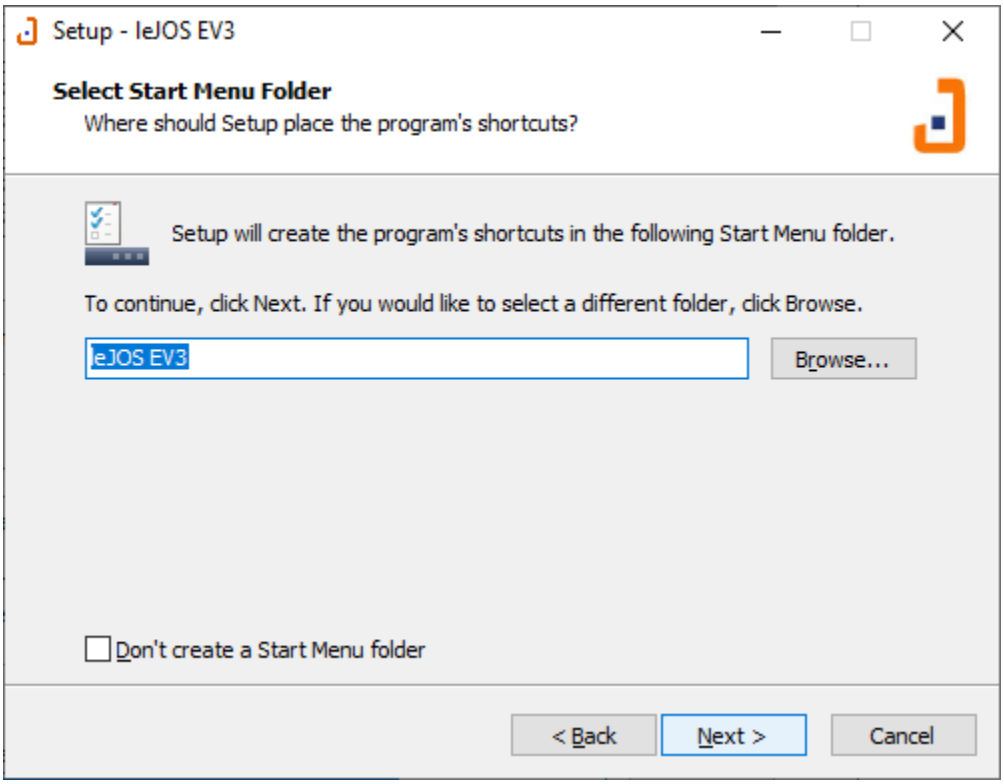
Press **Next** to accept the default file location.



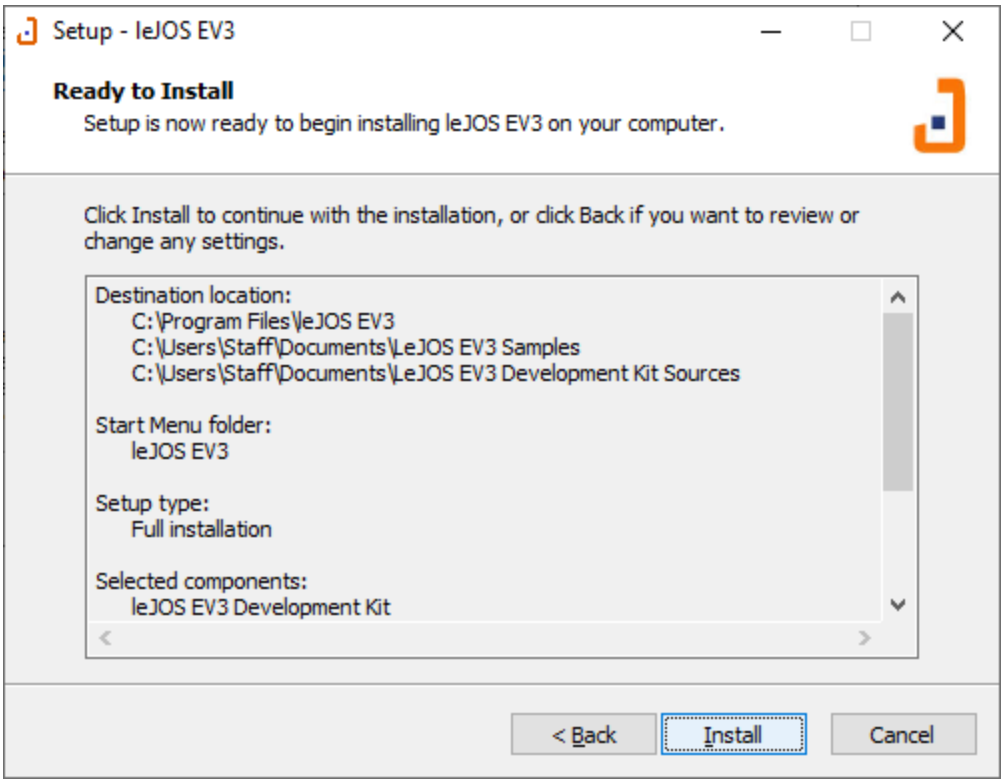
Select to Full Installation to get everything (documentation, source files and sample projects).



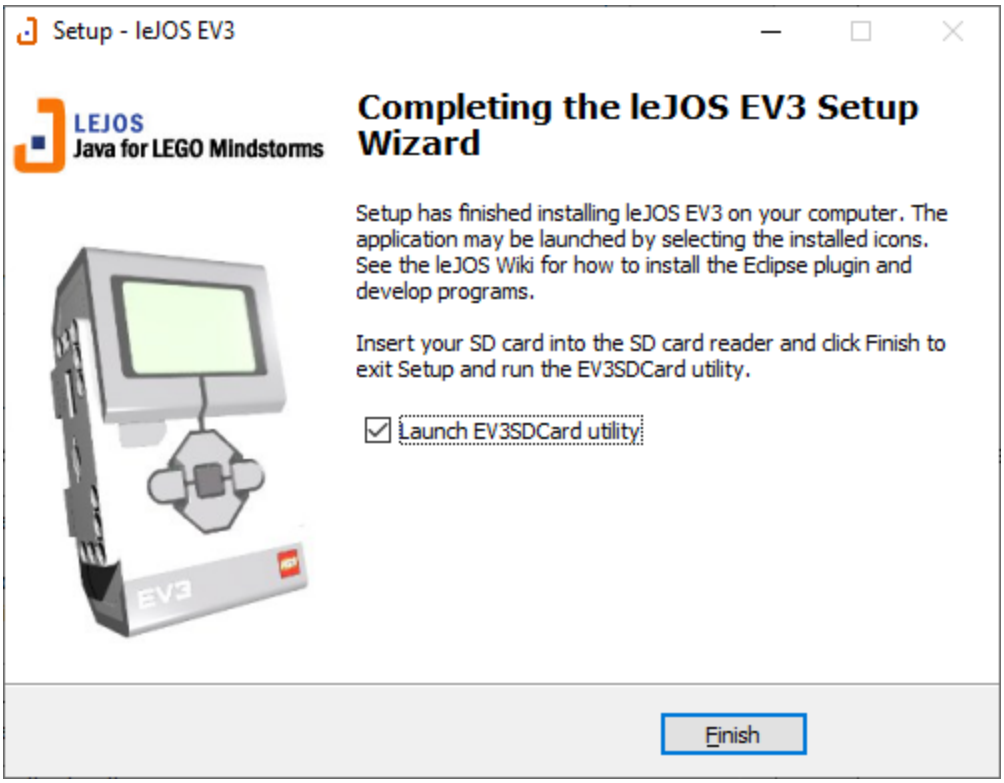
Press **Next** to proceed.



Press **Next** to proceed.



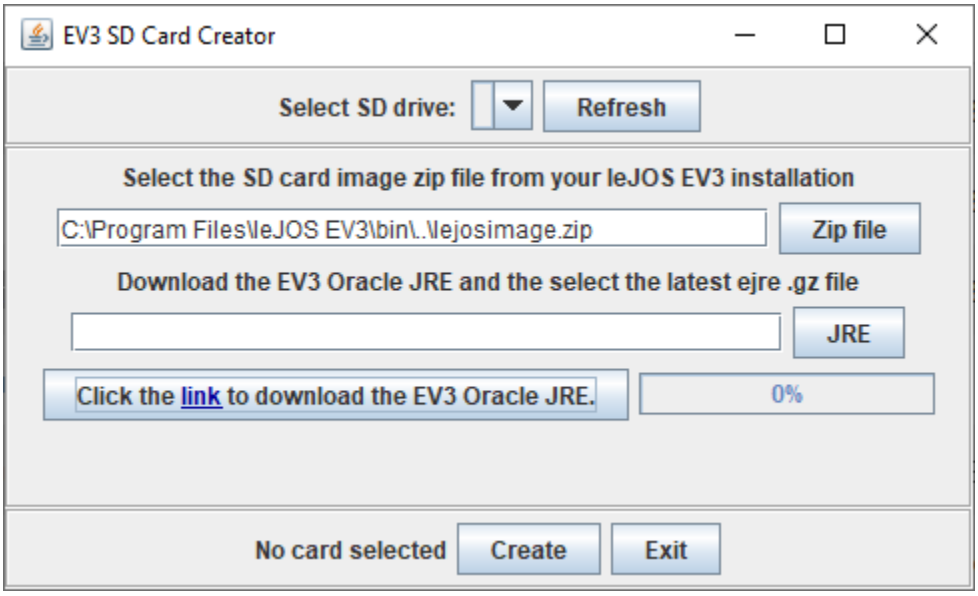
Press **Install** to begin the install process.



You can launch the EV3SDCard utility now to flash the microSD card inserted into your computer. If you are not ready now, you can access this tool from:

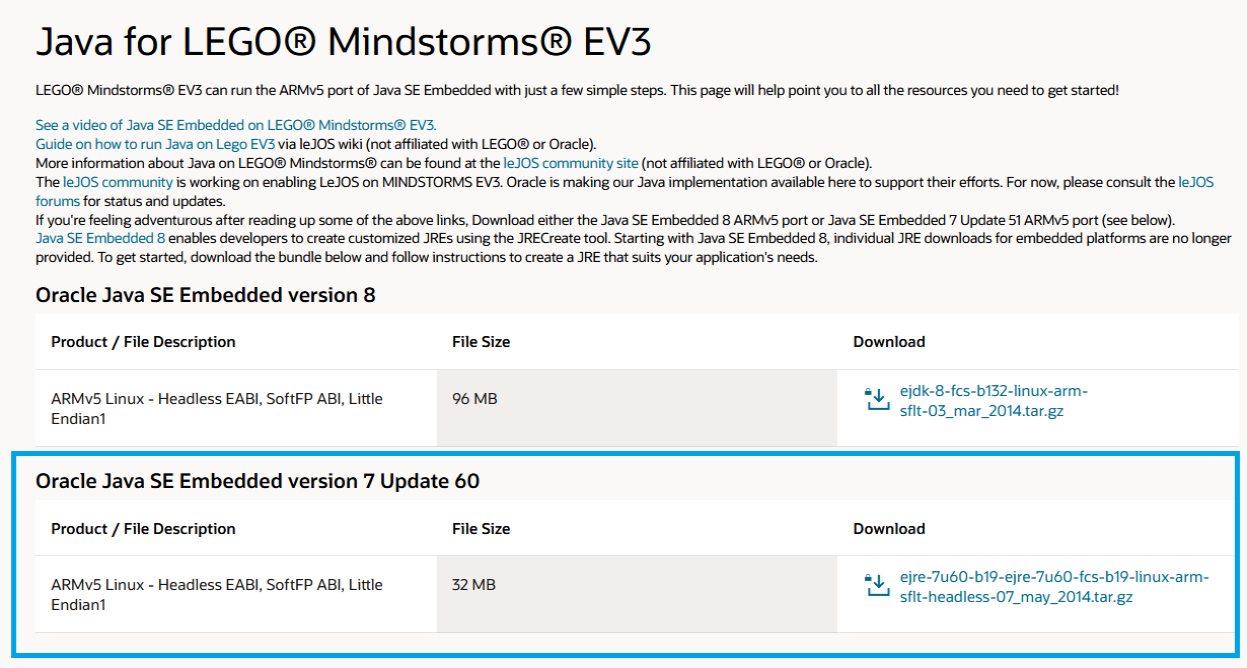
C:\Program Files\leJOS EV3\bin\ev3sdcard.bat (or in the bin folder of the tar.gz file if you are on Linux/Mac).

Flashing the microSD Card:



Click on the **link to download the EV3 Oracle JRE**, however select the older **Oracle Java SE Embedded version 7 Update 60** on that page**. This version is compatible with leJOS**.

http://www.oracle.com/technetwork/java/embedded/downloads/javase/javaseemeddedev3-1982511.html



Java for LEGO® Mindstorms® EV3

LEGO® Mindstorms® EV3 can run the ARMv5 port of Java SE Embedded with just a few simple steps. This page will help point you to all the resources you need to get started!

