# Java SDK and IDE

# Evolution of Java

- Java keeps evolving to:
    - Improve **performance**
    - Add **modern programming features**
    - Enhance **security**
    - Support **scalability & cloud-native apps**
- Java is **backward compatible** (mostly).

# Java Release Timeline

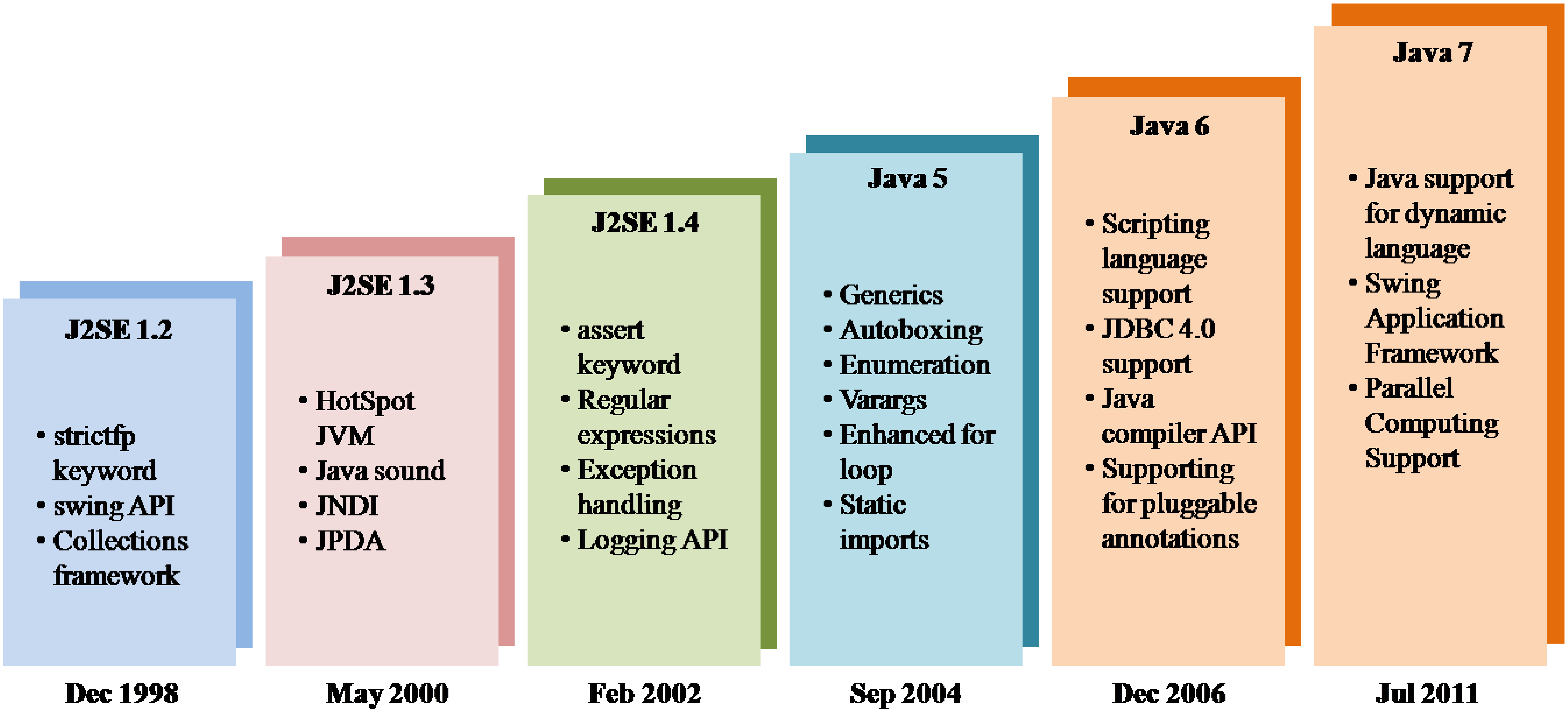
| Version | Year | Type |
|---|---|---|
| Java 1.0 | 1996 | Initial |
| Java 5 | 2004 | Major |
| Java 8 | 2014 | Game changer |
| Java 11 | 2018 | LTS |
| Java 17 | 2021 | LTS |
| Java 21 | 2023 | LTS |

- **LTS = Long-Term Support**

# Java Versions

| Version | Key Features |
|---|---|
| Java 5 | Generics, Annotations, Enums |
| Java 7 | try-with-resources, NIO.2 |
| **Java 8** | Lambdas, Streams, Functional Programming |
| Java 9 | Module System (JPMS) |
| Java 11 (LTS) | HTTP Client, String APIs |
| **Java 17 (LTS)** | Records, Sealed Classes |
| Java 21 (LTS) | Virtual Threads |

# Java Versions



**J2SE 1.2**

- strictfp keyword
- swing API
- Collections framework

**Dec 1998**

**J2SE 1.3**

- HotSpot JVM
- Java sound
- JNDI
- JPDA

**May 2000**

**J2SE 1.4**

- assert keyword
- Regular expressions
- Exception handling
- Logging API

**Feb 2002**

**Java 5**

- Generics
- Autoboxing
- Enumeration
- Varargs
- Enhanced for loop
- Static imports

**Sep 2004**

**Java 6**

- Scripting language support
- JDBC 4.0 support
- Java compiler API
- Supporting for pluggable annotations

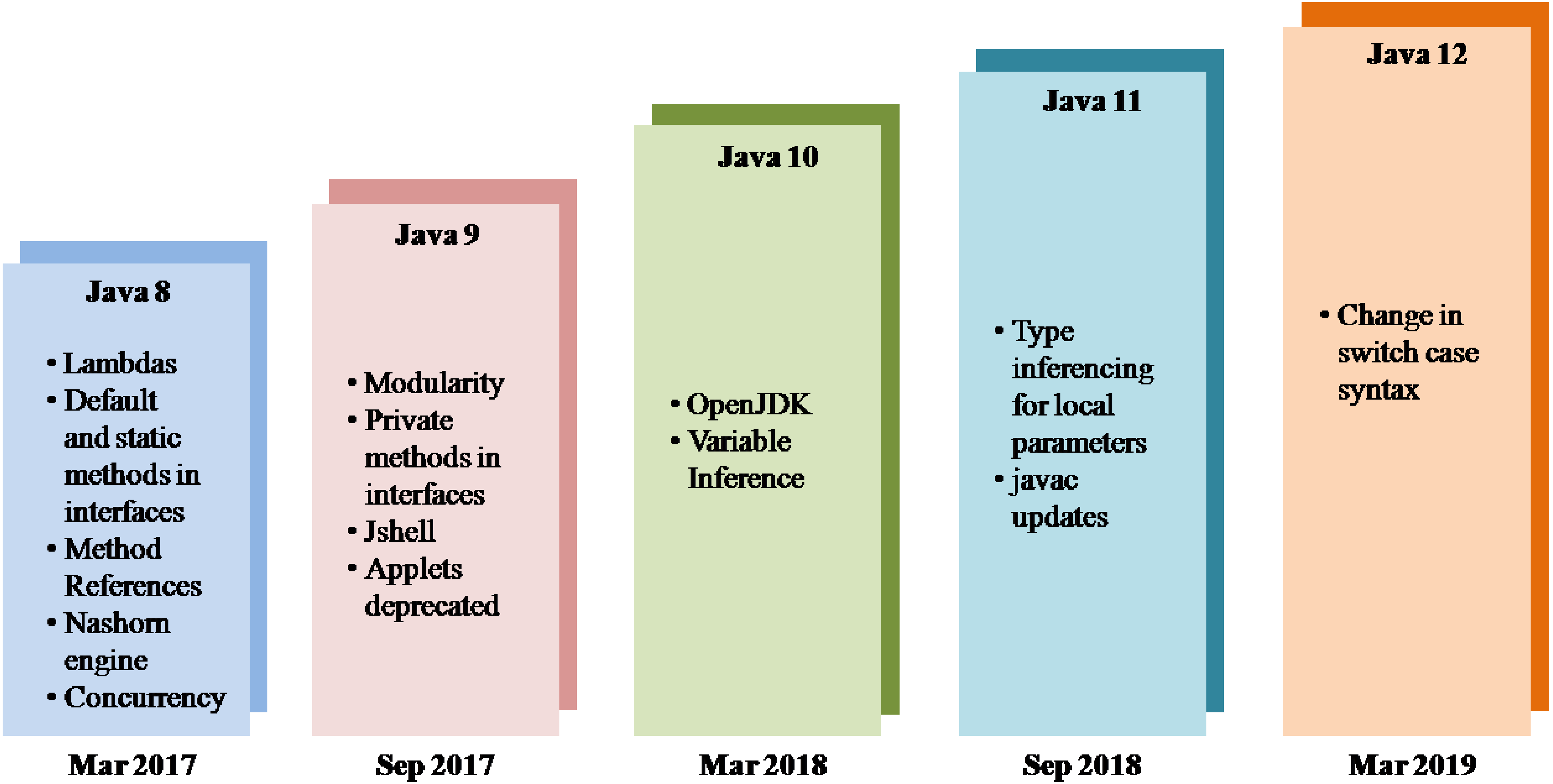
**Dec 2006**

**Java 7**

- Java support for dynamic language
- Swing Application Framework
- Parallel Computing Support

**Jul 2011**

# Java Versions



**Java 8**

- Lambdas
- Default and static methods in interfaces
- Method References
- Nashorn engine
- Concurrency

