



Wasmer

- Containers - A container format for Package Managers

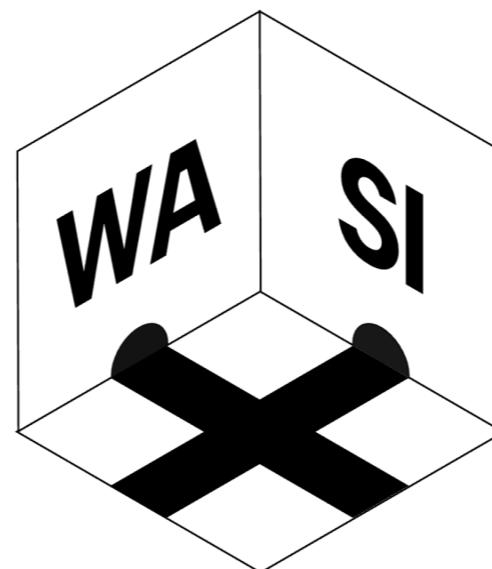


Rudra Arora

- Masters @TCD
- ❤️ open-source
- Maintainer - WASIX.org
- DevRel at Wasmer

**Wasmer makes software
universally available**

Wasmer Ecosystem



-  **Most popular Wasm Runtime with more than 16K ⭐ on GitHub**
- **Pluggable**
-  **Fun Fact! Our runtime is also called Wasmer**



- **Leading Wasm Registry**
- **Serving packages like python, FFMpeg, SpiderMonkey, Ruby, SQLite, PHP...**
- **Fun Fact! Uses Wasmer Container under the hood**



-  **In Beta**
-  **Fully based on Wasm Technology**
-  **Fun Fact! Also uses Wasmer Container under the hood**

We live and breathe
WebAssembly!

Presenting a new container format

But first...

“you don't need to run until you have the
, relay in your hand”

“you don't need to run until you have the
relay in your hand”

–By me, thought last night

Problems with OCI containers in Package Distribution & Edge Computing?



Slow Startup Time

12

-  **Requires Unpacking**
-  **Indexing of filesystem**
 - **Critical for Random File Access**



Platform Dependent

13

-  **execution environment defined per container**
- **X platform specific configuration**
 - **x86 doesn't work optimally in Mac M1/M2**



Analogy

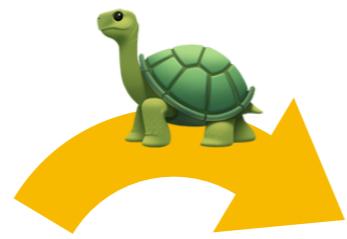
14

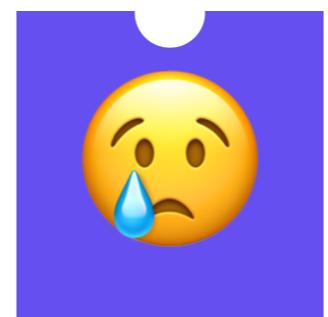




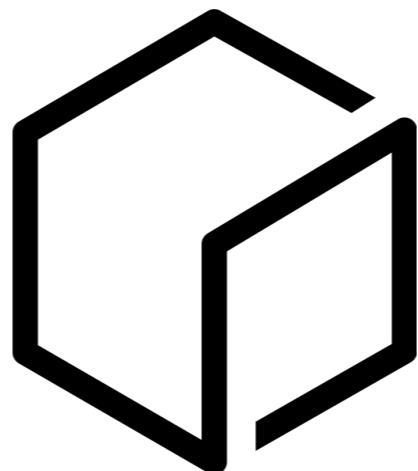
Analogy

15











Wasmer Containers



Design Considerations

20

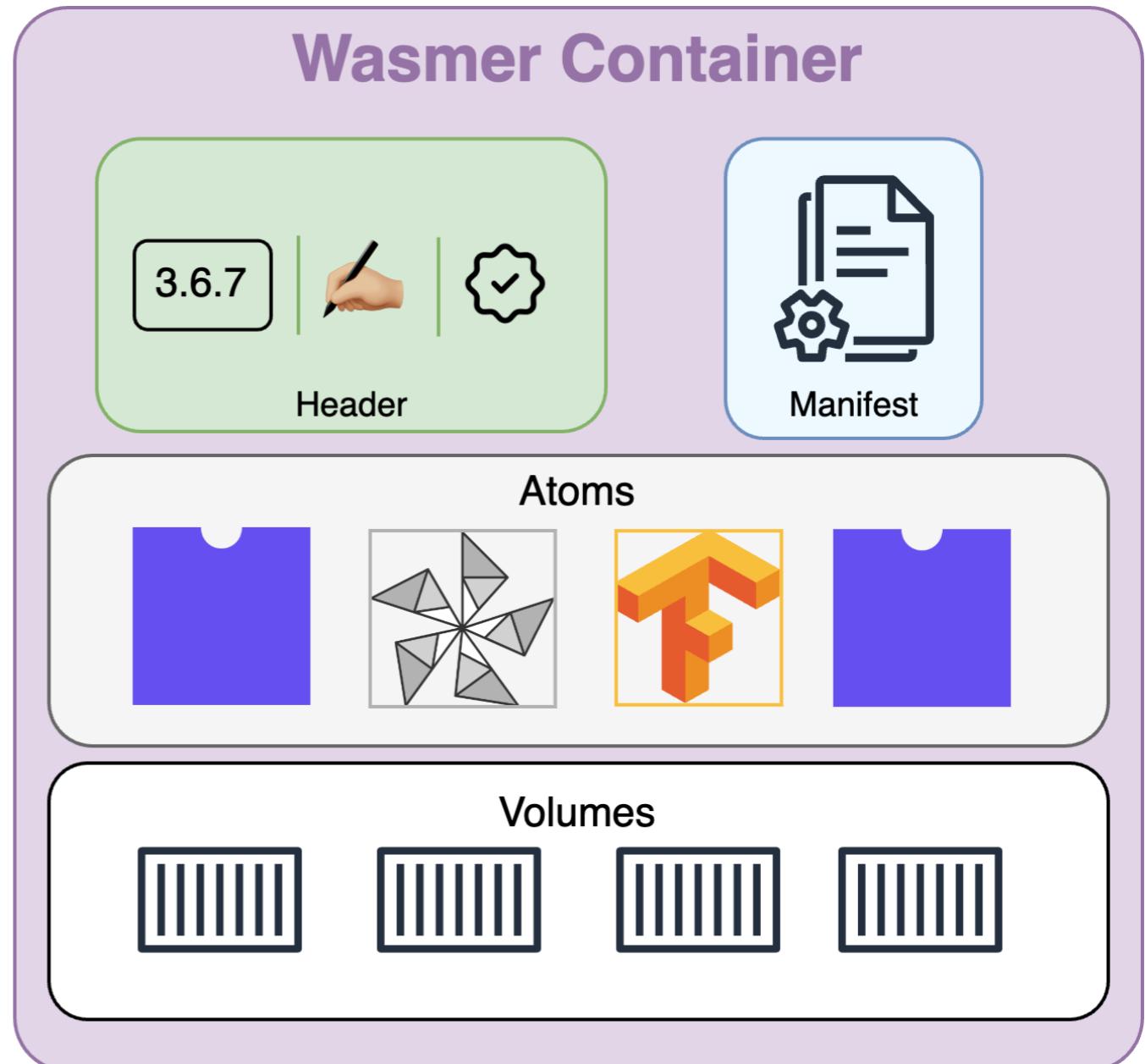
- Environment agnostic
- Small Binary Size
- Super fast File Access
- Verifiable



-  A Container Format
- Binary Layer \Leftrightarrow Data Layer like **WASM**
- Runtime agnostic
 -  once and run anywhere
 -  irrespective of the architecture



- Header
- Manifest
- Atoms
- File System Volumes



- Package metadata
- Defines computational units
- Defines Permissions in the host
- Stored as CBOR, specified as JSON

"package.json" for wasmer container

```
... manifest

{
  "use": { ... },
  "package": {
    "wasmer.registry": {
      "name": "mypackage",
      "version": "0.1.0",
      "license": "MIT",
      "description": "...",
      ...
    },
    "atoms": { ... },
    "commands": { ... },
    "entrypoint": "mycommand"
  }
}
```

- Executable Binaries ⚡
- Can be
 - WebAssembly Modules
 - ONNX Model
 - TensorFlow Model

