Amazon Corretto

Corretto 8 User Guide
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What Is Amazon Corretto 8?

Amazon Corretto is a no-cost, multiplatform, production-ready distribution of the Open Java Development Kit (OpenJDK). Corretto comes with long-term support that includes performance enhancements and security fixes. Corretto is certified as compatible with the Java SE standard and is used internally at Amazon for many production services. With Corretto, you can develop and run Java applications on operating systems such as Amazon Linux 2, Windows, and macOS.

This guide includes a list of patches applied to the OpenJDK for this release of Amazon Corretto 8, and installation instructions for the platforms supported by this version.

Related Information

In addition to this guide, see the following resources for developers:

- Amazon Corretto 8 Overview
- GitHub:
  - Documentation source
  - JDK Source

Contributing to the SDK

Developers can contribute feedback in the following ways:

- Submit issues on GitHub:
  - Submit documentation issues
  - Report a bug or request a feature
- Submit pull requests in the documentation or JDK source GitHub repositories to contribute to the SDK development
List of Patches for Amazon Corretto 8

This section lists all the patches applied to OpenJDK for Amazon Corretto 8. We also provide links to the issues in the OpenJDK project.

[C8-1] Prevent premature OutOfMemoryException when G1 GC invocation is suspended by a long-running native call.

Programs that use the G1 GC could experience spurious out-of-memory (OOM) exceptions even when the Java heap was far from filled up. This happened when a spin loop that waited for long-running native calls gave up after only two rounds. This small patch makes this loop wait as long as it takes. Typically a few more rounds suffice. Worst case, a full GC would eventually occur (thanks to JDK-8137099) and also resolve the issue. The patch includes a unit test that provokes needing more than two rounds, and succeeds only if the patch is in place. See JDK-8137099 for discussion.

[C8-2] Back port from OpenJDK 10, fixing JDK-8177809: “File.lastModified() is losing milliseconds (always ends in 000)”.

The patch removes inconsistencies in how the last-modified timestamp of a file is reported. It standardizes the behavior across build platforms and Java methods so that the user receives second-level precision. See JDK-8177809.

[C8-3] Back port from OpenJDK9, fixing JDK-8150013, “ParNew: Prune nmethods scavengable list”.

This patch reduces pause latencies for the Parallel and the CMS garbage collector. GC “root scanning” speeds up by up to three orders of magnitude by reducing redundant code inspections.

[C8-4] Back port from OpenJDK 9, fixing JDK-8047338: “javac is not correctly filtering non-members methods to obtain the function descriptor”.

This patch fixes a compiler bug that caused compile-time errors when a functional interface threw an exception that extend Exception.

[C8-5] Back port from OpenJDK 10, fixing JDK-8144185: “javac produces incorrect RuntimeInvisibleTypeAnnotations length attribute”.

This problem made Findbugs, JaCoCo, and Checker Framework fail on some well-formed input programs.

[C8-6] Trigger string table cleanup in G1 based on string table growth.

This patch triggers "mixed" G1 collections needed to clean out the string table entries based on string table growth, not just Java heap use. The latter is an independent measurement and may trigger too rarely or even never, in some applications. Then the string table may grow without bounds, which is effectively a native memory leak. See JDK-8213198.

[C8-7] Backport from OpenJDK 9, fixing JDK-8149442: “MonitorInUseLists should be on by default, deflate idle monitors taking too long”.

This patch makes removing a performance bottleneck for highly thread-intensive applications the default setting. Enabling MonitorInUseLists allows more efficient deflation of only potentially in-use monitors, instead of the entire population of monitors.

[C8-8] Back port from OpenJDK 11, fixing JDK-8198794: “Hotspot crash on Cassandra 3.11.1 startup with libnuma 2.0.3”.

This patch prevents Cassandra 3.11.1 from crashing at startup.
[C8-9] Back port from OpenJDK 11, fixing JDK-8195115: “G1 Old Gen MemoryPool CollectionUsage.used values don't reflect mixed GC results”.

Without this patch, it's impossible to determine how full the heap is by means of JMX when using the G1 GC.

[C8-10] Speed up Class.getSimpleName() and Class.getCanonicalName().

