The good, the bad, the native

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What
is
Cloud
Native

“Cloud-native technology is when engineers and software people utilize *cloud computing* to build tech that’s **faster** and more **resilient**, and they do that to meet customer demand really **quickly**.”

Priyanka Sharma, CNCF’s General Manager

https://learn.microsoft.com/en-us/dotnet/architecture/cloud-native/definition

https://aws.amazon.com/what-is/cloud-native/

https://cloud.google.com/learn/what-is-cloud-native

Microservices

Containers

Orchestration

Scalability

Cloud-native architectures employ infrastructure automation, helping to eliminate downtime due to human error. You can balance load based on demand, allowing you to **optimize cost** and **performance better**.

Lower costs

A streamlined software delivery process reduces the costs of delivering new updates and features. Cloud-native applications also allow for **sharing resources** and **on-demand consumption**, significantly lowering your operating costs.

Higher availability

Cloud-native architectures provide high availability and reliability as they reduce operational complexity, simplify configuration changes, and offer **autoscaling** and **self-healing**.

Cloud-native applications make the most of modern infrastructure's dynamic, distributed nature to achieve **greater speed**, agility, **scalability**, reliability, and **cost efficiency**.

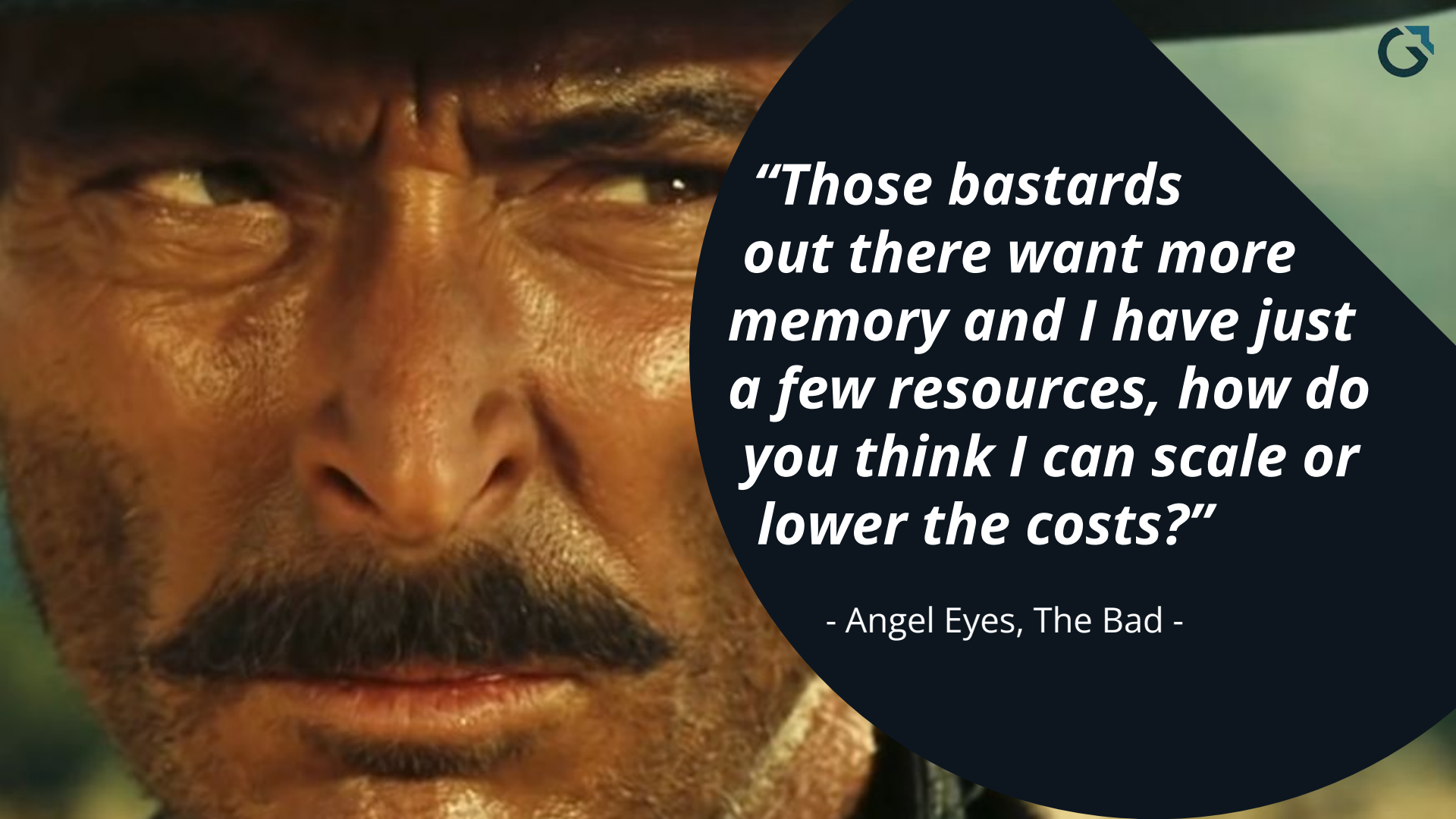
Smaller memory footprint

Less CPU consumption

Lower startup time

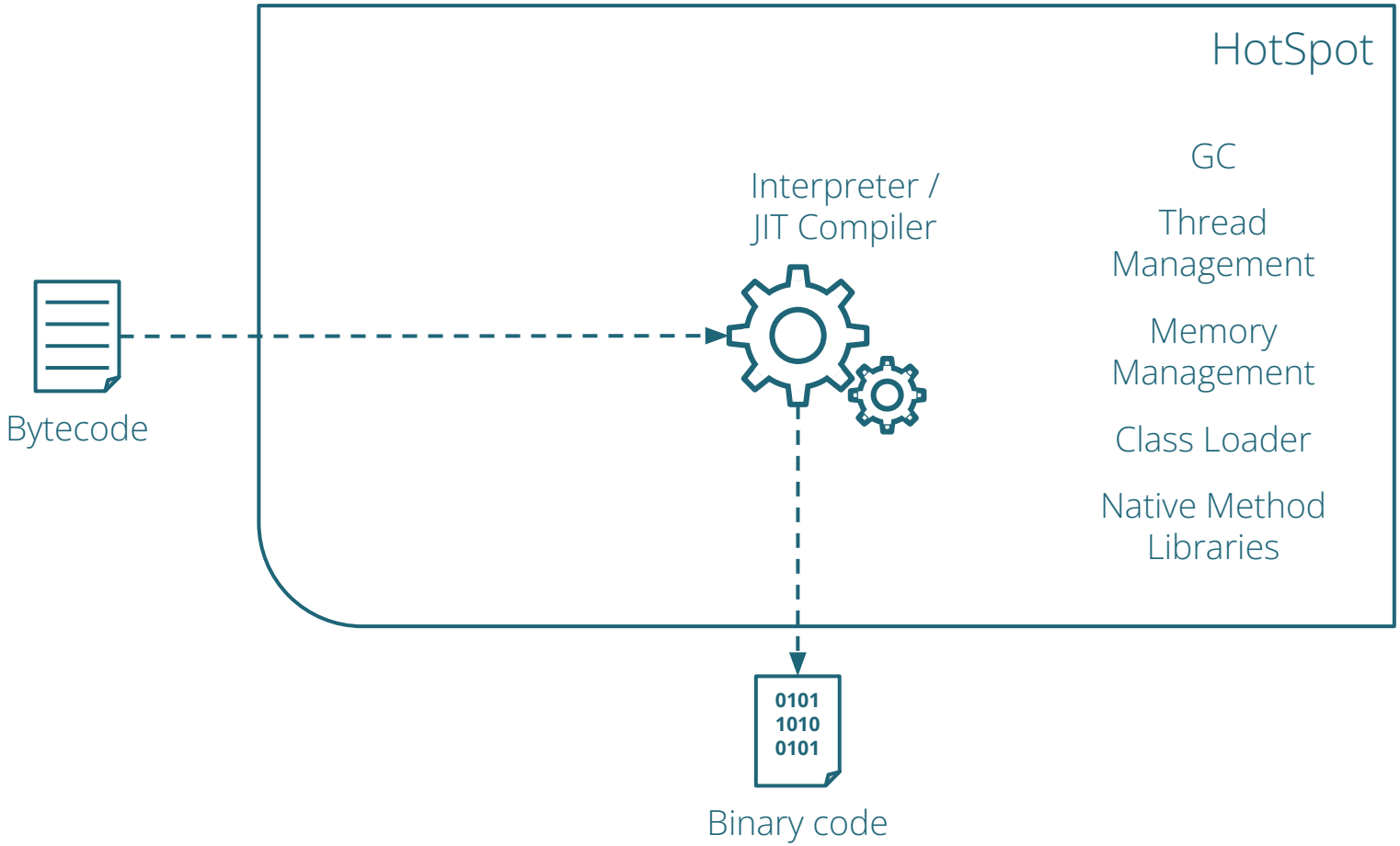
The JVM microservices frameworks ecosystem