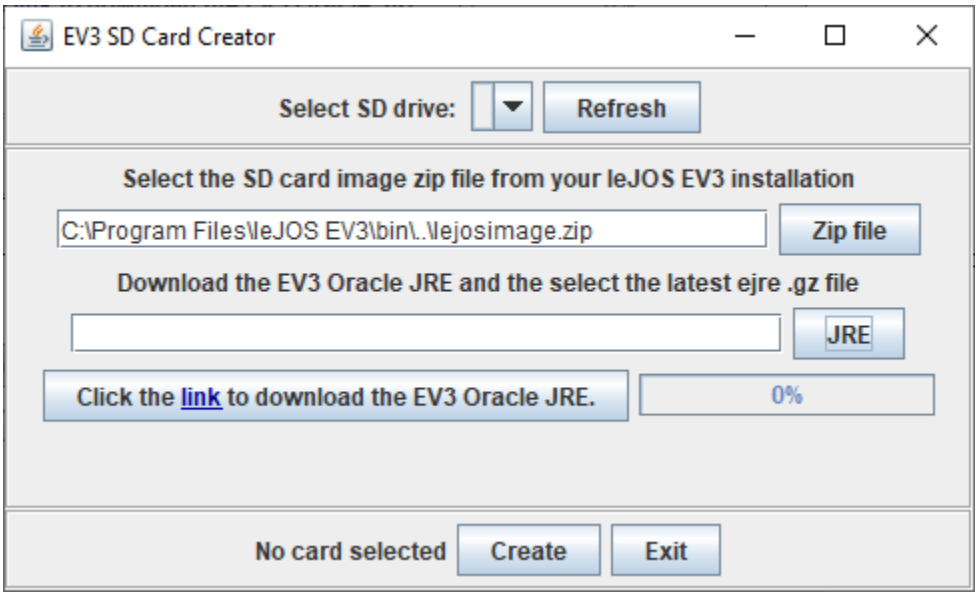
See a video of Java SE Embedded on LEGO® Mindstorms® EV3.
Guide on how to run Java on Lego EV3 via leJOS wiki (not affiliated with LEGO® or Oracle).
More information about Java on LEGO® Mindstorms® can be found at the leJOS community site (not affiliated with LEGO® or Oracle).
The leJOS community is working on enabling LeJOS on MINDSTORMS EV3. Oracle is making our Java implementation available here to support their efforts. For now, please consult the leJOS forums for status and updates.
If you're feeling adventurous after reading up some of the above links, Download either the Java SE Embedded 8 ARMv5 port or Java SE Embedded 7 Update 51 ARMv5 port (see below).
Java SE Embedded 8 enables developers to create customized JREs using the JRECreate tool. Starting with Java SE Embedded 8, individual JRE downloads for embedded platforms are no longer provided. To get started, download the bundle below and follow instructions to create a JRE that suits your application's needs.

Oracle Java SE Embedded version 8

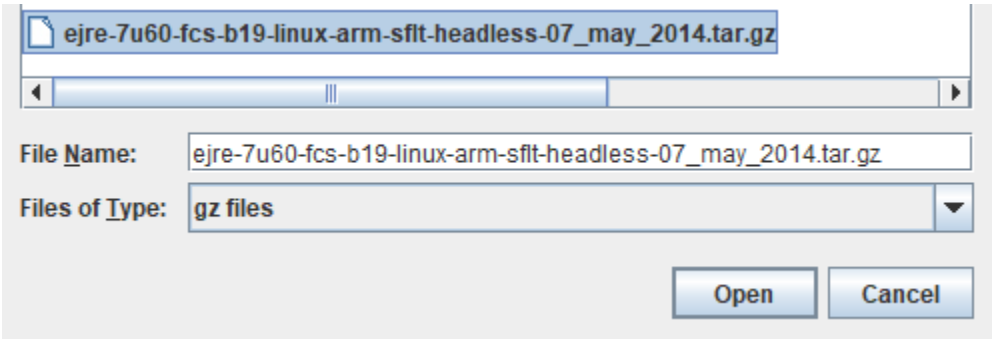
Product / File Description	File Size	Download
ARMv5 Linux - Headless EABI, SoftFP ABI, Little Endian1	96 MB	ejdk-8-fcs-b132-linux-arm-sflt-03_mar_2014.tar.gz

Oracle Java SE Embedded version 7 Update 60

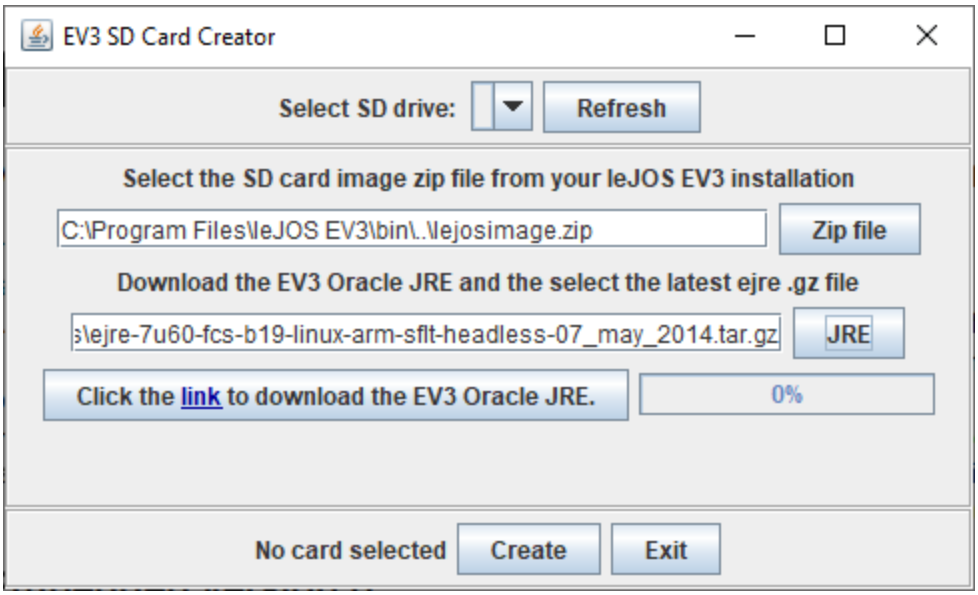
Product / File Description	File Size	Download
ARMv5 Linux - Headless EABI, SoftFP ABI, Little Endian1	32 MB	ejre-7u60-b19-ejre-7u60-fcs-b19-linux-arm-sflt-headless-07_may_2014.tar.gz



Once the JRE has been downloaded, you can select it by clicking on the **JRE button** for download to the MicroSD card.



Press **Open** to select



Make sure to select the SD drive from above and then press on **Create**. It will open a terminal and take some time to install. If you installed the incorrect JRE file, you will get an error when turning on the robot.

Insert the memory card into the EV3 with pin side down. Best to have a piece of tape stuck to the top of the card, for easy removal. Otherwise use pliers to grip the card to remove.

Here is a video on

How to remove the microSD Card

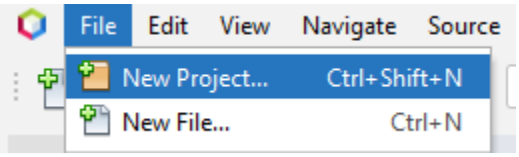
Turn on the EV3 and the system will take about 8 mins or so to complete the installation. You will immediately know if there is a problem within the 1st min.

Now your robot is ready to accept Java programs!

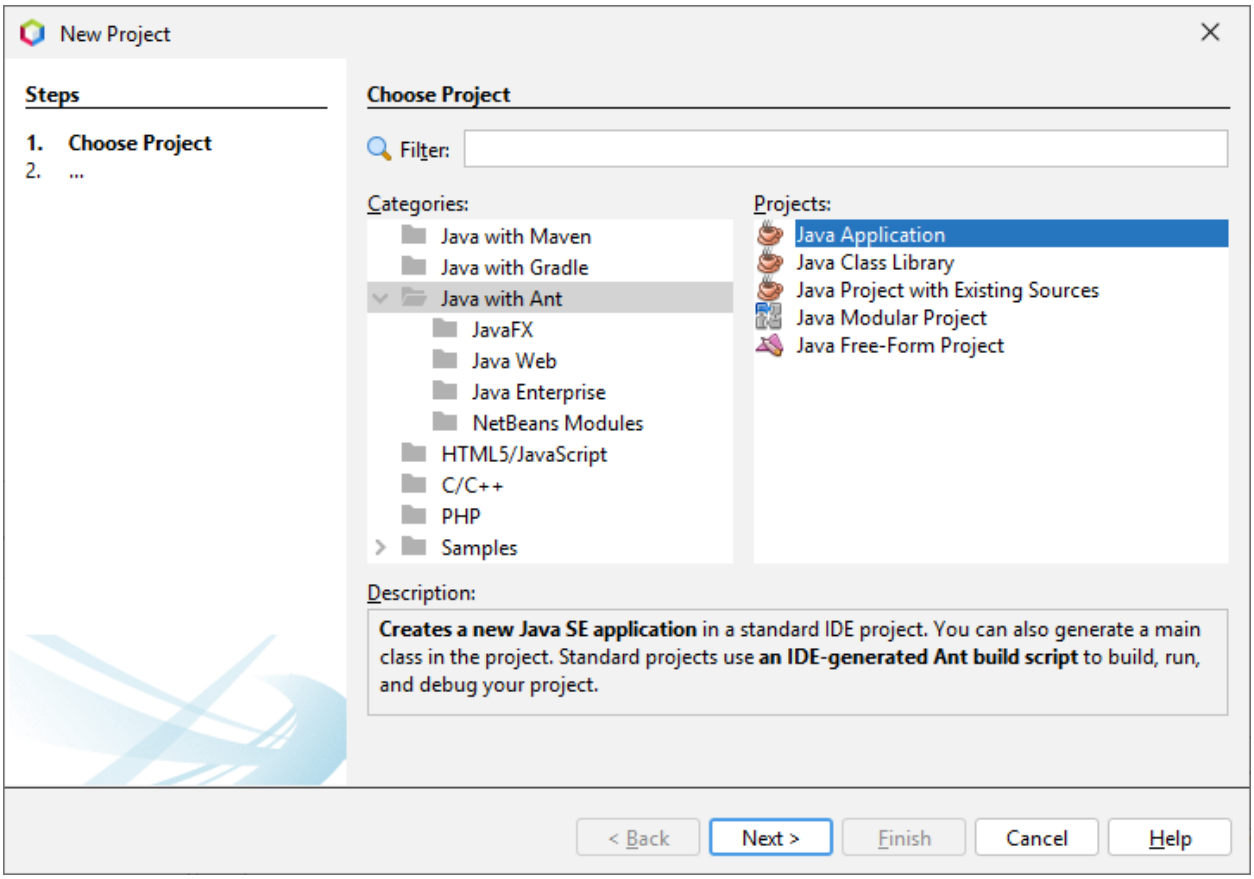
Programming the EV3 Using NetBeans

New Project

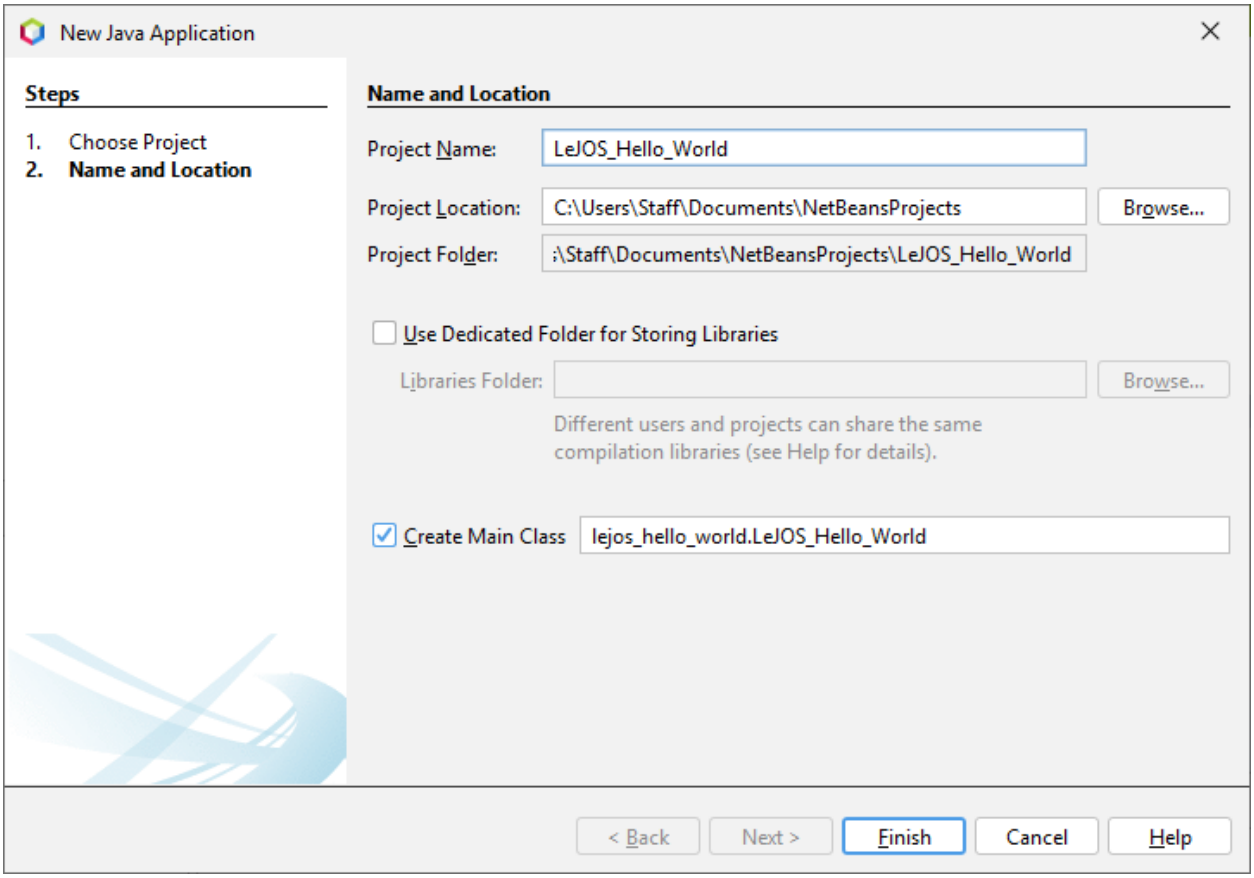
Making a new project



From the **File** menu, select **New Project**.