Memorization greatly speeds up these functions. This patch includes correctness unit tests. See JDK-8187123.

[C8-11] Back port of JDK-8068736 from OpenJDK9, fixing “Avoid synchronization on Executable/Field.declaredAnnotations”.

Improves the performance of Executable/Field.declaredAnnotations() by result caching that avoids thread synchronization.

[C8-12] Back port from OpenJDK 9, fixing JDK-8077605: “Initializing static fields causes unbounded recursion in javac”.

[javac silently ignores malformed classes in the annotation processor”.

javac silently swallowed malformed class files in an annotation processor and returned with exit code 0. With this patch, javac reports an error message and returns with a non-zero exit code.

[C8-13] Improved error message for the jmap tool.

Updated error messages to suggest additional approaches when the target process is unresponsive. See JDK-8213443.

[C8-14] Fixed JDK-8185005: “Improve performance of ThreadMXBean.getThreadInfo(long ids[], int maxDepth)”.

This patch improves the performance of a JVM-internal function that looks up a Java Thread instance from an OS thread ID. This benefits several ThreadMXBean calls such as getThreadInfo(), getThreadCpuTime(), and getThreadUserTime(). The relative performance improvement increases with the number of threads in the JVM, as linear search is replaced by a hash table lookup.

[C8-15] Back port from OpenJDK 12, fixing JDK-8206075: “On x86, assert on unbound assembler Labels used as branch targets”.

Label class instances (used to define pseudo-assembly code) can be used incorrectly in both the C1 and Interpreter. The most common mistake for a label is being “branched to” but never defined as a location in code via bind(). An assert was added to catch these and thus triggered 106 jtreg/hotspot and 17 jtreg/jdk test failures. We then determined that the label battalion_counter_overflow was not bound when UseLoopCounter was True, but UseOnStackReplacement was False. This is now fixed and guarded by the above tests.

[C8-16] Improve portability of JVM source code when using gcc7.

This patch places up-to-date type declarations in all places where the gcc switch “-Wno-deprecated-declarations” would flag problems. It also enables the switch to catch future related issues. This makes the source code compile on all present Amazon Linux versions. This is a combination of much of JDK-8152856, JDK-8184309, JDK-8185826, JDK-8185900, JDK-8187676, JDK-8196909, JDK-8196985, JDK-8199685, JDK-8200052, JDK-8200110, JDK-8209786, JDK-8210836, JDK-8211146, JDK-8211370, JDK-8211929, JDK-8213414, and JDK-8213575.

[C8-17] Back port from JDK 10, fixing JDK-8195848: “JTREG test for StartManagementAgent fails”.

See http://serviceability-dev.openjdk.java.narkive.com/cDFw2ce9 for more details.

[C8-18] Re-enables a legacy/disabled cipher suite to pass two TCK tests that would otherwise fail.

Three backports from OpenJDK9 to support using preinstalled libraries.

Backported items: JDK-8043805 for libjpeg, JDK-8035341 for libpng, and JDK-8042159 for lcms2.
Integration of aarch64 support from IcedTea 3.8.

Updates to vendor-related metadata.

Identifies Amazon as the vendor of this OpenJDK distribution and adds hyperlinks for reporting issues.

Back port from OpenJDK 9, fixing JDK-8048782: “OpenJDK: PiscesCache : xmax/ymax rounding up can cause RasterFormatException”.

The bug is related to sun.java2d.pisces.PiscesCache constructor that accepts ‘(int minx,int miny,int maxx,int maxy)’ arguments: the internal ‘bboxX1’ and ‘bboxY1’ are set to values one greater than given maximum X and Y values.
Amazon Corretto 8 Guide for Linux

The topics in this section describe installation instructions for Amazon Corretto 8 on Linux platforms.

Topics
- Amazon Corretto 8 Installation Instructions for Amazon Linux 2 (p. 5)
- Amazon Corretto 8 Installation Instructions for Debian-Based and RPM-Based Linux Distributions (p. 6)

Amazon Corretto 8 Installation Instructions for Amazon Linux 2

This topic describes how to install and uninstall Amazon Corretto 8 on a host or container running the Amazon Linux 2 operating system.