Demo project


“Those bastards out there want more memory and I have just a few resources, how do you think I can scale or lower the costs?”
- Angel Eyes, The Bad -

GraalVM

The JVM is an **abstraction** of an underlying actual machine that **interprets** the *bytecode* generated by the compilation of a code supported by the JVM itself.


HotSpot
GC
Thread Management
Memory Management
Class Loader
Native Method Libraries
Interpreter / JIT Compiler
Bytecode
0101
1010
0101
Binary code

Interpreter

- Slow execution
- Interprets bytecode and collects profiling informations
- Fast startup

C1

- JIT
- Compiles code when it gets frequently executed
- Continue collecting profiling information
- Fast warmup

C2

- JIT
- Compiles and optimizes code when it's executed often enough and reaches certain thresholds
- Uses profiling informations
- High peak performance

Polyglot VM

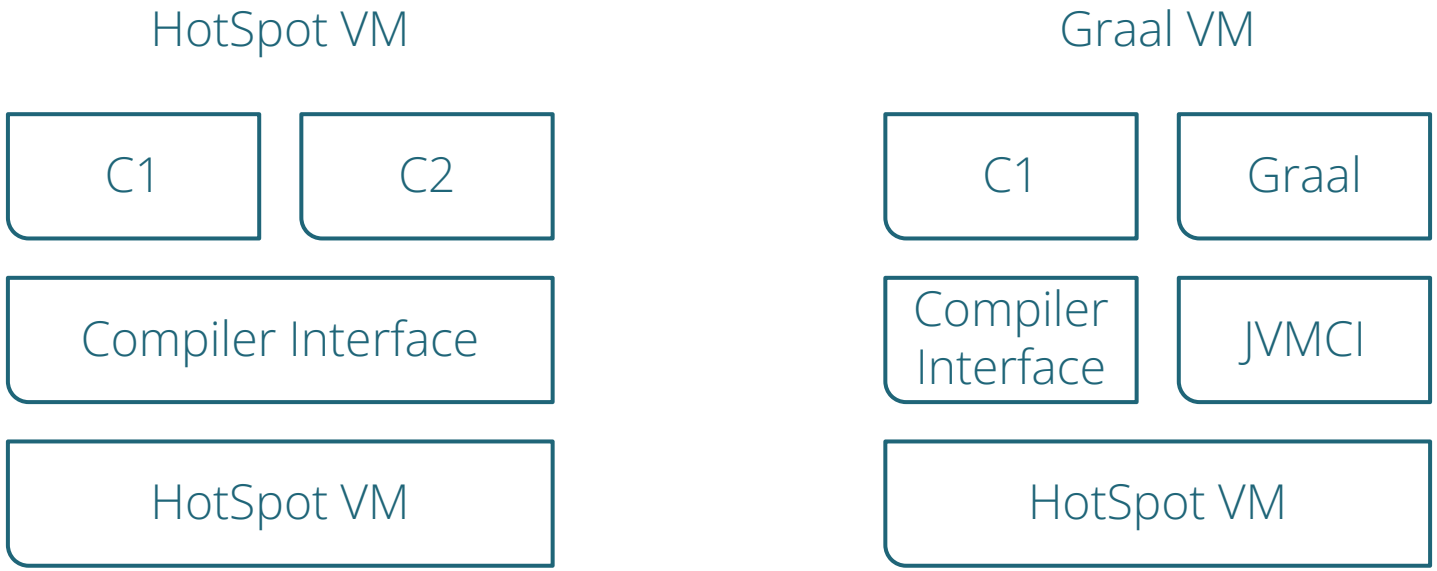
- Runtimes for many languages: Python, Ruby, Javascript, etc.

