How to make a world-class integration testing library?

Testcontainers

testcontainers.org

testcontainers-rs Public

A library for integration-testing against docker containers from within Rust.

Rust 173 50 23 (5 issues need help) 6 Updated 2 hours ago

testcontainers-java Public

Testcontainers is a Java library that supports JUnit tests, providing lightweight, throwaway instances of common databases, Selenium web browsers, or anything else that can run in a Docker container.

Java 5,580 MIT 1,100 355 (26 issues need help) 106 Updated 2 hours ago

testcontainers-scala Public

Docker containers for testing in scala

Scala 479 MIT 83 16 2 Updated yesterday

testcontainers-go Public

Testcontainers is a Golang library that providing a friendly API to run Docker container. It is designed to create runtime environment to use during your automatic tests.

Go 1,190 MIT 172 51 20 Updated yesterday

testcontainers-python Public

Python 452 Apache-2.0 101 20 (3 issues need help) 22 Updated 3 days ago

Oleg Šelajev

Developer relations

@shelajev

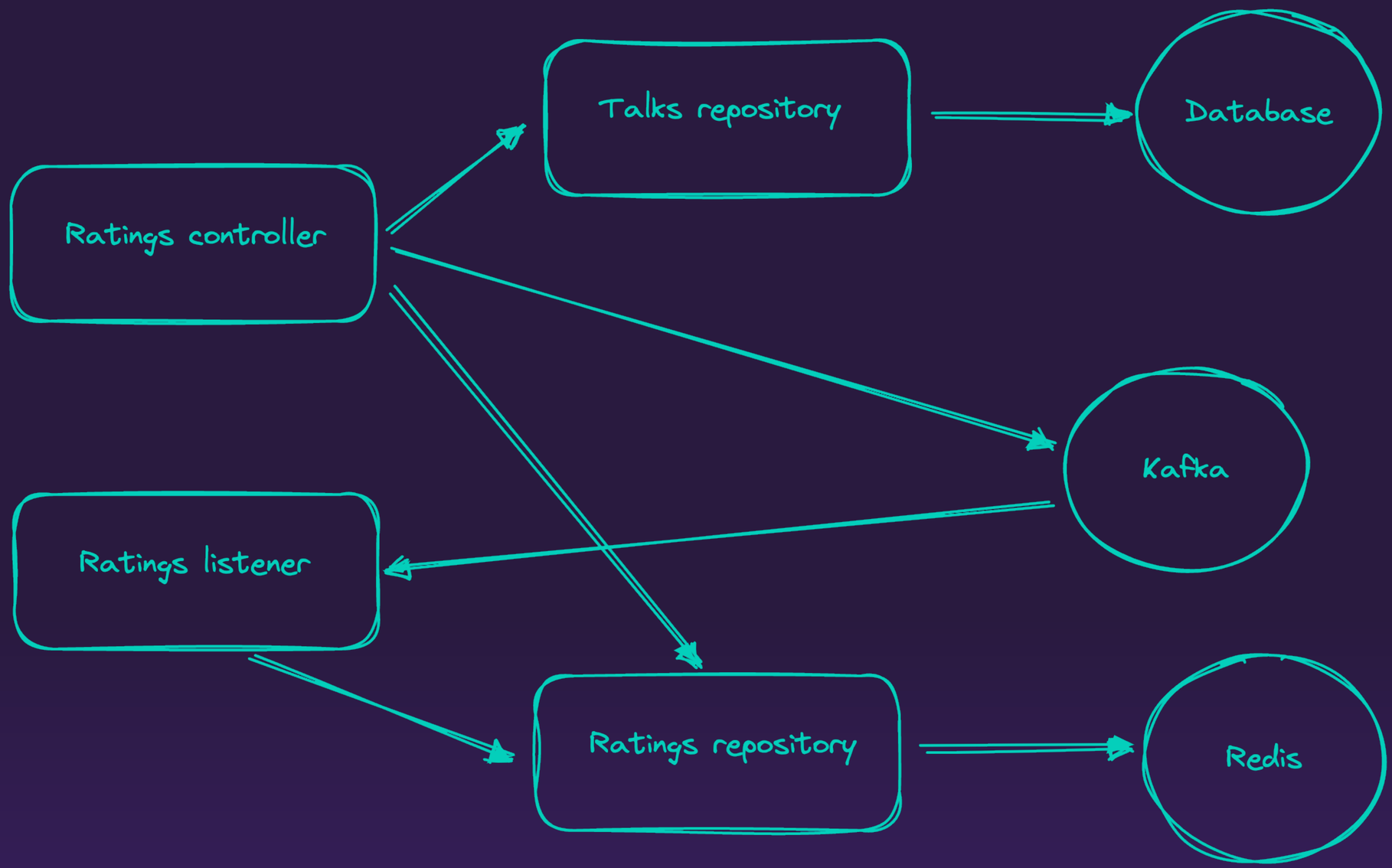
github.com/shelajev

oleg@atomicjar.com

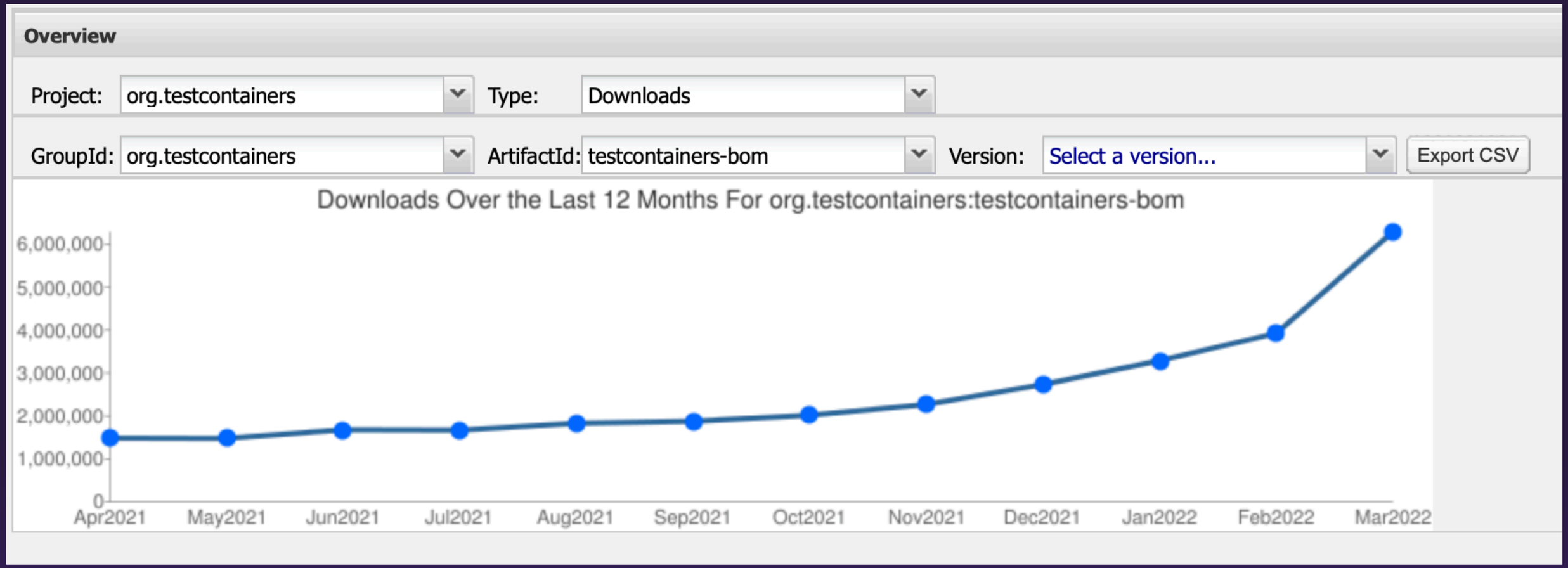
ATOMICJAR

Model:

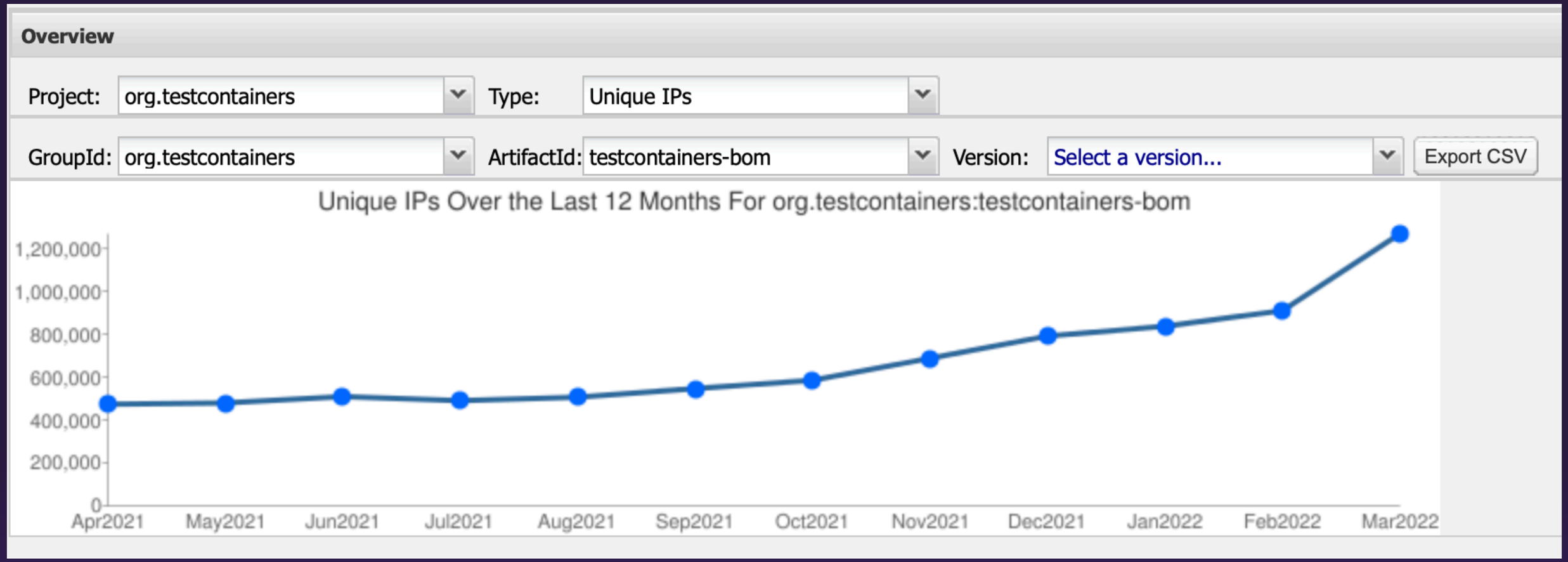
```
record Rating (String talkId, Integer value) {}
```

