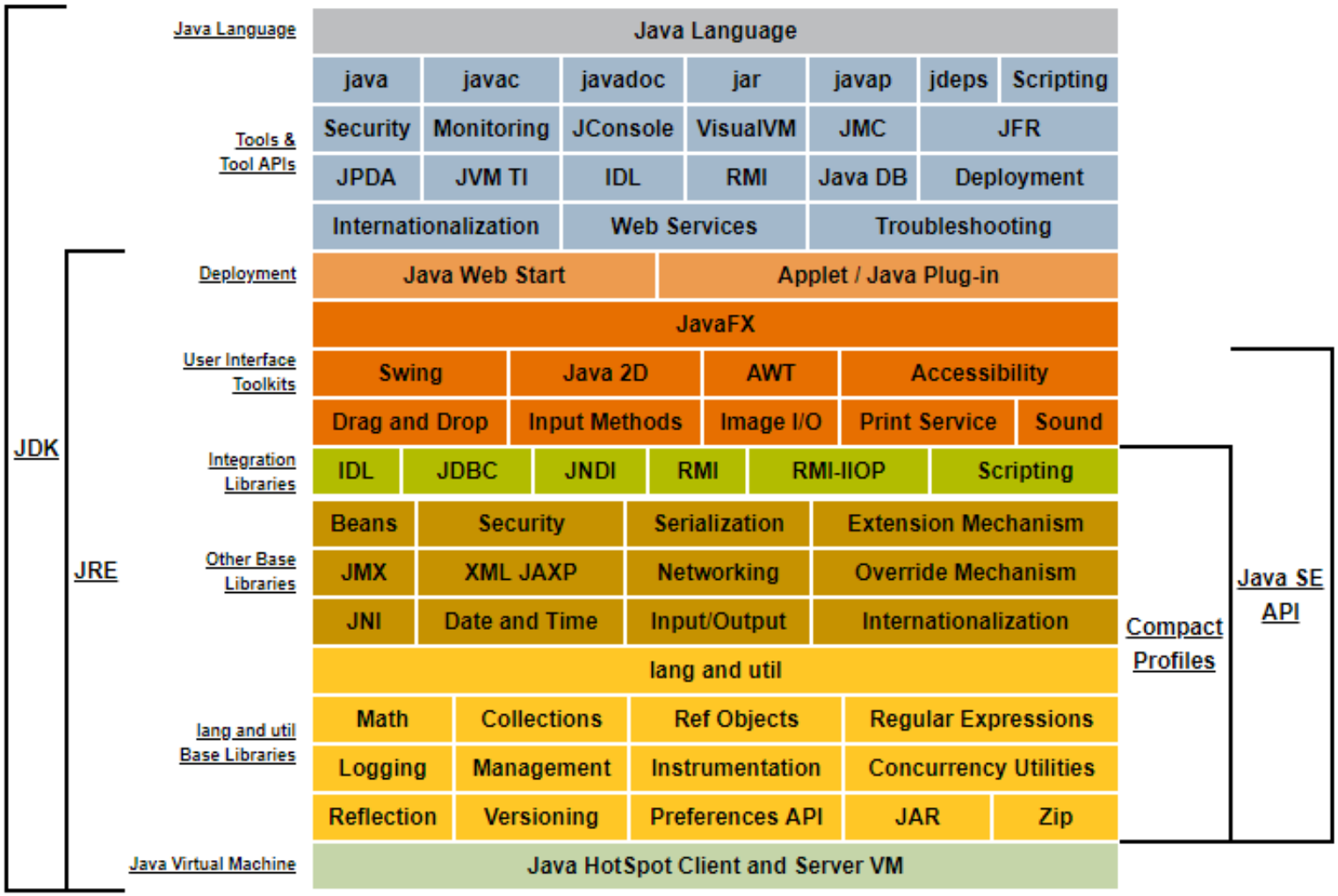
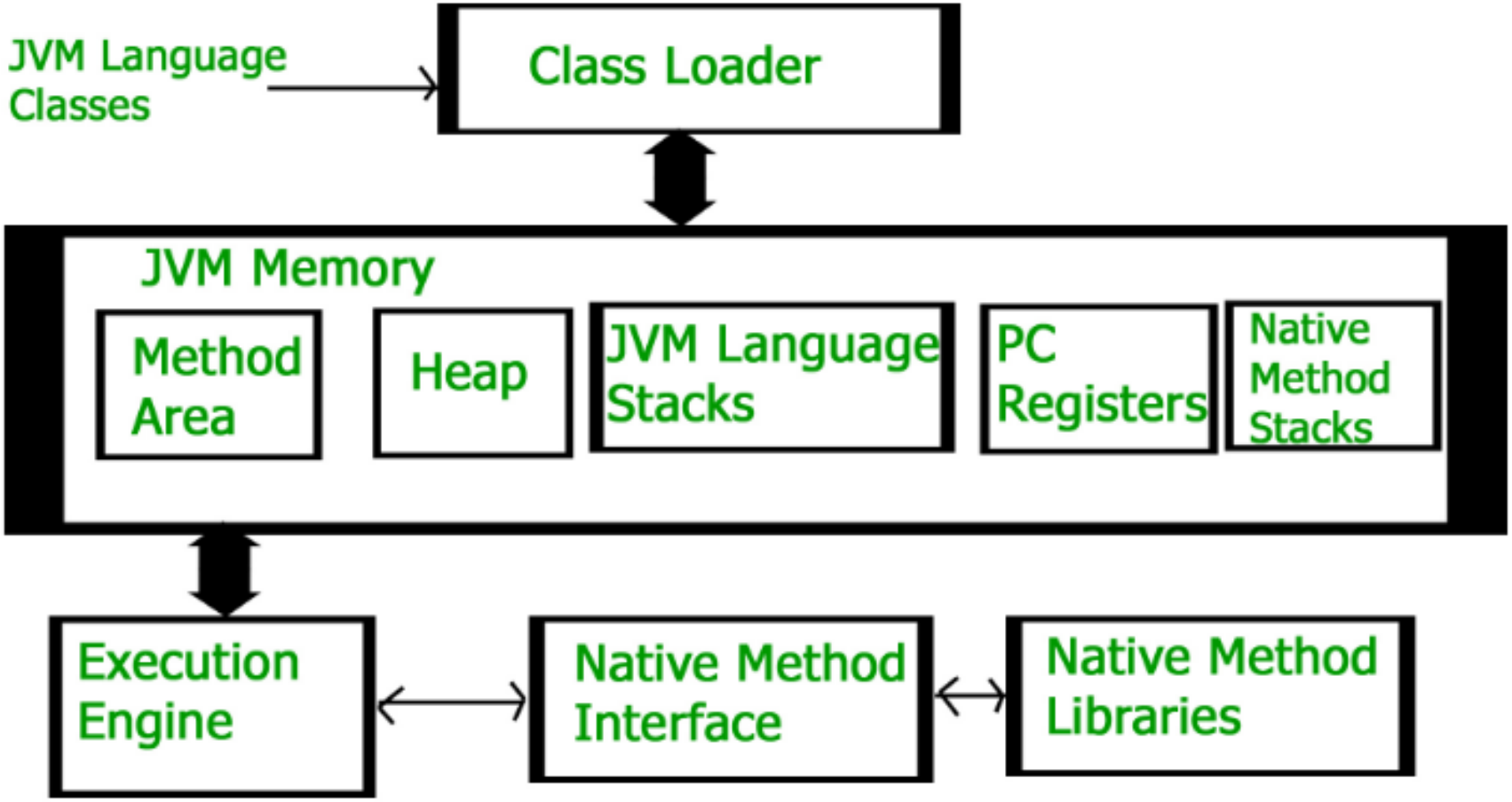
JAVA INTERNALS / ARCHITECTURE