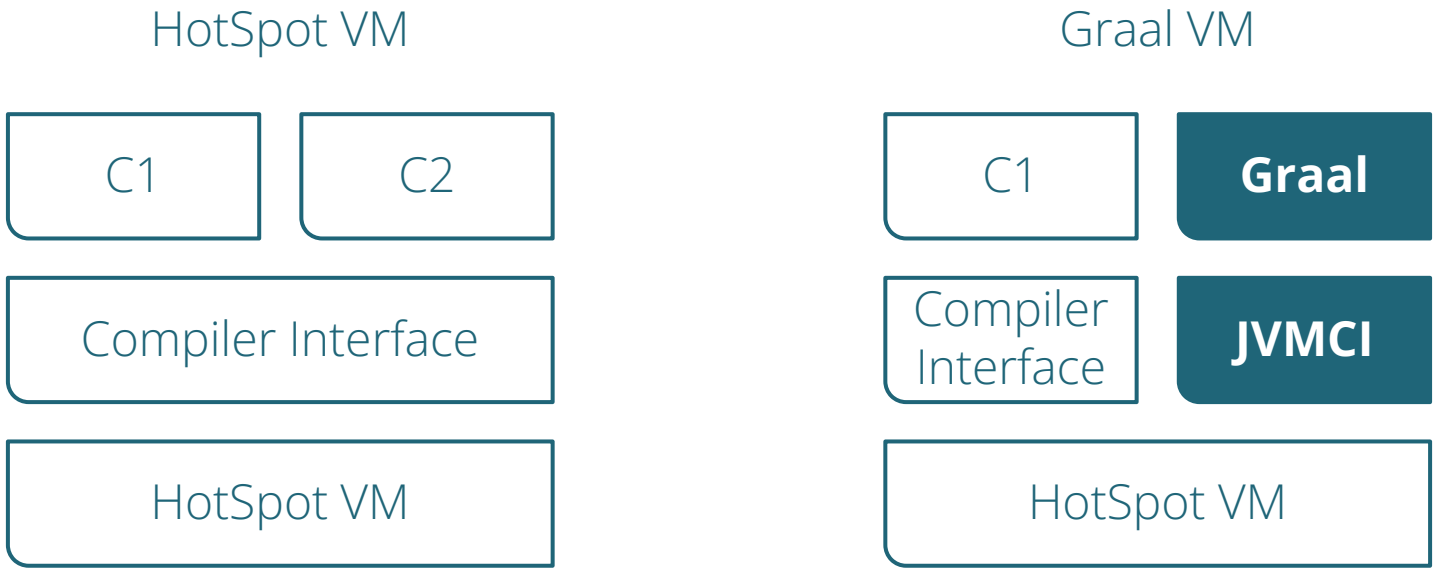
Graal compiler

- C2 implementation
- Various optimizations
- Removes unnecessary object allocations on the heap

Native image

- AOT
- Compiles to native platform executables


HotSpot VM
C1
C2
Compiler Interface
HotSpot VM
Graal VM
C1
Graal
Compiler Interface
JVMCI
HotSpot VM