**Mar 2017**

**Java 9**

- Modularity
- Private methods in interfaces
- Jshell
- Applets deprecated

**Sep 2017**

**Java 10**

- OpenJDK
- Variable Inference

**Mar 2018**

**Java 11**

- Type inferencing for local parameters
- javac updates

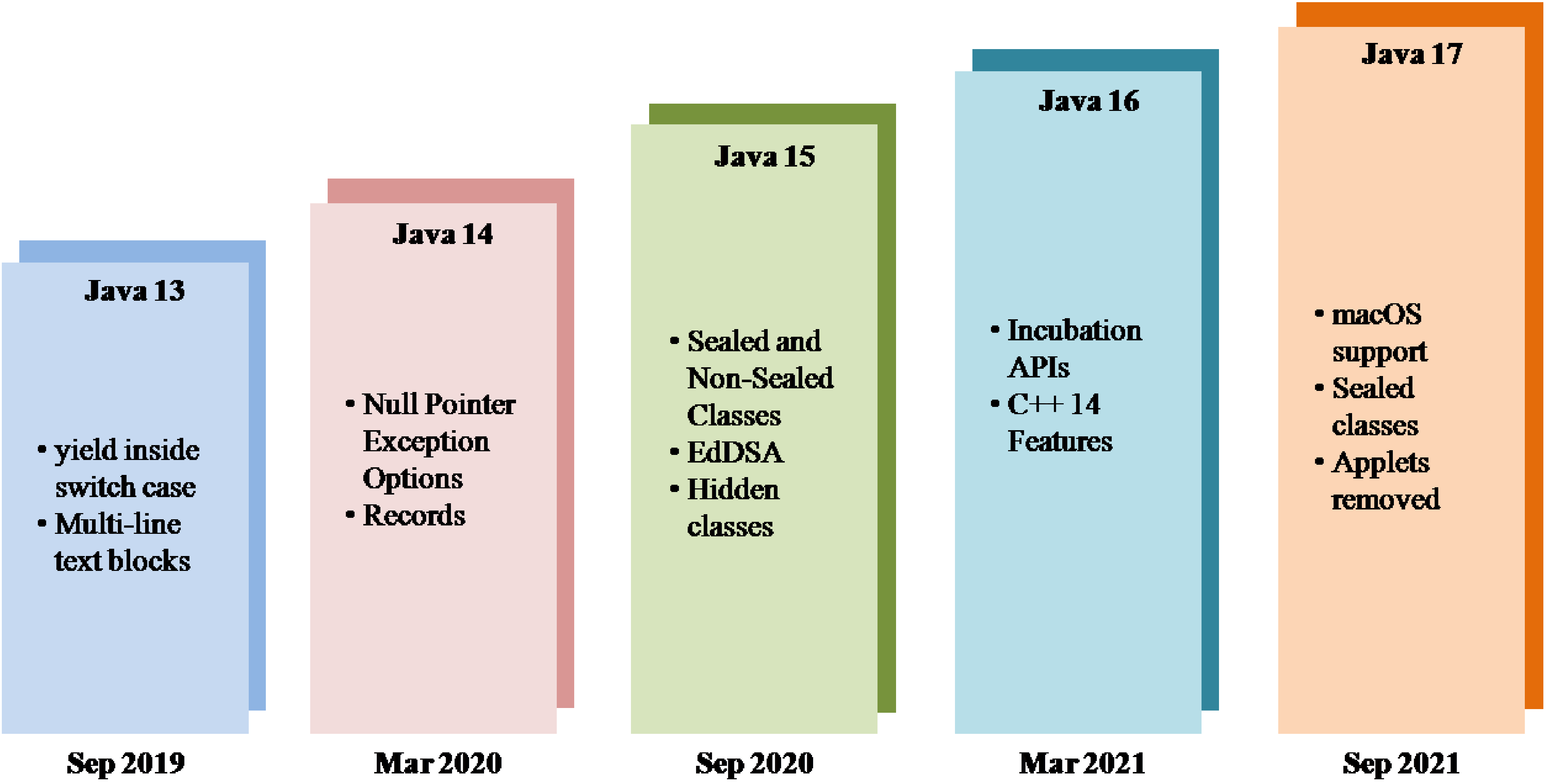
**Sep 2018**

**Java 12**

- Change in switch case syntax

**Mar 2019**

# Java Versions



**Java 13**

- yield inside switch case
- Multi-line text blocks

**Sep 2019**

**Java 14**

- Null Pointer Exception Options
- Records

**Mar 2020**

**Java 15**

- Sealed and Non-Sealed Classes
- EdDSA
- Hidden classes

**Sep 2020**

**Java 16**

- Incubation APIs
- C++ 14 Features

**Mar 2021**

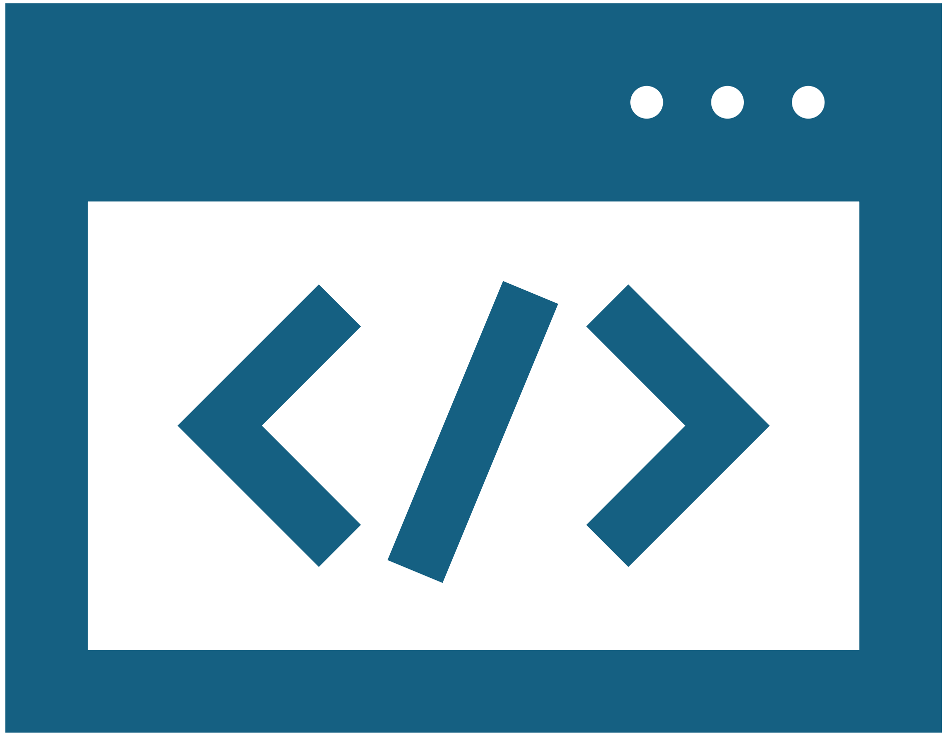
**Java 17**

- macOS support
- Sealed classes
- Applets removed

**Sep 2021**

# What is OpenJDK?

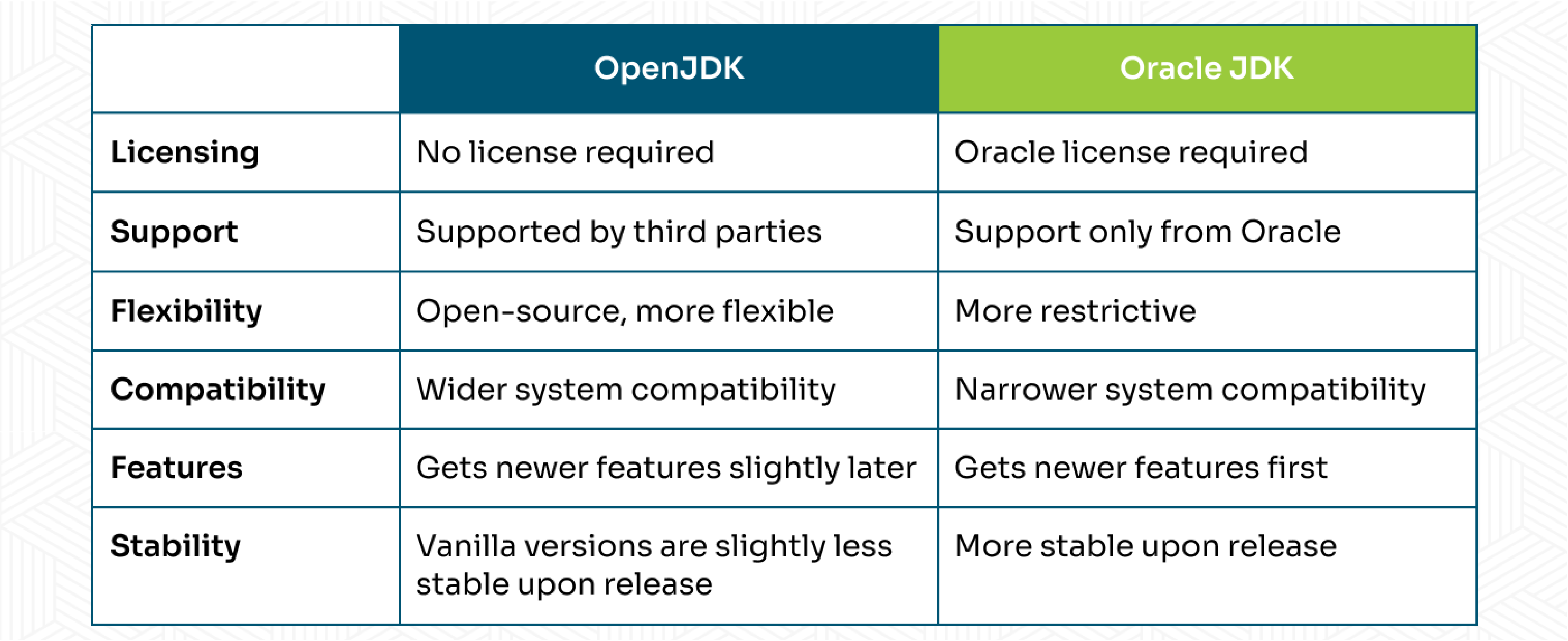
- **OpenJDK (Open Java Development Kit):**
- Official **open-source implementation** of Java
- Maintained by:
  - Oracle
  - Red Hat
  - Amazon
  - Microsoft
- Follows Java SE specifications



# OpenJDK vs Oracle JDK

| Feature | OpenJDK | Oracle JDK |
|---|---|---|
| License | Open source (GPL) | Commercial |
| Cost | Free | Paid (prod use) |
| Performance | Same | Same |
| Updates | Community & vendors | Oracle |
| Usage | Industry standard | Enterprise support |

# OpenJDK vs Oracle JDK



| | OpenJDK | Oracle JDK |
|---|---|---|
| **Licensing** | No license required | Oracle license required |
| **Support** | Supported by third parties | Support only from Oracle |
| **Flexibility** | Open-source, more flexible | More restrictive |
| **Compatibility** | Wider system compatibility | Narrower system compatibility |
| **Features** | Gets newer features slightly later | Gets newer features first |
| **Stability** | Vanilla versions are slightly less stable upon release | More stable upon release |

# Why Companies Prefer OpenJDK?

- Free & open source
- No licensing cost
- Backed by major companies
- Used in:
- Spring Boot
- Microservices
- Docker containers
- Cloud platforms (AWS, Azure)
- Most enterprise applications today use **OpenJDK 17**, as it is stable, free, and well supported

# What is JDK

The Java Development Kit (JDK) is a comprehensive, cross-platform software bundle required to develop, compile, debug, and package Java applications.

It includes the Java Runtime Environment (JRE)—featuring the Java Virtual Machine (JVM) and libraries—plus essential tools.

It is essential for writing code that runs on Java platforms.

# Key Components of the JDK

- The JDK contains all necessary tools to create Java applications:
- **RE (Java Runtime Environment):** Included to run the code.
- **javac (Compiler):** Converts .java source code into .class bytecode.
- **java (Interpreter/Launcher):** Runs the compiled Java applications.
- **jar (Archiver):** Packages multiple files into a single JAR archive.
- **javadoc:** Generates documentation from source code comments.
- **jdb (Debugger):** Used for debugging applications.

# Commonly Used JDK Distributions

- **Oracle JDK:** Provided by Oracle Corporation.
- **OpenJDK:** An open-source, community-driven version.

# What is JRE (Java Runtime Environment)?

- **JRE (Java Runtime Environment)** provides the **environment required to run Java applications**.
- It **does NOT** help in developing Java programs.
  It is only for **execution**.