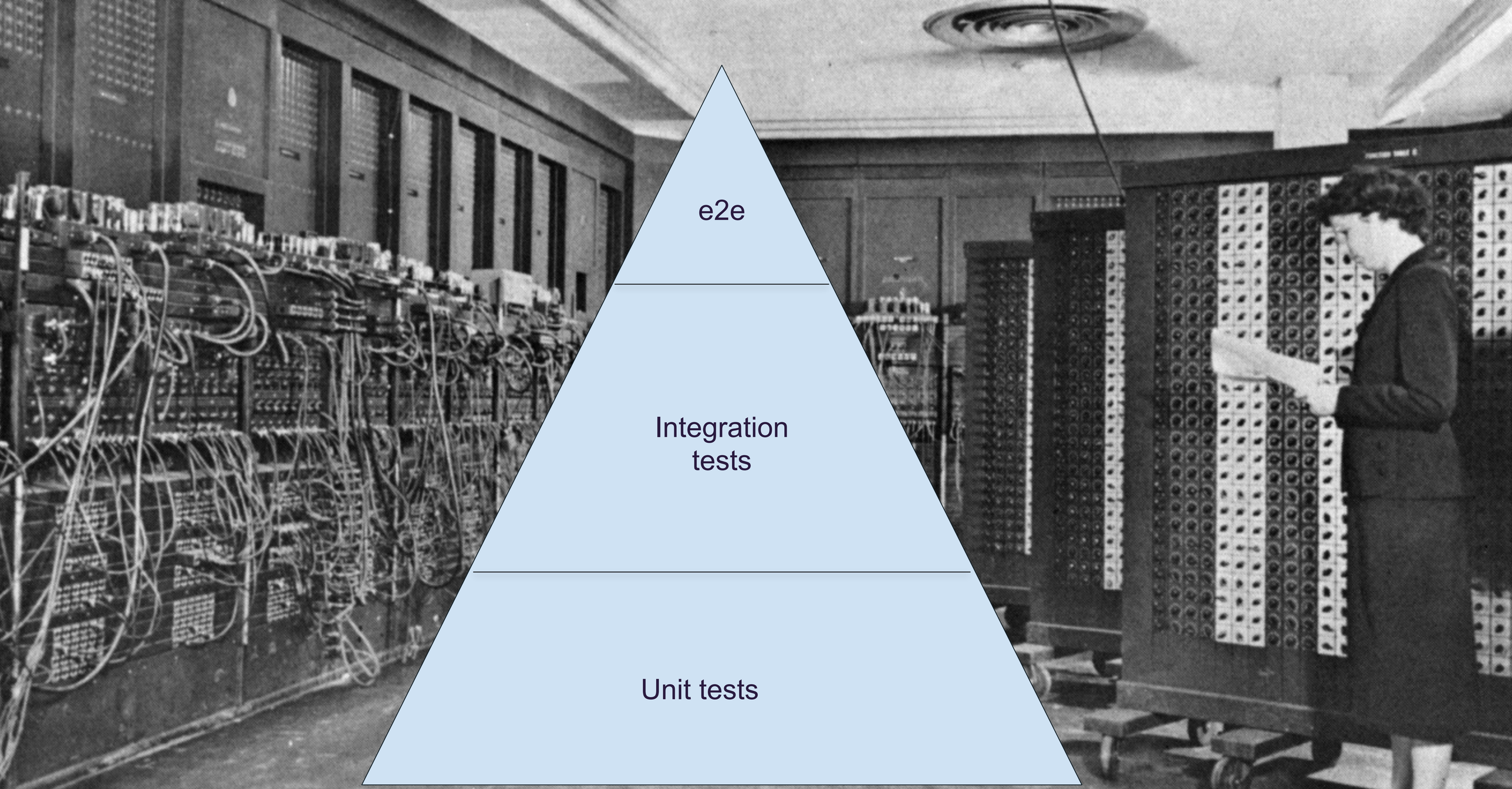


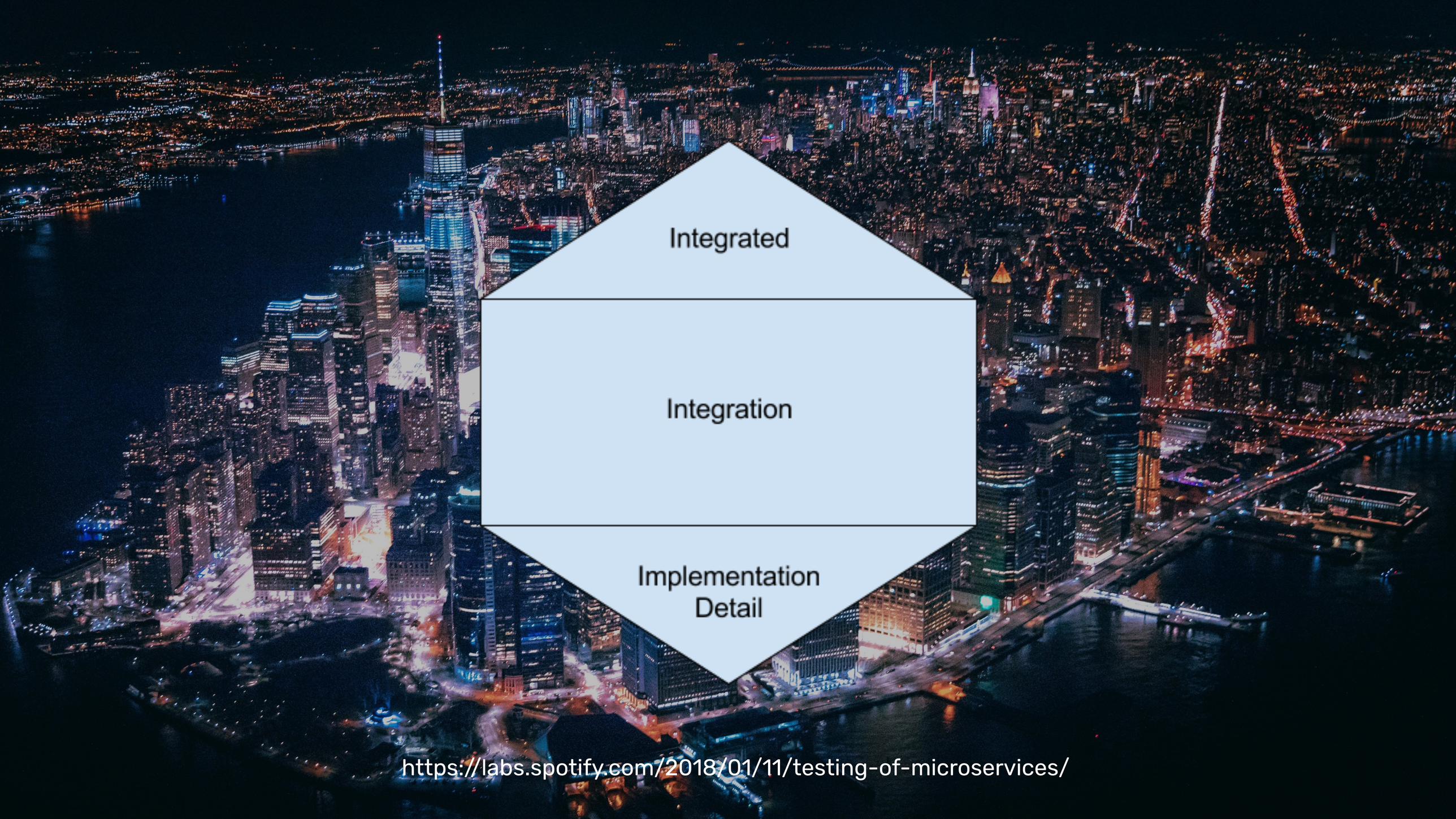
Downloads


Overview
Project: org.testcontainers
Type: Downloads
GroupId: org.testcontainers
ArtifactId: testcontainers-bom
Version: Select a version...
Export CSV
Downloads Over the Last 12 Months For org.testcontainers:testcontainers-bom
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Apr2021
May2021
Jun2021
Jul2021
Aug2021
Sep2021
Oct2021
Nov2021
Dec2021
Jan2022
Feb2022
Mar2022

