JavaFX 9 by Example

Rich-client applications for any platform

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Third Edition

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Sean Phillips
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Apress®

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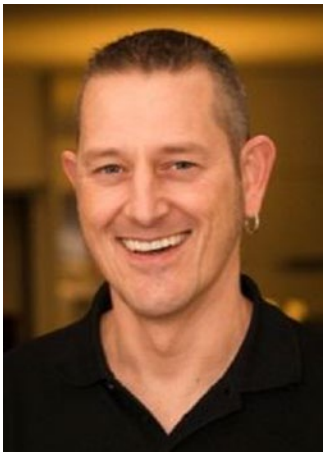
Contents at a Glance

Contents

About the Authors

Carl Dea is a principal software engineer. He has been developing software for over 20 years, for many clients from Fortune 500 companies to nonprofit organizations. He has written software ranging from mission-critical applications to ecommerce-based Web applications. His passion for software development started when his middle school science teacher showed him a TRS-80 computer. Carl has been using Java since the very beginning, and he has been a huge JavaFX enthusiast since the early days, when it was its own language called JavaFX script. His current software development interests are UI/UX, game programming, data visualizations, embedded systems, smartphones, AI, and robotics. When Carl is not working, he and his wife enjoy canoeing and day trips to the beach. Carl and his wife are proud parents of their younger daughter who attends Salisbury University. Carl and his wife are also proud of their older daughter, who is a high school teacher in Anne Arundel County Maryland. Carl loves to code socially at `http://github.com/carldea`. He blogs at `http://carlfx.wordpress.com/`. Carl is also connected to LinkedIn at `http://www.linkedin.com/in/carldea`, and his Twitter handle is `@carldea`. Carl lives in Pasadena, Maryland, USA.



Gerrit Grunwald is a software engineer with more than 10 years of experience in software development. He has been involved in development of Java desktop applications and controls. His current interests include JavaFX, HTML5, and Swing, especially development of custom controls in these technologies. Gerrit is also interested in Java-driven embedded technologies like JavaSE Embedded on Raspberry Pi, i.MX6, BeagleBone Black, CubieBoard2, and similar devices. He is a true believer in open source software and has participated in popular projects like JFXtras.org as well as his own projects (Enzo, SteelSeries Swing, and SteelSeries Canvas). Gerrit is an active member of the Java community, where he founded and leads the Java User Group Münster (Germany), co-leads the JavaFX and IoT community at Oracle, and is a JavaOne RockStar and Java Champion. He is also a speaker at conferences and user groups internationally.

José Pereda, Ph.D in Structural Engineering, works as a software engineer at Gluon. Being on Java since 1999, he is a JavaFX advocate, developing JavaFX applications for mobile platforms and embedded platforms. He also works on open source projects (JFXtras, FXyz, `https://github.com/jperedadnr`), co-authoring a JavaFX book (JavaFX 8 Introduction by Example), blogging (`http://jperedadnr.blogspot.com.es/`), tweeting (`@JPeredaDnr`), and speaking at conferences (such as JavaOne, JAX, Jfokus, JavaLand, and Coding Serbia). José lives with his wife and four kids in Valladolid, Spain.

Sean Phillips is a Java software architect currently working on ground systems for Space Science missions at the NASA Goddard Space Flight Center. He has developed embedded systems, along with modeling simulation, and visualization software for projects from commercial and military RADAR, heavy manufacturing, Battlespace Awareness, and Orbital Flight Dynamics. Sean is the lead developer of F(X)yz (`http://birdasaur.github.io/FXyz/`), a free third-party library for JavaFX 3D components and data visualization tools. Sean enjoys sharing his experiments through blog entries on various sites, including Java.net (`https://weblogs.java.net/blogs/sean.mi.phillips`), The NetBeans DZone (`http://netbeans.dzone.com/users/seanmiphillips`), and personal media (Twitter `@SeanMiPhillips`).

Sean lives in Bowie, Maryland, USA, with his very supportive wife Zulma and sons Sebastian and Sean Alexander.