Option 1: Use the yum Package Manager on Amazon Linux

1. Enable the yum repository in Amazon Linux 2.

   Example
   
   ```
   sudo amazon-linux-extras enable corretto8
   ```

2. You can install Amazon Corretto 8 as either the runtime environment (JRE) or the full development environment (JDK). The development environment includes the runtime environment.

   Install Amazon Corretto 8 as JRE.

   Example
   
   ```
   sudo yum install java-1.8.0-amazon-corretto
   ```

   Install Amazon Corretto 8 as JDK.

   Example
   
   ```
   sudo yum install java-1.8.0-amazon-corretto-devel
   ```

   The installation location is /usr/lib/jvm/java-1.8.0-amazon-corretto.<cpu_arch>.

Option 2: Download and Install RPMs Manually

1. Download RPMs from the Downloads (p. 15) page for your CPU architecture. To install the JDK, you will need to download the RPMs for both the JDK and the JRE.

2. Install using yum localinstall.
Verify Your Installation

In the terminal, run the following command to verify the installation.

Example

```
sudo yum localinstall java-1.8.0-amazon-corretto*.rpm
```

Expected output for 8u232:

```
openjdk version "1.8.0_232"
OpenJDK Runtime Environment Corretto-8.232.09.1 (build 1.8.0_232-b09)
OpenJDK 64-Bit Server VM Corretto-8.232.09.1 (build 25.232-b09, mixed mode)
```

If you see a version string that doesn't mention Corretto, run the following command to change the default `java` or `javac` providers.

Example

```
sudo alternatives --config java
```

If using the JDK you should also run:

```
sudo alternatives --config javac
```

Uninstall Amazon Corretto 8

You can uninstall Amazon Corretto 8 with the following commands.

Uninstall JRE:

Example

```
sudo yum remove java-1.8.0-amazon-corretto
```

Uninstall JDK:

Example

```
sudo yum remove java-1.8.0-amazon-corretto-devel
```

Amazon Corretto 8 Installation Instructions for Debian-Based and RPM-Based Linux Distributions

This topic describes how to install Amazon Corretto 8 on Debian-based and RPM-based Linux distributions.
If you need to install Amazon Corretto 8 on Amazon Linux 2, see Installing on Amazon Linux 2 (p. 5).

## Install Amazon Corretto 8 on Debian-Based Linux

This section describes how to install and uninstall Amazon Corretto 8 on a host or container running a Debian-based operating system.

### Using apt

To use the Corretto Apt repositories on Debian-based systems, such as Ubuntu, import the Corretto public key and then add the repository to the system list by using the following commands:

**Example**

```
wget -O- https://apt.corretto.aws/corretto.key | sudo apt-key add -
sudo add-apt-repository 'deb https://apt.corretto.aws stable main'
```

After the repository is added, you can install Corretto 8 by running this command:

**Example**

```
sudo apt-get update; sudo apt-get install -y java-1.8.0-amazon-corretto-jdk
```

### Download and Install the Debian Package Manually

1. Download the Linux `.deb` file from the Downloads (p. 15) page. Before you install the JDK, install the `java-common` package.

   **Example**

   ```
sudo apt-get update && sudo apt-get install java-common
   ```

2. Install the `.deb` file by using `dpkg --install`. e.g. install x86_64 deb using the following command:

   **Example**

   ```
sudo dpkg --install java-1.8.0-amazon-corretto-jdk_8.242.07-1_amd64.deb
   ```

### Verify Your Installation

In the terminal, run the following command to verify the installation.

**Example**

```
java -version
```

For example, expected output for Corretto-8.242.07.1:

```
openjdk version "1.8.0_242"
OpenJDK Runtime Environment Corretto-8.242.07.1 (build 1.8.0_242-b07)
OpenJDK 64-Bit Server VM Corretto-8.242.07.1 (build 25.242-b07, mixed mode)
```
If you see a version string that doesn't mention Corretto, run the following command to change the default java or javac providers.

**Example**

```bash
sudo update-alternatives --config java
```

If you're using the JDK, you should also run the following.

```bash
sudo update-alternatives --config javac
```

### Uninstall Amazon Corretto 8

You can uninstall Amazon Corretto 8 by using the following command.