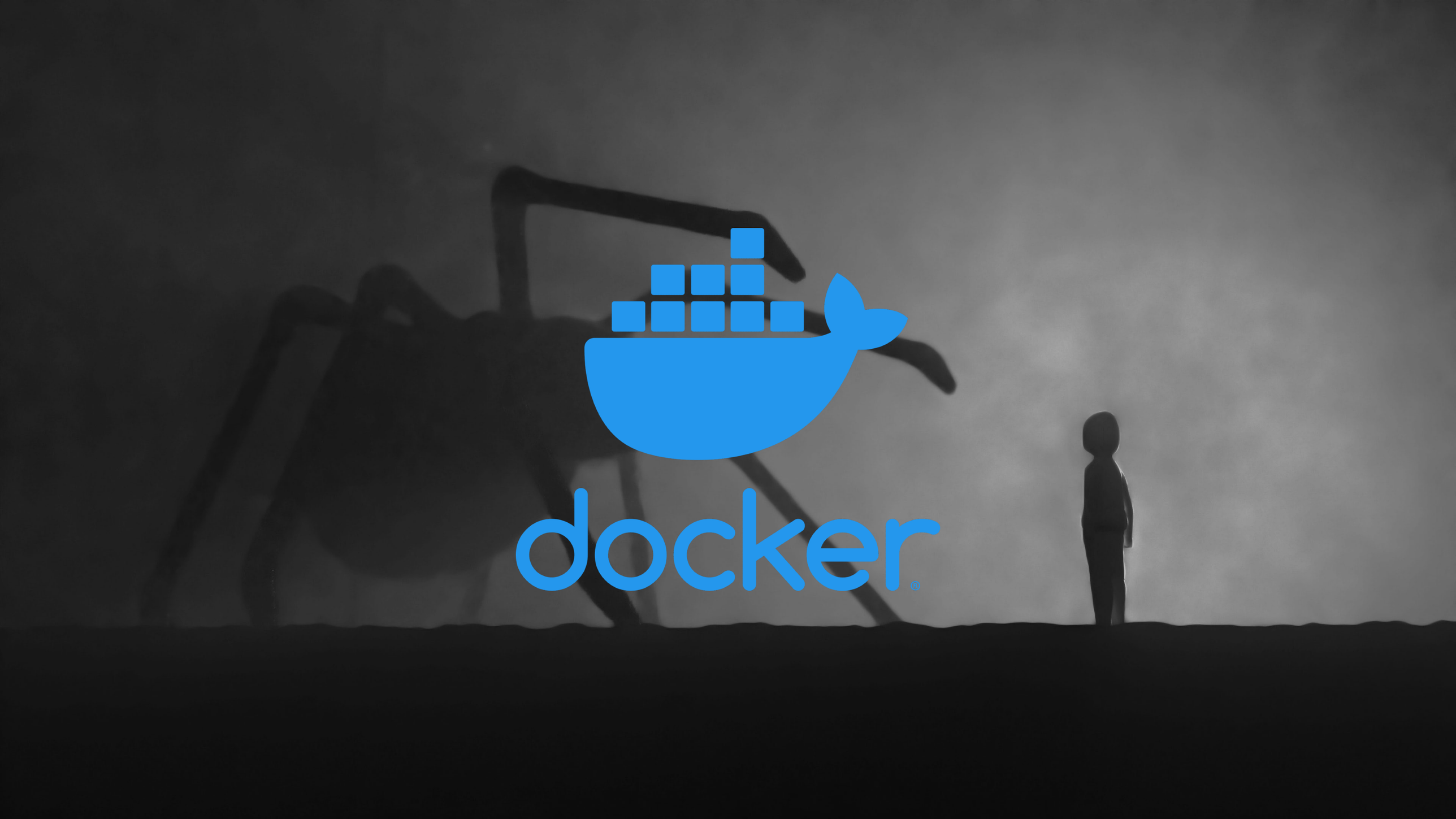
Unique IPs


Overview
Project: org.testcontainers
Type: Unique IPs
GroupId: org.testcontainers
ArtifactId: testcontainers-bom
Version: Select a version...
Export CSV
Unique IPs Over the Last 12 Months For org.testcontainers:testcontainers-bom
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Apr2021
May2021
Jun2021
Jul2021
Aug2021
Sep2021
Oct2021
Nov2021
Dec2021
Jan2022
Feb2022
Mar2022