Select the Category of **Java with Ant** and a Project **Java Application** and then press **Next**.



Fill in the project name and then press **Finish**.

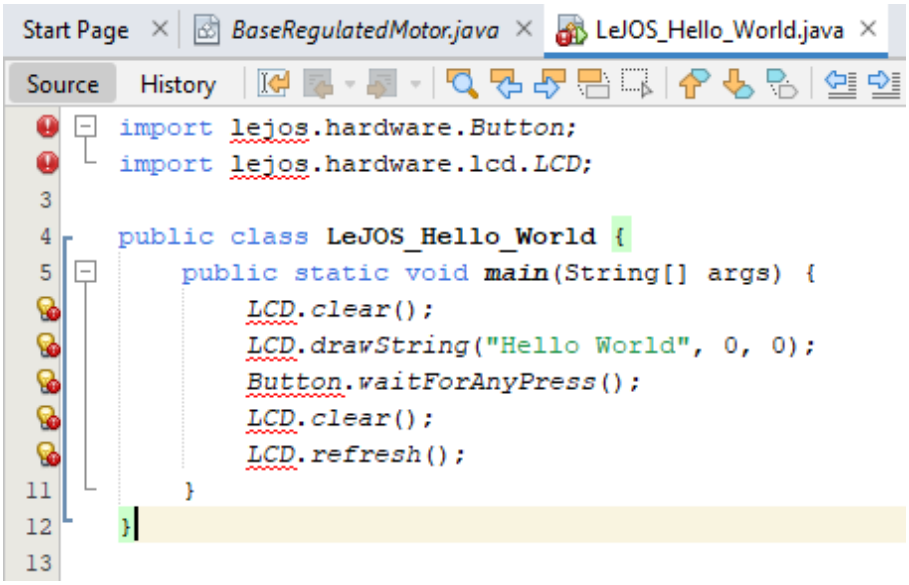
Sample EV3 Hello World Program

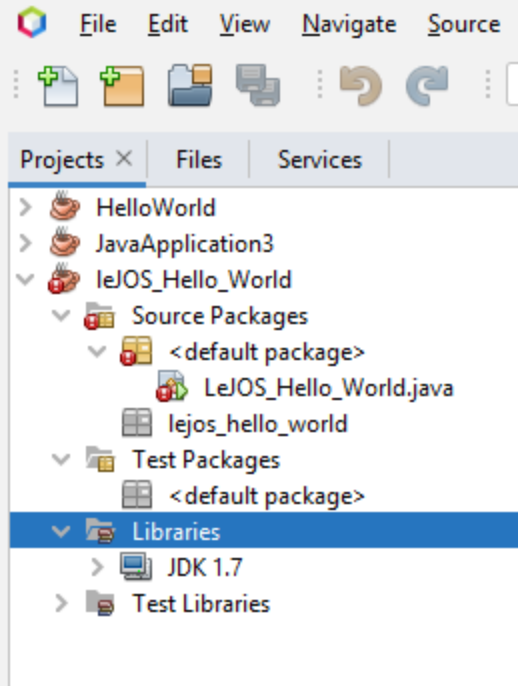
For the source code of your project, enter this sample code:

```
import lejos.hardware.Button;
import lejos.hardware.lcd.LCD;


public class LeJOS_Hello_World {
    public static void main(String[] args) {
        LCD.clear();
        LCD.drawString("Hello World", 0, 0);
        Button.waitForAnyPress();
        LCD.clear();
        LCD.refresh();

    }
}
```

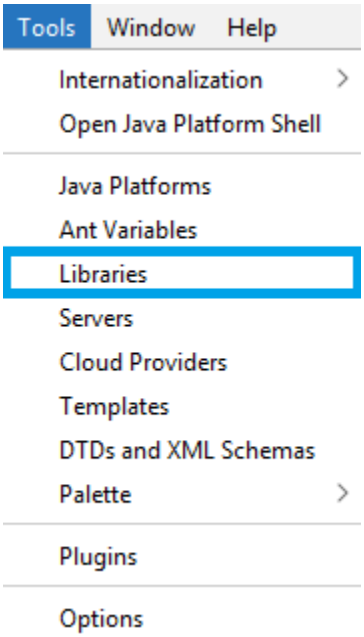




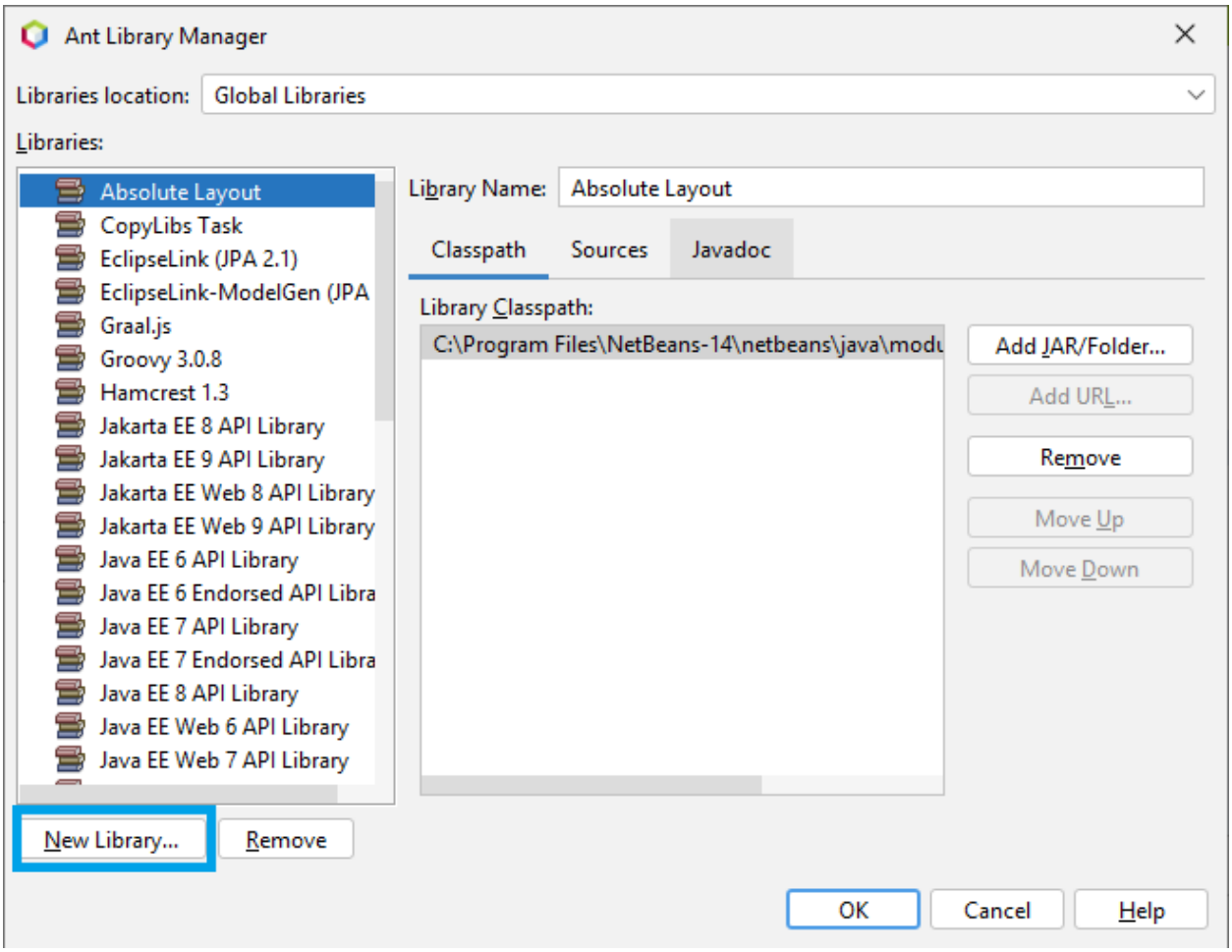
Notice the red exclamation marks above? Those are errors because NetBeans does not know where to find the libraries that are being imported by your code. Now let's add the libraries to the project.

Adding in leJOS libraries

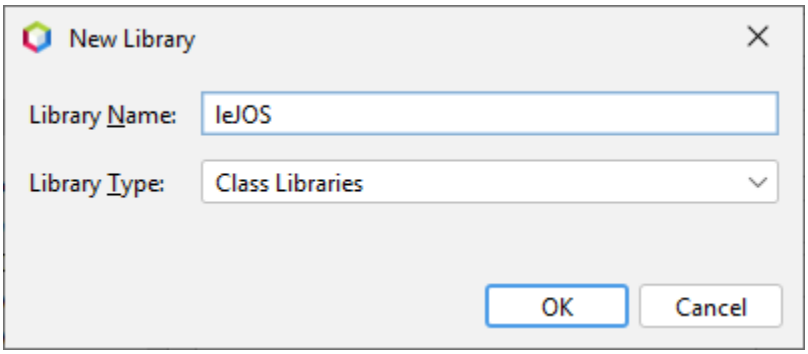
Inside of NetBeans you need to add in the EV3 libraries.

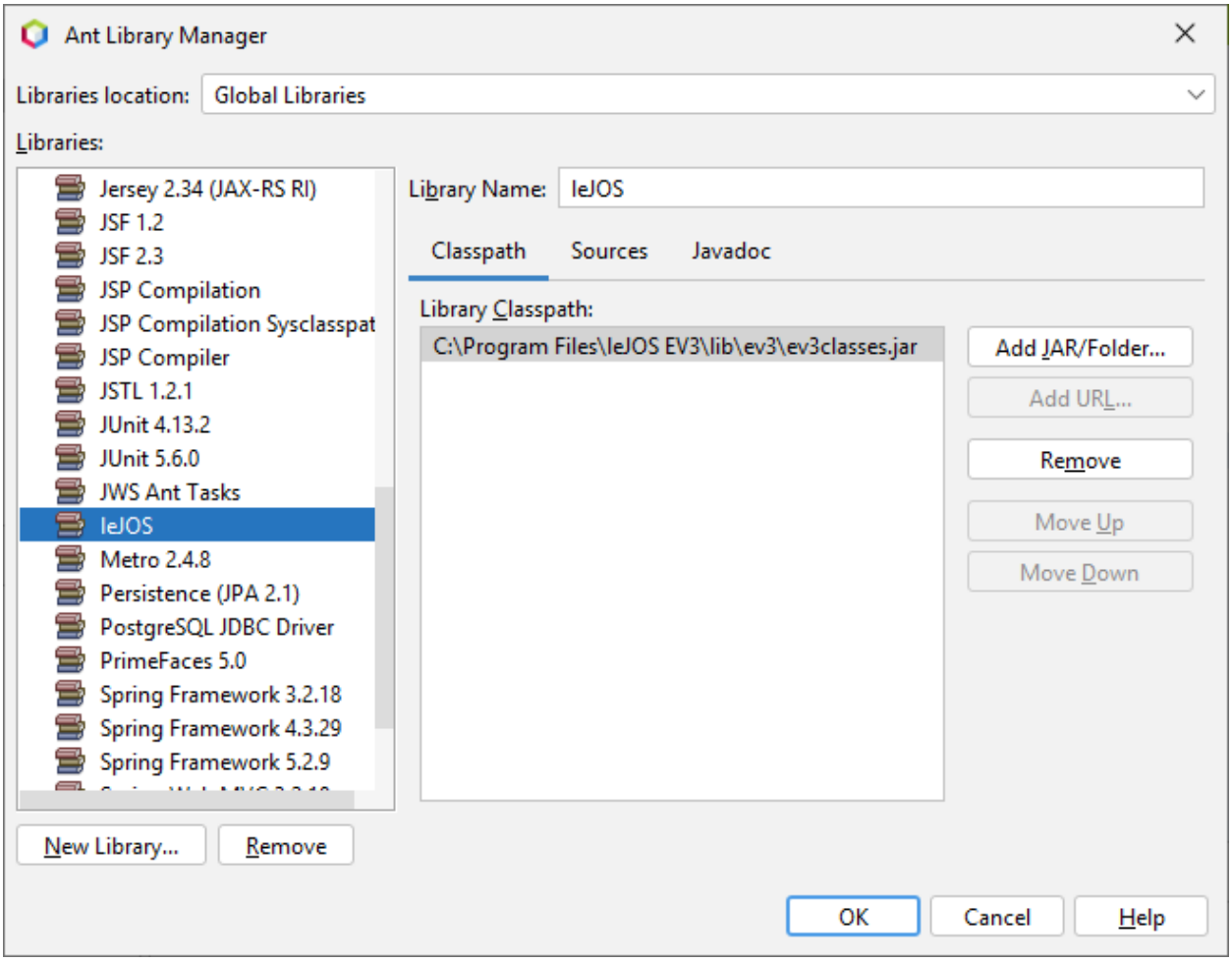


Select from the main menu, select **Tools**, **Libraries**.