Mark Heckler is a Principal Technologist & Developer Advocate at Pivotal, a conference speaker, and published author focusing on software development for the Internet of Things and the cloud. He has worked with key players in the manufacturing, retail, medical, scientific, telecom, and financial industries, and with various public sector organizations to develop and deliver critical capabilities on time and on budget. Mark is an open source contributor, author/curator of a developer-focused blog, and on Twitter (`@MkHeck`). Mark lives with his very understanding wife, three kids, and dog in St. Louis, Missouri, USA.

About the Technical Reviewer

Brian Molt has been a software developer at a manufacturing company in Nebraska for close to 14 years. During his time there, he has programmed with multiple languages on a variety of platforms, including RPGLE on an AS/400, web developing with ASP.NET, desktop application development with JavaFX, and recently REST services with JAX-RS.

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Whether, then, you eat or drink or whatever you do, do all to the glory of God (1 Corinthians 10:31, NASB).

—Carl Dea

Introduction

Welcome to *JavaFX 9 by Example*.

What is JavaFX?

JavaFX is Java's next-generation graphical user interface (GUI) toolkit that allows developers to rapidly build rich cross-platform applications. Built from the ground up, JavaFX takes advantage of modern GPUs through hardware-accelerated graphics while providing well-designed programming interfaces enabling developers to combine graphics, animation, and UI controls. The new JavaFX 9 is a pure Java language application programming interface (API). The goal of JavaFX is to be used across many types of devices, such as embedded devices, smartphones, TVs, tablet computers, and desktops.

Nandini Ramani, former VP of Development at Oracle, plainly states the intended direction of JavaFX as a platform in the following excerpt from the screencast *Introducing JavaFX*:

> *The industry is moving toward multi-core/multi-threading platforms with GPUs. JavaFX leverages these attributes to improve execution efficiency and UI design flexibility. Our initial goal is to give architects and developers of enterprise applications a set of tools and APIs to help them build better data-driven business applications.*
>
> —Nandini Ramani, former Oracle Corp. VP of Development, Java Client Platform

Before the creation of JavaFX, the development of rich client-side applications involved the gathering of many separate libraries and APIs to achieve highly functional applications. These separate libraries include media, UI controls, Web, 3D, and 2D APIs. Because integrating these APIs together can be rather difficult, the talented engineers at Oracle created a new set of JavaFX libraries that roll up all the same capabilities under one roof. JavaFX is the "Swiss Army Knife" of GUI toolkits (Figure FM-1). JavaFX 9 is a pure Java (language) API that allows developers to leverage existing Java libraries and tools.

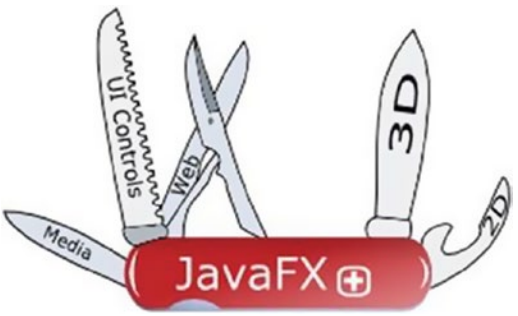

Figure FM-1. *JavaFX*

Depending on who you talk to, you are likely to encounter different definitions of "user experience" (or in the UI world, UX). But one fact remains—the users will always demand better content and increased usability from GUI applications. In light of this fact, developers and designers often work together to craft applications to fulfill this demand. JavaFX provides a toolkit that helps both the developer and designer (in some cases, the same person) create functional, yet aesthetically pleasing, applications. Another thing to acknowledge, when developing a game, media player, or the usual enterprise application, is that JavaFX will not only assist in developing richer UIs, but you'll also find that the APIs are extremely well-designed to greatly improve developer productivity (we're all about the user of the API's perspective).

Although this book doesn't go through an exhaustive study of all of JavaFX 8 and 9's capabilities, you will find common use cases that can help you build richer applications. Hopefully, this book will lead you in the right direction by providing practical, real-world examples.