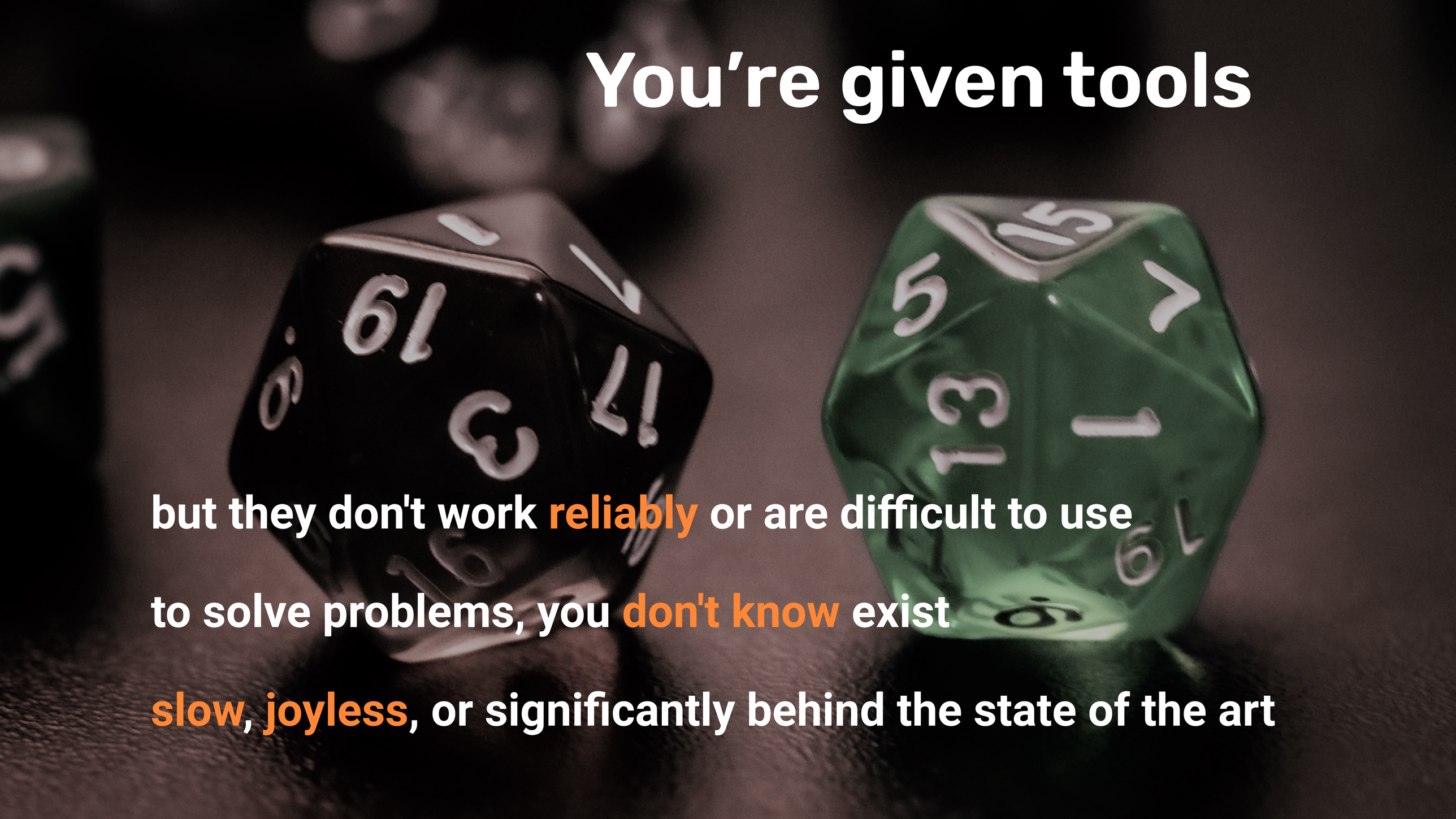
https://labs.spotify.com/2018/01/11/testing-of-microservices/


docker


IT WORKS ON MY MACHINE
THEN WE'LL SHIP YOUR MACHINE
AND THAT IS HOW DOCKER WAS BORN


Installing apps
Running them in Docker
imgflip.com

Is this the goal?



You’re given tools

but they don't work **reliably** or are difficult to use

to solve problems, you **don't know** exist

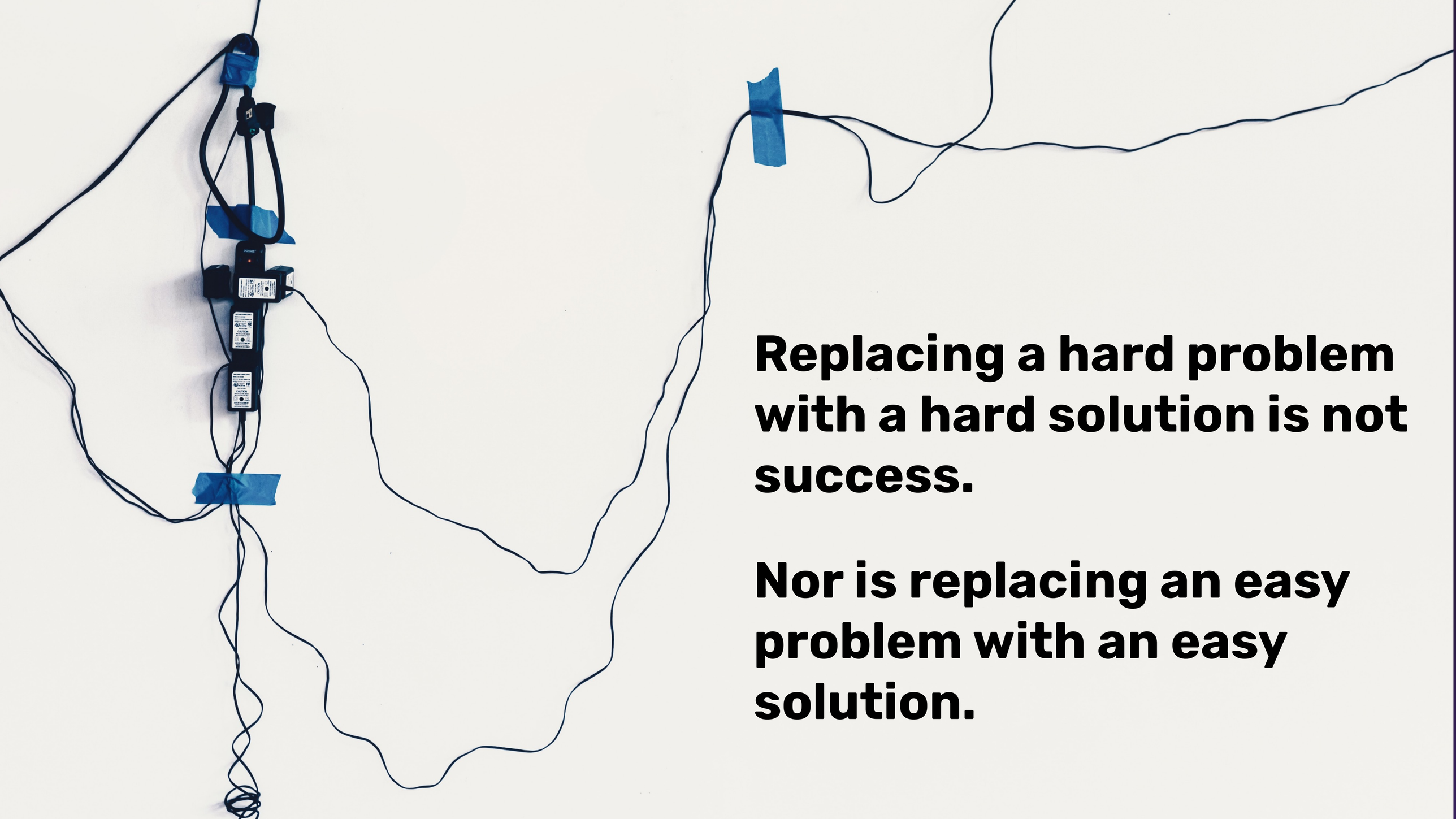
slow, **joyless**, or significantly behind the state of the art

```yaml
---
version: '2'
services:
  zookeeper:
    image: confluentinc/cp-zookeeper:7.0.1
    ports:
      - "32181:32181"
    environment:
      ZOOKEEPER_CLIENT_PORT: 32181
      ZOOKEEPER_TICK_TIME: 2000

kafka:
  image: confluentinc/cp-kafka:7.0.1
  ports:
    - "29092:29092"
  depends_on:
    - zookeeper
  environment:
    KAFKA_BROKER_ID: 1
    KAFKA_ZOOKEEPER_CONNECT:
zookeeper:32181
    KAFKA_ADVERTISED_LISTENERS:
PLAINTEXT://localhost:29092

KAFKA_OFFSETS_TOPIC_REPLICATION_FACTO
: 1
```