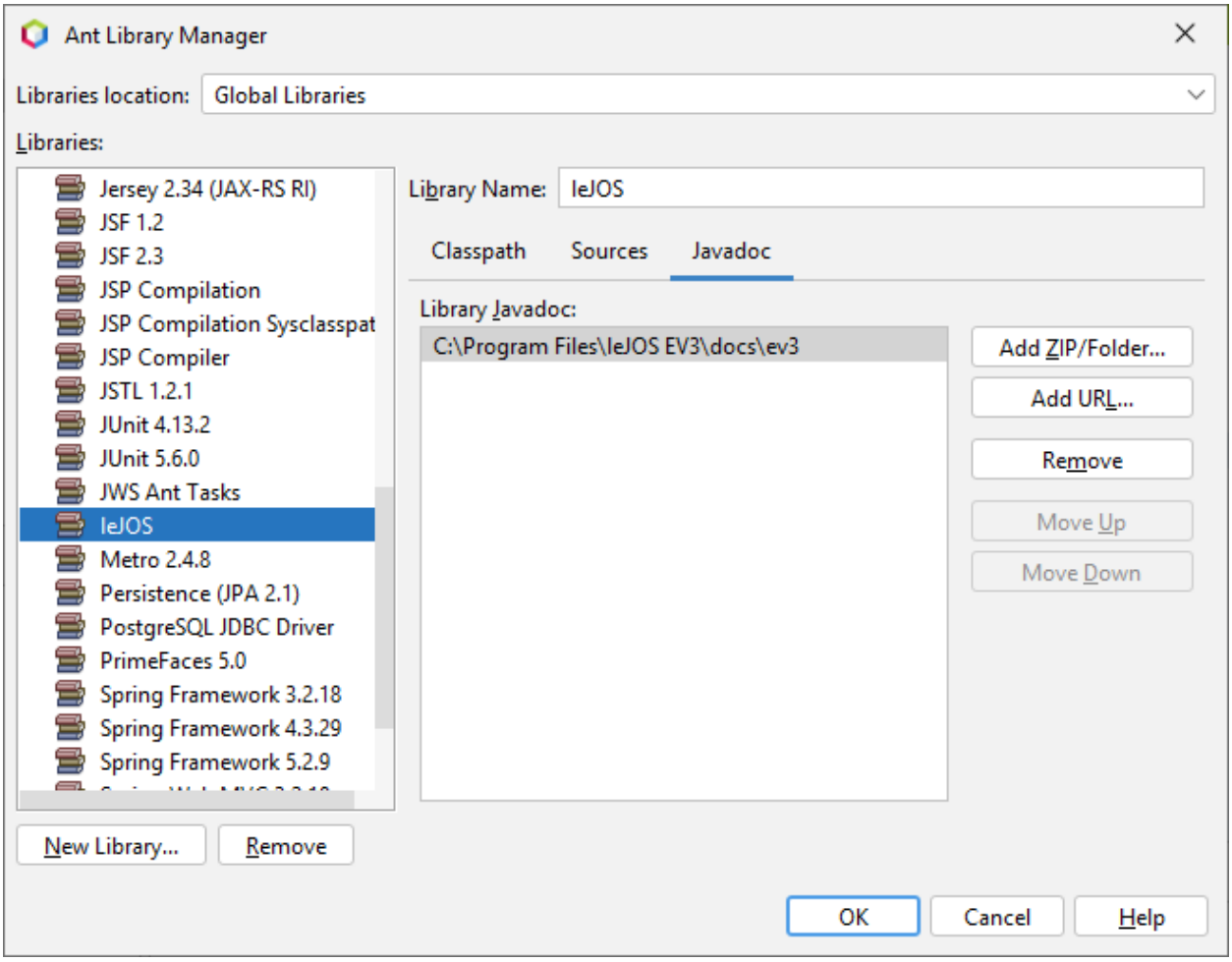


Select **New Library** from the left side of the window on the bottom. Name the library leJOS.





Select leJOS and then on the right side menu for the Classpath select add JAR/Folder and give it the folder location of where you installed leJOS libraries, such as:
C:\Program Files\leJOS EV3\lib\ev3\ev3classes.jar

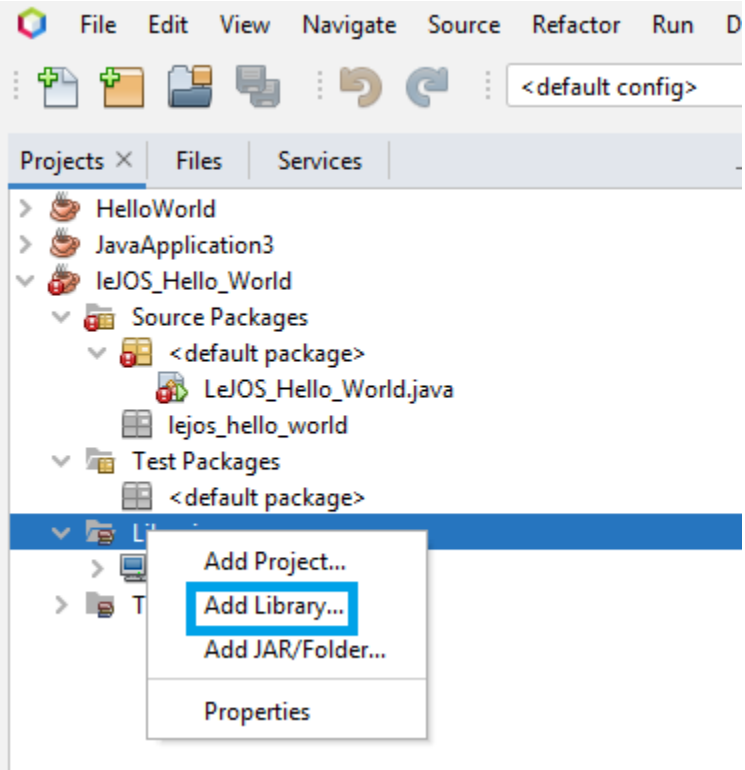


Select leJOS and then on the right side menu for the Javadoc select add JAR/Folder and give it the folder location of where you installed leJOS docs, such as:
C:\Program Files\leJOS EV3\docs\ev3

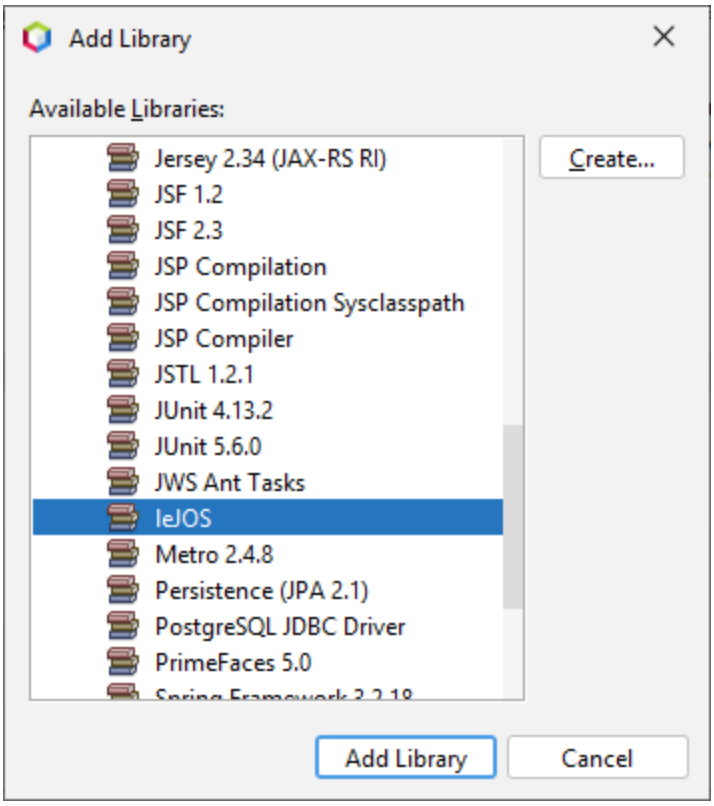
OK out the menu and now you can do the properties of the project. Make sure your project is selected on the Projects Menu.

Using Libraries

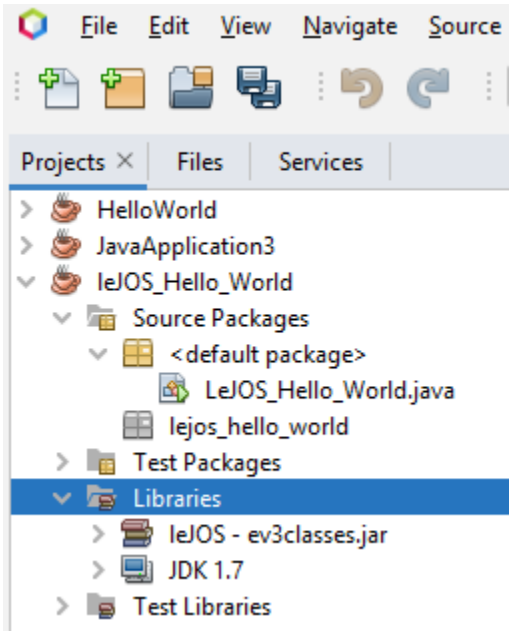
In the Projects tab on the left, right click on **Libraries**.



Then select **Add Library**.



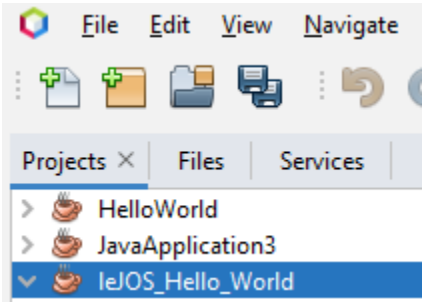
Select **leJOS**, then press **Add Library**.



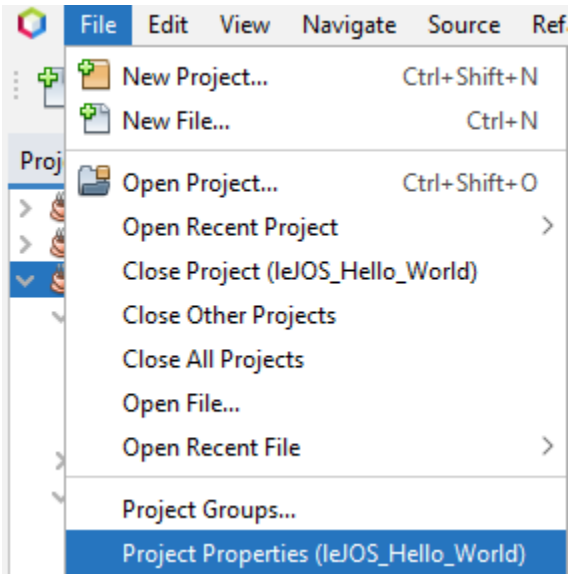
Now the error exclamation mark icons about the libraries are gone.

JDK

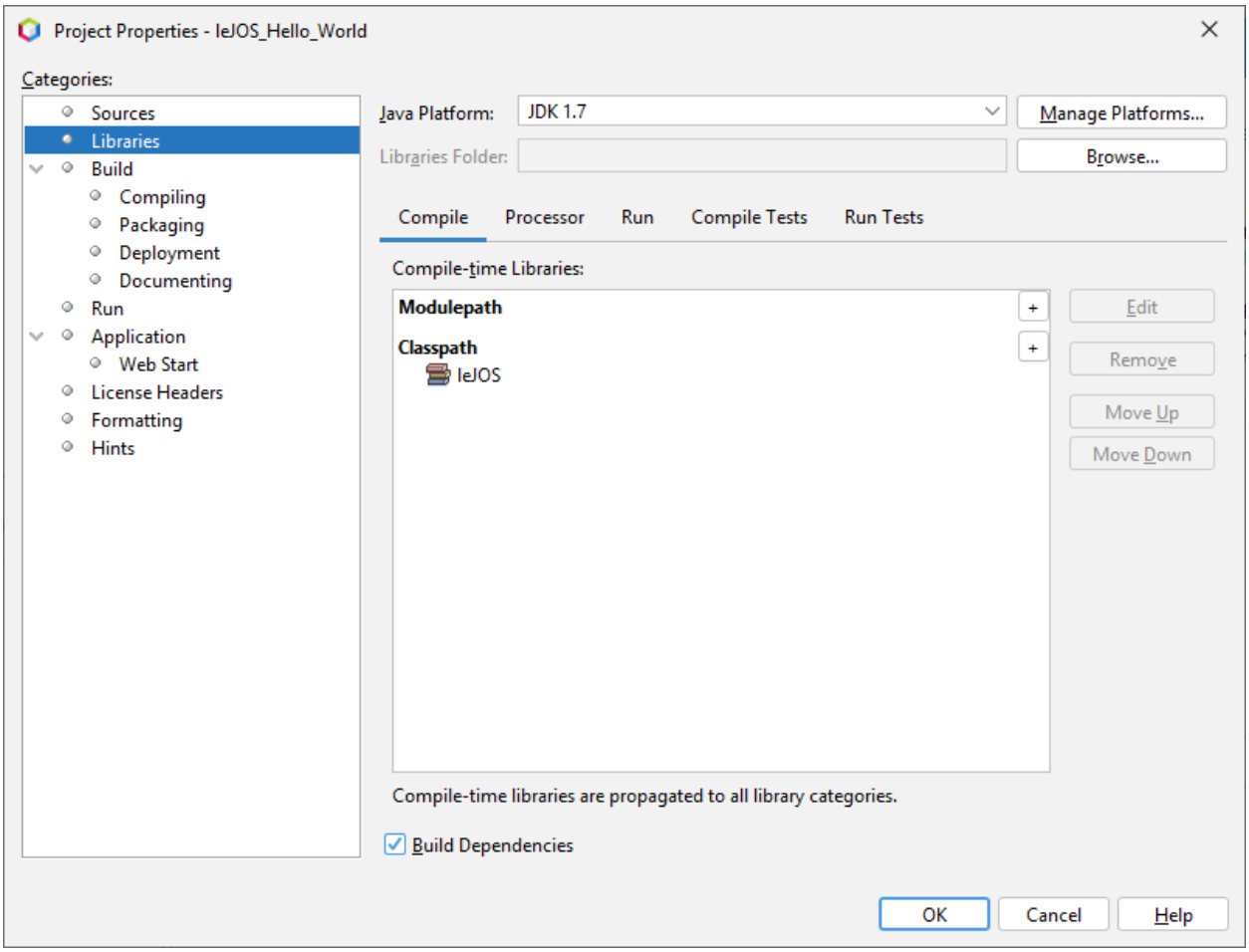
Now let's set the Java Platform, to the Java SE 7 (1.7) Platform, for the project to be compatible with the version on the EV3.