Some History

In 2005 Sun Microsystems acquired the company SeeBeyond, where a software engineer named Chris Oliver created a graphics-rich scripting language known as F3 (Form Follows Function). F3 was later unveiled by Sun Microsystems at the 2007 JavaOne conference as JavaFX. On April 20, 2009, Oracle Corporation announced the acquisition of Sun Microsystems, making Oracle the new steward of JavaFX.

At JavaOne 2010, Oracle announced the JavaFX roadmap, which included its plans to phase out the JavaFX scripting language and re-create the JavaFX platform for the Java platform as Java-based APIs. As promised based on the 2010 roadmap, JavaFX 2.0 SDK was released at JavaOne, in October 2011. In addition to the release of JavaFX 2.0, Oracle announced its commitment to take steps to open source JavaFX, thus allowing the community to help move the platform forward. Open sourcing JavaFX will increase its adoption, enable a quicker turnaround time on bug fixes, and generate new enhancements.

Between JavaFX 2.1 and 2.2, the number of new features grew rapidly. Table FM-1 shows the numerous features included between versions 2.1 and 2.2. JavaFX 2.1 was the official release of the Java SDK on a MacOS. JavaFX 2.2 was the official release of the Java SDK on the Linux operating system.

The Java 8 release was announced March 18, 2014. Java 8 has many new APIs and language enhancements, which includes lambdas, Stream API, Nashorn JavaScript engine, and JavaFX APIs. Relating to JavaFX 8, the following features include 3D graphics, rich text support, and printing APIs.

Java 9 is expected to be released some time in September of 2017. Java 9 has so many features, but the most important feature is modularization, better known as *Project Jigsaw*.

What You Will Learn in This Book

In this book, you will be learning JavaFX 9 capabilities by following practical examples. These examples will, in turn, provide you with the knowledge needed to create your own rich client applications. Following Java's mantra, "Write once, run anywhere," JavaFX also preserves this same sentiment. Because JavaFX 9 is written entirely in the language of Java, you will feel right at home.

Most of the examples can be compiled and run under Java 8. However, some of them are designed to take advantage of Java 9's language enhancements. While working through this book with JavaFX 8 and 9, you will see that the JavaFX APIs and language enhancements will help you to become a more productive developer. Having said this, we encourage you to explore all the new Java 8 capabilities.

This book covers JavaFX 8 and 9's fundamentals, modules, lambdas, properties, layouts, UI controls, printer, animation, custom UIs, charts, media, web, 3D, Arduino, touch events, and gestures.

Who This Book Is For

If you are a Java developer looking to take your client-side applications to the next level, you will find this book your guide to help you begin creating usable and aesthetically pleasing user interfaces. Also, if you are an experienced Java Swing, Flash/Flex, SWT, or web developer who wants to learn how to create high-performance rich client-side applications, then this is the book for you.

How This Book Is Structured

This book is arranged in a natural progression from beginner to intermediate and advanced level concepts. For the Java developer, none of the concepts mentioned in this book should be extremely difficult to figure out. This book is purely example-based and discusses major concepts before demonstrating applications. For each project, after showing the output from executing the code, we'll provide a detailed explanation walking through the code. Each example can be easily adapted to meet your own needs when developing a game, media player, or your usual enterprise application. The more experienced a Java UI developer you are, the more freedom you'll have to jump around to different chapters and examples throughout the book. However, any Java developer can progress through the book and learn the skills needed to enhance their everyday GUI applications.

CHAPTER 1

Getting Started

To get started using this book to learn JavaFX 9, you will want to set up your development environment to compile and run many of its examples. In this chapter you will learn how to install the required software, such as the Java development kit (JDK) and the NetBeans integrated development environment (IDE). After installing the required software, you will begin by creating a traditional JavaFX HelloWorld example. Once you are comfortable with the development environment, I will walk through the JavaFX HelloWorld source code. Finally, you will get a glimpse of how to package your application as a standalone application to be launched and distributed.

