



OpenJDK 11

Using jlink to customize Java runtime environment

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Abstract

OpenJDK 11 is a Red Hat offering on the Red Hat Enterprise Linux platform. The Using jlink to customize Java runtime images guide provides an overview of Jlink, and explains how to create and use customize Java runtime image using jlink.

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MAKING OPEN SOURCE MORE INCLUSIVE

Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see [our CTO Chris Wright's message](#).

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- In the Red Hat Customer Portal, view the document in **Multi-page HTML** format.

Procedure

To provide your feedback, perform the following steps:

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NOTE

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2. Highlight the section of the document where you want to provide feedback.
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A text box appears in the feedback section on the right side of the page.
4. Enter your feedback in the text box and click **Submit**.
A documentation issue is created.
5. To view the issue, click the issue tracker link in the feedback view.

CHAPTER 1. OVERVIEW OF JLINK

Jlink is a Java command line tool that is used to generate a custom Java runtime environment (JRE). You can use your customized JRE to run Java applications.

Using jlink, you can create a custom runtime environment that only includes the relevant class file.

CHAPTER 2. CREATING A CUSTOM JAVA RUNTIME ENVIRONMENT FOR NON-MODULAR APPLICATIONS

You can create a custom Java runtime environment (JRE) from a non-modular application using the **jlink** tool.

Prerequisites

- Install [OpenJDK 11](#).



NOTE

It is always recommended to use the [portable tarball](#) as a basis of jlink'ed runtime.

Procedure

1. Create a simple Hello World application using Logger class.
 - a. You have the base OpenJDK 11 available in the **jdk-11** folder:

```
$ ls jdk-11
bin conf demo include jmods legal lib man NEWS release
$ ./jdk-11/bin/java -version
openjdk version "11.0.10" 2021-01-19 LTS
OpenJDK Runtime Environment 18.9 (build 11.0.10+9-LTS)
OpenJDK 64-Bit Server VM 18.9 (build 11.0.10+9-LTS, mixed mode)
```

- b. Create a directory for your application:

```
$ mkdir -p hello-example/sample
```

- c. Create **hello-example/sample/HelloWorld.java** file with the following content:

```
package sample;

import java.util.logging.Logger;

public class HelloWorld {
    private static final Logger LOG = Logger.getLogger(HelloWorld.class.getName());
    public static void main(String[] args) {
        LOG.info("Hello World!");
    }
}
```

- d. Compile your application:

```
$ ./jdk-11/bin/javac -d . $(find hello-example -name \*.java)
```

- e. Run your application **without** a custom JRE:

```
$ ./jdk-11/bin/java sample.HelloWorld
Mar 09, 2021 10:48:59 AM sample.HelloWorld main
INFO: Hello World!
```

In this case, the base OpenJDK takes 311 MB to run a single class.

- f. (Optional) You can inspect the OpenJDK and see many non-required modules for your application:

```
$ du -sh jdk-11/
313M jdk-11/

$ ./jdk-11/bin/java --list-modules
java.base@11.0.10
java.compiler@11.0.10
java.datatransfer@11.0.10
java.desktop@11.0.10
java.instrument@11.0.10
java.logging@11.0.10
java.management@11.0.10
java.management.rmi@11.0.10
java.naming@11.0.10
java.net.http@11.0.10
java.prefs@11.0.10
java.rmi@11.0.10
java.scripting@11.0.10
java.se@11.0.10
java.security.jgss@11.0.10
java.security.sasl@11.0.10
java.smartcardio@11.0.10
java.sql@11.0.10
java.sql.rowset@11.0.10
java.transaction.xa@11.0.10
java.xml@11.0.10
java.xml.crypto@11.0.10
jdk.accessibility@11.0.10
jdk.aot@11.0.10
jdk.attach@11.0.10
jdk.charsets@11.0.10
jdk.compiler@11.0.10
jdk.crypto.cryptoki@11.0.10
jdk.crypto.ec@11.0.10
jdk.dynalink@11.0.10
jdk.editpad@11.0.10
jdk.hotspot.agent@11.0.10
jdk.httpserver@11.0.10
jdk.internal.ed@11.0.10
jdk.internal.jvmstat@11.0.10
jdk.internal.le@11.0.10
jdk.internal.opt@11.0.10
jdk.internal.vm.ci@11.0.10
jdk.internal.vm.compiler@11.0.10
jdk.internal.vm.compiler.management@11.0.10
jdk.jartool@11.0.10
jdk.javadoc@11.0.10
jdk.jcmd@11.0.10
jdk.jconsole@11.0.10
jdk.jdeps@11.0.10
jdk.jdi@11.0.10
```

```
jdk.jdwp.agent@11.0.10
jdk.jfr@11.0.10
jdk.jlink@11.0.10
jdk.jshell@11.0.10
jdk.jsobject@11.0.10
jdk.jstatd@11.0.10
jdk.localedata@11.0.10
jdk.management@11.0.10
jdk.management.agent@11.0.10
jdk.management.jfr@11.0.10
jdk.naming.dns@11.0.10
jdk.naming.ldap@11.0.10
jdk.naming.rmi@11.0.10
jdk.net@11.0.10
jdk.pack@11.0.10
jdk.rmic@11.0.10
jdk.scripting.nashorn@11.0.10
jdk.scripting.nashorn.shell@11.0.10
jdk.sctp@11.0.10
jdk.security.auth@11.0.10
jdk.security.jgss@11.0.10
jdk.unsupported@11.0.10
jdk.unsupported.desktop@11.0.10
jdk.xml.dom@11.0.10
jdk.zipfs@11.0.10
```