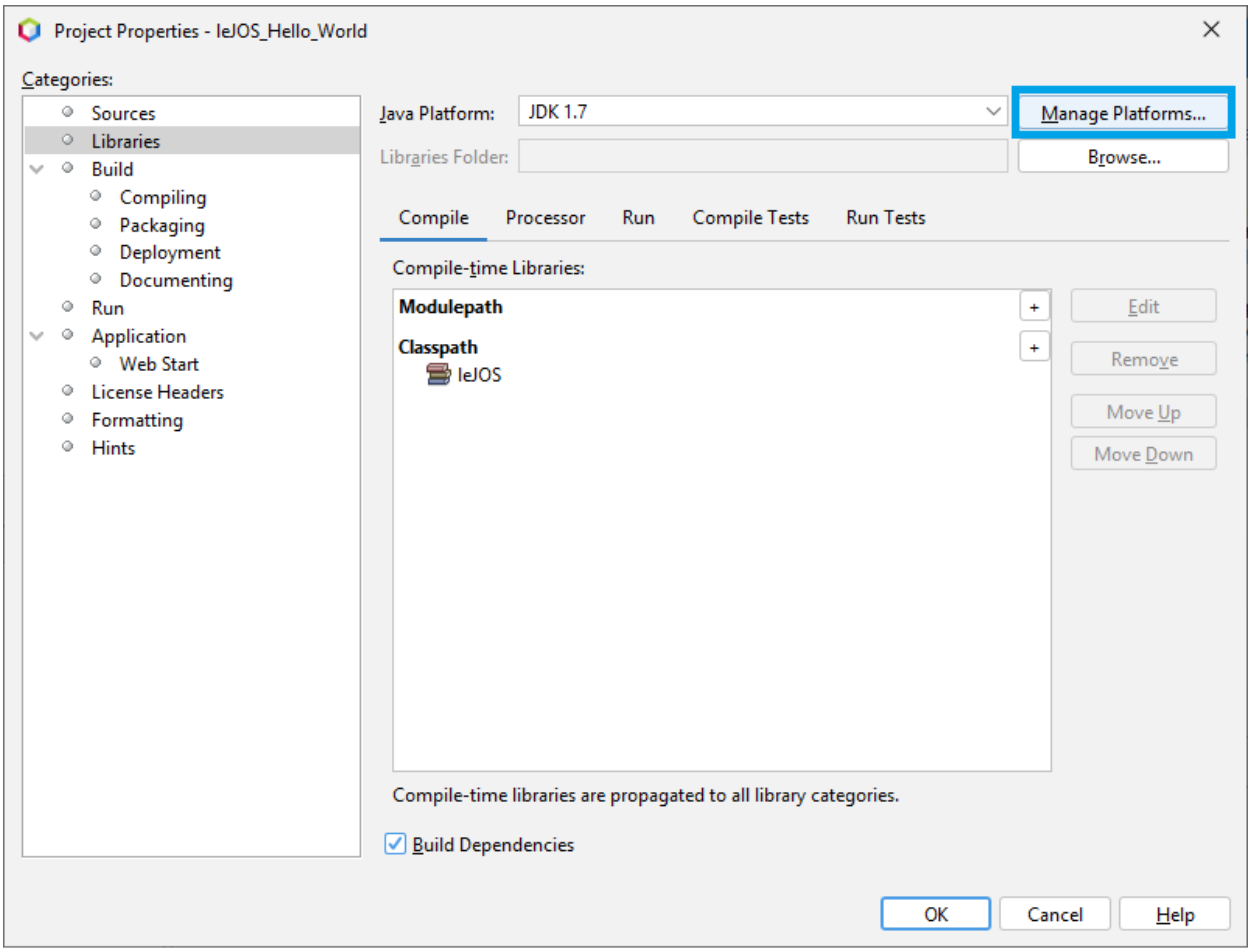
Select the Project.



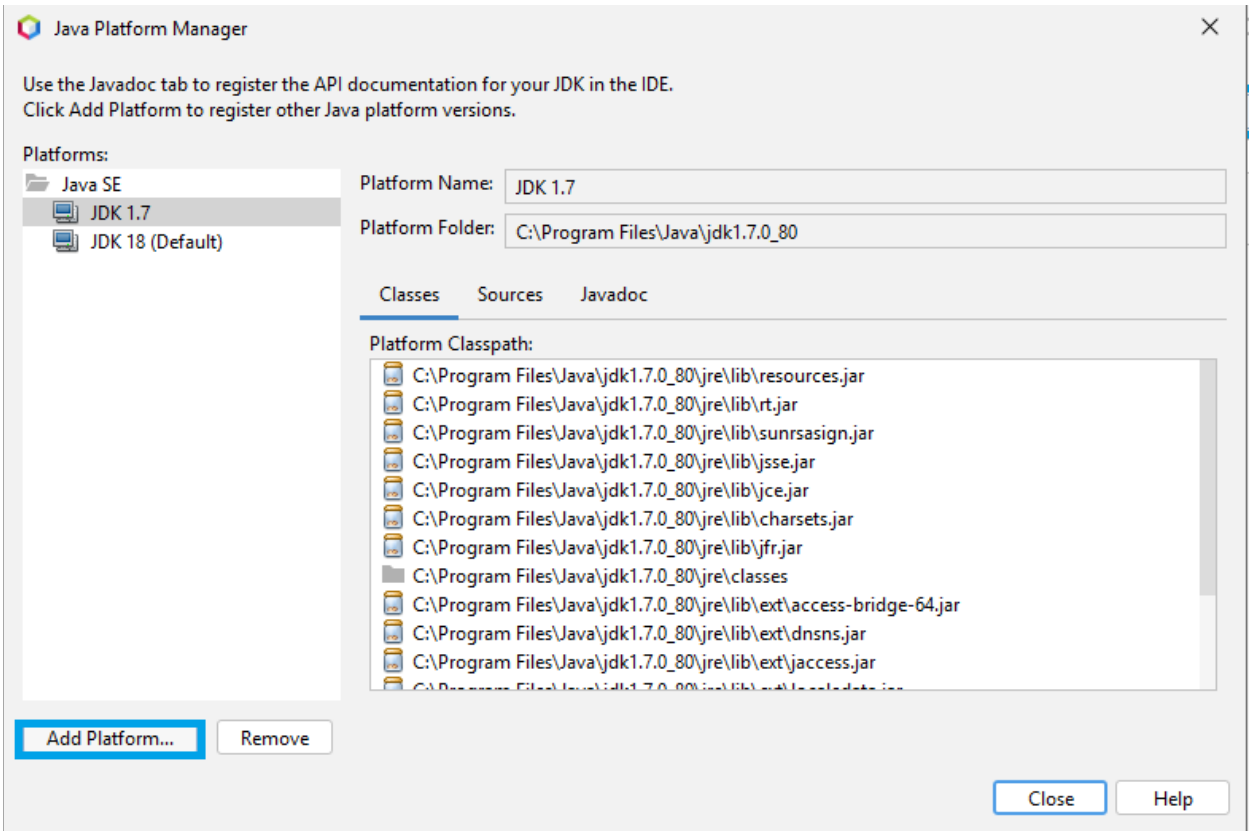
Then select **File**, **Project Properties.**