I realize many developers are partial to their IDEs and editors, so I've also provided three ways to compile and run the HelloWorld example. In the first way to compile and run code you will be using the NetBeans IDE, in the second way you will learn how to use the command line (terminal window), and thirdly you will be using a build tool called *Gradle* to compile and launch JavaFX applications. The second and third strategies are for those who are not fond of fancy IDEs. If you are more comfortable with the *Eclipse* and *IntelliJ* IDE, you will be happy to know that Gradle can generate the respective project files that will allow your projects to be easily loaded into them.

If you are already familiar with the installation of the Java Development Kit (JDK), Gradle, and the NetBeans IDE, you can skip to Chapter 2, which covers Java 9 Jigsaw. Let's get started!

Downloading Required Software

When using this book, you'll find that many examples may still be written using the Java 8 JDK; however Chapter 2 and a few other chapters will get into Java 9-specific concepts, making the Java 9 JDK a requirement. One of the primary changes to the Java platform is modularity (Jigsaw). Modularity will truly transform your client-side applications. You are probably wondering exactly, "how is it transformed?" Well, imagine building a Java application that occupies a smaller footprint in memory and on disk space. This means users will experience faster load times and a better user experience!

Having said this, go ahead and download Java 9 Java Development Kit (JDK) or later. In this chapter, you will see the steps on installing the JDK on Windows, MacOS X, and Linux. You can download the Java 9 JDK from the following URL:

`http://www.oracle.com/technetwork/java/javase/downloads/index.html`

Another tool that we have not mentioned in prior editions is *Gradle*. Gradle has become an industry standard in building projects and artifacts in the real world. Later, I will walk you through how to install Gradle, but for now head over to `gradle.org` and look for the download link. At the download link you will be presented with two binary distributions. One is just a binary distribution and the other is a full distribution that includes the source code and documentation. The binary distribution is required to build applications, so you'll want to download it. Go to the following URL to download Gradle's Build tool:

`https://gradle.org/gradle-download`

C. Dea et al., *JavaFX 9 by Example*, DOI 10.1007/978-1-4842-1961-4_1

Installing an integrated development environment (IDE) is optional for the book; however if you choose to use an IDE you will be able get all the benefits of code highlighting, code completion, incremental debugging, refactoring, and many modern developer conveniences. The top three IDEs used in the wild are NetBeans, IntelliJ, and Eclipse. Although this book walks you through installing the NetBeans IDE, it doesn't mean we are partial to NetBeans or any other IDEs. I've chosen NetBeans because release schedules are usually on par with the major JDK releases and it's quite mature, especially when it comes to tooling and JavaFX application development. NetBeans has numerous JavaFX demo projects (example templates) built-in and the Scene Builder tool. Scene Builder is a graphical tool used to build JavaFX UIs visually.

Another pro tip is learning about Gradle *tasks,* which are capable of generating Java projects for either IntelliJ or Eclipse IDE with a single command. To learn more about Gradle tasks that can automatically set up IntelliJ and Eclipse projects, visit the following links:

- IntelliJ: https://docs.gradle.org/current/userguide/idea_plugin.html
- Eclipse: https://docs.gradle.org/current/userguide/eclipse_plugin.html

The following are URLs to download your favorite IDE:

- NetBeans: https://netbeans.org/downloads
- IntelliJ: https://www.jetbrains.com/idea/download
- Eclipse: https://eclipse.org/downloads

Currently, JavaFX 9 from Oracle corp. runs on the following operating systems:

- Windows OS (Vista, 7, 8, 10) 32- and 64-bit
- MacOS X (64-bit)
- Ubuntu Linux 12.x - 13.x (32- and- 64-bit)

To see a detailed listing of all the supported operating systems, visit the following link:

http://jdk.java.net/9/supported

While you may not see your supported operating system or hardware, you will be happy to know about the OpenJDK and OpenJFX projects, which allow you to build Java and JavaFX yourself! To learn more about OpenJDK or OpenJFX, visit the following URLs:

- OpenJDK: http://openjdk.java.net
- OpenJFX: https://wiki.openjdk.java.net/display/OpenJFX/Main

After downloading the appropriate software versions for your operating system, you will install the Java 9 JDK, Gradle, and/or your chosen IDE.