# What does JRE contain?

JRE is made of **three main components**:

JVM (Java Virtual Machine)

Core Java Libraries

Supporting Files

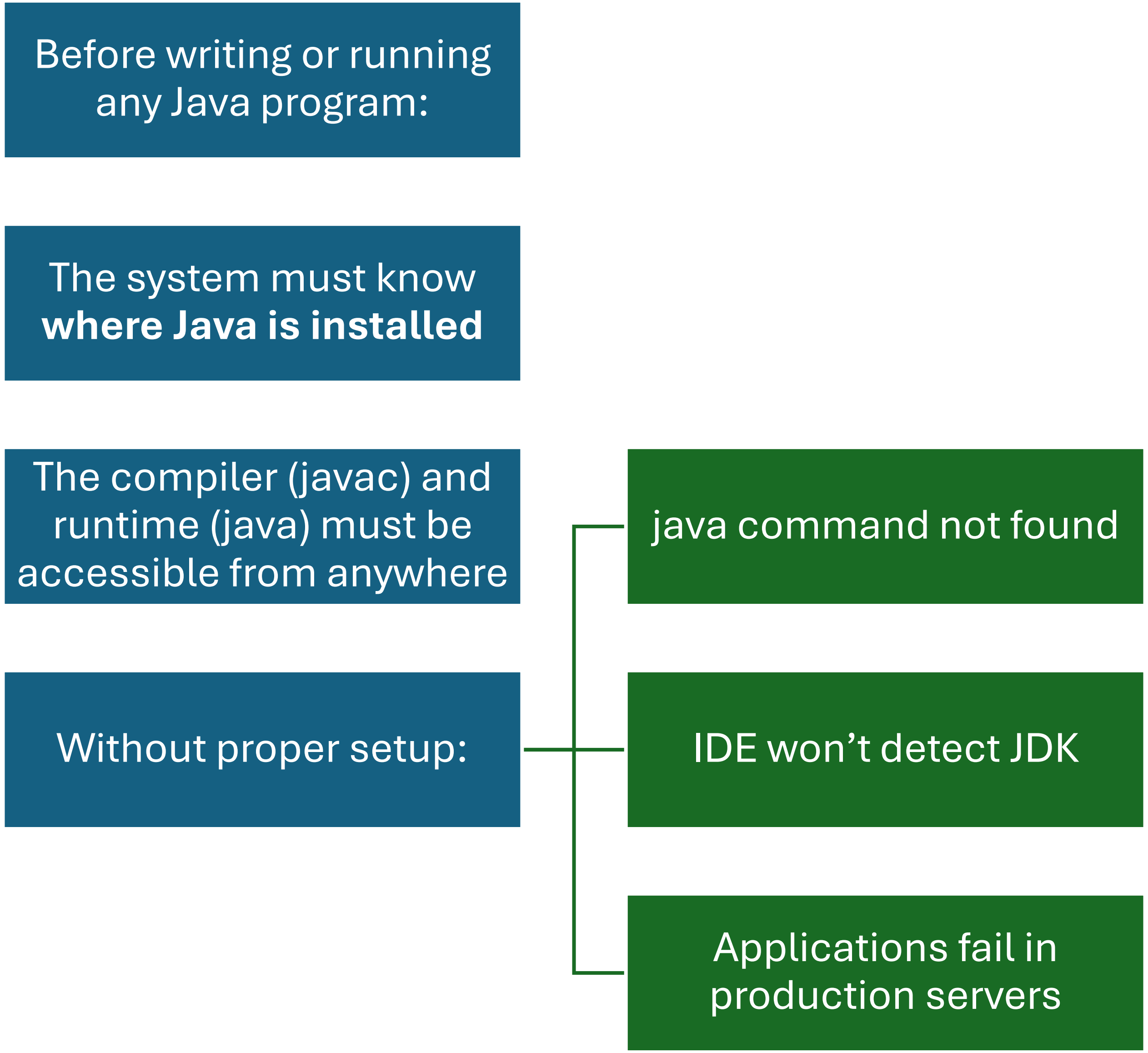
# What JRE does NOT contain

Compiler (javac)
Debugger
Development tools

That’s why **you cannot write or compile Java code using only JRE**

# Java Installation & Environment Settings

# Why Java Installation & Environment Setup Is Important



Before writing or running any Java program:

The system must know **where Java is installed**

The compiler (javac) and runtime (java) must be accessible from anywhere

Without proper setup:

- java command not found
- IDE won’t detect JDK
- Applications fail in production servers

# Steps to Install Java (Windows / Linux / macOS)

**Step 1:**
**Download JDK**

Download from:

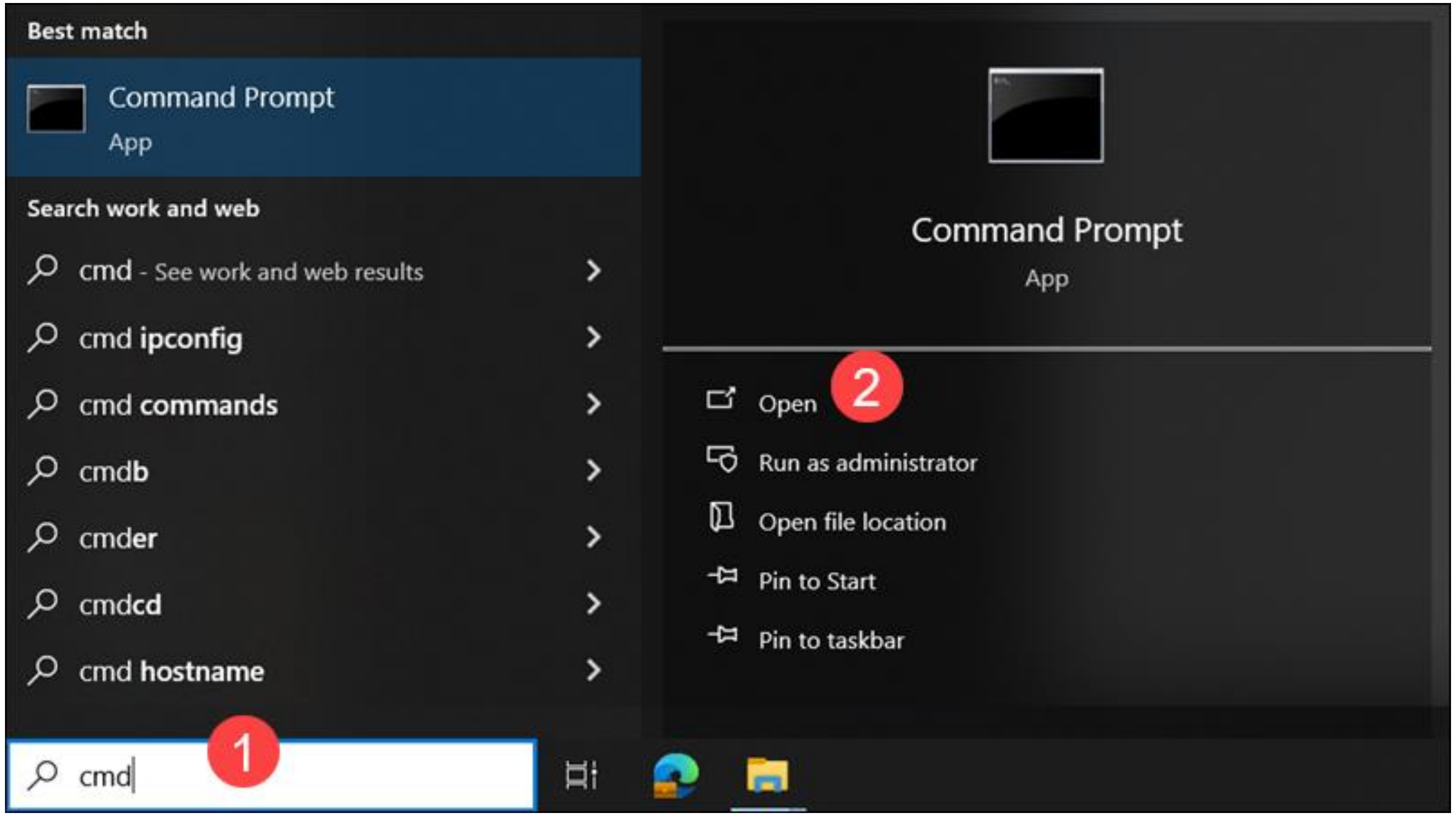
- Oracle JDK (licensed)
- OpenJDK (free & preferred)

Recommended:

- **OpenJDK 17** (LTS, industry standard)

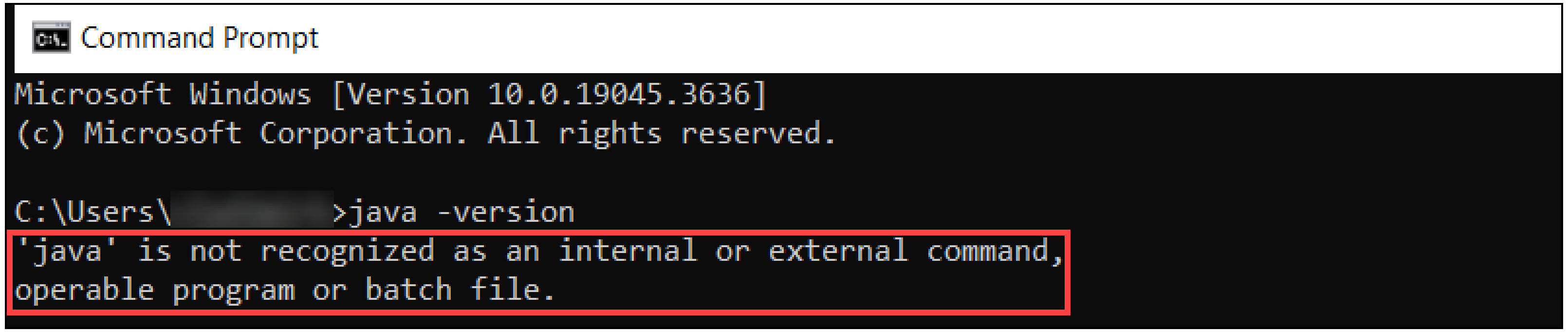
# Check if Java Is Installed

- Before installing the latest Java Development Kit, check if a **Java version is already installed on Windows**:
- 1. Type **cmd** in the Windows search bar.
- 2. **Open** the **command prompt**.