Sample **Hello World** application has very few dependencies. You can use jlink to create custom runtime images for your application. These images help you run your application with only required OpenJDK dependencies.

2. Determine module dependencies of your application using **jdeps** command:

```
$/jdk-11/bin/jdeps -s ./sample/HelloWorld.class
HelloWorld.class -> java.base
HelloWorld.class -> java.logging
```

3. Build a custom java runtime image for your application:

```
$/jdk-11/bin/jlink --add-modules java.base,java.logging --output custom-runtime
$ du -sh custom-runtime
50M custom-runtime/
$/custom-runtime/bin/java --list-modules
java.base@11.0.10
java.logging@11.0.10
```



NOTE

The size of your custom java runtime image is being reduced to 50M runtime image from 313M runtime image.

4. You can verify the reduced runtime of your application:

```
$ ./custom-runtime/bin/java sample.HelloWorld  
Jan 14, 2021 12:13:26 PM HelloWorld main  
INFO: Hello World!
```

The generated JRE with your sample application does not have any other dependencies.

You can distribute your application together with your custom runtime for deployment.



NOTE

Rebuild the custom java runtime images for your application with every security update of your base OpenJDK.

CHAPTER 3. CREATING A CUSTOM JAVA RUNTIME ENVIRONMENT FOR MODULAR APPLICATIONS

You can create a custom Java runtime environment from a modular application using the **jlink** tool.

Prerequisites

- Install [OpenJDK 11](#).



NOTE

It is always recommended to use the [portable tarball](#) as a basis of Jlink'ed runtime.

Procedure

1. Create a simple Hello World application using Logger class.
 - a. You have the base OpenJDK 11 available in the **jdk-11** folder:

```
$ ls jdk-11
bin conf demo include jmods legal lib man NEWS release
$ ./jdk-11/bin/java -version
openjdk version "11.0.10" 2021-01-19 LTS
OpenJDK Runtime Environment 18.9 (build 11.0.10+9-LTS)
OpenJDK 64-Bit Server VM 18.9 (build 11.0.10+9-LTS, mixed mode)
```

- b. Create a directory for your application:

```
$ mkdir -p hello-example/sample
```

- c. Create **hello-example/sample/HelloWorld.java** file with the following content:

```
package sample;

import java.util.logging.Logger;

public class HelloWorld {
    private static final Logger LOG = Logger.getLogger(HelloWorld.class.getName());
    public static void main(String[] args) {
        LOG.info("Hello World!");
    }
}
```

- d. Create **hello-example/module-info.java** file with the following content:

```
module sample
{
    requires java.logging;
}
```

- e. Compile your application:

```
$ ./jdk-11/bin/javac -d example $(find hello-example -name \*.java)
```

- f. Run your application **without** a custom JRE:

```
$ ./jdk-11/bin/java -cp example sample.HelloWorld
Mar 09, 2021 10:48:59 AM sample.HelloWorld main
INFO: Hello World!
```

In this case, the base OpenJDK takes 311 MB to run a single class.