Installing the Java 9 Development Kit

Once you have downloaded the correct version of Java for your particular operating system, follow the steps outlined in this section to install the Java 9 JDK. I assume you've downloaded Oracle's Java 9 JDK, but if not, go to following location:

`http://www.oracle.com/technetwork/java/javase/downloads/index.html`

In the following sections, you will follow steps to install Java 9 on the three popular operating systems: Microsoft Windows, MacOS X, and Linux.

Installing the JDK on Microsoft Windows

The following steps use the Java 9 JDK 64-bit version for the Windows 10 operating system. If your Windows operating system is different, refer to the following link for further details.

`http://www.oracle.com/technetwork/java/javase/overview/index.html`

The following are steps to install the Java 9 JDK on the Windows OS:

1. Install the Java 9 JDK by right-clicking the installer's executable (`jdk-9-windows-x64.exe`) to run as an administrator. Typically, other operating systems will pop up a similar warning dialog box to alert you of the risks of installing or running binary files. Click the Run button to proceed.
2. Begin the installation process by clicking on the Next button, as shown in Figure 1-1.

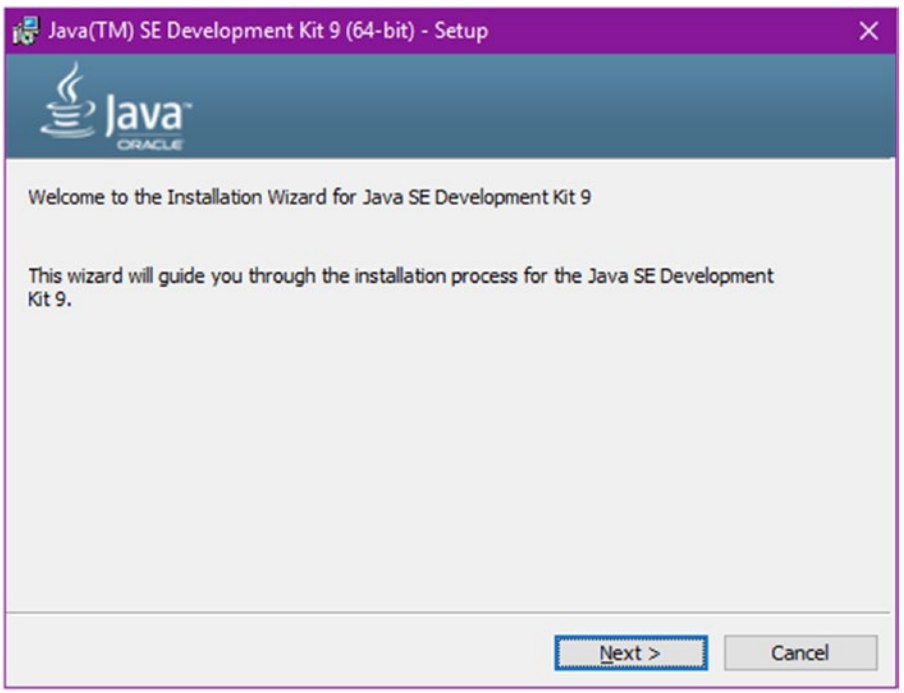

Figure 1-1. *Java SE Development Kit 9 installation process*

3. Next, you'll be presented with the Custom Setup window allowing you to select optional features shown in Figure 1-2. Here, you'll just accept the default selections and click the Next button to continue.