HotSpot VM
C1
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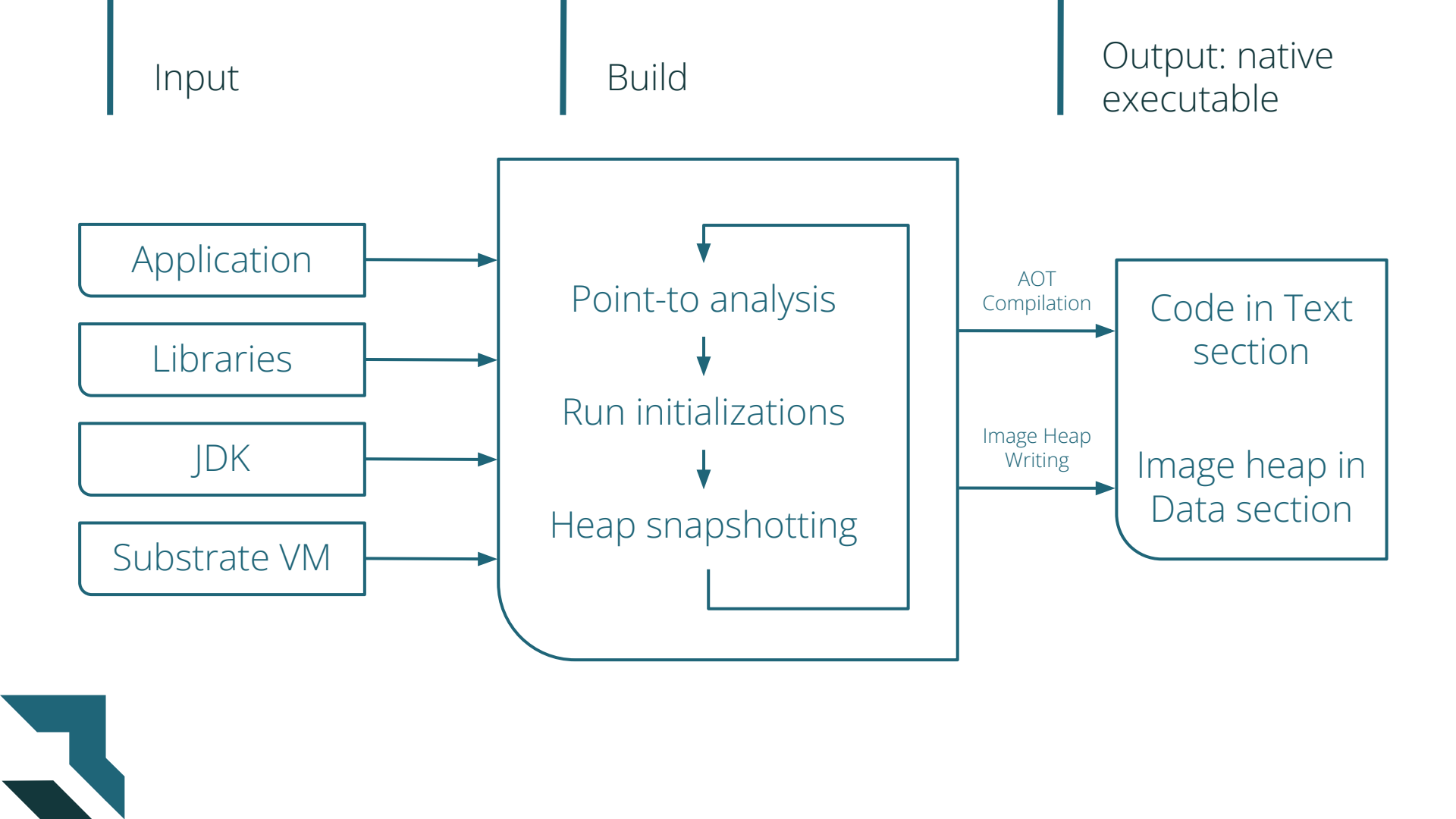
Ahead
Of
Time


Input
Build
Output: native executable
Application
Libraries
JDK
Substrate VM
Point-to analysis
Run initializations
Heap snapshotting
AOT Compilation
Image Heap Writing
Code in Text section
Image heap in Data section

Demo project - Native

Smaller memory footprint

Less CPU consumption

Lower startup time

Scalability

Lower costs

Higher availability

“I… I will sleep peacefully… because I know that the native… is watching over me”
- Blondie, The Good -