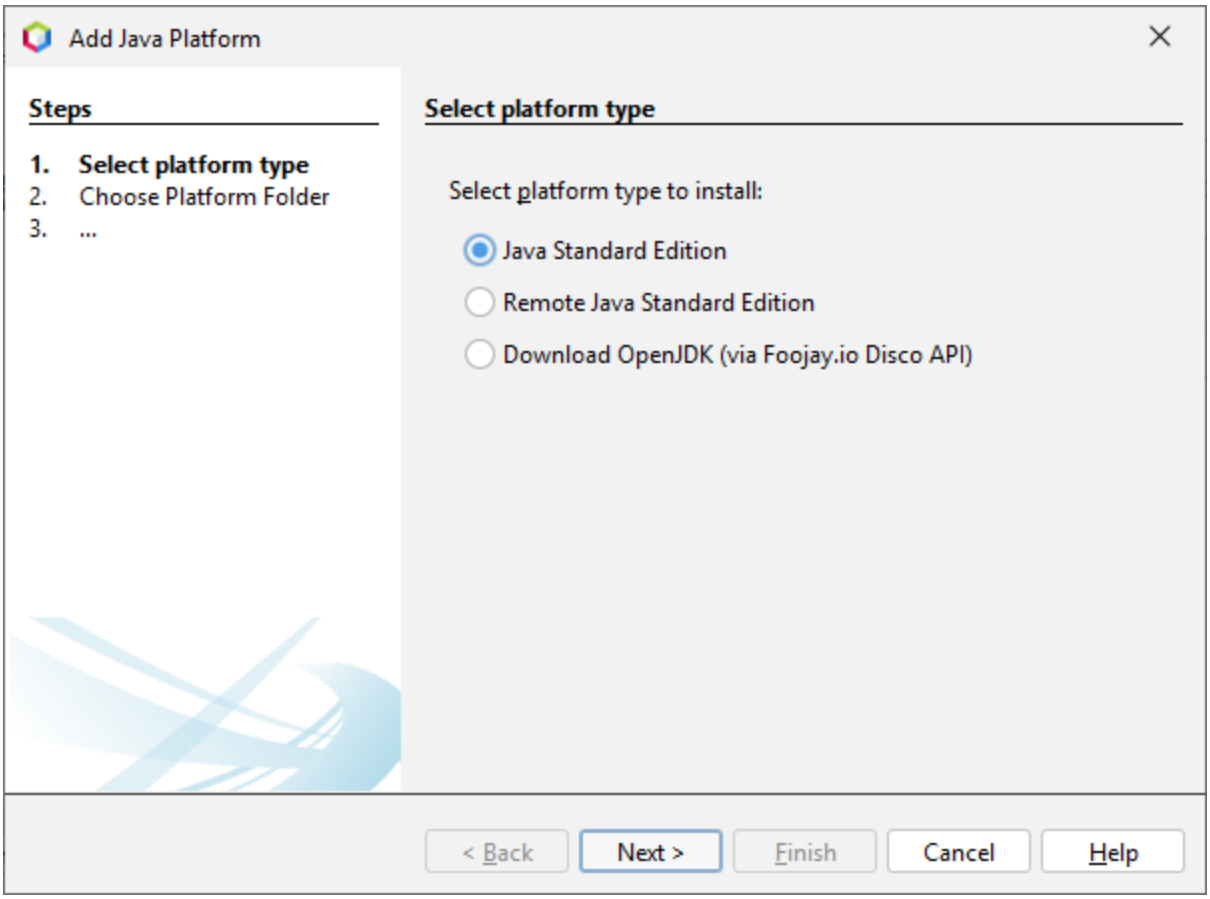
Select **Libraries**



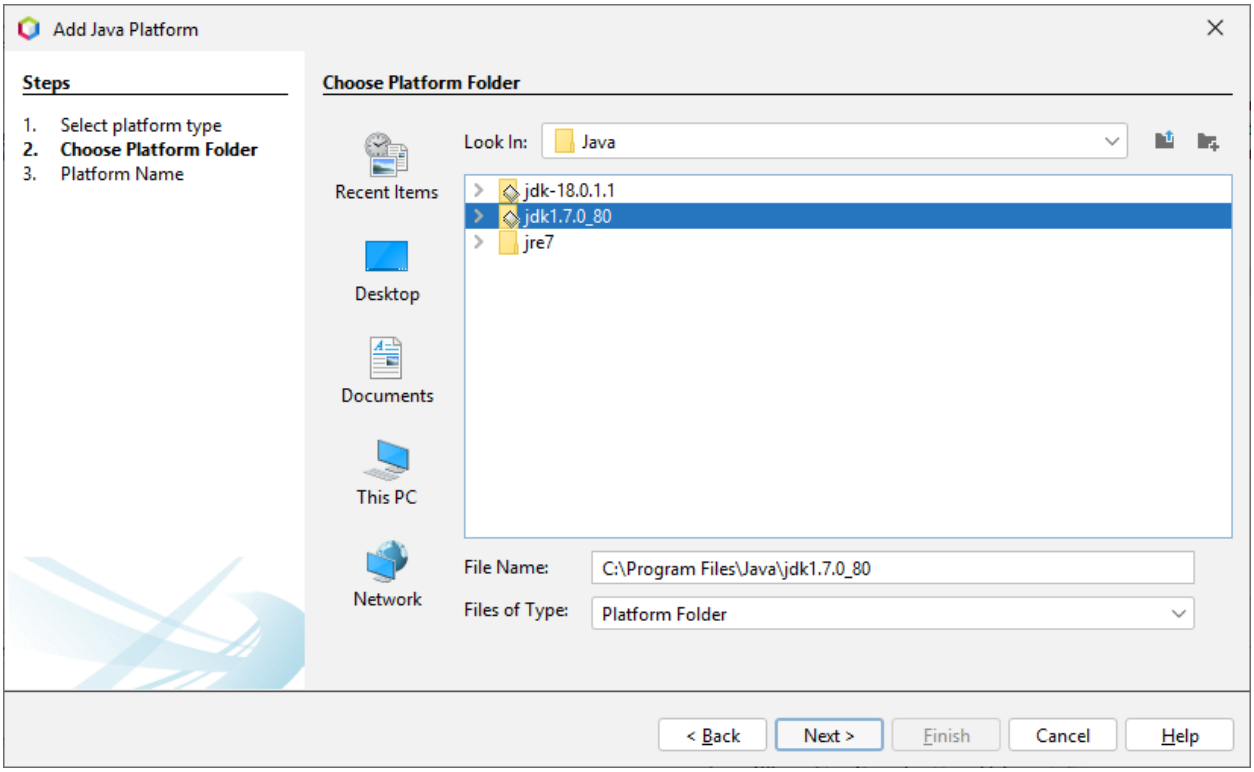
Select **Manage Platform**



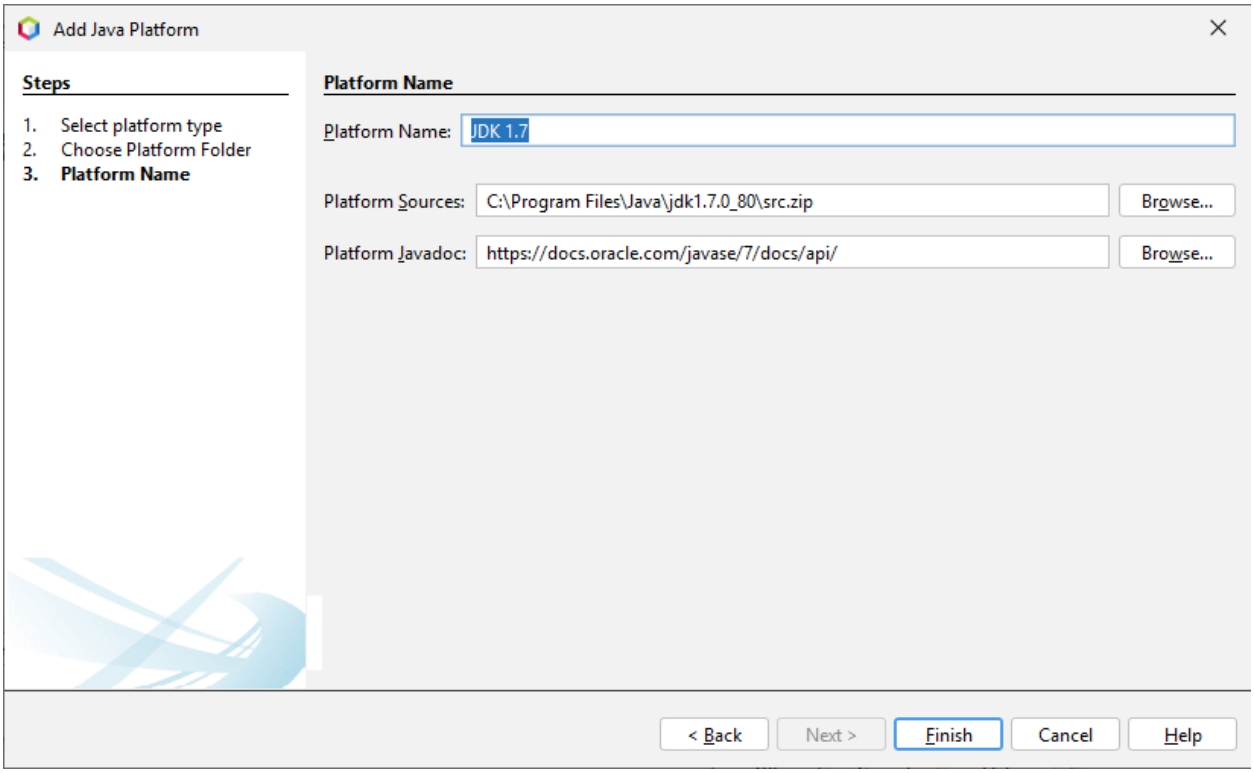
Select **Add Platform**



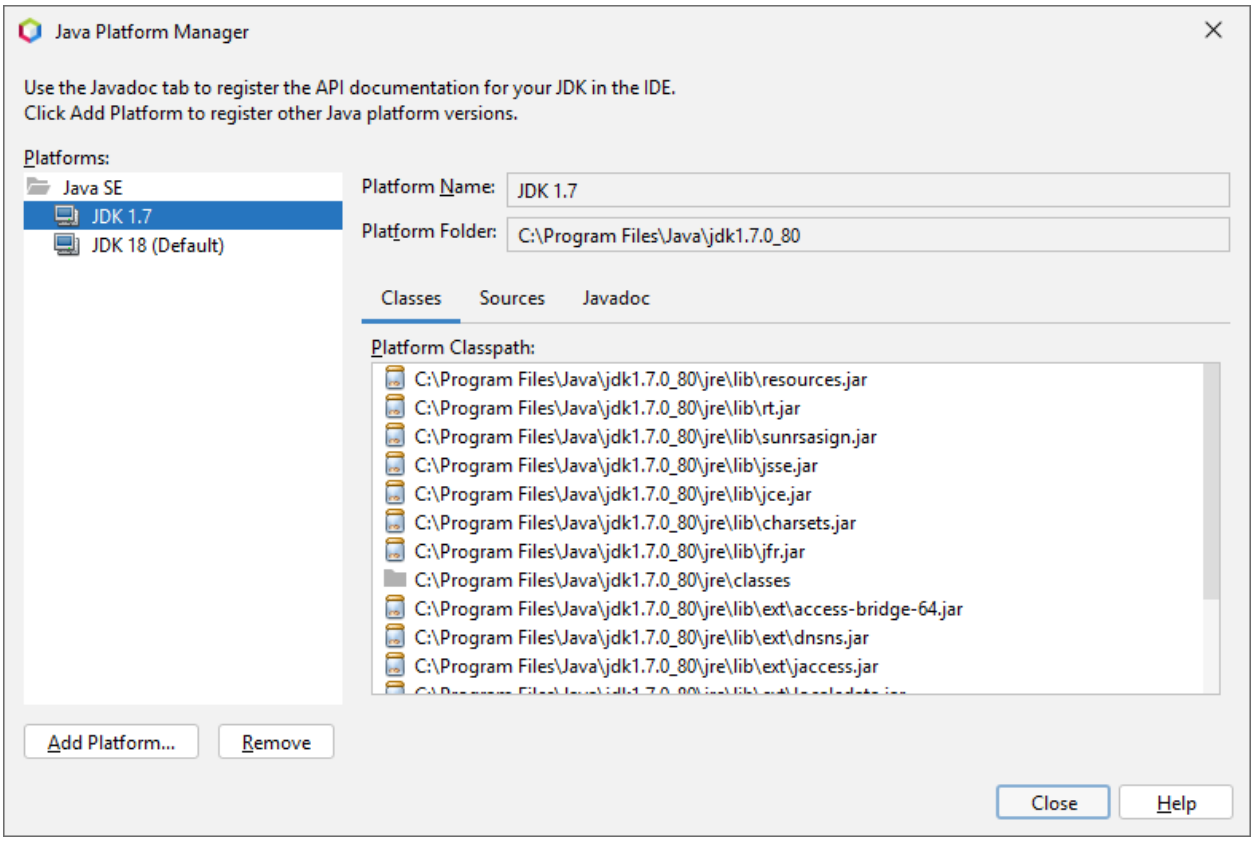
Select **Java Standard Edition**.



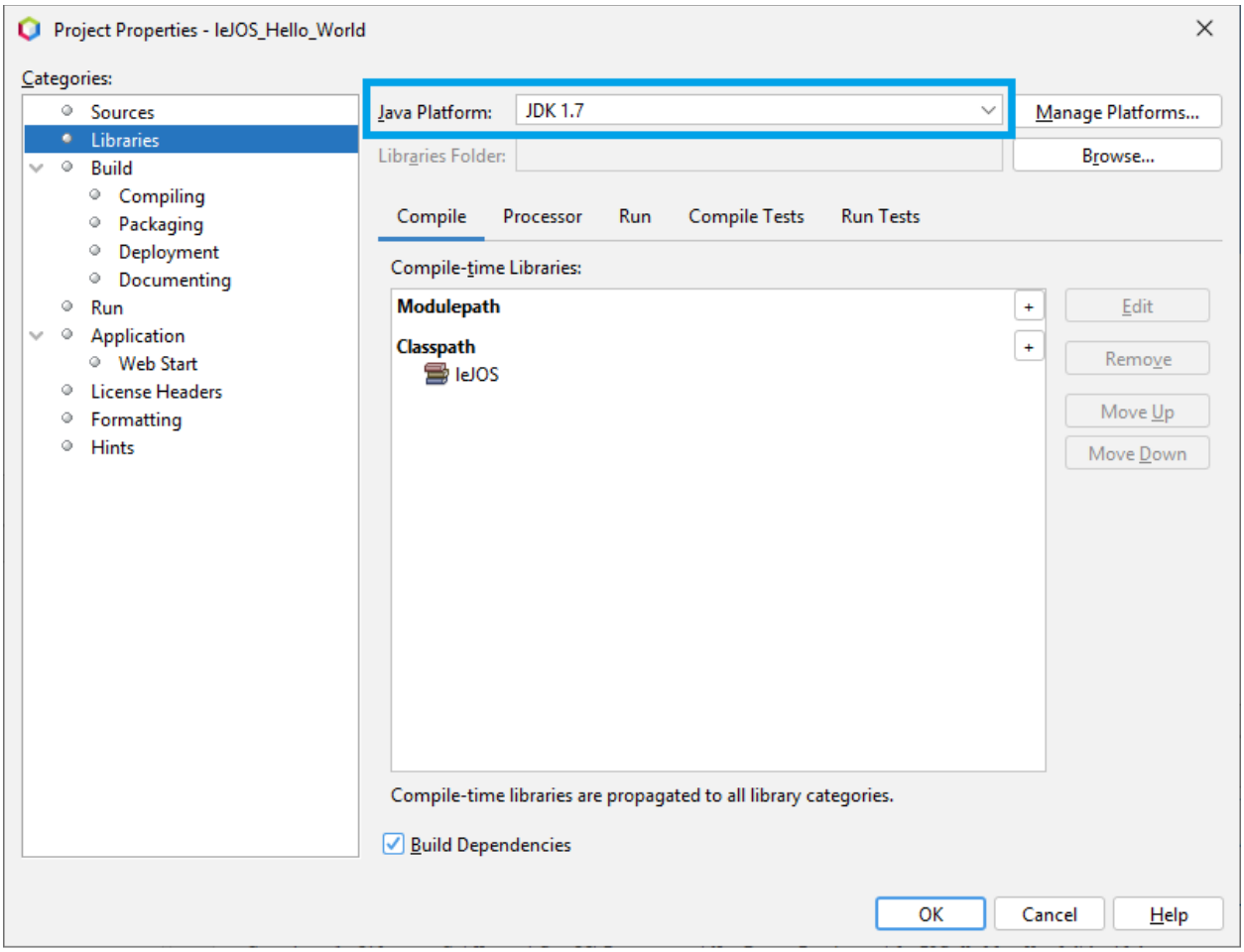
Then select the path where **jdk1.7.0_80** is installed, such as **C:\Program Files\Java\jdk1.7.0_80** then press **Next**.



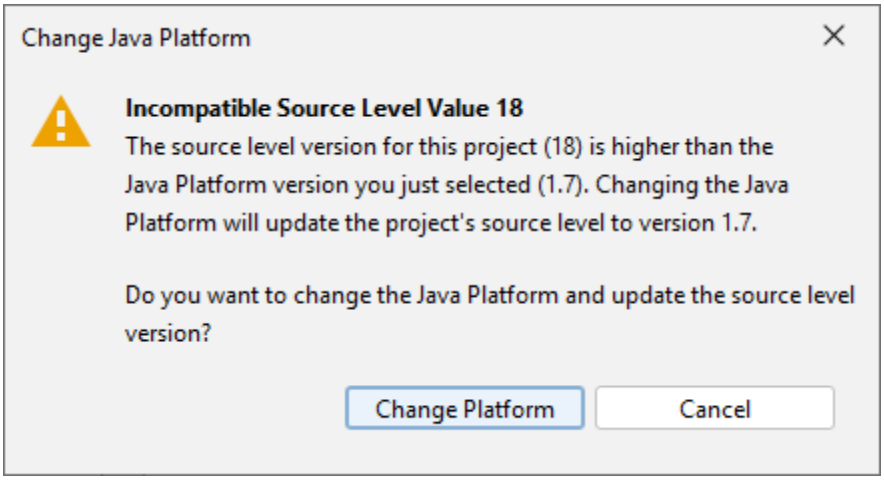
Select **Finish**.



Press **Close** to finish up.