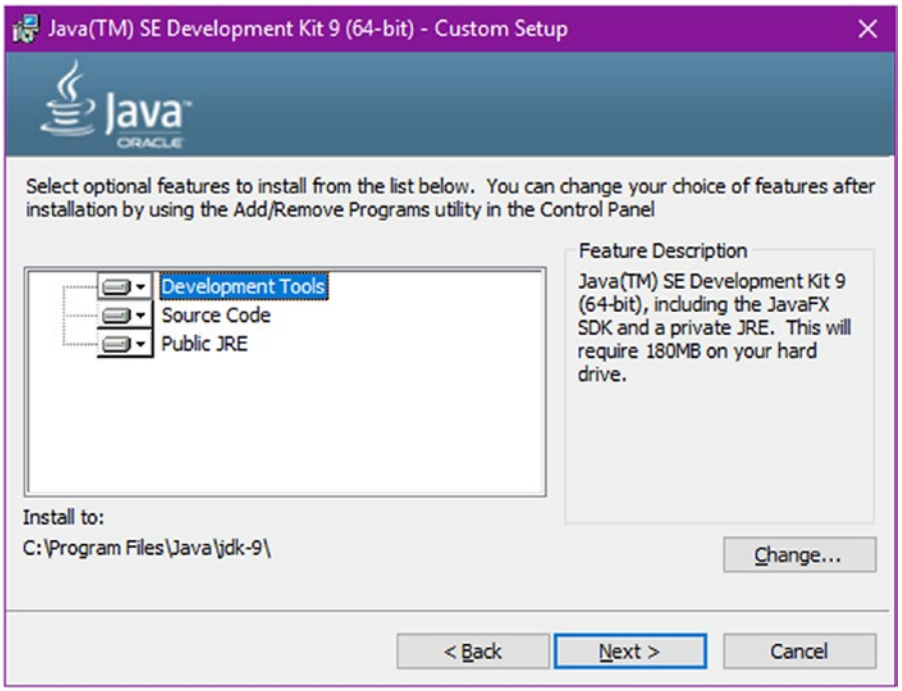

Figure 1-2. *Java SE Development Kit 9 optional features*

4. Afterward, the installation process will display a progress bar, as shown in Figure 1-3.

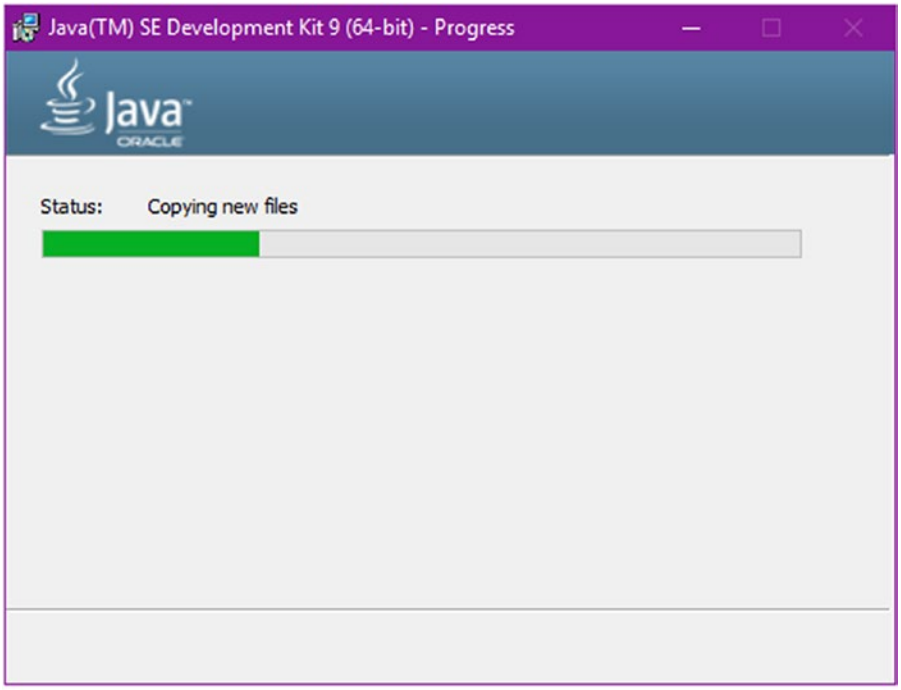

Figure 1-3. *Java SE Development Kit 9 installation in progress*