What does winning look like?



Replacing a hard problem with a hard solution is not success.

Nor is replacing an easy problem with an easy solution.


Reliability

Trustworthyness

Shifting failures left

Errors making sense

Sensible defaults

Developers are **people** too!

System checks

ℹ Checking the system...

✔ Docker version should be at least 1.6.0

✔ Docker environment should have more than 2GB free disk space

✔ File should be mountable

✔ A port exposed by a docker container should be accessible

During

```
CONTAINER ID   IMAGE                        COMMAND                   CREATED          STATUS          PORTS
                                                                                            NAMES
1d086deb291b   postgres:14-alpine           "docker-entrypoint.s…"    6 seconds ago    Up 4 seconds    0.0.0.0:54663->5432/tcp,
 :::54663->5432/tcp                                                                         clever_satoshi
895dea775351   confluentinc/cp-kafka:5.4.3  "sh -c '#!/bin/bash\n…"   23 seconds ago   Up 20 seconds   9092/tcp, 0.0.0.0:54459-
>2181/tcp, :::54459->2181/tcp, 0.0.0.0:54460->9093/tcp, :::54460->9093/tcp   beautiful_shannon
9ba7b0670e6f   redis:6-alpine               "docker-entrypoint.s…"    35 seconds ago   Up 32 seconds   0.0.0.0:54305->6379/tcp,
 :::54305->6379/tcp                                                                         friendly_blackburn
6594984b1654   testcontainers/ryuk:0.3.3    "/app"                    46 seconds ago   Up 44 seconds   0.0.0.0:54131->8080/tcp,
 :::54131->8080/tcp                                                                         testcontainers-ryuk-d5041454-dd4f-46ff-845b-7013d55
d41d2
```