**Uninstall JDK:**

**Example**

```bash
sudo dpkg --remove java-1.8.0-amazon-corretto-jdk
```

### Install Amazon Corretto 8 on RPM-Based Linux

#### Using yum

To use Corretto RPM repositories with the yum package manager (such as Amazon Linux AMI), import the Corretto public key and then add the repository to the system list. For most systems, you must run the following commands:

**Example**

```bash
sudo rpm --import https://yum.corretto.aws/corretto.key
sudo curl -L -o /etc/yum.repos.d/corretto.repo https://yum.corretto.aws/corretto.repo
```

After the repository is added, you can install Corretto 8 by running this command:

**Example**

```bash
sudo yum install -y java-1.8.0-amazon-corretto-devel
```

#### Using zypper

To use Corretto RPM repositories with the zypper package manager (such as openSUSE), import the Corretto public key and then add the repository to the system list by running the following commands:

**Example**

```bash
sudo zypper addrepo https://yum.corretto.aws/corretto.repo; sudo zypper refresh
```

After the repository is added, you can install Corretto 8 by running this command:
Example

```bash
sudo zypper install java-1.8.0-amazon-corretto-devel
```

**Download and install RPM package manually**

1. Download the Linux `.rpm` file from the Download (p. 15) page.
2. Install the downloaded `.rpm` file using `yum localinstall`. e.g. install x86_64 rpm using the following command:

   **Example**

   ```bash
   sudo yum localinstall java-1.8.0-amazon-corretto-devel-1.8.0_242.b07-1.x86_64.rpm
   ```

**Verify Your Installation**

In the terminal, run the following command to verify the installation.

**Example**

```bash
java -version
```

For example, expected output for Corretto-8.242.07.1:

```text
openjdk version "1.8.0_242"
OpenJDK Runtime Environment Corretto-8.242.07.1 (build 1.8.0_242-b07)
OpenJDK 64-Bit Server VM Corretto-8.242.07.1 (build 25.242-b07, mixed mode)
```

If you see a version string that doesn't mention Corretto, run the following command to change the default `java` or `javac` providers.

**Example**

```bash
sudo alternatives --config java
```

If you're using the JDK, you should also run the following.

```bash
sudo alternatives --config javac
```

**Uninstall Amazon Corretto 8**

You can uninstall Amazon Corretto 8 by using the following

**Uninstall JDK:**

**Example**

```bash
sudo yum remove java-1.8.0-amazon-corretto-devel
```
Amazon Corretto 8 Guide on Windows

The topics in this section describe installation instructions for Amazon Corretto 8 on the Windows operating system. Windows builds are supported on Windows 7 and 10, and on Windows Server 2008, 2012, and 2016.

Topics

• Amazon Corretto 8 Installation Instructions for Windows 7 or Later (p. 10)

Amazon Corretto 8 Installation Instructions for Windows 7 or Later

This topic describes how to install and uninstall Amazon Corretto 8 on a host or container running the Windows 7 or later operating system.

Install Amazon Corretto 8

1. Download a Windows .msi file from the Downloads (p. 15) page.
2. Double-click the .msi file to start the installation wizard.
3. Follow the steps in the wizard.

   You have the option of setting a custom installation path. By default, Amazon Corretto 8 is installed at C:\Program Files\Amazon Corretto\. If you set a custom path, make a note of it for the next step.

4. Once the install wizard is finished, set the JAVA_HOME and PATH environment variables.

   Set JAVA_HOME to the installation location, noting that the directory contains the currently installed version. For example, if the default directory is used for 8u242, then set JAVA_HOME as C:\Program Files\Amazon Corretto\jdk1.8.0_242.

   Add %JAVA_HOME%\bin to the current PATH variable.

