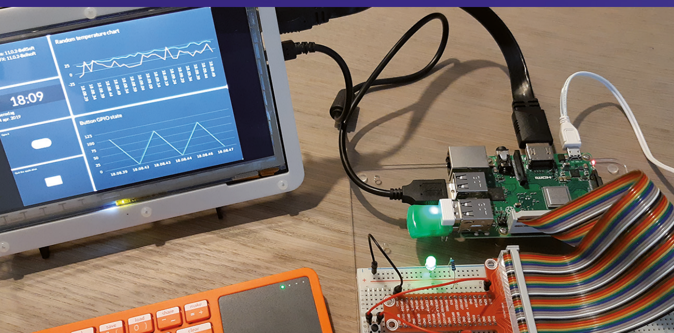
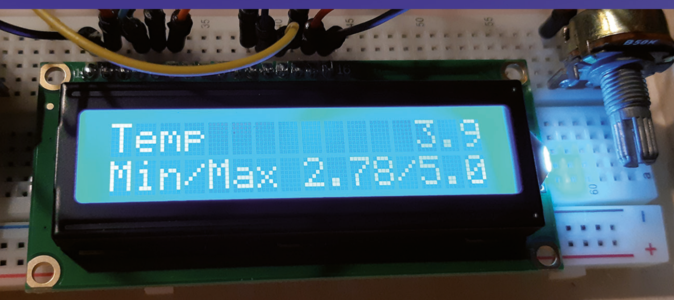
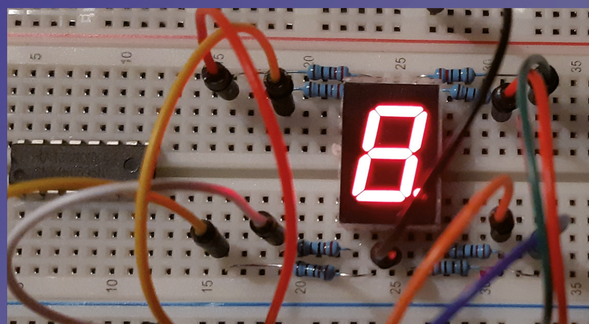
Getting Started with Java on the Raspberry Pi







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spring

JavaFx

Pi4J

Frank Delporte

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Getting Started with Java
on the Raspberry Pi

Frank Delporte

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Chapter 1: Introduction

Welcome! Whether you are a newbie in Java, and want to learn from examples, or know the language, and want to get started with electronics and a Raspberry Pi, I hope you will find valuable new information in here!

This is not a book to learn every aspect of the Java language. There are already a lot of those written by way better programmers than me, so please check your bookstore or an online course if you want to get a real deep knowledge of the Java programming language. My goal was to bundle **a lot of sample code and information**, I collected while learning and experimenting, and to get anyone interested in Java to take **a quick start by using the examples to set up their experiments**. By following these examples, you will also learn the language bit by bit.

Over the last couple of years, I focused on Java in my professional job. But on the other hand, I also got involved in CoderDojo (a coding club for children) where I first was able to make a blinking LED with some simple code on Arduino and a Pi.

If I see how kids learn to work with electronics and programming at CoderDojo, I'm jealous those things didn't exist when I was a kid. Yes, I managed to control a relay-board with my Commodore 64 but it took me years to collect all needed knowledge and components to reach that goal. Now thanks to online shopping and knowledge sharing that same result can be achieved in days or hours…

As a professional Java-developer with a love for open-source, I set myself as a personal goal for 2019 to run a recent Java version (Java 11 or newer) on the Pi, with a **JavaFX user interface, and control an LED** with it. Very basic I know, but it resulted in a series of blog posts about each step to reach this goal. Based on these blog posts, I also wrote an article for MagPi (in the Dutch and French July 2019 edition) and produced an Udemy course[1].

And as a **blinking LED is the equivalent of a "Hello World" program**, I continued with experimenting and ended up with… this getting started book! A whole list of easy "recipes" to get you started with many different Java libraries and electronics to build your projects. Take one or more of these "recipes", combine and mix them to your taste, experiment and explore!