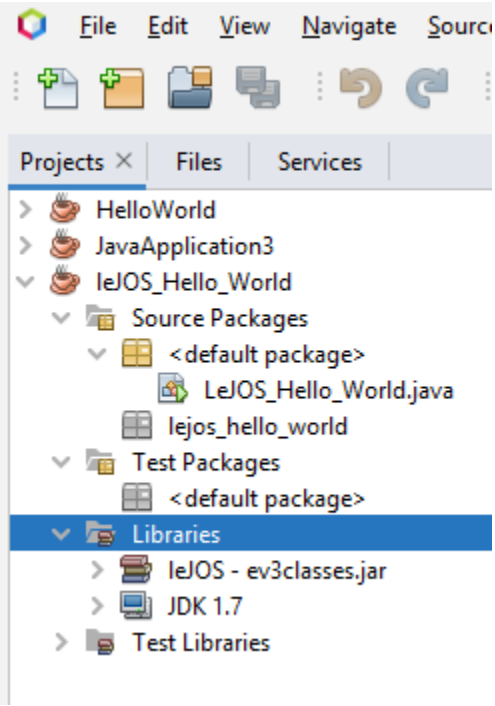


Select the **Java Platform as JDK 1.7**.



Press **Change Platform**. Then when done with the Project Properties press OK.

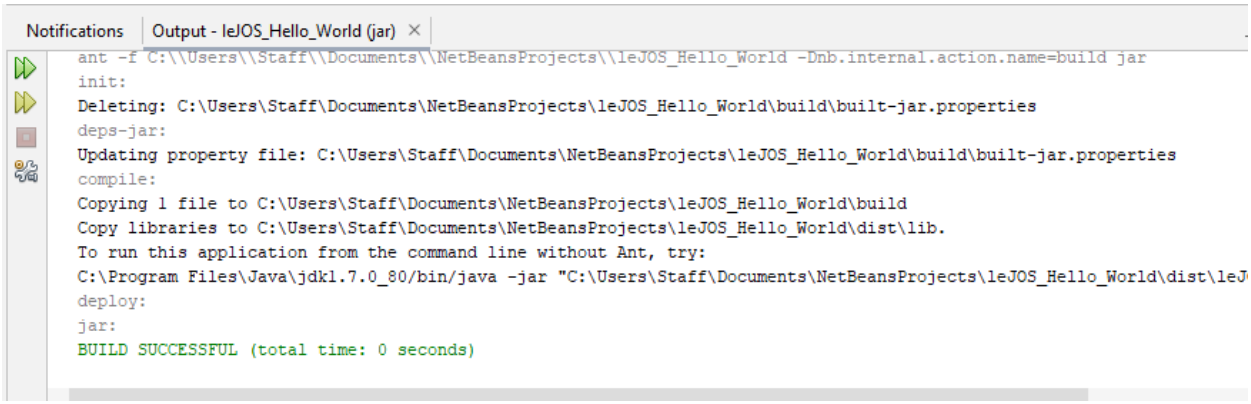
When you are done, you should have the following Libraries.



Building Your Project

Build the following program to test things out:

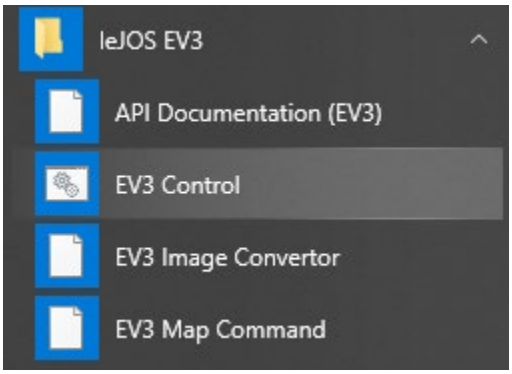
From the **Run** menu, select **Build Project**.



You should get a successful build. If you get an error, make sure that your project is using **JDK 1.7** as the Java Platform. A distributable version of your project is now in the **dist** directory of your project.

Uploading Java Programs to the EV3

Use the EV3 Control Center to upload the file and run it.



On Windows, it is in the **leJOS EV3** program group (also found in the bin folder of where you installed leJOS (C:\Program Files\leJOS EV3\bin). On Mac/Linux, it is in the bin folder of the tar.gz file.

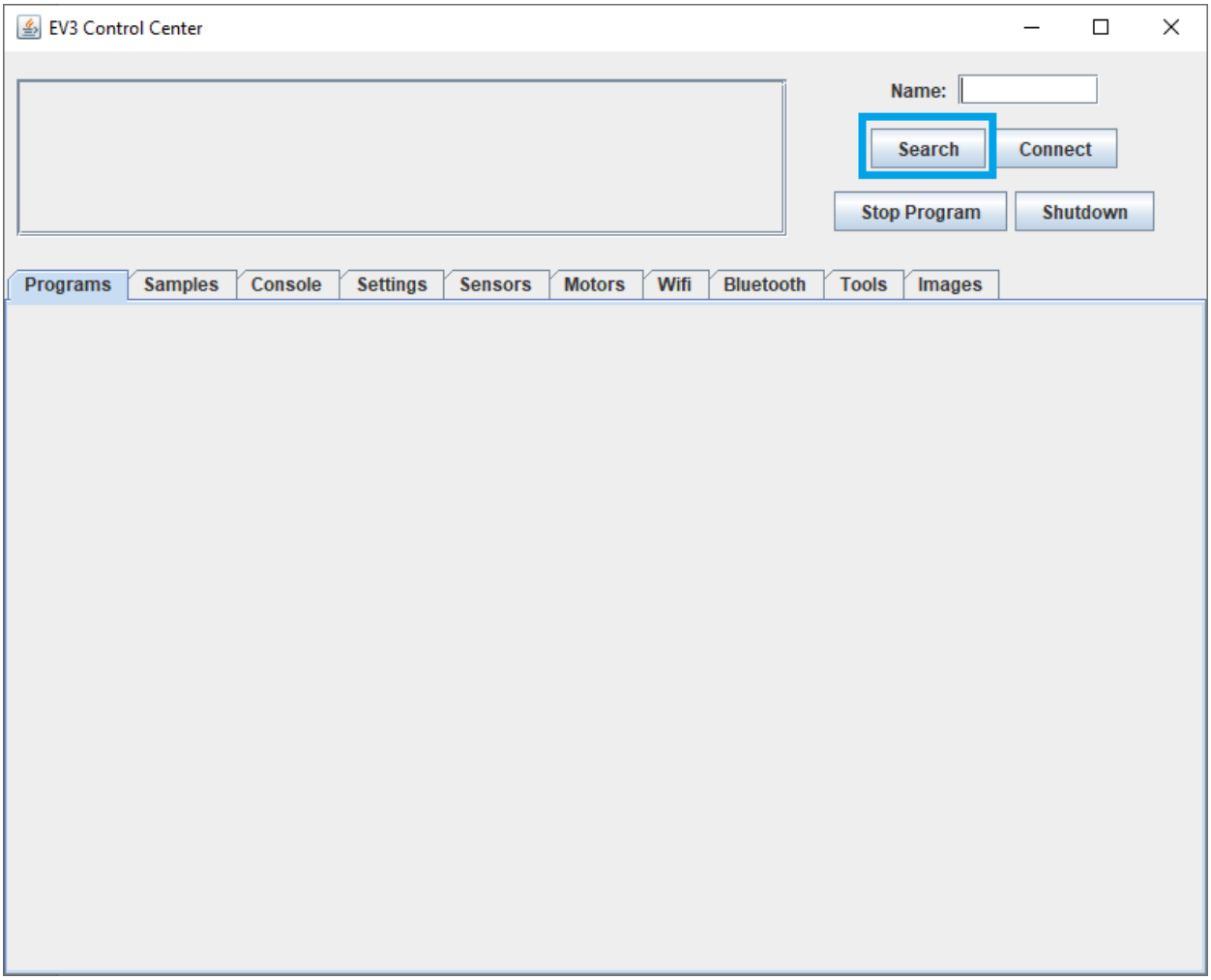
Make sure your EV3 is flashed with the leJOS firmware and the install process has completed. Be sure the EV3 is powered on and that the system has finished loading (you will see a menu on the screen).

Make sure to connect the EV3 to the USB port on your computer. There is support for Wifi/Bluetooth connection, however we used the USB connection only.

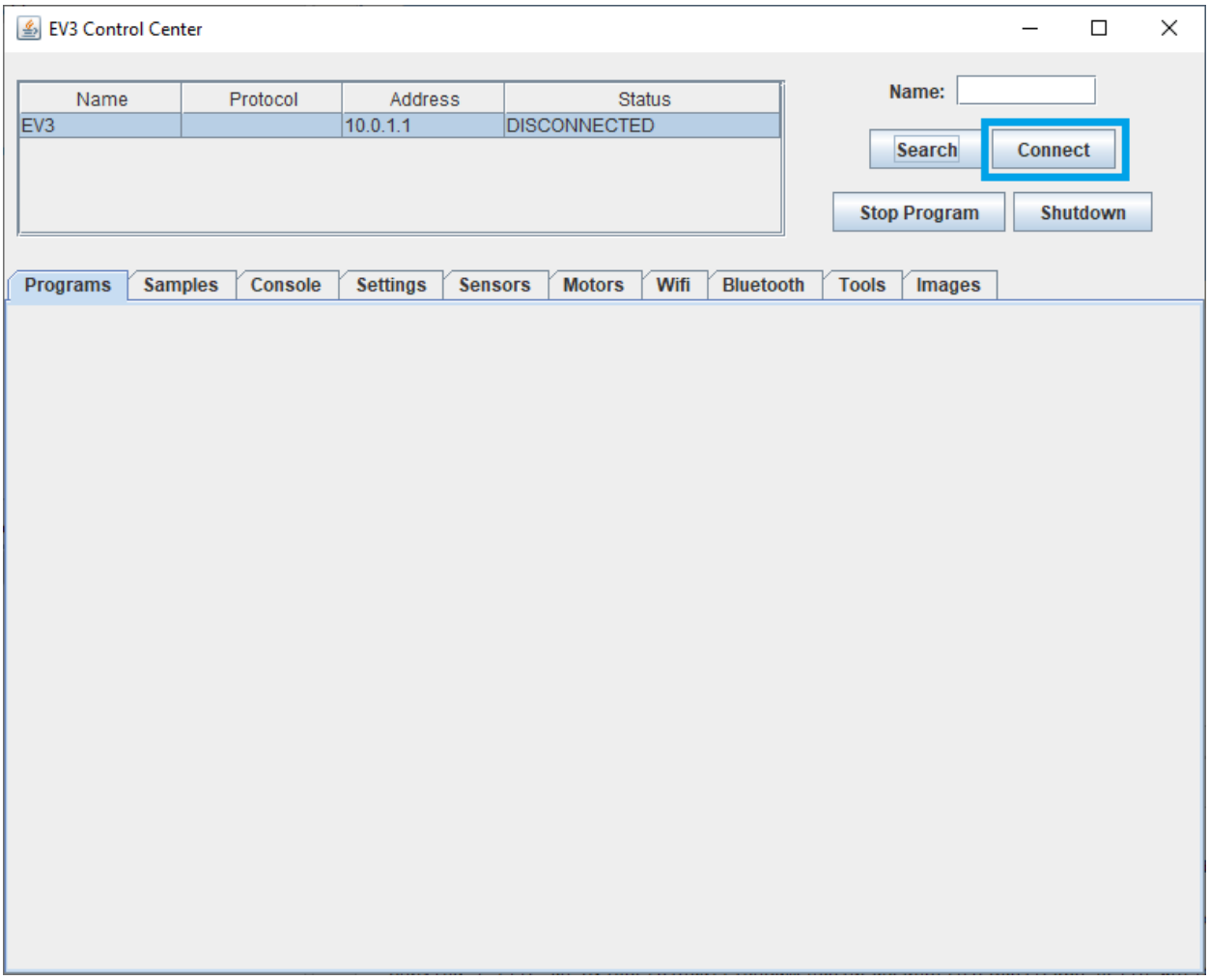
In order for USB connection to work, you need to have installed the older edition of the EV3 Mindstorms lab software; that contains the USB driver. If this is your first-time doing development work with the EV3, the software link is below:

https://education.lego.com/en-us/downloads/retiredproducts/mindstorms-ev3-lab/software