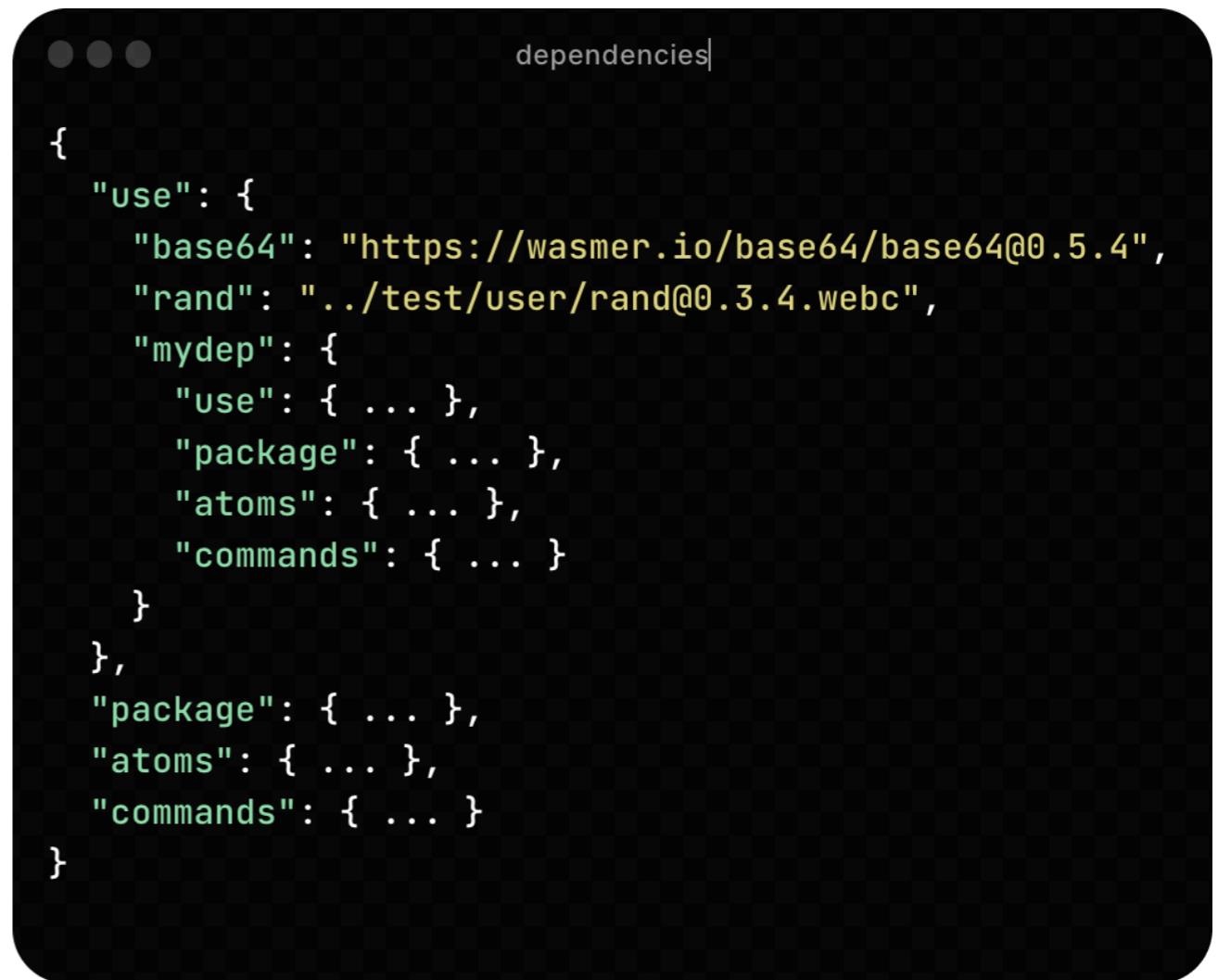
```
... atoms

{
  "use": { ... },
  "package": { ... },
  "atoms": {
    "a": {
      "kind": "https://webc.org/kind/wasm",
      "signature": "sha256:b73947205873..."
    },
    "b": {
      "kind": "https://webc.org/kind/tensorflow-SavedModel",
      "signature": "sha256:a673957meuzvcz37..."
    }
  },
  "commands": { ... },
  "entrypoint": "..."
}
```

- Volumes
 - Files
- Indexed
- No compression or encryption like WA
 - Fast File Access
 - Transport layer takes care of it

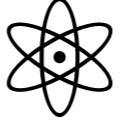
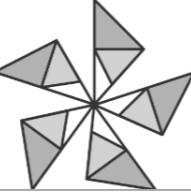


- Defined as
 - URL
 - filepath
 - Registry package
 -  Filesystem Isolation



```
dependencies

{
  "use": {
    "base64": "https://wasmer.io/base64/base64@0.5.4",
    "rand": "../test/user/rand@0.3.4.webc",
    "mydep": {
      "use": { ... },
      "package": { ... },
      "atoms": { ... },
      "commands": { ... }
    }
  },
  "package": { ... },
  "atoms": { ... },
  "commands": { ... }
}
```

	
	<ul style="list-style-type: none">• WASIX• WCGI• Emscripten
	<ul style="list-style-type: none">• ONNX Runner
	<ul style="list-style-type: none">• TensorFlow Runner
	<ul style="list-style-type: none">• POSIX System

*Inspired by Fuchsia

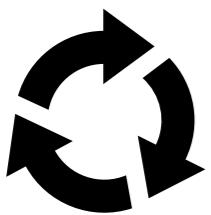


Python's Sample Manifest

28



Atom



Runner



Entry

```
python manifest

{
    "atoms": {
        "python": {
            "kind": "webc.org/kind/wasm",
            "signature": "sha256-2332341234"
        }
    },
    "commands": {
        "python": {
            "runner": "webc.org/runner/wasi/command@unstable_",
            "annotations": {
                "atom": "python",
                "ENV": ["PYTHON_HOME=/python"],
                "mountAtomInVolume": "/python/python.wasm"
            }
        },
        "pip": {
            "runner": "webc.org/runner/wasi/command@unstable_",
            "annotations": {
                "atom": "python",
                "ENV": ["PYTHON_HOME=/python"],
                "ARGS": "-m pip",
                "mountAtomInVolume": "/python/python.wasm"
            }
        }
    },
    "entrypoint": "python"
}
```