Oh, and this is not an anti-Python or anti-C book! Java is the language I love and use the most, **but for every problem, you need to select the best solution**. And in some cases, this could be Java or something else…

1 https://www.udemy.com/course/use-java-11-and-java-fx-11-on-a-raspberry-pi

Content overview

You can read this book from start to end, but can also use it as a "cookbook" and select the topics of your interest. For instance, you don't need to know the history of Java to work with it, but it's here for your reference.

In between some of the chapters you find a short "Just a thought"-piece about the things I find important and I would like to share with you. I'm also very happy I could interview some of my heroes, included in the chapters they are related to.

Chapter 1: Introduction: On the next pages you can find more info about the sources used in this book and are available for free online, and some additional info about read-me-files and a thank- you-list.

Chapter 2: Tools and hardware used in this book: Setup a Raspberry Pi with Raspbian and an overview of the software used on both Pi and PC. Also generic info about some of the most-used hardware components in this book.

Chapter 3: Choosing an IDE: Info about IntelliJ IDEA and Visual Studio Code.

Chapter 4: About Java: History of Java, different versions and tools within the eco-system and how to install it on your Pi and PC. And of-course a crash course so you get a grasp of the language if it's completely new to you.

Chapter 5: Raspberry Pi pinning: Different types of Raspberry Pi-boards and the different headers, pins and pin types and how you can use them to connect different types of hardware.

Chapter 6: What is Maven?: More info on Maven, the tool we will use to test, build and run our Java projects on PC and Pi.

Chapter 7: About JavaFX: The visual Java framework we will use to build beautiful user interfaces to interact with our Pi and hardware.

Chapter 8: Bits and bytes: The magic of ones and zeros and how they are combined into longer values.

Chapter 9: PI4J: A framework that makes it easier to work with the GPIOs from Java with multiple hardware examples.

Chapter 10: Spring: Building a Java application which exposes our Pi as a web service to store data or control the GPIOs.

Chapter 11: Message Queues: Use your Pi as a message handler to receive and send messages to different devices like other Pi's, PCs or Arduino's.

About me

I'm Frank Delporte (@FrankDelporte[2] on Twitter, °1973) who started programming at age 11 when I got a Commodore 64. With Basic as the programming language, some magnetic switches, and a relay board, I managed to control my Lego train. After studying at a film school, I started my professional career as a video editor, but quickly got involved in the first multimedia and online video projects in Belgium. Combining my interest in multimedia and programming, this resulted in a journey through C#, Flash, HTML/JavaScript, Flex, SQL, Qt, Java…

Currently, I work as a technical lead and software developer at Televic Rail in Belgium with a team of highly skilled hard- and software-engineers. We are building the next generation of Passenger Information Systems used onboard rail vehicles to inform the passengers in the best possible way so they are fully informed about their journey. Making a bridge between on- and off-board data sources empower us to combine information into nice looking and easy to read screens.

I always try to **"get things moving and done"** while trying to stick to the **KISS principle** (see "Important abbreviations").

As the best way to learn is teaching, I was one of the first lead coaches of CoderDojo in Belgium and started two Dojo's (Roeselare and Ieper) where I first came into contact with Arduino, Pi, and all those other amazing tools, all thanks to the inspiring colleague-coaches. On my blog webtechie.be[3], some projects are shared, which resulted in an article for MagPi which was the starting point for this book.

I live together with my wife Conny and son Vik in Passendale (Belgium), a small town that was one of the main battlegrounds of WWI.

2 https://twitter.com/FrankDelporte
3 www.webtechie.be

Sources and scripts used in this book

Within this book, many open-source projects are described and used. So **all the sources and scripts which are given as examples in this book are also shared as open source**.