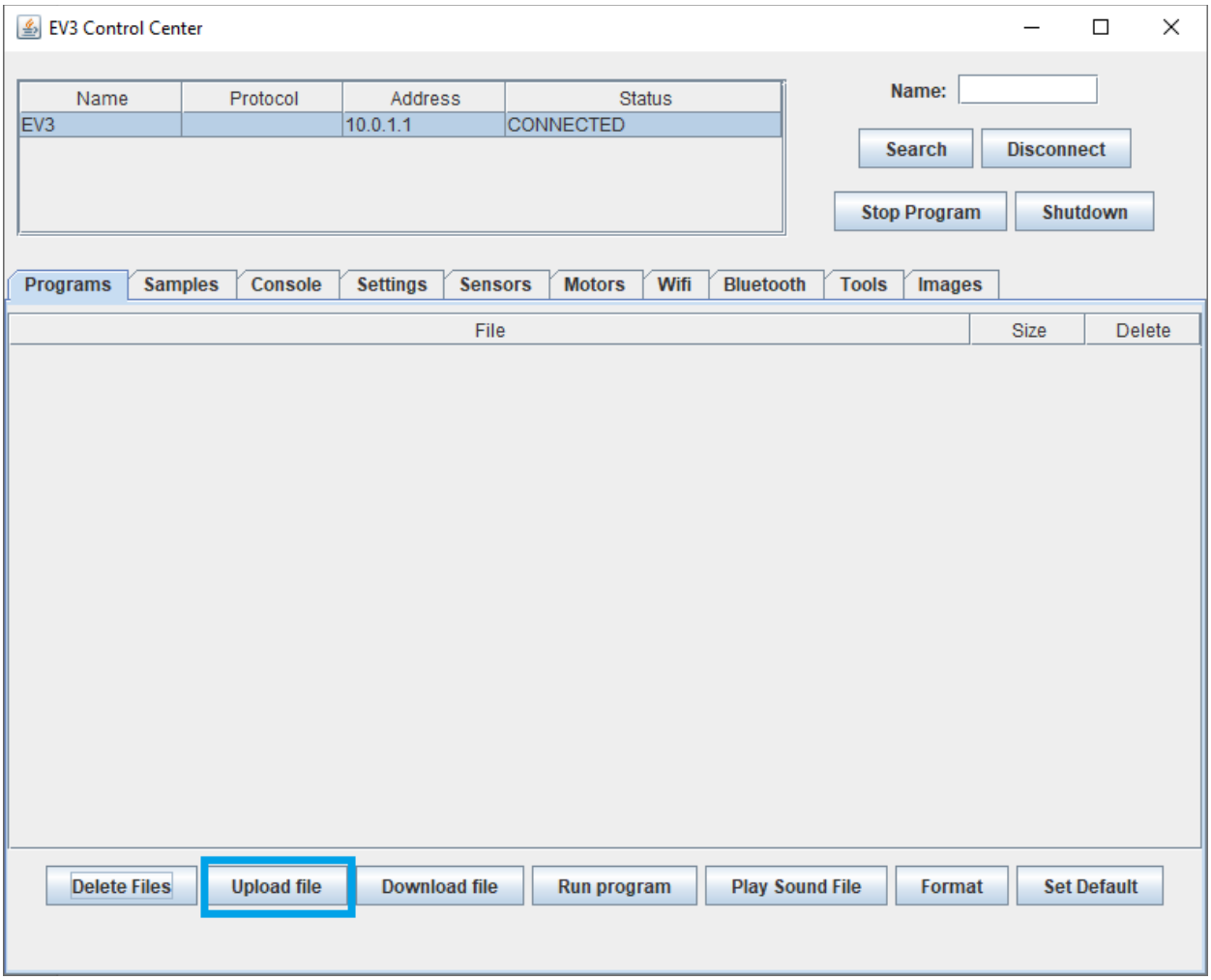
Using the leJOS EV3 Control Center



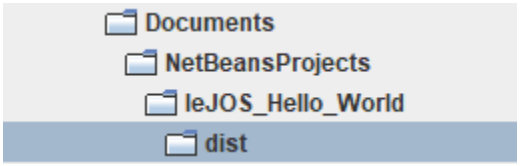
Select **Search** to locate the robot.

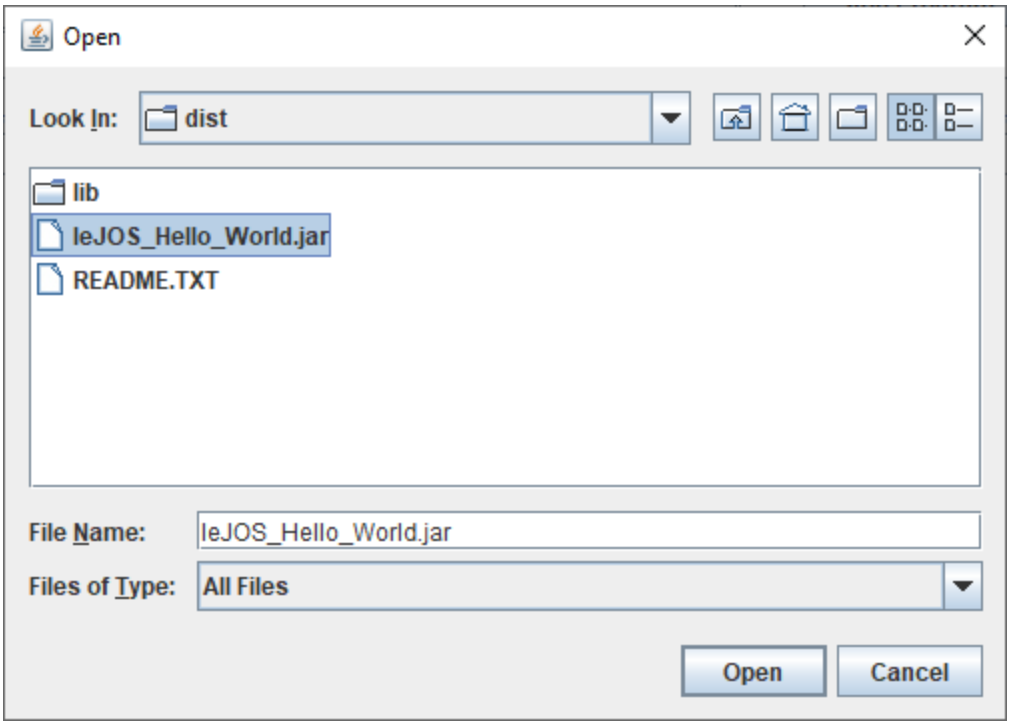


Once the robot has been found, press on **Connect**.



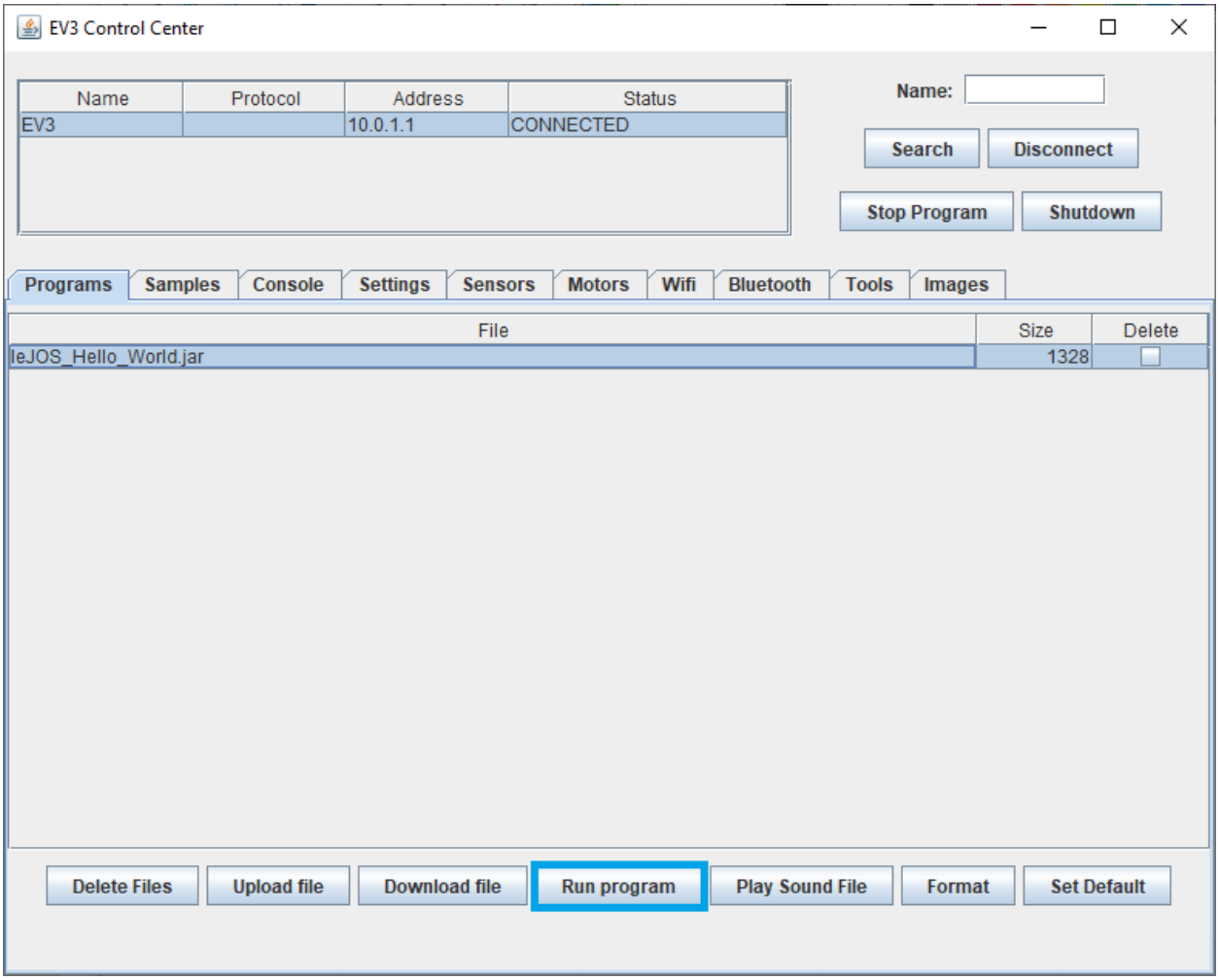
Press on **Upload file**, to upload the **JAR** file of the distribution (found in the **dist** folder) version of your project.





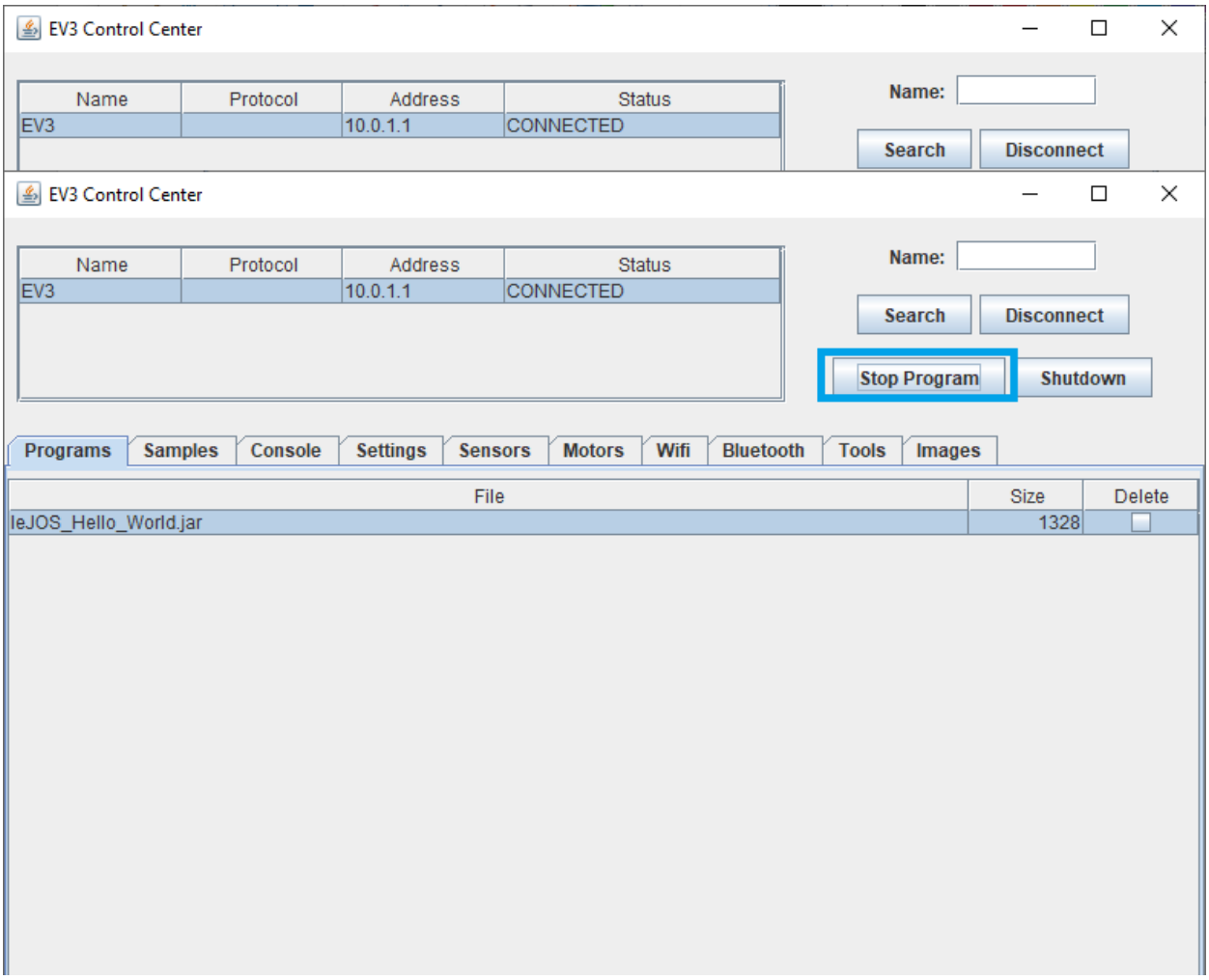
Select the jar file and press **Open**.

It will upload to your robot.



Select it and press **Run program**.

Wait a few seconds and you will see the program running on your robot. Press any key exit this example program.



You can stop a program by pressing **Stop Program**. If the robot is not connected to the computer, you can force stop it by holding **ENTER** (center button) and pressing the **DOWN** button.

The sample program designed to stop if you press any key on the robot.

Now you can program your EV3 with Java!

Be sure to read the API documentation found here:

https://lejos.sourceforge.io/ev3/docs/

Here is an interesting tutorial on programming the EV3 in Java using leJOS:

https://stemrobotics.cs.pdx.edu/node/4576.html