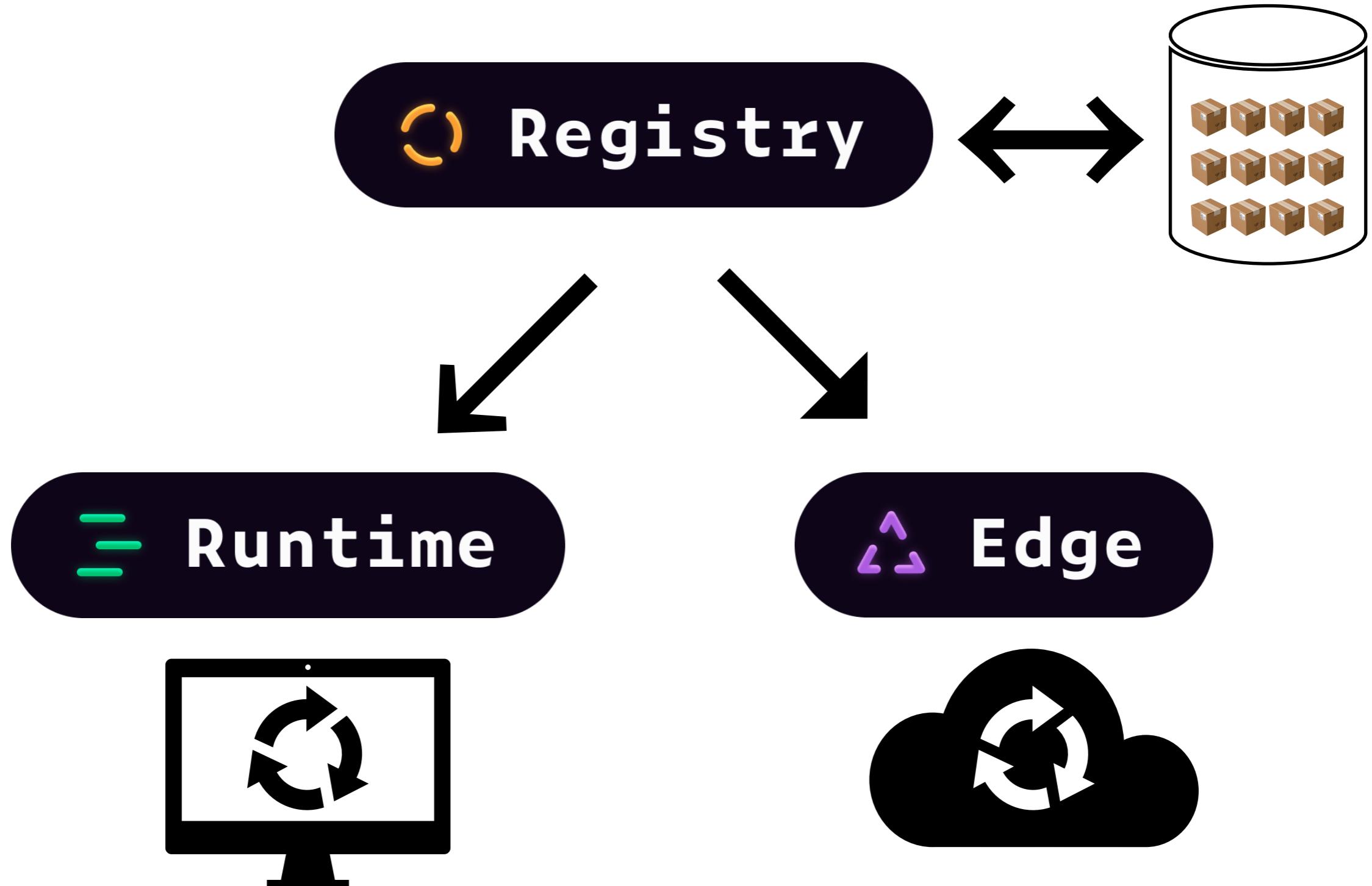
Advantages

29

- ~ Lazily Download per need
-  Leverage HTTP headers
-  Random File access in $O(1)$ time
- Cache shared Dependencies
- Precompile Artefacts

 Used Where?

30





Runs Everywhere

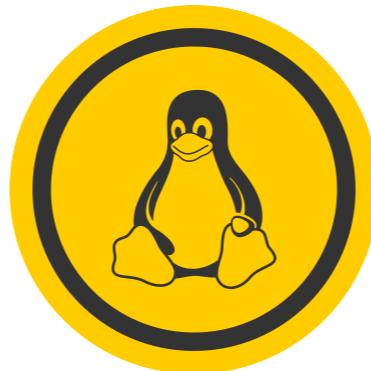
```
● ● ● ✘ 1                               wasmer run python/python
○ ~ ▶ uname -m
arm64
○ ~ ▶ wasmer run python/python
Python 3.6.7 (default, Feb 14 2020, 03:17:48)
[Wasm WASI vClang 9.0.0 (https://github.com/llvm/llvm-project 0399d5a9682b3cef7 on generic
c
Type "help", "copyright", "credits" or "license" for more information.
>>> █
```





Runs Everywhere

```
seb@Seb-PC:~/git/wasmer/target/release$ uname -a
Linux Seb-PC 5.15.90.1-microsoft-standard-WSL2 #1 SMP Fri Jan 27 02:56:13 UTC 2023 x86_64 GNU/Linux
seb@Seb-PC:~/git/wasmer/target/release$ ./wasmer run python/python
Python 3.6.7 (default, Feb 14 2020, 03:17:48)
[Wasm WASI vClang 9.0.0 (https://github.com/llvm/llvm-project 0399d5a9682b3cef7) on generic
Type "help", "copyright", "credits" or "license" for more information.
>>> print("hello")
hello
```



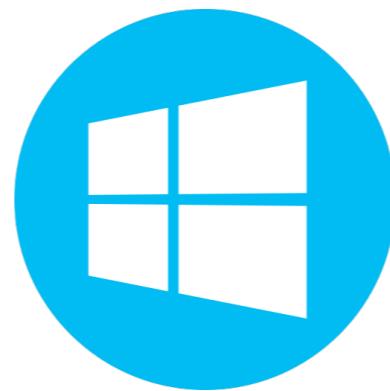


Runs Everywhere

```
Windows PowerShell
Copyright (C) Microsoft Corporation. Tous droits réservés.

Testez le nouveau système multiplateforme PowerShell https://aka.ms/pscore6

PS C:\Users\seb> 1:
PS L:> cd .\git\wasmer\target\release\
PS L:\git\wasmer\target\release> wasmer run python/python
Could not find platform dependent libraries <exec_prefix>
Consider setting $PYTHONHOME to <prefix>[:<exec_prefix>]
Python 3.6.7 (default, Feb 14 2020, 03:17:48)
[Wasm WASI vClang 9.0.0 (https://github.com/llvm/llvm-project 0399d5a9682b3cef7 on generic
Type "help", "copyright", "credits" or "license" for more information.
>>> print("hello")
hello
>>> |
```





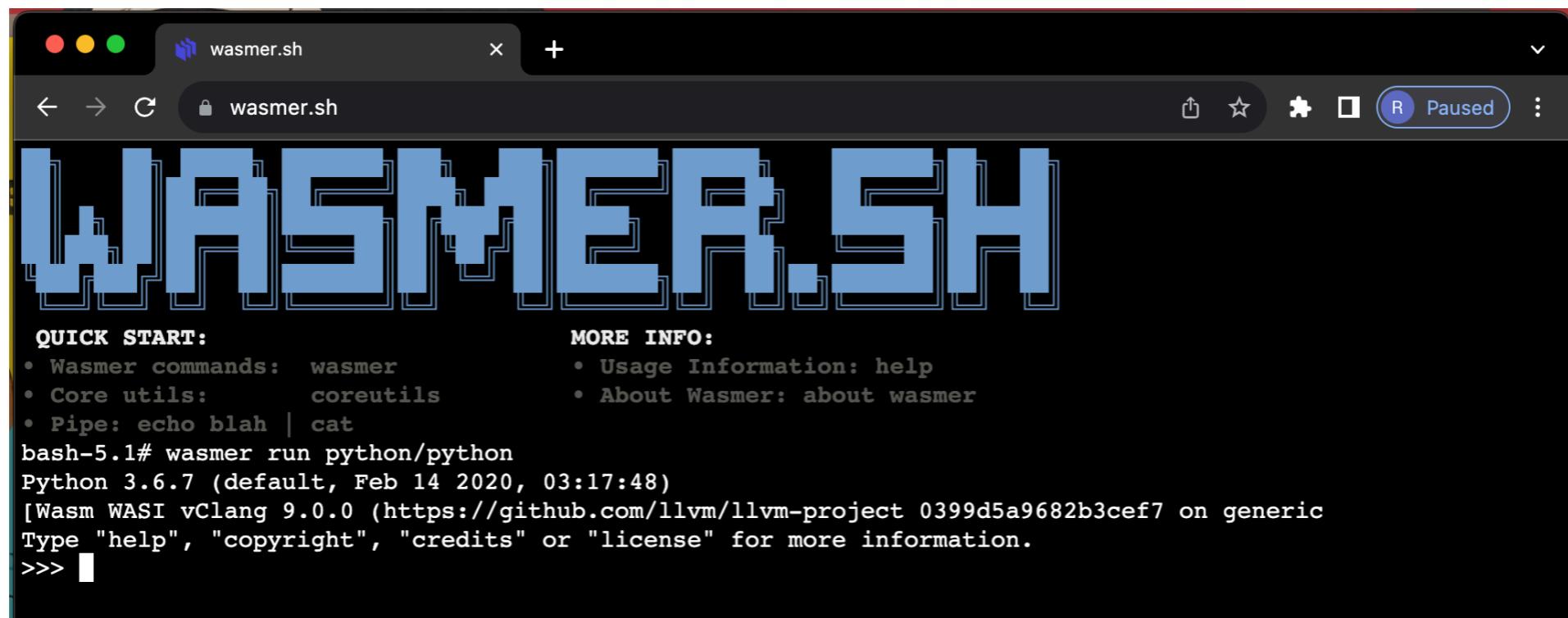
Runs Everywhere

```
seb@starfive:~/git/wasmer/target/release$ uname -a
Linux starfive 5.15.0-starfive #1 SMP Mon Feb 27 14:03:14 EST 2023 riscv64 GNU/Linux
seb@starfive:~/git/wasmer/target/release$ ./wasmer run python/python
Python 3.6.7 (default, Feb 14 2020, 03:17:48)
[Wasm WASI vClang 9.0.0 (https://github.com/llvm/llvm-project 0399d5a9682b3cef7) on generic
Type "help", "copyright", "credits" or "license" for more information.
>>> print("hello")
hello
>>> |
```