- g. (Optional) You can inspect the OpenJDK and see many non-required modules for your application:

```
$ du -sh jdk-11/
313M jdk-11/
```

```
$ ./jdk-11/bin/java --list-modules
java.base@11.0.10
java.compiler@11.0.10
java.datatransfer@11.0.10
java.desktop@11.0.10
java.instrument@11.0.10
java.logging@11.0.10
java.management@11.0.10
java.management.rmi@11.0.10
java.naming@11.0.10
java.net.http@11.0.10
java.prefs@11.0.10
java.rmi@11.0.10
java.scripting@11.0.10
java.se@11.0.10
java.security.jgss@11.0.10
java.security.sasl@11.0.10
java.smartcardio@11.0.10
java.sql@11.0.10
java.sql.rowset@11.0.10
java.transaction.xa@11.0.10
java.xml@11.0.10
java.xml.crypto@11.0.10
jdk.accessibility@11.0.10
jdk.aot@11.0.10
jdk.attach@11.0.10
jdk.charsets@11.0.10
jdk.compiler@11.0.10
jdk.crypto.cryptoki@11.0.10
jdk.crypto.ec@11.0.10
jdk.dynalink@11.0.10
jdk.editpad@11.0.10
jdk.hotspot.agent@11.0.10
jdk.httpserver@11.0.10
jdk.internal.ed@11.0.10
jdk.internal.jvmstat@11.0.10
jdk.internal.le@11.0.10
jdk.internal.opt@11.0.10
jdk.internal.vm.ci@11.0.10
```

```
jdk.internal.vm.compiler@11.0.10
jdk.internal.vm.compiler.management@11.0.10
jdk.jartool@11.0.10
jdk.javadoc@11.0.10
jdk.jcmd@11.0.10
jdk.jconsole@11.0.10
jdk.jdeps@11.0.10
jdk.jdi@11.0.10
jdk.jdwp.agent@11.0.10
jdk.jfr@11.0.10
jdk.jlink@11.0.10
jdk.jshell@11.0.10
jdk.jsobject@11.0.10
jdk.jstatd@11.0.10
jdk.localedata@11.0.10
jdk.management@11.0.10
jdk.management.agent@11.0.10
jdk.management.jfr@11.0.10
jdk.naming.dns@11.0.10
jdk.naming.ldap@11.0.10
jdk.naming.rmi@11.0.10
jdk.net@11.0.10
jdk.pack@11.0.10
jdk.rmic@11.0.10
jdk.scripting.nashorn@11.0.10
jdk.scripting.nashorn.shell@11.0.10
jdk.sctp@11.0.10
jdk.security.auth@11.0.10
jdk.security.jgss@11.0.10
jdk.unsupported@11.0.10
jdk.unsupported.desktop@11.0.10
jdk.xml.dom@11.0.10
jdk.zipfs@11.0.10
```

Sample **Hello World** application has very few dependencies. You can use jlink to create custom runtime images for your application. These images help you run your application with only required OpenJDK dependencies.

2. Create your application module:

```
$ mkdir sample-module
$ ./jdk-11/bin/jmod create --class-path example/ --main-class sample.HelloWorld --module-version 1.0.0 -p example sample-module/hello.jmod
```

3. Create a custom JRE with the required modules and a custom application launcher for your application.

```
$ ./jdk-11/bin/jlink --launcher hello=sample/sample.HelloWorld --module-path sample-module --add-modules sample --output custom-runtime
```

4. List the modules of the produced custom JRE.
Observe that only a fraction of the original OpenJDK remains.

```
$ du -sh custom-runtime
50M custom-runtime/
```



```
$ ./custom-runtime/bin/java --list-modules
java.base@11.0.10
java.logging@11.0.10
sample@1.0.0
```

**NOTE**

The size of your custom java runtime image is being reduced to 50M runtime image from 313M runtime image.

5. Launch the application using the **hello** launcher.

```
$ ./custom-runtime/bin/hello
Jan 14, 2021 12:13:26 PM HelloWorld main
INFO: Hello World!
```

The generated JRE with your sample application does not have any other dependencies other than **java.base**, **java.logging**, and **sample** module.

You can distribute your application bundled with the custom runtime in **custom-runtime**. It includes your application.

**NOTE**

Rebuild the custom java runtime images for your application with every security update of your base OpenJDK.

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