JDK, JVM, and JRE are all related components in the Java ecosystem, each serving a specific role in the development and execution of Java applications:

JDK (Java Development Kit):

The JDK is a software development kit that provides tools, libraries, and executables necessary for Java application development. It includes the Java compiler (javac), which translates Java source code (.java files) into bytecode (.class files). Additionally, the JDK contains various development tools like java, javap, javadoc, and more. These tools are essential for writing, compiling, and debugging Java programs.

The JDK also includes the Java Runtime Environment (JRE), as developers need the runtime to run and test their Java applications during the development process. Therefore, the JDK contains everything necessary for both development and execution.

JVM (Java Virtual Machine):

The JVM is the runtime environment in which Java bytecode (.class files) is executed. It provides a platform-independent execution environment for Java programs, meaning Java bytecode can be run on any system with a compatible JVM. The JVM interprets the bytecode and translates it into machine code specific to the underlying hardware and operating system.

The JVM is responsible for various tasks, including memory management (garbage collection), bytecode interpretation, and just-in-time (JIT) compilation to optimize performance. Each platform (Windows, macOS, Linux, etc.) typically has its own implementation of the JVM, which ensures cross-platform compatibility for Java applications.

JRE (Java Runtime Environment):

The JRE is the subset of the JDK required to run Java applications. It includes the JVM, class libraries, and other supporting files necessary to execute Java bytecode. Unlike the JDK, the JRE does not include development tools like the Java compiler (javac), javadoc, etc. It is meant for end-users who only need to run Java applications and do not need to develop or compile Java code.

In summary:

JDK: The complete development kit that includes the JRE along with development tools and libraries for Java application development.

JVM: The runtime environment responsible for executing Java bytecode on various platforms.

JRE: The subset of the JDK containing the JVM and necessary runtime libraries for running Java applications. It does not include development tools.