Where to find them

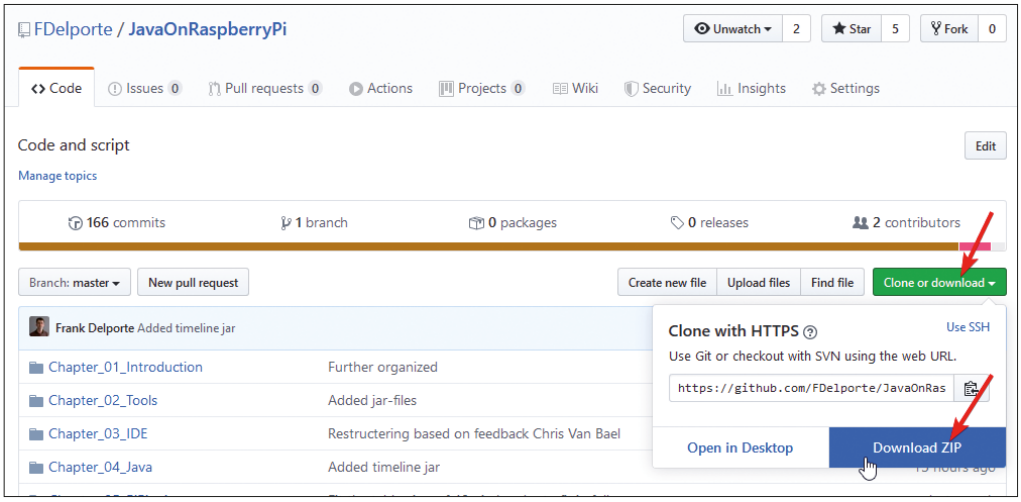
Everything is combined into one GitHub project:

JavaOnRaspberryPi[4]. Keep an eye on this project for any changes and corrections. Changes will be listed in the file CHANGES.md[5].

The sources are structured to match the chapters in this book so you can easily find each example.

Get the sources

If you are new to GitHub (source control systems), just click the download button on the site and you will get a full copy of everything in one zip file.



Get sources from GitHub as ZIP

On the other hand, if you know how to checkout code, please do! It will give you a copy of all the code and scripts but also allow you to make changes and improvements and send them as pull requests if you know how to work with git. **It would be great if the samples could be further improved by you! I'm looking forward to your pull request.**

4 https://github.com/FDelporte/JavaOnRaspberryPi
5 https://github.com/FDelporte/JavaOnRaspberryPi/blob/master/CHANGES.md

Here is how you check out the code into your home directory on the Pi:

```
$ cd /home/pi
$ mkdir Book
$ cd Book
$ git clone https://github.com/FDelporte/JavaOnRaspberryPi.git
```

Inside most of the projects, you'll find a "target" directory with the jar-file which you can run directly if you don't want to modify the code and/or build the project yourself. More info on building and running later in this book…

The styling used in the book

All the code and scripts in this book are formatted like this, where "…" means a portion of the code is skipped in this book, but fully available in the sources.

```
public class HelloWorldExample{
  public static void main(String args[]){
    System.out.println("Hello World !");
    ...
  }
}
```

Command and script examples have the same styling, and when the line starts with a "$" that means it is a command you must type in in the terminal, the following lines are the output you will get, for example, for the command "java -version":

```
$ java -version
openjdk 11-BellSoft 2018-09-25
OpenJDK Runtime Environment (build 11-BellSoft+0)
OpenJDK Server VM (build 11-BellSoft+0, mixed mode)
```

All references to the sources in the GitHub project will look like this, referring to the subdirectory in the GitHub project[6]:

Chapter_01_Introduction > README.md

Tips will be displayed like this.

Don't forget to check the README file!

6 https://github.com/FDelporte/JavaOnRaspberryPi

Read the README!

There is a README file in the root folder, but also in each chapter, sometimes also in the projects. This will help you to easily use the scripts, set up a project, etc.

The README of most chapters also has a "Read more" section where you can find links to more info about the topics of that chapter.

Adding a README file is a good practice, even when you are the only person working on a project! Minimally it needs to contain a title and description, how to work on the project and how to build, test and run it.