# Check if Java Is Installed

- Enter the following command to check the Java version in Windows:
- java –version



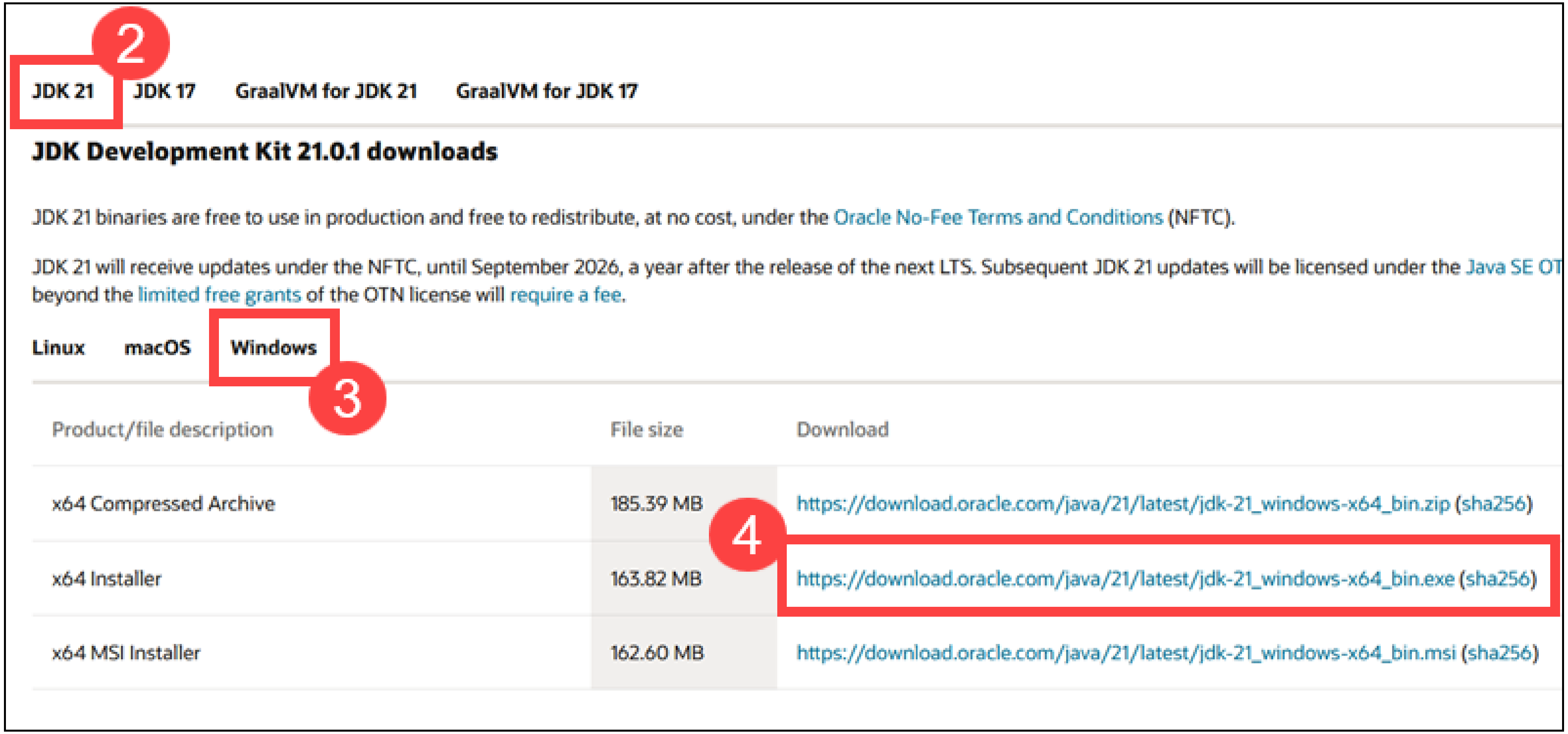
```
Microsoft Windows [Version 10.0.19045.3636]
(c) Microsoft Corporation. All rights reserved.

C:\Users\[redacted]>java -version
'java' is not recognized as an internal or external command,
operable program or batch file.
```

-
- the message states that *Java is not recognized as an internal or external command*, which indicates that Java is not installed. If the system displays a Java version number, remove the old Java installation before proceeding.

# Download Java for Windows

- OpenJDK is an **open-source** project that provides **source code** for implementing the Java platform. Many companies, including Oracle, offer distributions of OpenJDK as installers or binaries.
- To download the latest Java Development Kit installation **file** for Windows:
- 1. Open a **web browser** and navigate to the **Oracle Java Downloads page**.
- 2. Select the latest JDK version. In this example, the latest available version is **JDK 21**.
- 3. Access the **Windows** tab.
- 4. Click the **x64 Installer** download link.

# Download Java for Windows



JDK 21 JDK 17 GraalVM for JDK 21 GraalVM for JDK 17

## JDK Development Kit 21.0.1 downloads

JDK 21 binaries are free to use in production and free to redistribute, at no cost, under the Oracle No-Fee Terms and Conditions (NFTC).

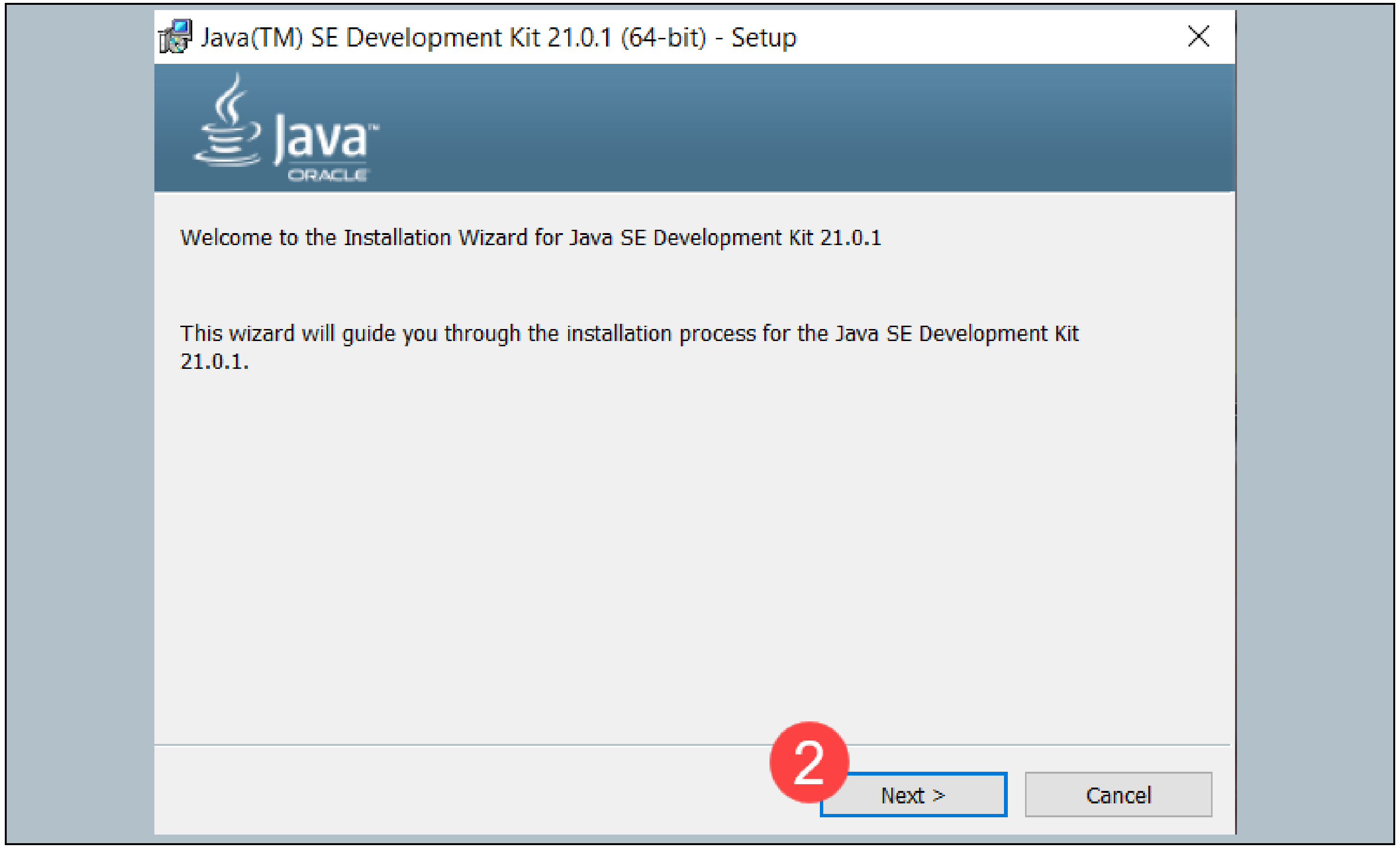
JDK 21 will receive updates under the NFTC, until September 2026, a year after the release of the next LTS. Subsequent JDK 21 updates will be licensed under the Java SE OT beyond the limited free grants of the OTN license will require a fee.

Linux macOS Windows

| Product/file description | File size | Download |
|---|---|---|
| x64 Compressed Archive | 185.39 MB | https://download.oracle.com/java/21/latest/jdk-21_windows-x64_bin.zip (sha256) |
| x64 Installer | 163.82 MB | https://download.oracle.com/java/21/latest/jdk-21_windows-x64_bin.exe (sha256) |
| x64 MSI Installer | 162.60 MB | https://download.oracle.com/java/21/latest/jdk-21_windows-x64_bin.msi (sha256) |

# Step 2: Install JDK

- To install Java on your Windows system:
- 1. Double-click the **downloaded Java file** to start the installation.
- 2. Once the installation wizard welcome screen appears, select **Next** to proceed.



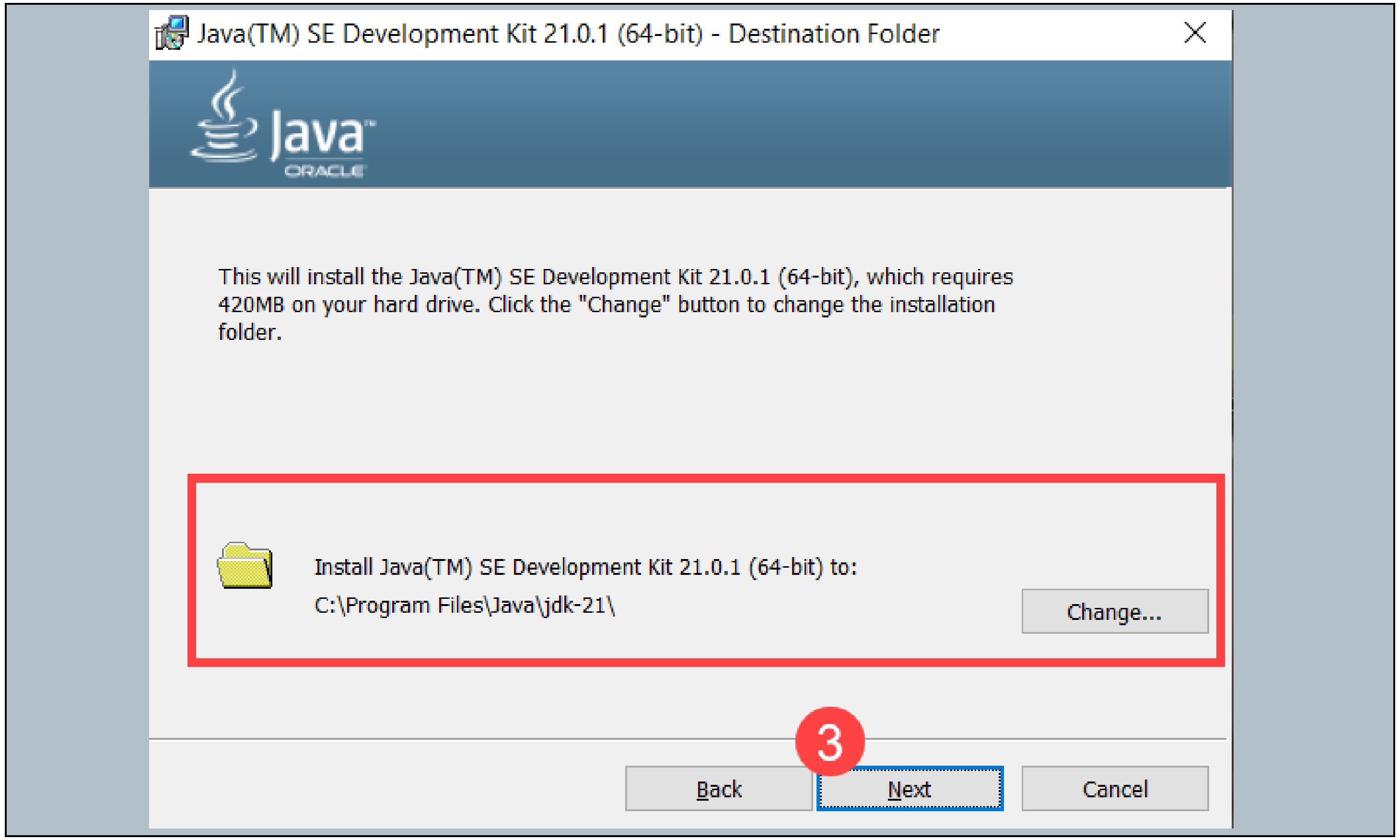
Java(TM) SE Development Kit 21.0.1 (64-bit) - Setup

Welcome to the Installation Wizard for Java SE Development Kit 21.0.1

This wizard will guide you through the installation process for the Java SE Development Kit 21.0.1.