5. Verify the installation by running java -version in a command prompt. You should see the following output.

   Example

   ```
   openjdk version "1.8.0_242"
   OpenJDK Runtime Environment Corretto-8.242.07.1 (build 1.8.0_242-b07)
   OpenJDK 64-Bit Server VM Corretto-8.242.07.1 (build 25.242-b07, mixed mode)
   ```

Uninstall Amazon Corretto 8

You can uninstall Amazon Corretto 8 by following the standard steps to uninstall an application from Windows.
1. Open *Programs and Features*.
2. Search for *Amazon Corretto 8* and then select it.
3. Choose *uninstall*. 
Amazon Corretto 8 Guide for macOS

The topics in this section describe installation instructions for Amazon Corretto 8 on macOS.

Topics
• Amazon Corretto 8 Installation Instructions for macOS 10.10 or later (p. 12)

Amazon Corretto 8 Installation Instructions for macOS 10.10 or later

This topic describes how to install and uninstall Amazon Corretto 8 on a host running macOS version 10.10 or later. You must have administrator privileges to install and uninstall Amazon Corretto 8.

Install Amazon Corretto 8

1. Download the Mac .pkg file from the Downloads (p. 15) page.
2. Double click the downloaded file to start the installation wizard. Follow the steps in the wizard.
3. Once the wizard completes, Amazon Corretto 8 will be installed in /Library/Java/JavaVirtualMachines/.

   You can run the following command in a terminal to get the complete installation path.

   **Example**

   ```bash
   /usr/libexec/java_home --verbose
   ```

4. Optionally, run the following commands in the terminal to set the JAVA_HOME variable.

   **Example**

   ```bash
   export JAVA_HOME=/Library/Java/JavaVirtualMachines/amazon-corretto-8.jdk/Contents/Home
   ```

Uninstall Amazon Corretto 8

You can uninstall Amazon Corretto 8 by running the following commands in a terminal.

**Example**

```bash
    cd /Library/Java/JavaVirtualMachines/
    sudo rm -rf amazon-corretto-8.jdk
```
Amazon Corretto 8 Guide for Docker

This section describes simple use cases for using Amazon Corretto 8 in Docker containers.

Topics
- Getting Started with Amazon Corretto 8 on Docker Images (p. 13)

Getting Started with Amazon Corretto 8 on Docker Images

This topic describes how to build and launch a Docker image that uses Amazon Corretto 8. You must have the latest version of Docker installed.

Using the official image for Amazon Corretto 8.

Amazon Corretto 8 is available as an official image on Docker Hub. The following example runs a container and displays Corretto’s version.

Example

docker run amazoncorretto:8 java -version

Output:

Example

openjdk version "1.8.0_242"
OpenJDK Runtime Environment Corretto-8.242.07.1 (build 1.8.0_242-b07)
OpenJDK 64-Bit Server VM Corretto-8.242.07.1 (build 25.242-b07, mixed mode)

Using the Corretto ECR Instance

To use the Corretto ECR instance, first authenticate the docker client to the Corretto registry (registry id: 489478819445) with the help of the instructions in this page. Once you have logged in, Corretto 8 images can be pulled or run using one of the following commands:

Example

docker pull 489478819445.dkr.ecr.us-west-2.amazonaws.com/corretto8:latest
docker run -it 489478819445.dkr.ecr.us-west-2.amazonaws.com/corretto8:latest /bin/bash

You can see the list of available images using:

Example

aws ecr list-images --region us-west-2 --registry-id 489478819445 --repository-name corretto8
Build a Docker Image with Amazon Corretto 8

Run the following command to build an image that uses Amazon Corretto 8.

**Example**

```bash
docker build -t amazon-corretto-8 github.com/corretto/corretto-8-docker
```

After the command completes, you have an image called `amazon-corretto-8`.

To launch this image locally, run the following command.

**Example**

```bash
docker run -it amazon-corretto-8
```

You can also push this image to Amazon ECR. See the Pushing an Image topic in the Amazon Elastic Container Registry User Guide for details.

Create an Image

You can create a new Docker image using Corretto's official Docker Hub image.

1. Create a Docker file with this content.

   **Example**

   ```bash
   FROM amazoncorretto:8
   RUN echo $'\n   public class Hello { \n   public static void main(String[] args) { \n   System.out.println("Welcome to Amazon Corretto!"); \n   } \n   }' > Hello.java
   RUN javac Hello.java
   CMD ["java", "Hello"]
   ```

2. Build the new image.

   **Example**

   ```bash
docker build -t hello-app .
   ```

3. Run the new image.

   **Example**

   ```bash
docker run hello-app
   ```

   You get the following output.