Guidelines

A README uses a list of conventions for the formatting, the ones used most in this book:

```
* "#", "##", "###"… for titles
* "*" for bullets
* "[title](link)" for links
* Three single ` before and after a code block
```

Example

This is a short example file:

```
# Chapter 3: Java
Chapter describing the history and current state of Java and how to install on a Pi.

## Links
* [AdoptOpenJDK](https://adoptopenjdk.net/)
* [BellSoft Liberica JDK](https://bell-sw.com/)
* [Duke the Java Mascot, explained](https://jaxenter.com/duke-the-java-mascot-explained-118397.html)
* [SDKMAN](https://sdkman.io/)
* [SDKMAN on Windows](https://ngeor.com/2019/12/07/sdkman-windows.html)

## Scripts
See the scripts directory to install specific Liberica SDK versions on the Pi.

To check the installed java version run this command in the terminal:

```
$ java -version
```
```

Screenshot of the source of a demo readme file

When you look at this file online it will look like this:

Screenshot of the demo readme file as shown on GitHub

What's next?
In the source files you can find an overview of links with interesting articles on how and why to write a good README:

Chapter_01_Introduction > README.md

Thanks to...

…**all open-source contributors and bloggers** who are constantly pushing Java, JavaFX, Pi4J and all those other marvelous tools, frameworks, libraries forward. Without them, we wouldn't be able to produce such easy to build and good-looking applications! Only a limited list is mentioned in this book, but there are a lot more and they are constantly sharing their work and knowledge on the internet. Keep an eye out for them!

…**my colleagues** who are always critical when doing pull requests and sharing their knowledge. I fully agree with the phrase "What one developer can do in one month, can be done by two developers in two months", but two experienced and critical developers will produce better code, than a solo player.

Read the book "The Mythical Man-Month" by Fred Brooks[7] if you want to know why a late software project becomes even later when adding manpower.

Or even better, buy two copies of this book for your manager, so he can read it twice as fast ;-)

7 https://en.wikipedia.org/wiki/The_Mythical_Man-Month

…**Elektor** who triggered me to start writing this book and publish it as a real paper book! A true bucket list thing achieved now.

…my wife and son, who I have neglected too much in the last months. I promised them that would change once this book was finished. It's a pity they know me too well and immediately asked what my next project would be :-)

…**the reviewers, interviewees and everyone who helped me to realize this book!**

Reviews, contributions, tips, feedback, ideas… by Stijn Deroo, Nathalie Delporte, Lieven Baes, Trisha Gee, Vlad Mihalcea, Kasper Zutterman, Ludo Joris, Jan Lamote, Kim Harding, Catherine Van Damme, Chris Van Bael, Mark Heckler, Pieterjan Deconinck, Kasia Pranke, Marian Faydula, Wouter Vanhauwaert, Michael Egger and… you? Please send me your feedback via e-mail on javaonraspberrypi@webtechie.be! You can also send me pull-requests on GitHub if you want to contribute to the examples.

Legal stuff

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Getting Started with Java on the Raspberry Pi

Frank Delporte is a software developer and technical lead with more than 25 years of experience in video, multimedia, technical project management, digital signage, and (web) programming. Since starting with a Commodore 64, his interests have evolved to include multiple technologies. Delporte loves to experiment and share his knowledge through blogging (webtechie.be), educating, and writing.

Controlling physical things with some lines of code can seem like magic! Getting Started with Java on the Raspberry Pi provides a thorough introduction to Java as well as instructions for installing it on the Raspberry Pi. You also receive many tips and tricks for improving your skills as a developer. And, above all, the book provides easy-to-understand examples on a wide variety of topics:

- The magic of bits and bytes and solving the confusion of Java signed values with the help of an LED number display.
- Beautiful user interfaces made with JavaFX so you can interact with the hardware.
- Pi4J applications to be able to control different types of hardware like LEDs, buttons, displays, LED strips, relays boards and more.
- Spring applications so you can interact with your RPi via web interfaces.
- How to set up a queue so you can send and receive messages to and from Arduino boards or other RPis.
- And a lot of other inspirational ideas and starter examples that will help you to build your dream do-it-yourself project.

If you are new to Java, you will learn the language bit by bit by following the examples. If you are an experienced Java programmer, you can extend your knowledge and learn to control the world around you with simple and inexpensive components.

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