# Step 2: Install JDK

- Choose the destination folder for the Java installation files, or stick to the default path and click **Next.**



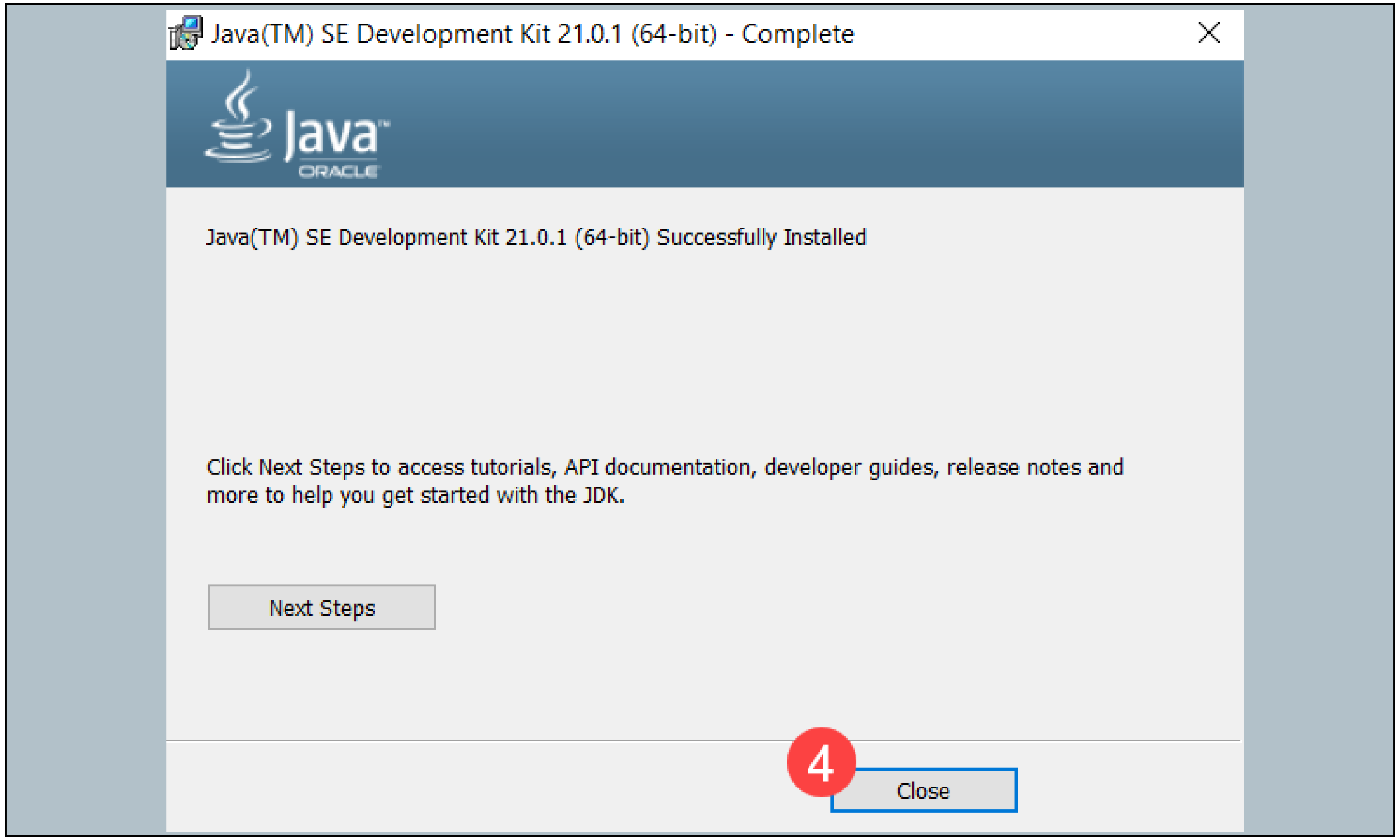
Java(TM) SE Development Kit 21.0.1 (64-bit) - Destination Folder

This will install the Java(TM) SE Development Kit 21.0.1 (64-bit), which requires 420MB on your hard drive. Click the "Change" button to change the installation folder.

Install Java(TM) SE Development Kit 21.0.1 (64-bit) to:
C:\Program Files\Java\jdk-21\

# Step 2: Install JDK

- The installation process is complete when the *Successfully Installed* message appears. Click **Close** to exit the wizard.



Java(TM) SE Development Kit 21.0.1 (64-bit) - Complete

Java(TM) SE Development Kit 21.0.1 (64-bit) Successfully Installed

Click Next Steps to access tutorials, API documentation, developer guides, release notes and more to help you get started with the JDK.

# Step 2: Install JDK

Default installation path:

C:\Program Files\Java\jdk-17

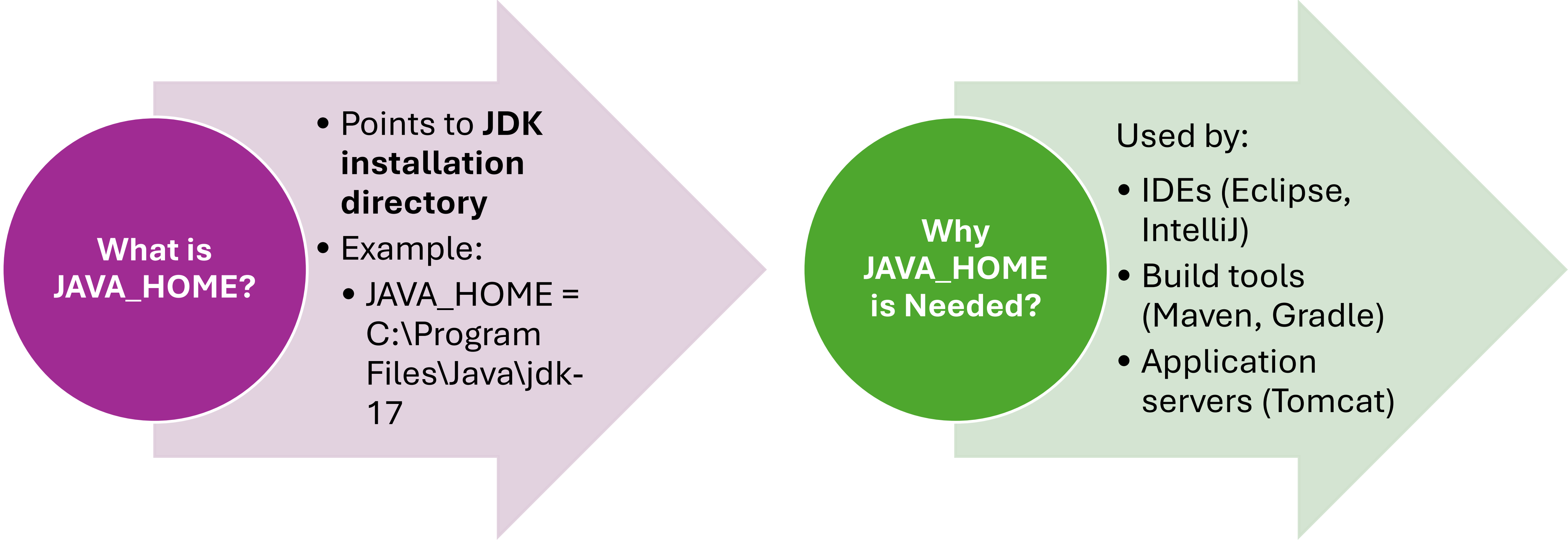
Linux:

sudo apt install openjdk-17-jdk

# Environment Variables

- Environment variables allow OS to:
  - Locate Java binaries
  - Run Java commands from any directory

# JAVA_HOME Variable



**What is JAVA_HOME?**

- Points to **JDK installation directory**
- Example:
  - JAVA_HOME = C:\Program Files\Java\jdk-17

**Why JAVA_HOME is Needed?**

Used by:

- IDEs (Eclipse, IntelliJ)
- Build tools (Maven, Gradle)
- Application servers (Tomcat)