   Welcome to Amazon Corretto!
Downloads for Amazon Corretto 8

This topic lists all the downloads available for Amazon Corretto 8. You can choose Permanent URLs pointing to the latest version, or use Version Specific URLs which point to a specific version.

Amazon Corretto 8 Permanent URLs

Permanent URLs always point to the most recent release of a package. For example, to retrieve the latest Linux Corretto 8 .tgz package by using a Permanent URL, you can run the following command from the CLI:

Example

```
wget https://corretto.aws/downloads/latest/amazon-corretto-8-aarch64-linux-jdk.tar.gz
```

These links can be used in scripts to pull the latest version of Amazon Corretto 8.

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**Note:** Notice that the above links follow this format:

**Example**

https://correto.aws/[latest/latest_checksum]/amazon-corretto-[corretto_version]-[cpu_arch]-[os]-[package_type].[file_extension]

### Signature Verification

The public key to verify the SIGNATURE file can be downloaded [here](#).

### Versioned Downloads

For versioned downloads and earlier versions, see [Corretto-8 Releases](#) on GitHub.

### Change Logs

For change logs, see [Corretto-8 Change logs](#) on GitHub.
The following table describes the documentation for this release of Amazon Corretto 8.

<table>
<thead>
<tr>
<th>update-history-change</th>
<th>update-history-description</th>
<th>update-history-date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Added YUM and APT repositories topic (p. 19)</td>
<td>Added information about using YUM and APT repositories.</td>
<td>December 18, 2019</td>
</tr>
<tr>
<td>Corretto version 8.232.09.2. (p. 19)</td>
<td>corretto-8 bug fix release for MacOS.</td>
<td>November 20, 2019</td>
</tr>
<tr>
<td>Corretto version 8.222.10.2. (p. 19)</td>
<td>corretto-8 release candidate for Amazon Linux 2</td>
<td>September 4, 2019</td>
</tr>
<tr>
<td>Corretto version 8.222.10.4. (p. 19)</td>
<td>corretto-8 release candidate for aarch64</td>
<td>July 26, 2019</td>
</tr>
<tr>
<td>Corretto version 8.222.10.3. (p. 19)</td>
<td>corretto-8 release for Windows.</td>
<td>July 16, 2019</td>
</tr>
<tr>
<td>Corretto version 8.222.10.2. (p. 19)</td>
<td>corretto-8 preview 2 for aarch64.</td>
<td>July 16, 2019</td>
</tr>
<tr>
<td>Corretto version 8.212.04.3. (p. 19)</td>
<td>corretto-8 preview for aarch64.</td>
<td>June 14, 2019</td>
</tr>
<tr>
<td>Corretto version 8.212.04.2. (p. 19)</td>
<td>8.212.04.2 released for Amazon Linux 2.</td>
<td>May 2, 2019</td>
</tr>
<tr>
<td>Corretto version 8.212.04.2. (p. 19)</td>
<td>Improves handling of TrueType fonts (JDK-8219066).</td>
<td>April 21, 2019</td>
</tr>
<tr>
<td>Amazon Corretto 8 is now in GA. (p. 19)</td>
<td>No changes have been made from the RC.</td>
<td>January 31, 2019</td>
</tr>
<tr>
<td>8u202: Add links for 8.202.08.2 RC and Amazon Linux 2 8.202.08.1. (p. 19)</td>
<td>Updates artifacts and instructions to point to current RC.</td>
<td>January 25, 2019</td>
</tr>
<tr>
<td>New Platform Release (1.8.0_192) (p. 19)</td>
<td>Bug fix release of Amazon Corretto 8 Developer Preview.</td>
<td>January 14, 2019</td>
</tr>
<tr>
<td>Bug fix Release</td>
<td>Bug fix release of Amazon Corretto 8 Developer Preview.</td>
<td>December 17, 2018</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Initial Release</td>
<td>Initial release of Amazon Corretto 8 Developer Preview.</td>
<td>November 14, 2018</td>
</tr>
</tbody>
</table>