Runs Everywhere



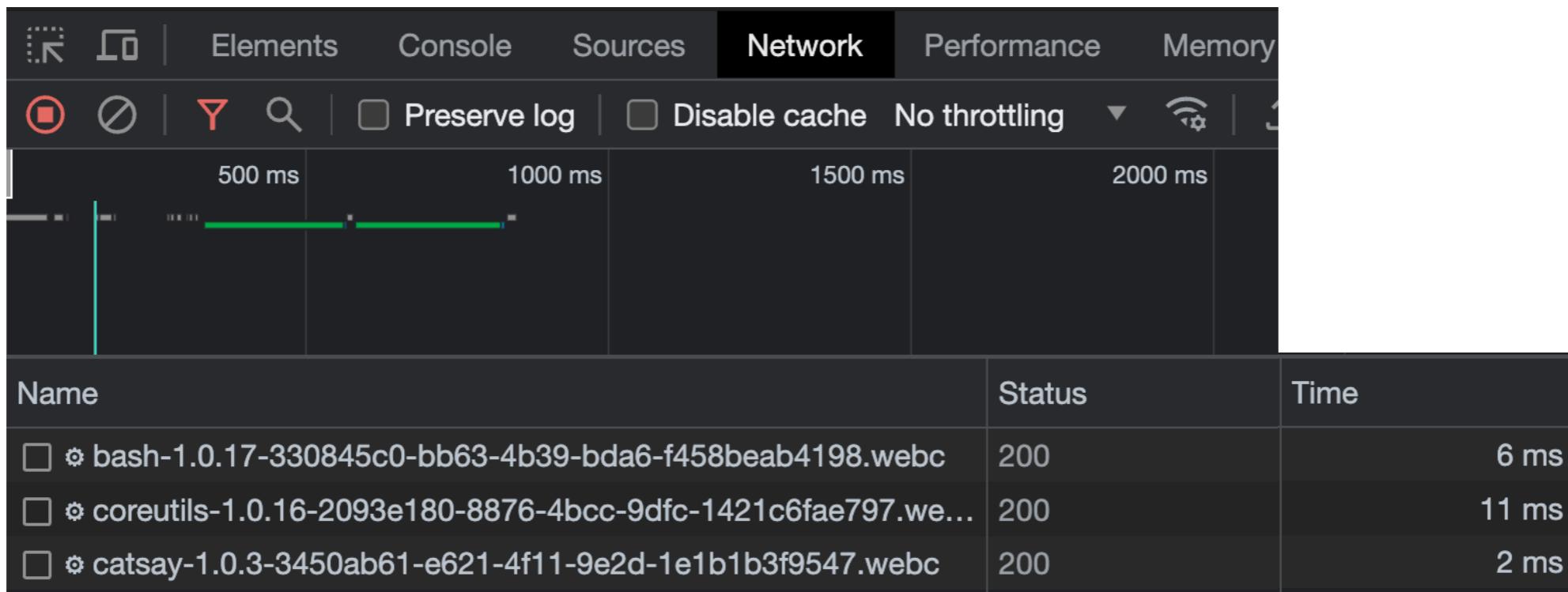


Demo Time



Under the hood - (incase demo gods don't align)

32

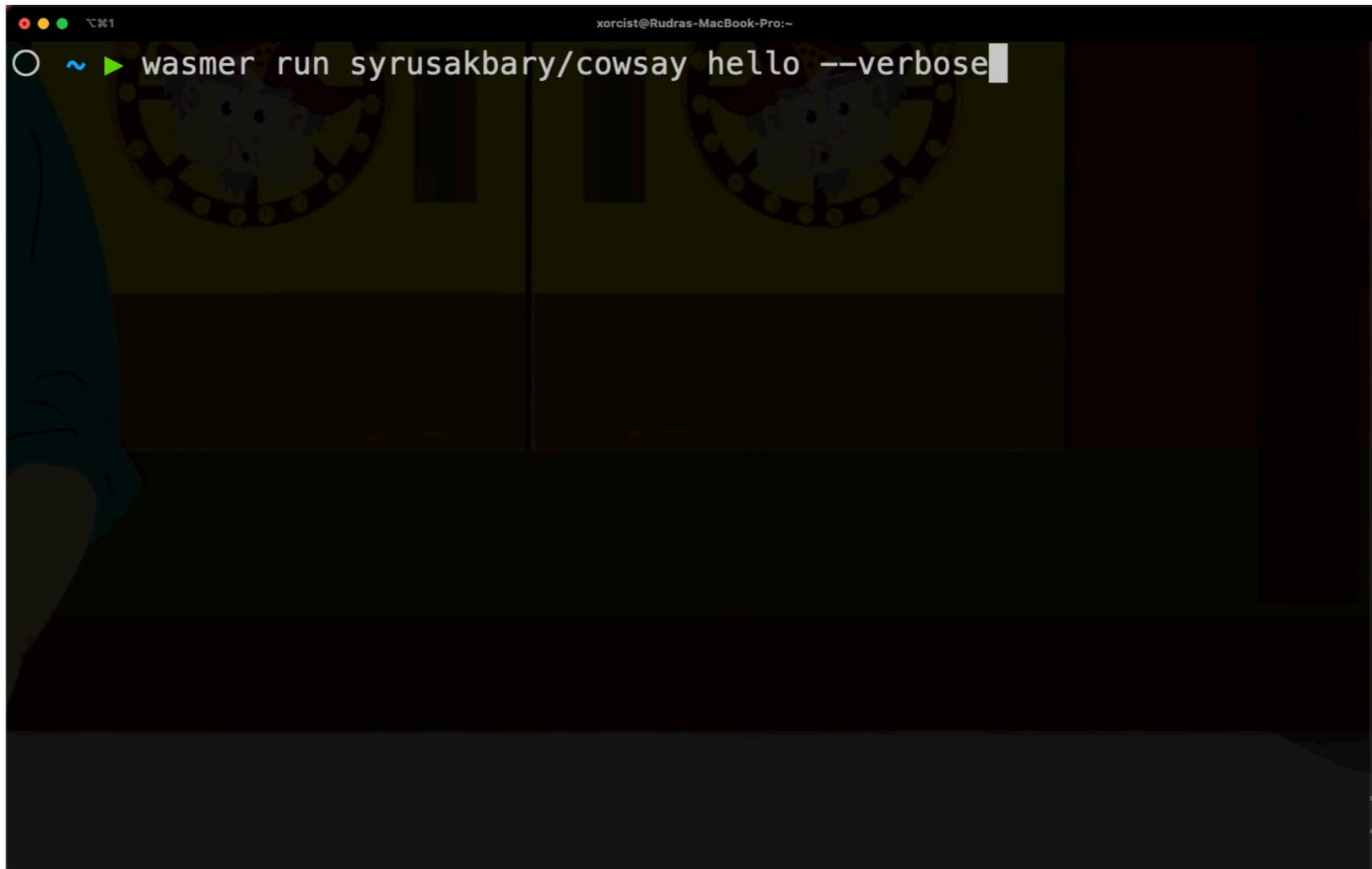




Under the hood - 🖥

(incase demo gods don't align)

33



A screenshot of a macOS terminal window titled 'Terminal'. The window has a dark background with a camouflage pattern. The title bar shows 'Terminal' and the user's name 'xorcist@Rudras-MacBook-Pro:~'. The command line shows the following text:

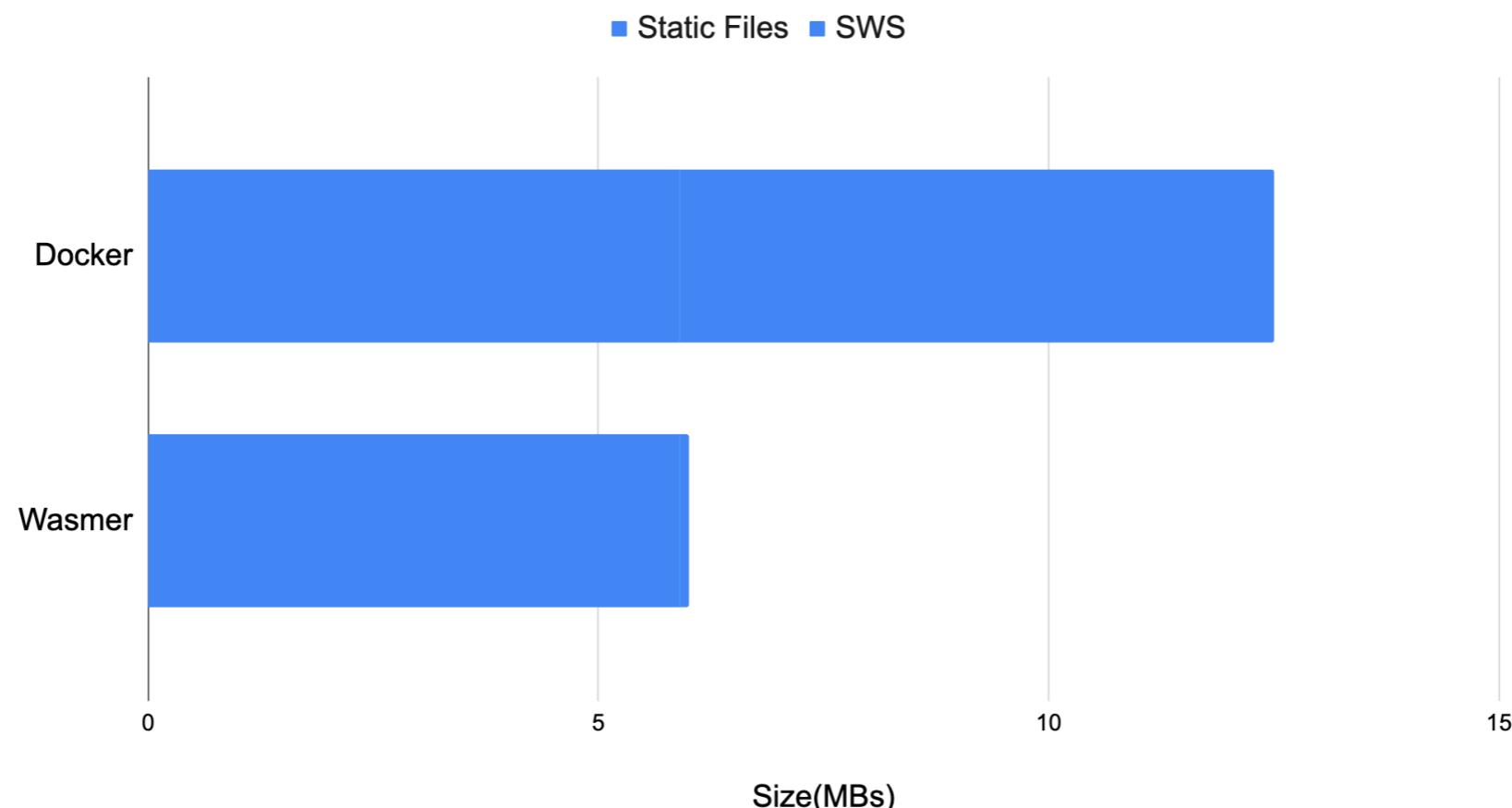
```
o ~ ▶ wasmer run syrusakbary/cowsay hello --verbose
```