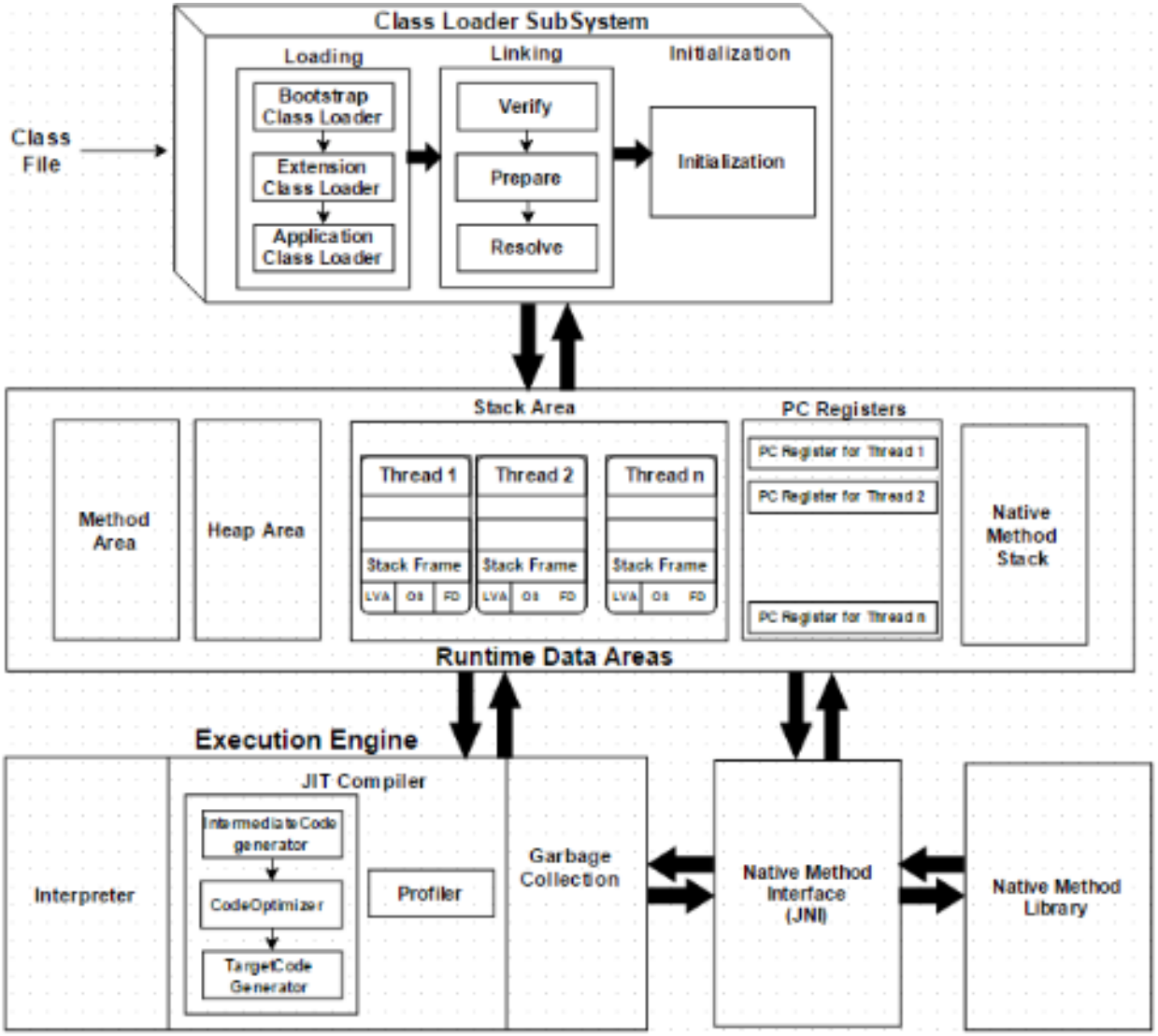
Java Conceptual Model (JVM/JRE/JDK)