After

```
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
```

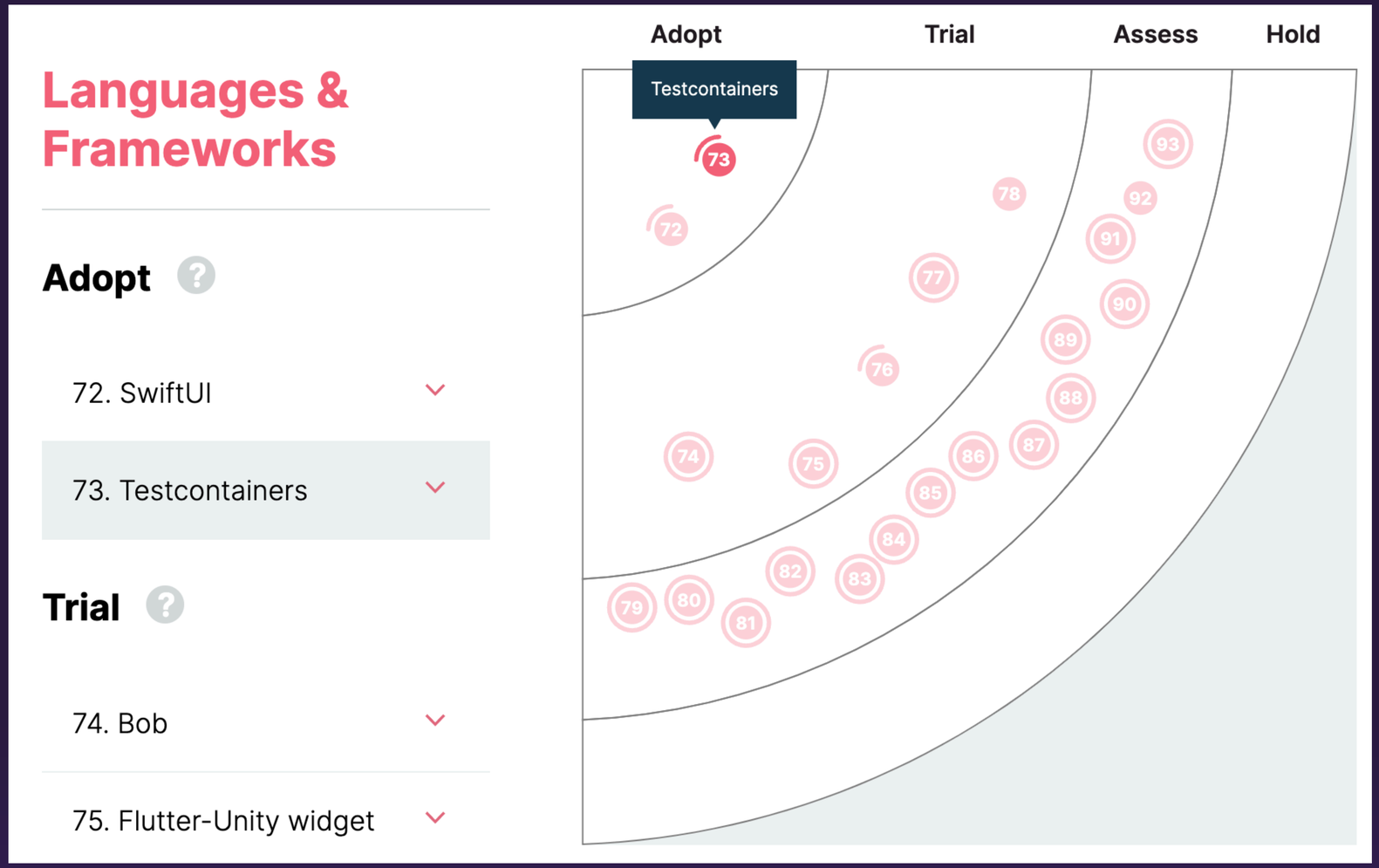

The problem
Extra mile
Port conflicts
Port randomization
Hard-coded scenarios
Data-driven tests
Slow tests
Parallelization

Technology radar

We think it's a useful default option for creating a reliable environment for running tests.

...

Our teams have consistently found this library of programmable, lightweight and disposable containers to make functional tests more reliable.



https://www.thoughtworks.com/en-us/radar/languages-and-frameworks/testcontainers

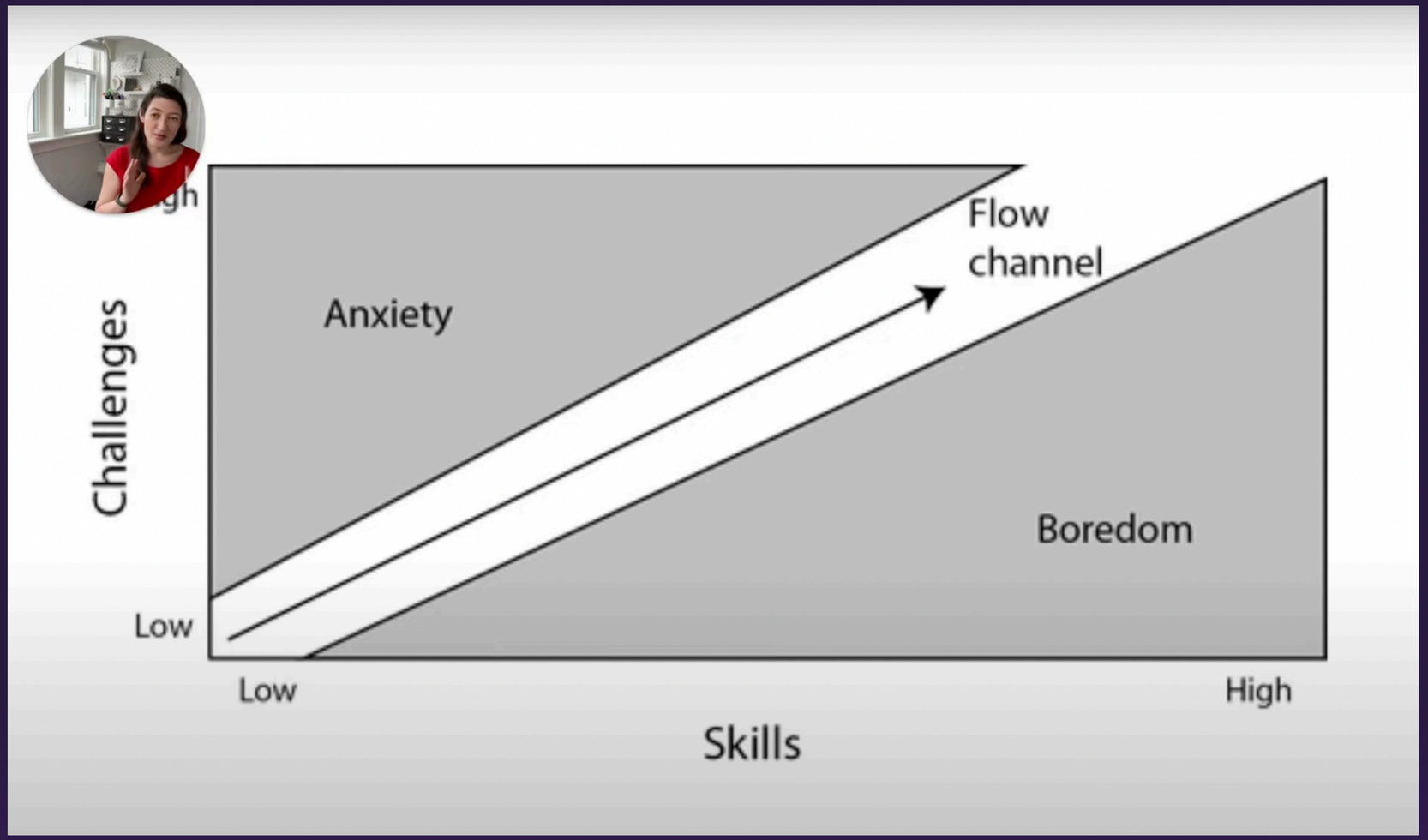
DevX Conf

by Gitpod

Is DevEx not good...
because we don't want it to be?