Package Size

34

SWS - docs.wasmer.io and Static Files



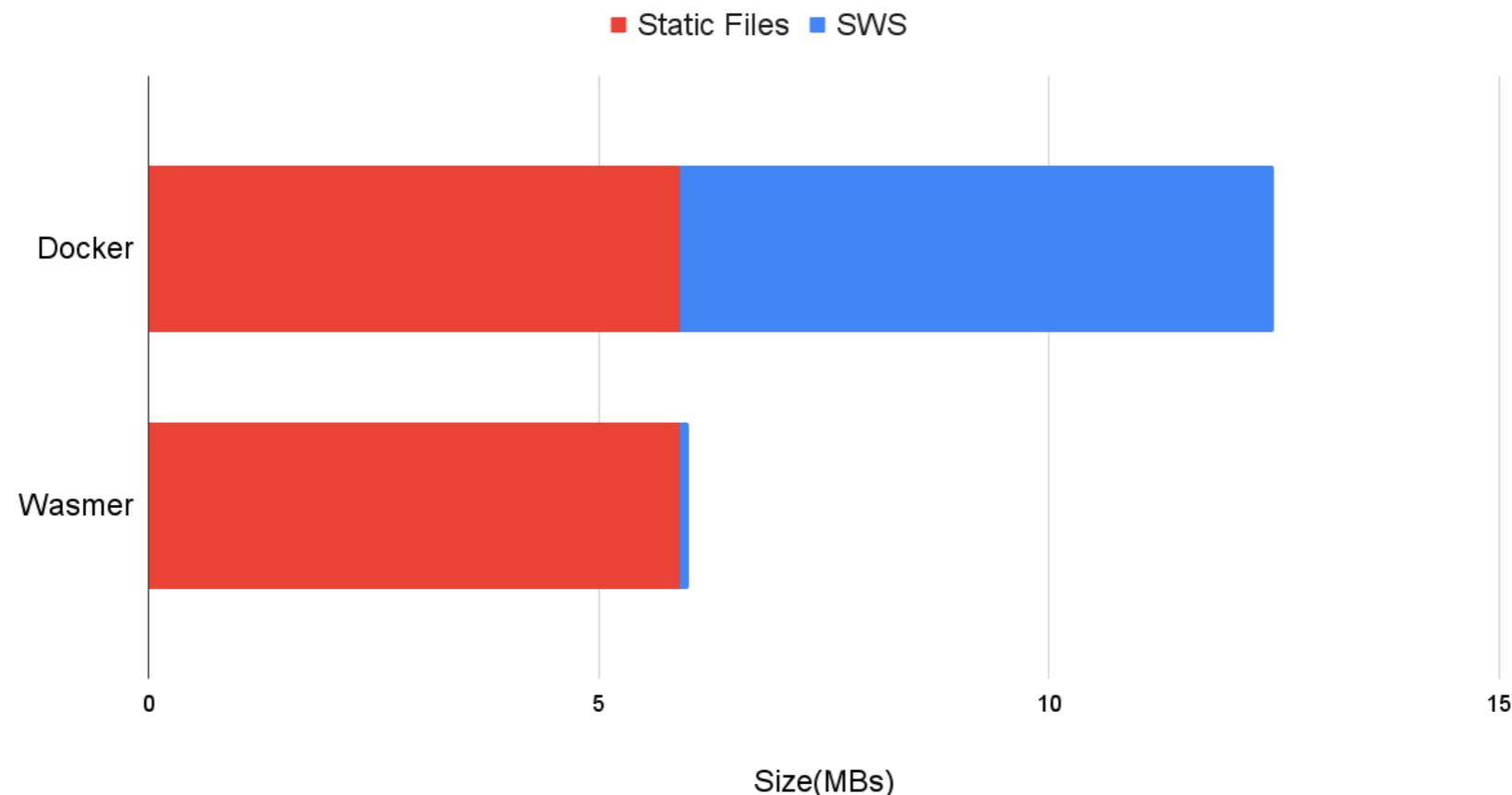
Lower is better*



Package Size

35

SWS - docs.wasmer.io and Static Files



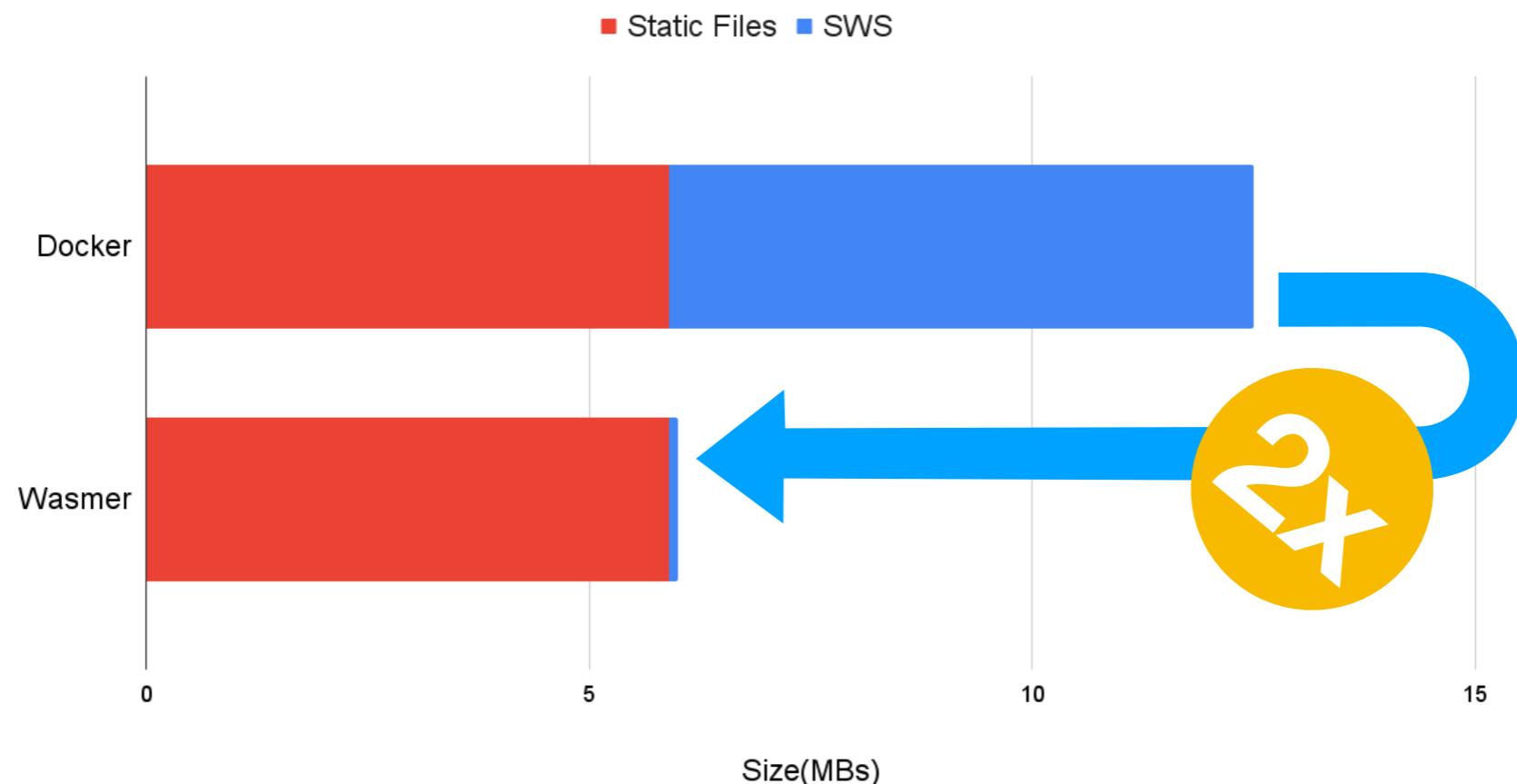
Lower is better*



Package Size

36

SWS - docs.wasmer.io and Static Files



Lower is better*



Package Size

37

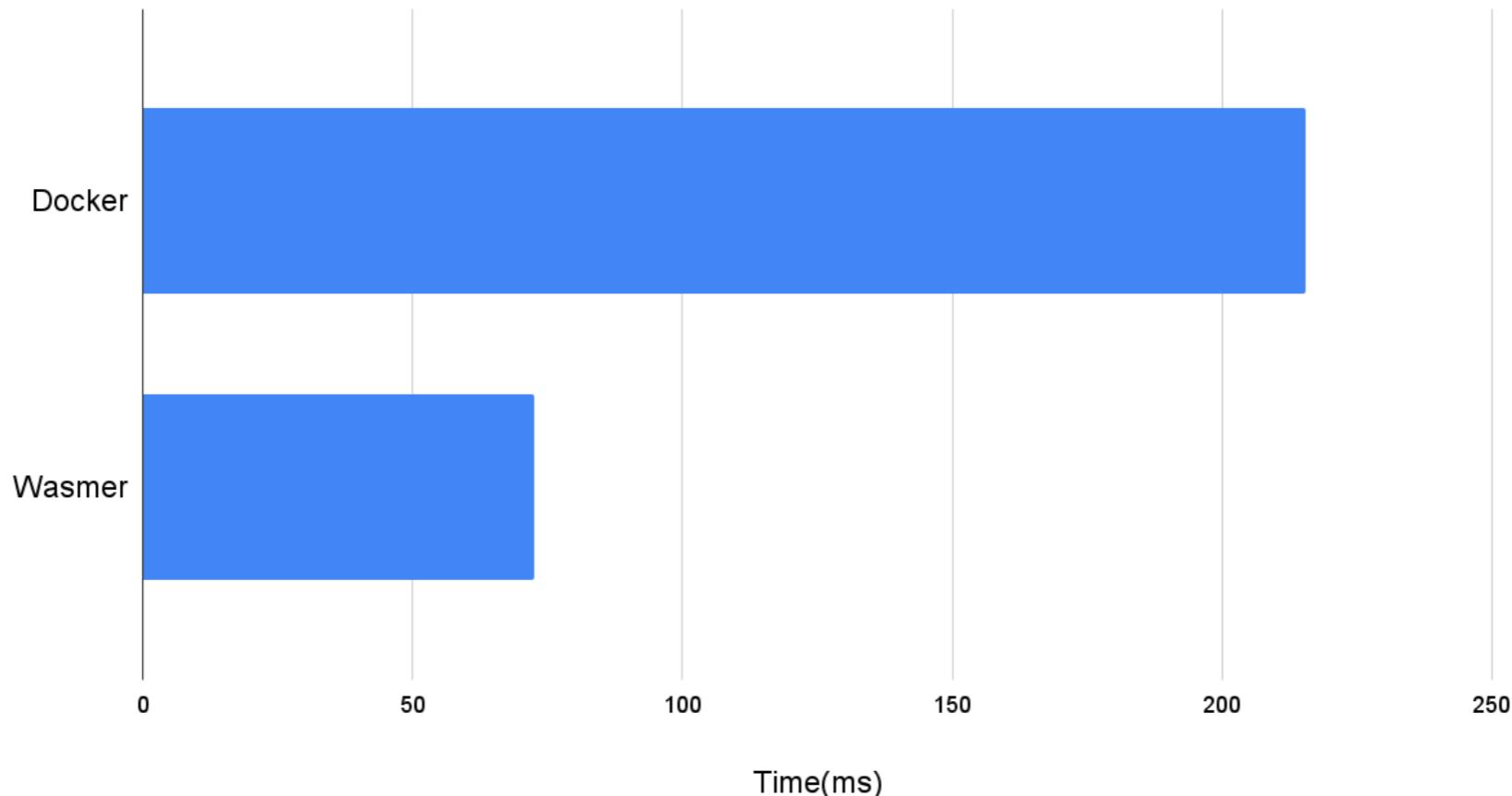
SWS - docs.wasmer.io and Static Files