# PATH Variable

**What is PATH?**

- List of directories where OS searches for executables

**Add:**

- %JAVA_HOME%\bin

**So OS can find:**

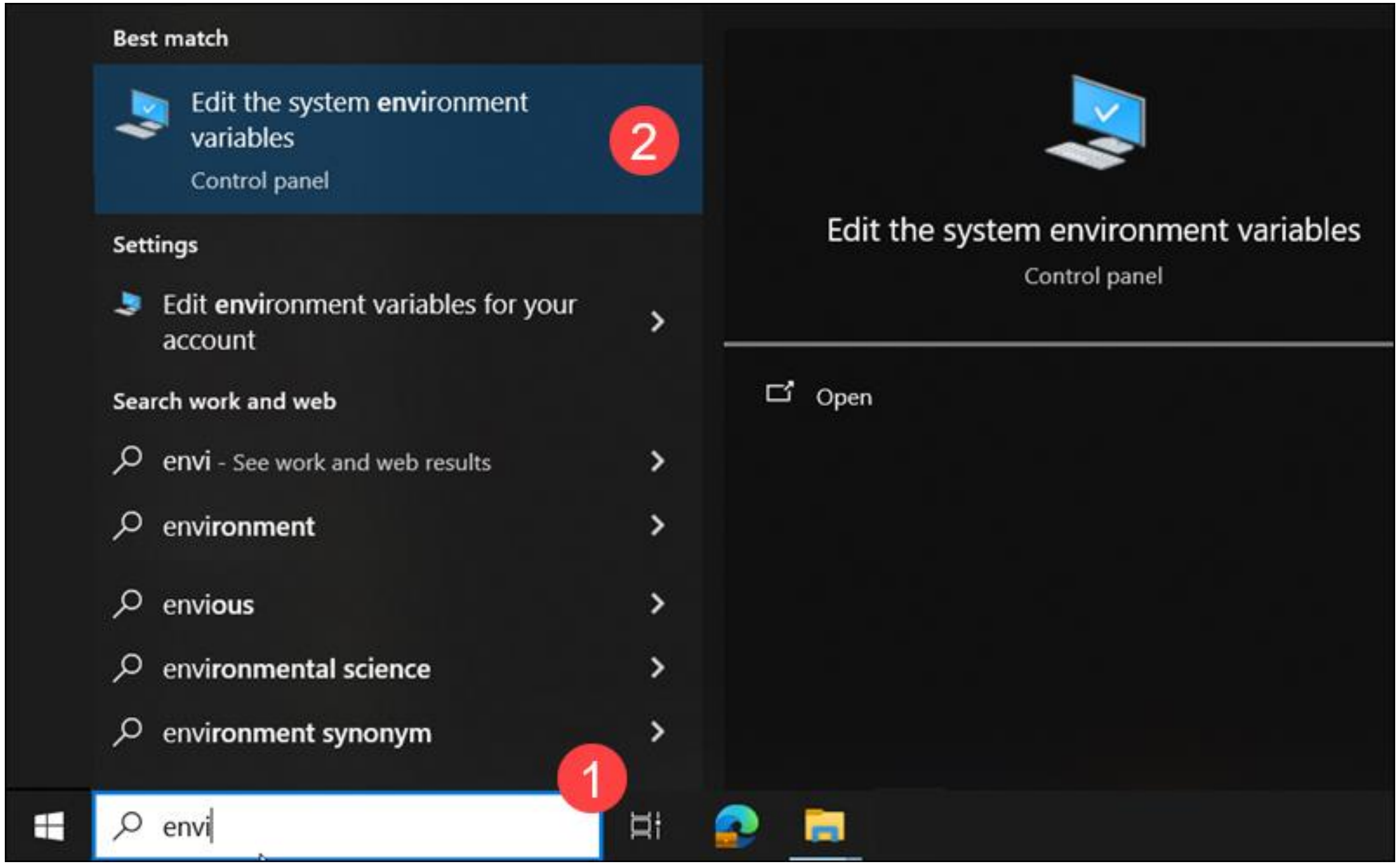
- java
- javac
- javadoc

# Setting Environment Variables (Windows)

- **Steps:**
  - Right click **This PC → Properties**
  - Advanced System Settings
  - Environment Variables
    - Add:
      - JAVA_HOME
      - Update PATH

# Setting Environment Variables (Windows)

- **Step 1: Add Java to System Variables**
- This step ensures that Java is accessible from the command line in any directory.
- 1. Open the **Start** menu and search for *environment variables*.
- 2. Select **Edit the system environment variables**.

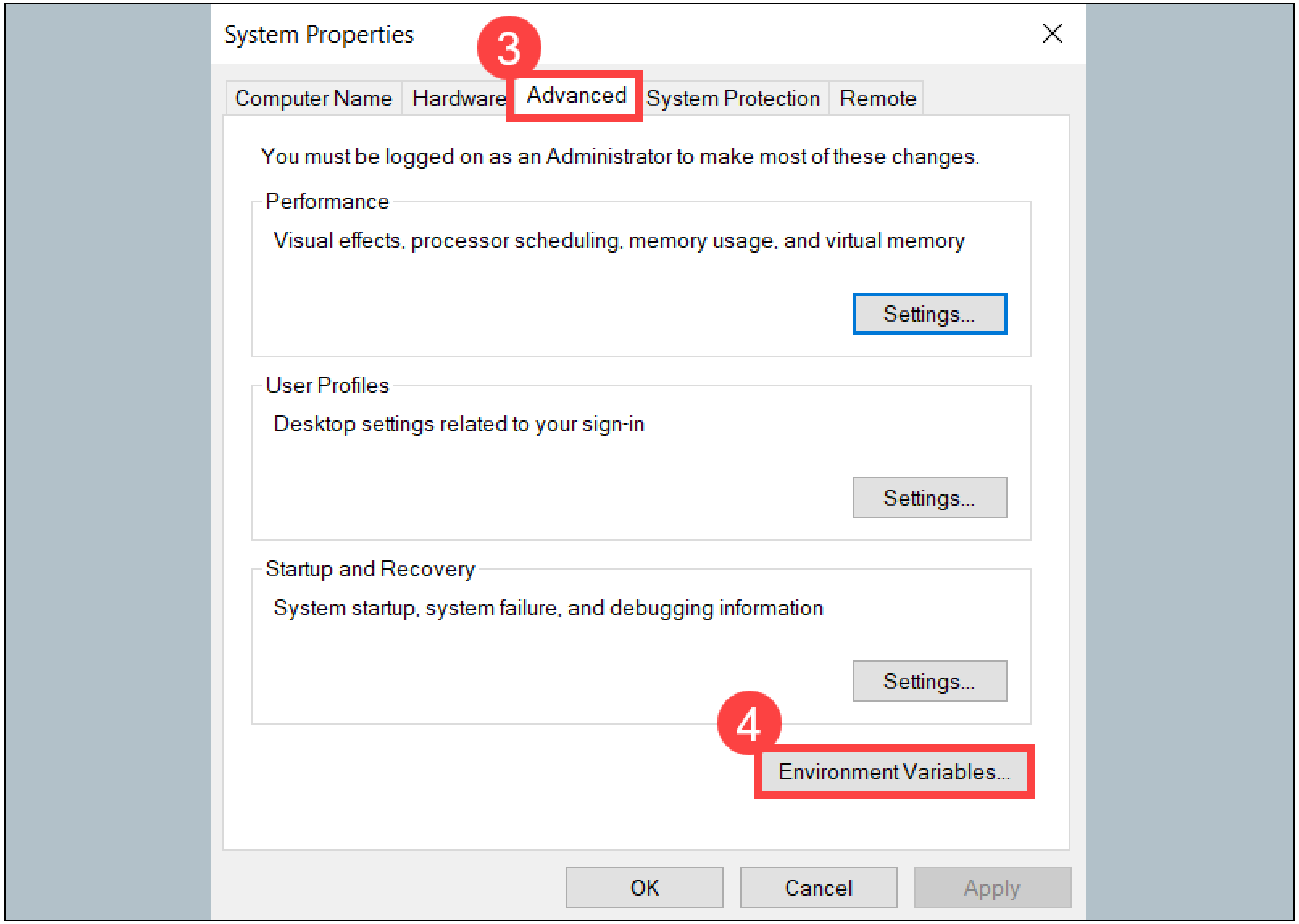


envi

Best match
Edit the system environment variables
Control panel
2
Settings
Edit environment variables for your account
Search work and web
envi - See work and web results
environment
envious
environmental science
environment synonym
1
Edit the system environment variables
Control panel
Open

# Setting Environment Variables (Windows)

- Select **Advanced** in the *System Properties* window.
- 4. Click **Environment Variables.**



System Properties

You must be logged on as an Administrator to make most of these changes.

Performance

Visual effects, processor scheduling, memory usage, and virtual memory

User Profiles

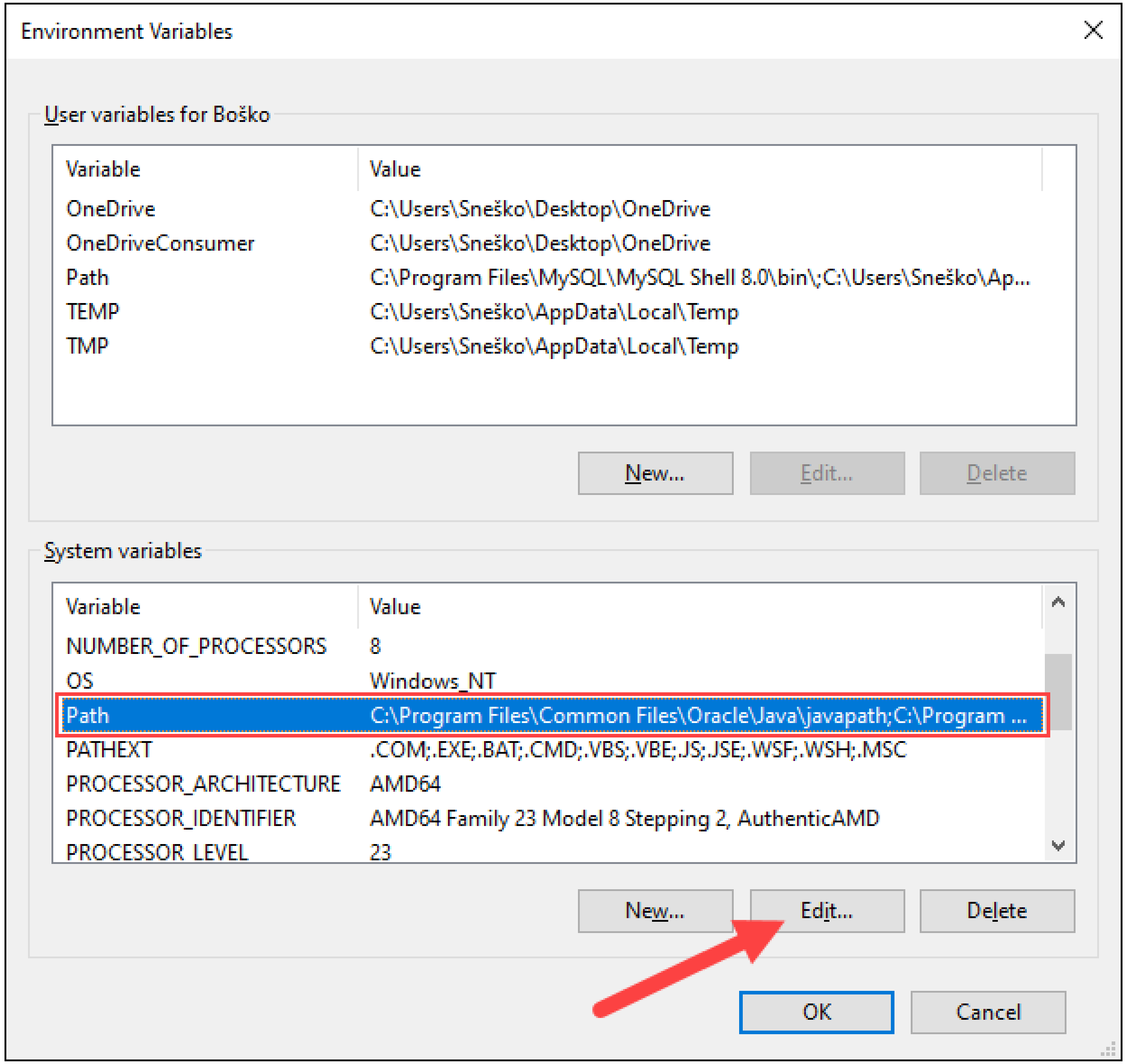
Desktop settings related to your sign-in

Startup and Recovery

System startup, system failure, and debugging information

# Setting Environment Variables (Windows)

- Select the **Path** variable in the *System variables* category and click **Edit**.