Native building drawbacks

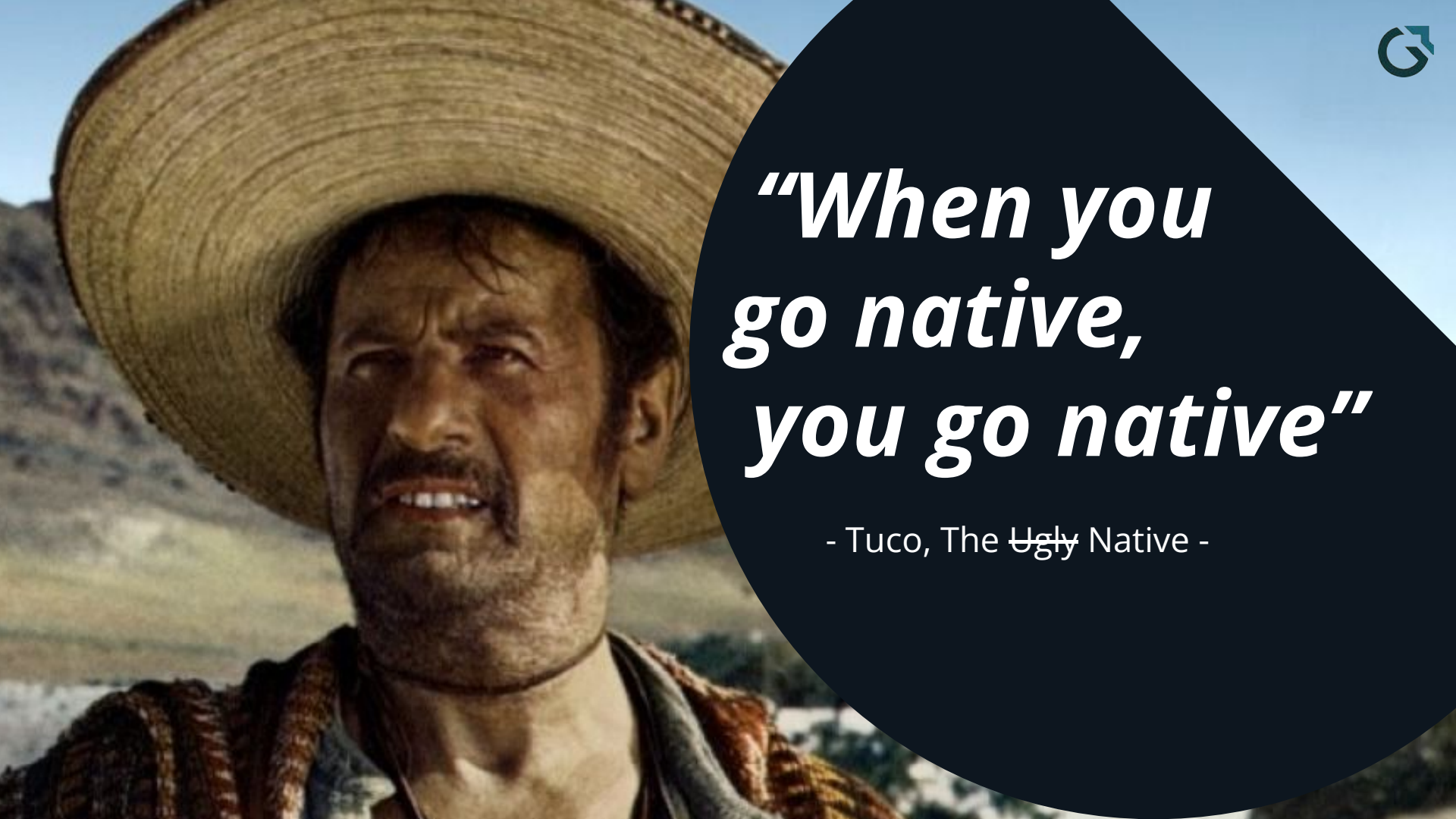
Native image takes **a lot** of time and needs **more resources** than bytecode generation.

Native image generates metadata performing static analysis under a **closed-world** assumption. Thus, some **dynamic** features require additional configuration: *reflection*, *dynamic proxying*, etc.

The **Tracing Agent** can be used to easily gather metadata and prepare configuration files.

Some libraries does not provide good enough **reachability metadatas**. Some include **dependencies** that we may need to manually exclude.

It is better to **avoid** *shaded* libraries.


“When you go native, you go native”
- Tuco, The ~~Ugly~~ Native -

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Priyanka Sharma, CNCF’s General Manager

Start using GraalVM native image

Use the Tracing Agent

Test the native executable or perform native tests

https://www.graalvm.org/22.0/reference-manual/native-image/

https://www.graalvm.org/latest/reference-manual/native-image/metadata/AutomaticMetadataCollection/

https://docs.spring.io/spring-boot/docs/current/reference/html/native-image.html

https://quarkus.io/guides/building-native-image

Thank you