⚡ Startup Time

38

SWS - docs.wasmer.io to serve first request

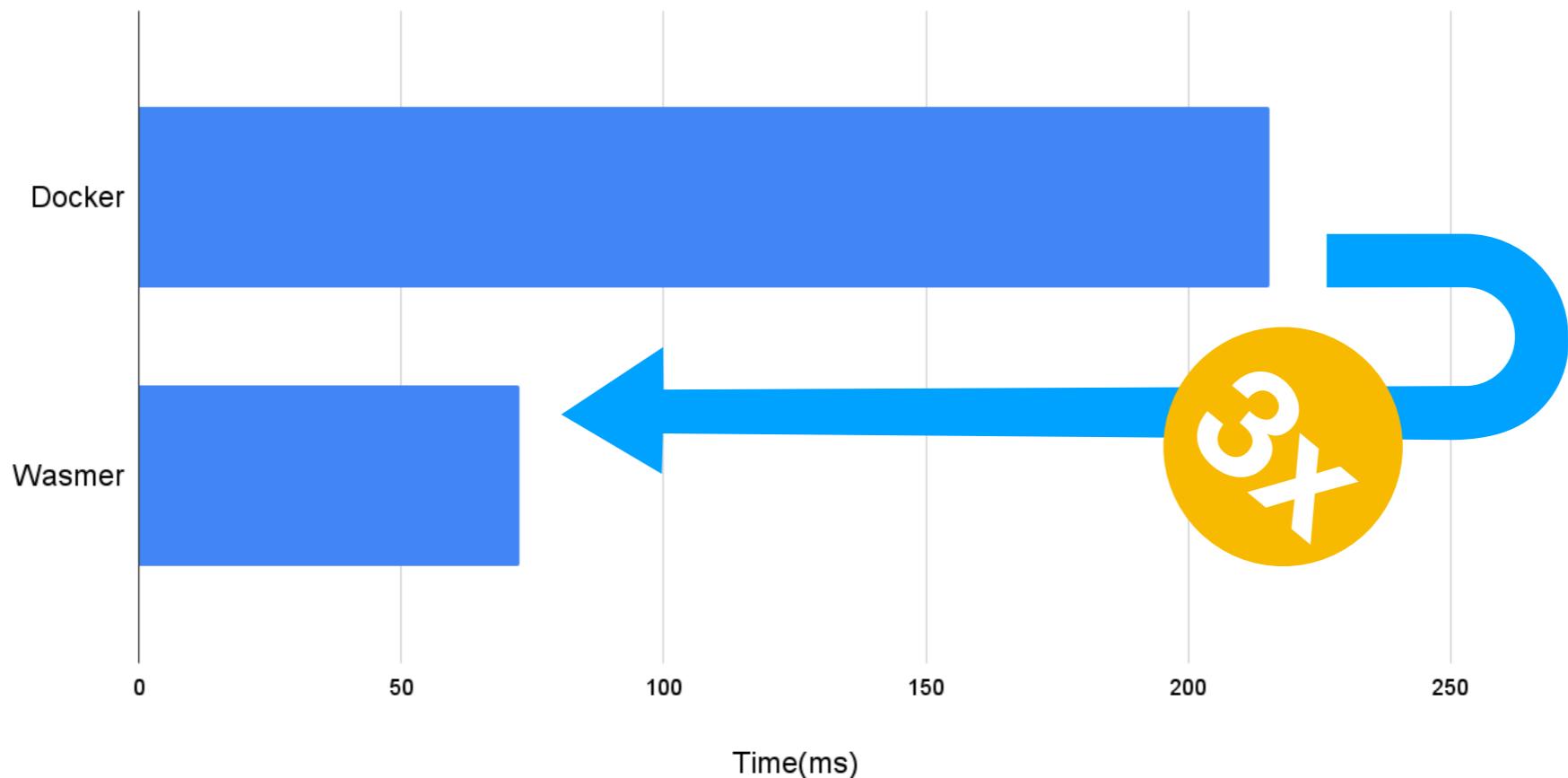


Lower is better*

⚡ Startup Time

39

SWS - docs.wasmer.io to serve first request



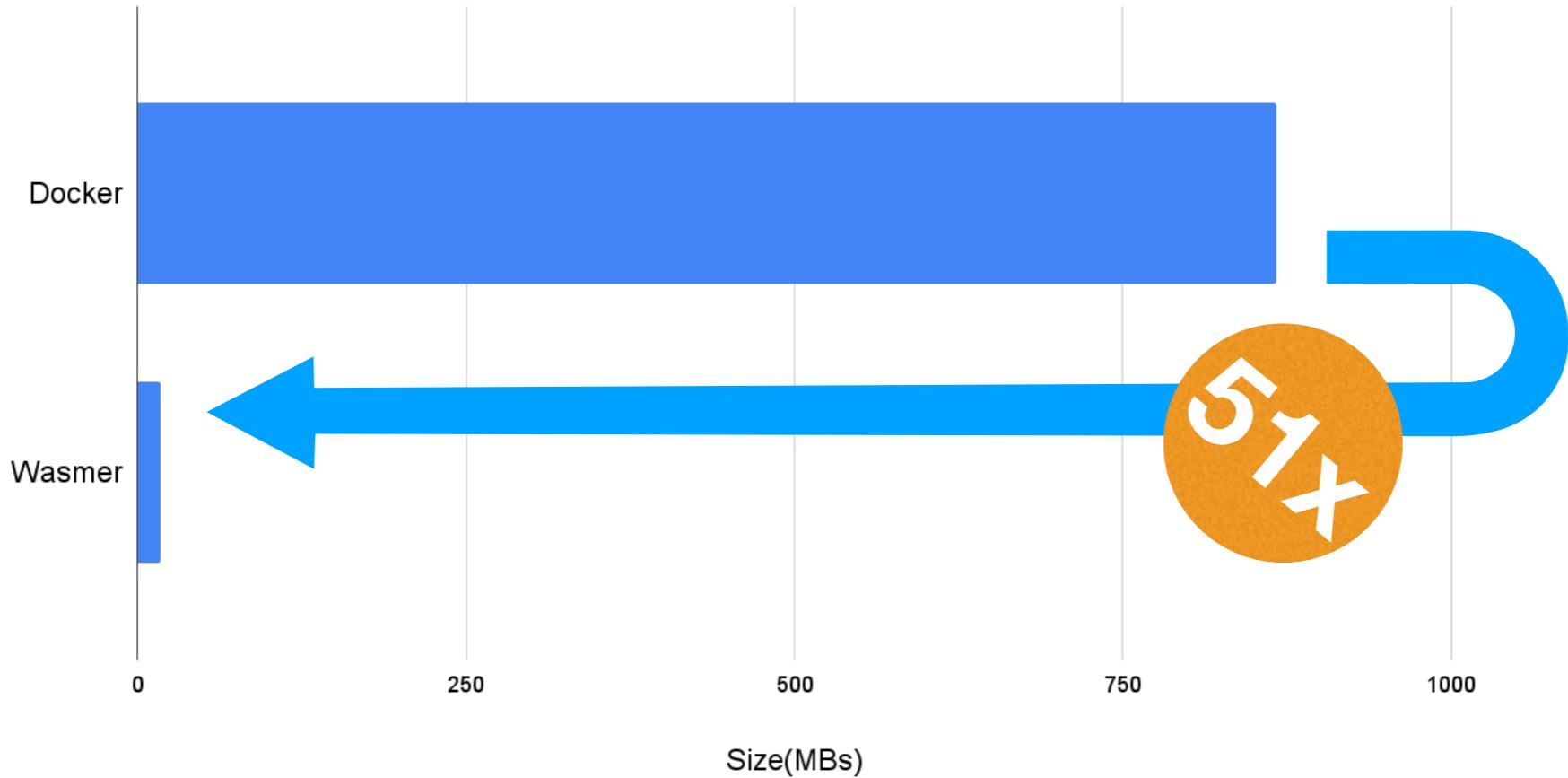
Lower is better*



Package Size

40

Python 3.6.7 image



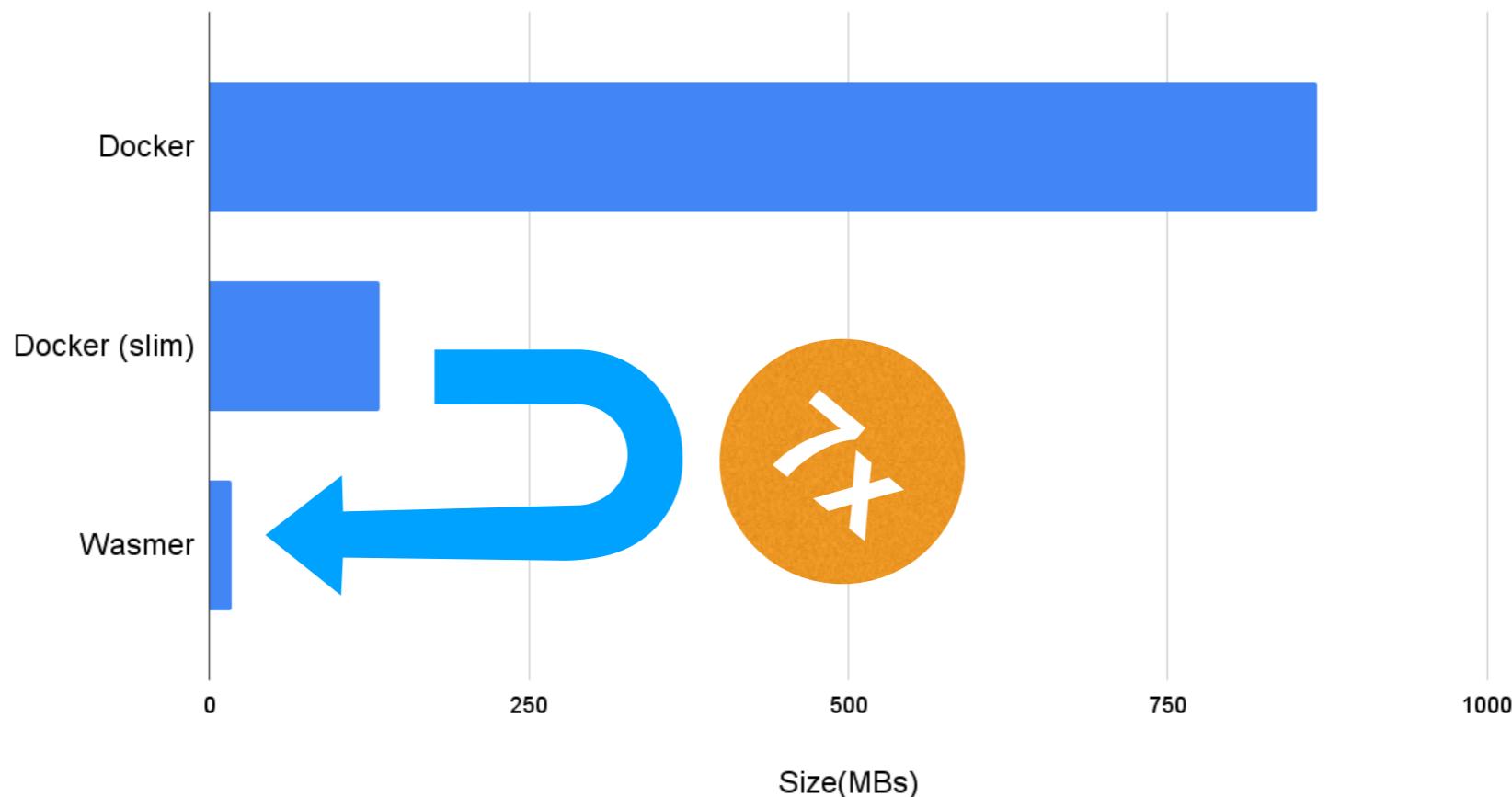
Lower is better*



Package Size

41

Python 3.6.7 image



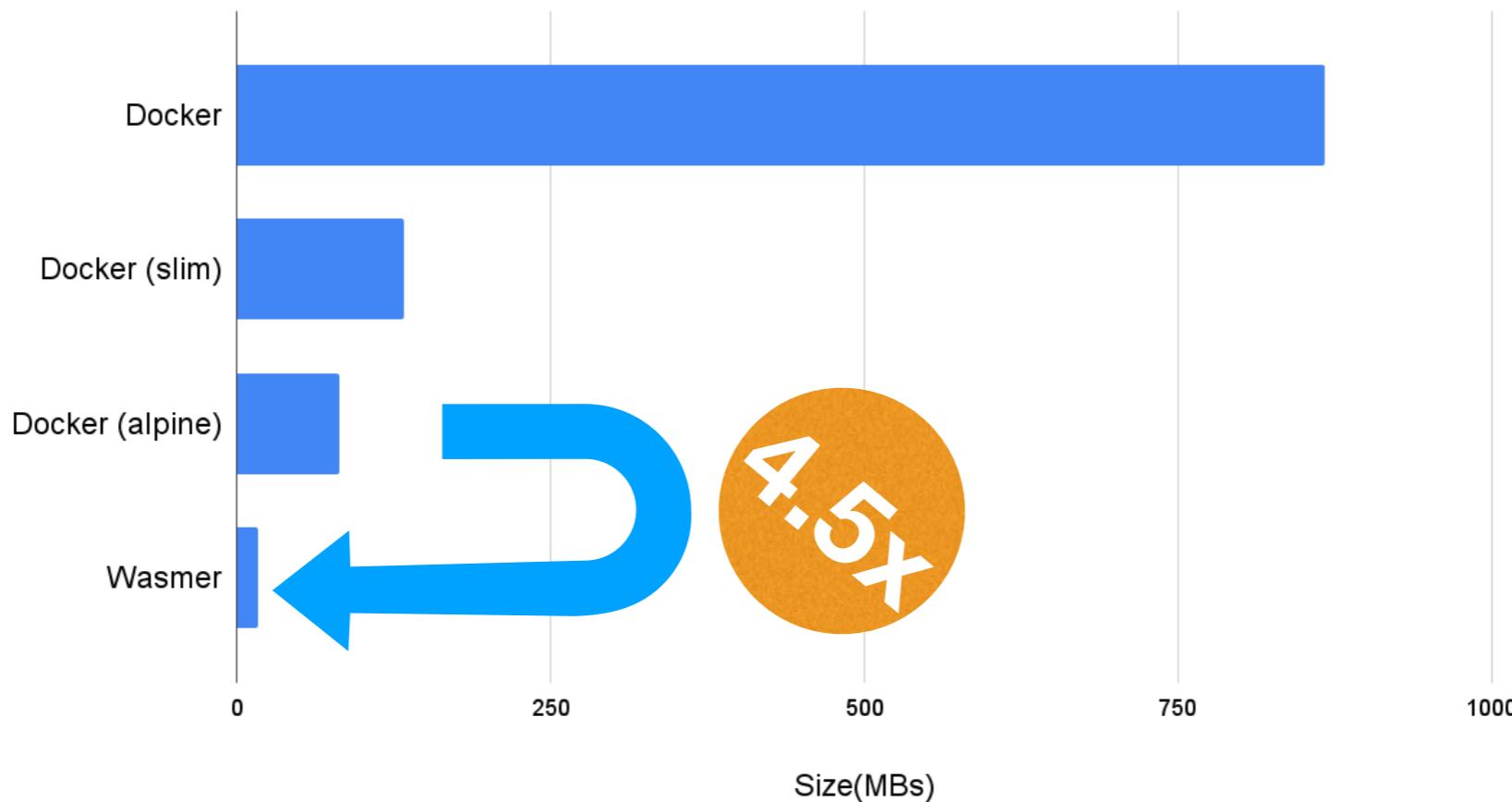