JVM Architecture



JVM Architecture (detailed)



JVM Components – Class Loader Subsystem

- **Loading** - Classes will be loaded by this component
  - Boot Strap – Loads classes from the bootstrap classpath
  - Extension – Loads classes which are inside the ext folder
  - Application – Loads from Application Level Classpath, Environment Variable etc
- **Linking**
  - Verify - Bytecode verifier will verify whether the generated bytecode is proper or not
  - Prepare - For all static variables memory will be allocated and assigned with default values
  - Resolve - All symbolic memory references are replaced with the original references from Method Area
- **Initialization**
  - All static variables will be assigned with the original values, and the static block will be executed

JVM Components – Runtime Data Area

- Method Area - All the class level data will be stored here, including static variables
- Heap Area - All the Objects and their corresponding instance variables and arrays will be stored here
- Stack Area - For every thread, a separate runtime stack will be created.
  All local variables will be created in the stack memory.
- PC Registers - Each thread will have separate PC Registers, to hold the address of current executing
  instruction once the instruction is executed the PC register will be updated with the next instruction
- Native Method Stacks - Native Method Stack holds native method information.
  For every thread, a separate native method stack will be created.

JVM Components – Execution Engine

- Interpreter
- JIT Compiler
  - Intermediate Code Generator
  - Code Optimizer
  - Target Code Generator
  - Profiler
- Garbage Collectors
- Java Native Interface
- Native Method Libraries

JVM Internals - Memory Management

- Memory Spaces
  - Heap - Primary storage of the Java program class instances and arrays
    - Young Generation [Eden Space, Survivor Space]
    - Old Generation
  - PermGen/Metaspace - Primary storage for the Java class metadata
  - Native Heap - native memory storage for the threads, stack, code cache including objects such as MMAP files and third party native libraries

JVM Internals – Garbage Collectors

- Serial Garbage Collector - Single threaded. Freezes all app threads during GC
- Parallel Garbage Collector - Multi threaded. Freezes all app threads during GC
- Concurrent Mark Sweep - Multi threaded with shorter GC pauses
- G1 Garbage Collector - Divides heap space into many regions and GCs region have more garbage
- ZGC Garbage Collector -Non-generational, suitable for ultra low-latency real-time apps with large heap
- Shenandoah Garbage Collector - Multi region, generational, low pause garbage collector
- No-Op Garbage Collector (Epsilon) - Designed for testing apps with lowest GC overhead

JVM Internals – Hotspot

- Region of a computer program where a high proportion of executed instructions occur or where most time is spent during the program's execution
- **Client VM** - Tuned for quick loading. It makes use of interpretation.
- **Server VM** - Loads more slowly, putting more effort into producing highly optimized JIT compilations to yield higher performance
- **Tiered Compilation** - uses both the client and server compilers in tandem to provide faster startup time than the server compiler, but similar or better peak performance

Thank You!