Environment Variables

User variables for Boško

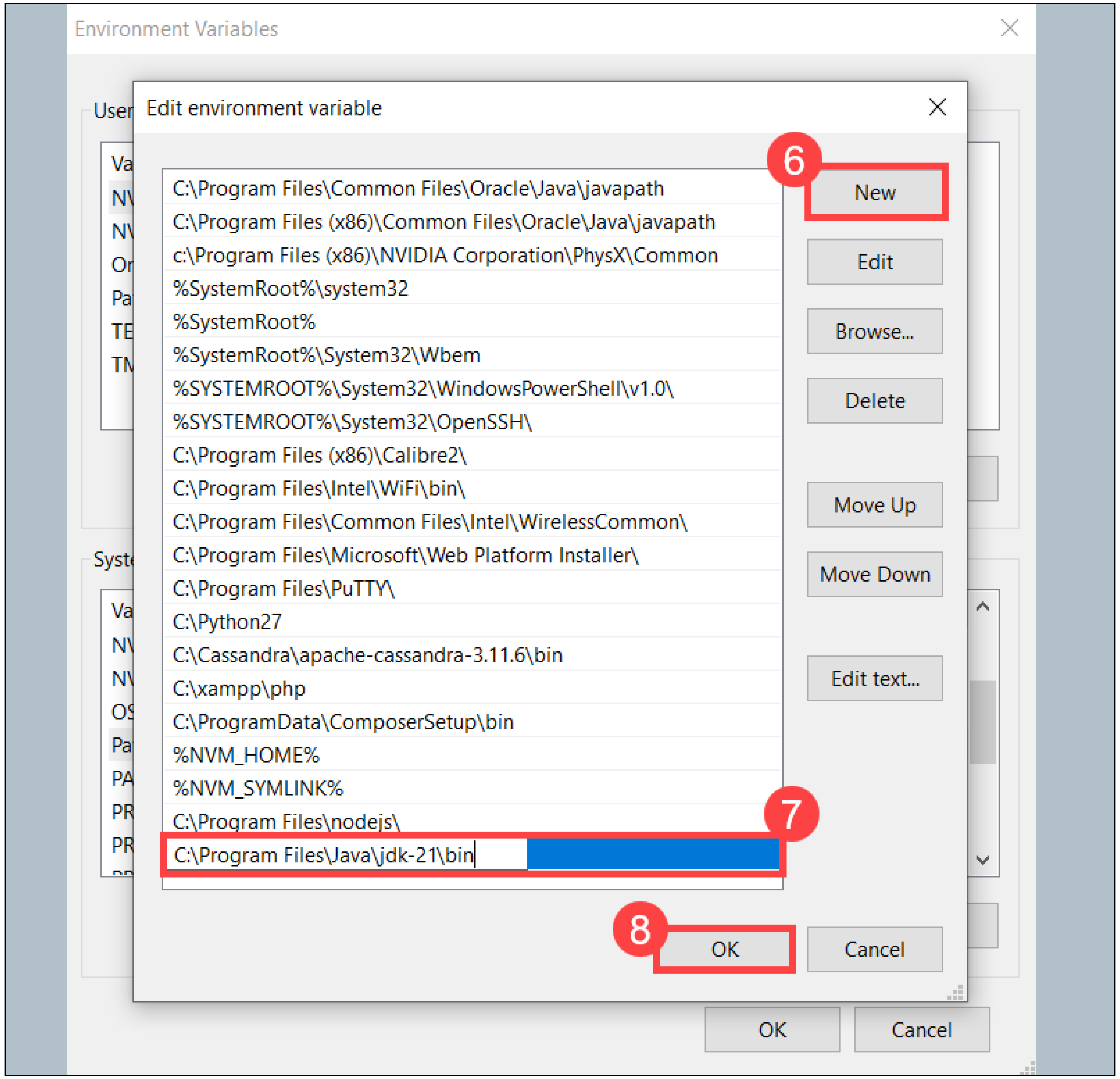
| Variable | Value |
|---|---|
| OneDrive | C:\Users\Sneško\Desktop\OneDrive |
| OneDriveConsumer | C:\Users\Sneško\Desktop\OneDrive |
| Path | C:\Program Files\MySQL\MySQL Shell 8.0\bin\;C:\Users\Sneško\Ap... |
| TEMP | C:\Users\Sneško\AppData\Local\Temp |
| TMP | C:\Users\Sneško\AppData\Local\Temp |

System variables

| Variable | Value |
|---|---|
| NUMBER_OF_PROCESSORS | 8 |
| OS | Windows_NT |
| Path | C:\Program Files\Common Files\Oracle\Java\javapath;C:\Program ... |
| PATHEXT | .COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC |
| PROCESSOR_ARCHITECTURE | AMD64 |
| PROCESSOR_IDENTIFIER | AMD64 Family 23 Model 8 Stepping 2, AuthenticAMD |
| PROCESSOR_LEVEL | 23 |

# Setting Environment Variables (Windows)

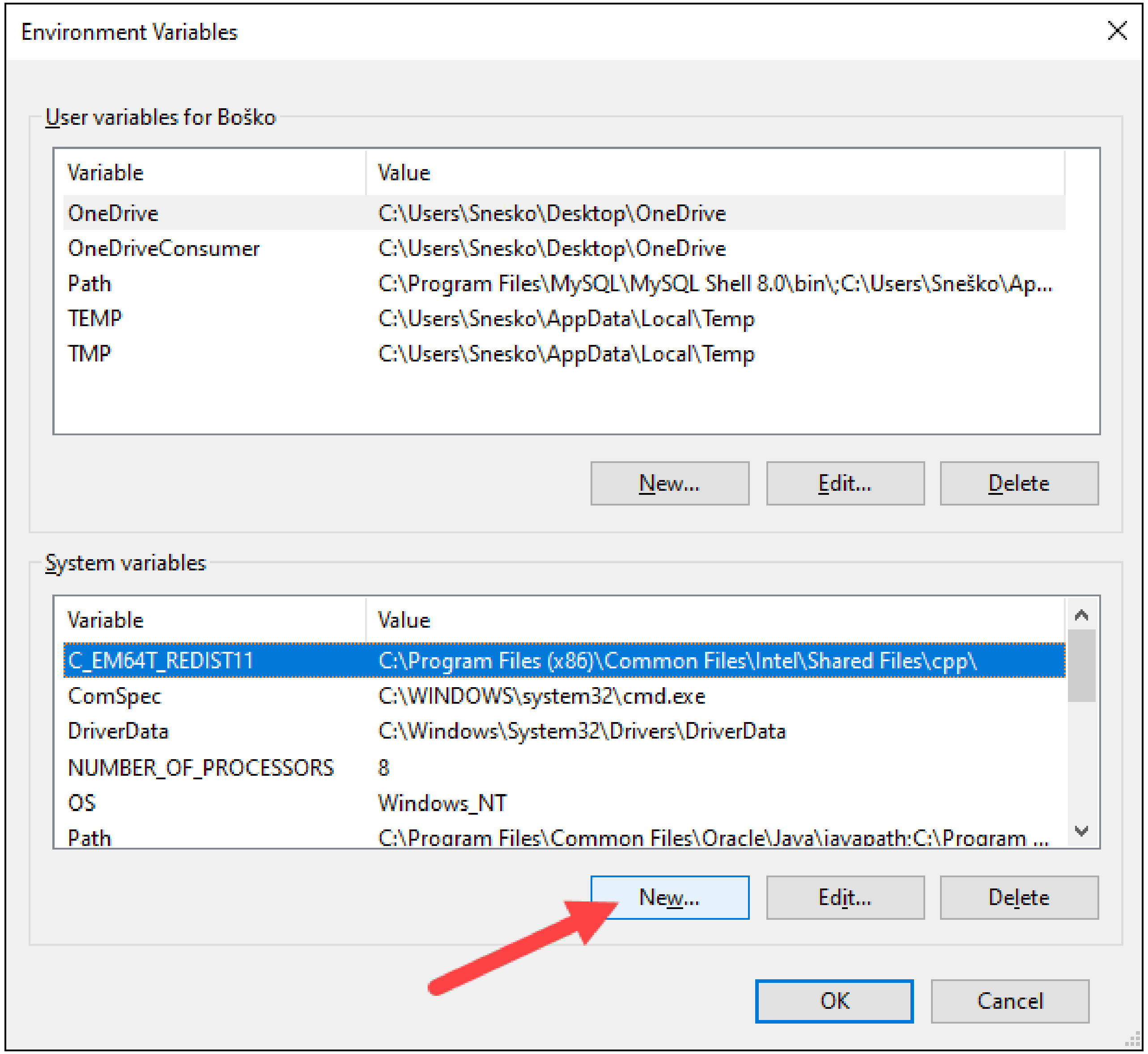
- Click **New**.
- 7. Enter the path to the Java bin directory.
- 8. Click **OK** to save the changes and exit the variable editing window.



C:\Program Files\Common Files\Oracle\Java\javapath
C:\Program Files (x86)\Common Files\Oracle\Java\javapath
c:\Program Files (x86)\NVIDIA Corporation\PhysX\Common
%SystemRoot%\system32
%SystemRoot%
%SystemRoot%\System32\Wbem
%SYSTEMROOT%\System32\WindowsPowerShell\v1.0\
%SYSTEMROOT%\System32\OpenSSH\
C:\Program Files (x86)\Calibre2\
C:\Program Files\Intel\WiFi\bin\
C:\Program Files\Common Files\Intel\WirelessCommon\
C:\Program Files\Microsoft\Web Platform Installer\
C:\Program Files\PuTTY\
C:\Python27
C:\Cassandra\apache-cassandra-3.11.6\bin
C:\xampp\php
C:\ProgramData\ComposerSetup\bin
%NVM_HOME%
%NVM_SYMLINK%
C:\Program Files\nodejs\
C:\Program Files\Java\jdk-21\bin

# Add JAVA_HOME Variable

- Some applications require the **JAVA_HOME** variable to point to the JDK installation directory. Follow the steps below to create the variable:
- 1. Click **New** under the *System variables* category to create a new variable.



Environment Variables

User variables for Boško

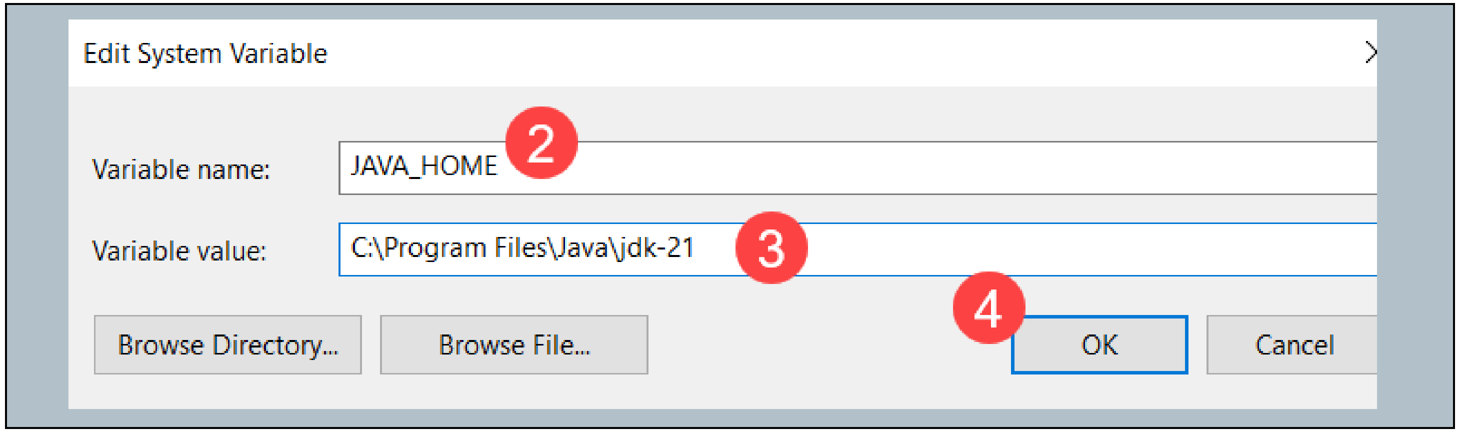
| Variable | Value |
|---|---|
| OneDrive | C:\Users\Snesko\Desktop\OneDrive |
| OneDriveConsumer | C:\Users\Snesko\Desktop\OneDrive |
| Path | C:\Program Files\MySQL\MySQL Shell 8.0\bin\;C:\Users\Sneško\Ap... |
| TEMP | C:\Users\Snesko\AppData\Local\Temp |
| TMP | C:\Users\Snesko\AppData\Local\Temp |

System variables

| Variable | Value |
|---|---|
| C_EM64T_REDIST11 | C:\Program Files (x86)\Common Files\Intel\Shared Files\cpp\ |
| ComSpec | C:\WINDOWS\system32\cmd.exe |
| DriverData | C:\Windows\System32\Drivers\DriverData |
| NUMBER_OF_PROCESSORS | 8 |
| OS | Windows_NT |
| Path | C:\Program Files\Common Files\Oracle\Java\javapath;C:\Program ... |

# Add JAVA_HOME Variable

- Name the variable **JAVA_HOME**.
- 3. Enter the path to your Java JDK directory in the variable value field.
- 4. Click **OK**.