Lower is better*



Package Size

42

Python 3.6.7 image



Lower is better*



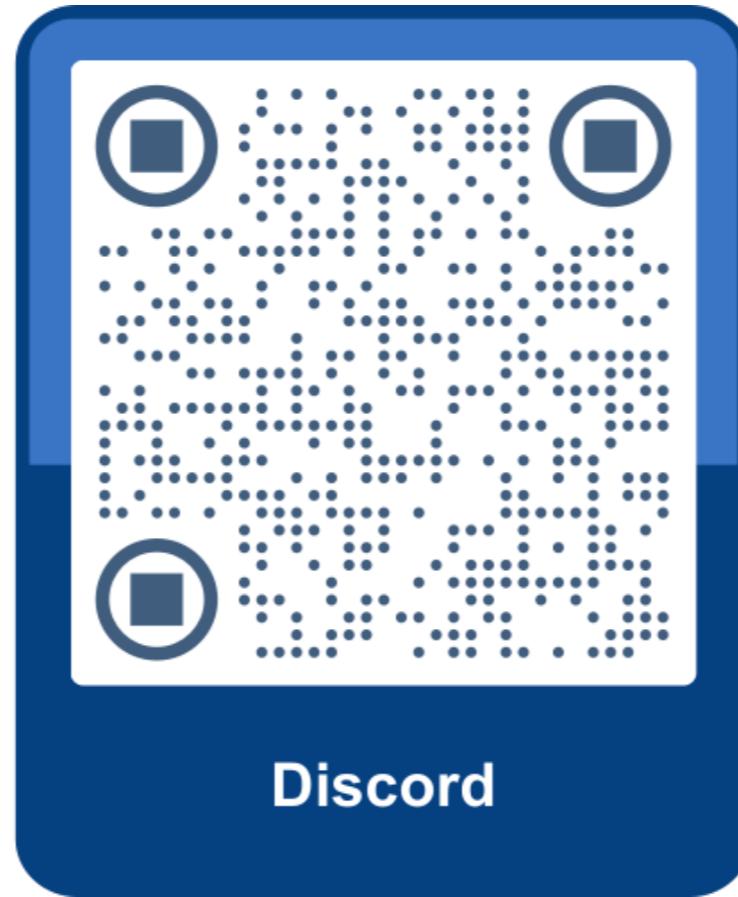
- W3C Subresource Integrity
- OCI
- Deno
- WebPackages
- Emscripten
- JARs
- Fuchsia Components
- Chrome Extensions
- Canonical Snap
- Android Permissions
- iOS entitlements
- Git Index





Wasmer Containers

Will be open-source



 **wasmer.io**

X **@wasmerio**



Thank You



Q/A