Edit System Variable

Variable name: JAVA_HOME

Variable value: C:\Program Files\Java\jdk-21

# Setting Environment Variables (Linux / macOS)

- export JAVA_HOME=/usr/lib/jvm/java-17-openjdk
- export PATH=$JAVA_HOME/bin:$PATH
- Persist in:
  - .bashrc
  - .zshrc

# Verifying Installation

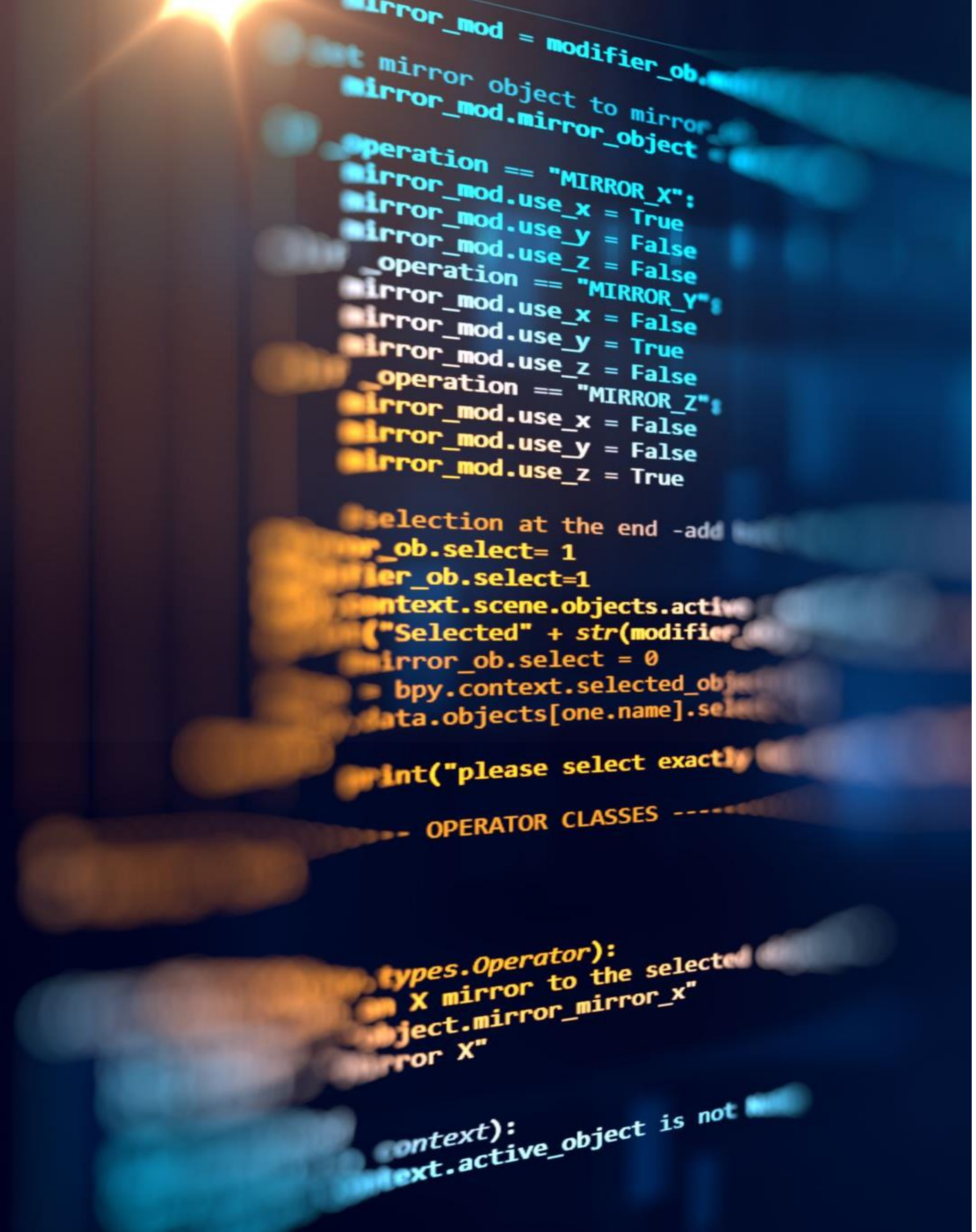
Open terminal / command prompt:

```
java -version

javac -version
```

Output:

```
openjdk version "17.0.8"
```

# BRIEF ABOUT IDE (INTEGRATED DEVELOPMENT ENVIRONMENTS)



# What is an IDE?

- An **IDE (Integrated Development Environment)** is a software application that provides a complete environment to:
  - Write Java code
  - Compile and run programs
  - Debug applications
  - Manage project structure and dependencies
  - Improve productivity using tools and automation
- **IDE = Code Editor + Compiler + Debugger + Build Tools + Project Manager**

# Why Do We Need an IDE for Java?

- Java projects can become large and complex (especially in real companies). IDE helps by:
- ✓ **Faster Development**
  - Auto-completion (suggestions)
  - Quick fixes
  - Code templates
- ✓ **Error Detection**
  - Highlights errors while typing
  - Suggests corrections instantly
- ✓ **Easy Debugging**
  - Breakpoints
  - Step-by-step execution
  - Variable inspection
- ✓ **Project Management**
  - Handles multiple files, packages, modules
  - Helps organize enterprise-level projects
- ✓ **Build & Dependency Support**
  - Maven / Gradle integration
  - Library management

# Popular Java IDEs

### IntelliJ IDEA (Most popular in industry)

- Best for:
- Spring Boot
- Enterprise apps
- Smart code suggestions
- Has Community (free) + Ultimate (paid)

### ◆ Eclipse

- Best for:
- Beginners
- Java EE projects
- Lightweight development
- Free and widely used

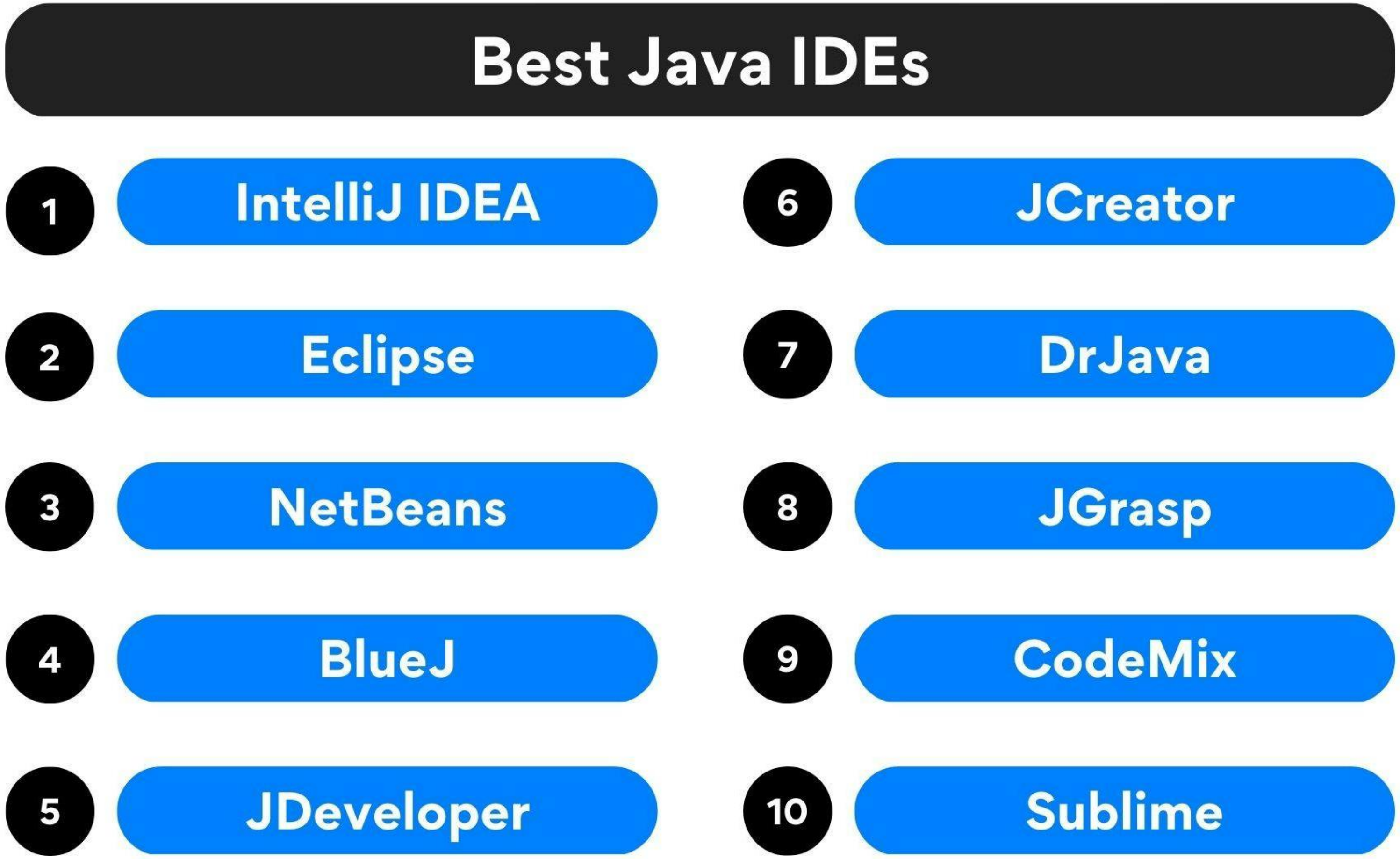
### ◆ NetBeans

- Best for:
- Students
- Simple Java projects
- Free and easy UI

### ◆ VS Code (Editor + Extensions)

- VS Code is not a full IDE by default, but becomes one with extensions:
- Java Extension Pack
- Maven support
- Debugger
- Good for lightweight development

# Popular Java IDEs



## Best Java IDEs

1. IntelliJ IDEA
2. Eclipse
3. NetBeans
4. BlueJ
5. JDeveloper
6. JCreator
7. DrJava
8. JGrasp
9. CodeMix
10. Sublime