ELLEN CHISA

Founder In Residence @Boldstart


Flow
channel
Anxiety
Challenges
Boredom
Low
Low
High
Skills

The simplest way

JDBC driver magic:

```
spring.datasource.url=jdbc:tc:postgresql:14-alpine://testcontainers/database
```

With a schema initialization:

```
jdbc:tc:mysql:5.7.34:///databasename?TC_INITSCRIPT=file:src/main/resources/
init_mysql.sql
```

With additional config:

```
jdbc:tc:postgresql:9.6.8:///databasename?TC_TMPFS=/testtmpfs:rw
```

The ecosystem of modules

```
KafkaContainer kafka = new KafkaContainer(
  DockerImageName.parse("confluentinc/cp-kafka").withTag("5.4.3")
)
```

```
        public ToxiproxyContainer toxiproxy = new
        ToxiproxyContainer(DockerImageName.parse("shopify/toxiproxy:2.1.0"))
          .withNetwork(network)
          .withNetworkAliases("toxiproxy");
```

```
PostgreSQLContainer<?> postgreSQLContainer =
  new PostgreSQLContainer<>(DockerImageName.parse("postgresql:14-alpine"));
```

```
    K3sContainer k3s = new K3sContainer(
                    DockerImageName.parse("rancher/k3s:v1.21.3-k3s1"))
      .withLogConsumer(new Slf4jLogConsumer(log));
```

Cassandra Module

CockroachDB Module

Couchbase Module

Clickhouse Module

DB2 Module

Dynalite Module

InfluxDB Module

MariaDB Module

MongoDB Module

MS SQL Server Module

MySQL Module

Neo4j Module

Oracle-XE Module

OrientDB Module

Postgres Module

Presto Module

Trino Module

RabbitMQ Module

Solr Container

Toxiproxy Module

Hashicorp Vault Module

Webdriver Containers

Azure Module

Docker Compose Module

Elasticsearch container

GCloud Module

HiveMQ Module

K3s Module

Kafka Containers

LocalStack Module

Mockserver Module

Nginx Module

Apache Pulsar Module

RabbitMQ Module

Developer Experience
Community
Technical excellence

+

The technology

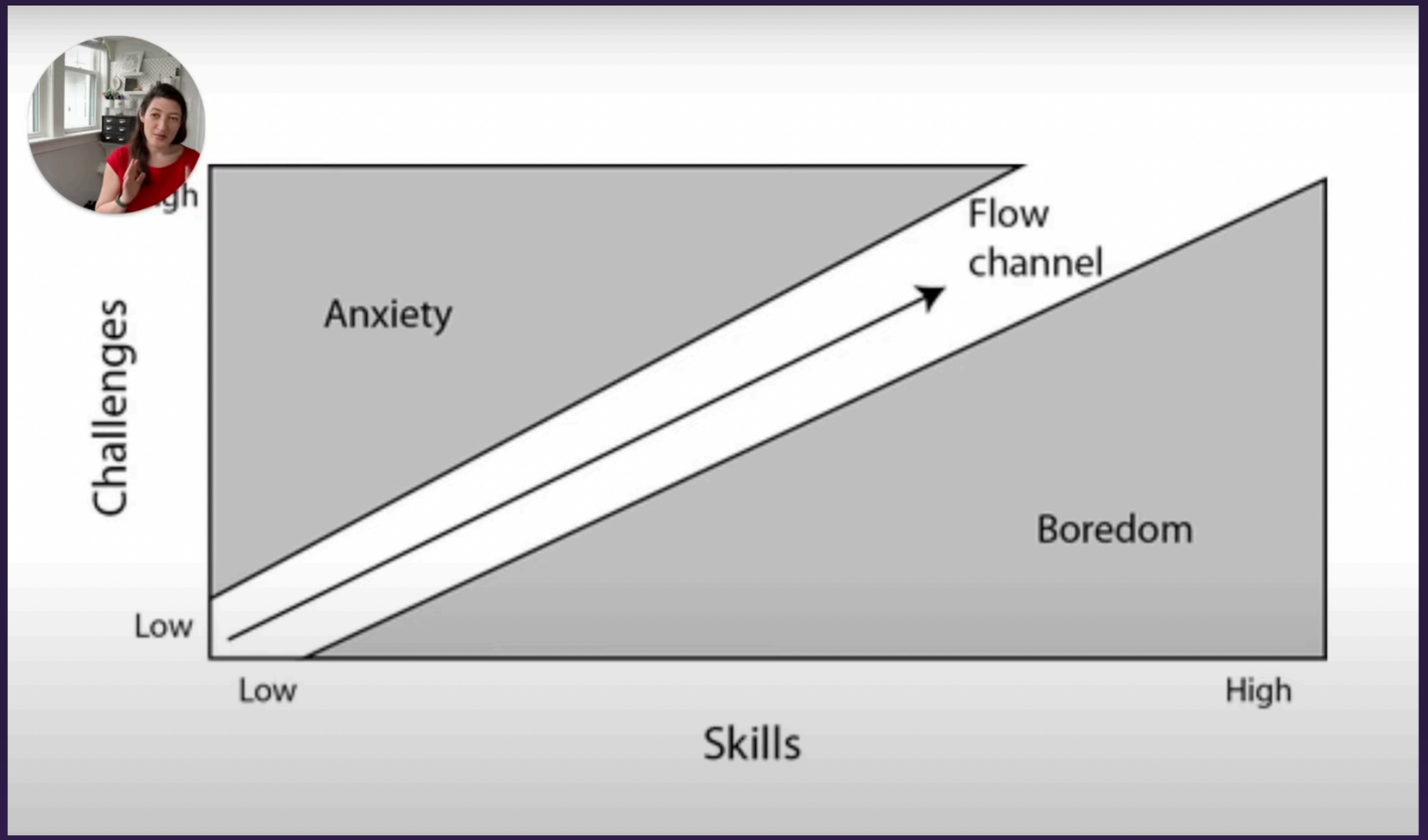
The generic API

```
GenericContainer<?> redis =
  new GenericContainer<>("redis:6-alpine")
    .withExposedPorts(6379);
```

The generic API

```
static GenericContainer<?> redis =
  new GenericContainer<>( dockerImageName: "redis:6-alpine")
    .withExposedPorts(6379).;
```

```
withCommand(String... commandParts)                    SELF
withCopyFileToContainer(MountableFile…                 SELF
withCopyToContainer(Transferable tran…                 SELF
withCreateContainerCmdModifier(Consum…                 SELF
withEnv(Map<String, String> env)                       SELF
withEnv(String key, String value)                      SELF
withEnv(String key, Function<Optional…                 SELF
withExtraHost(String hostname, String…                 SELF
withFileSystemBind(String hostPath, S…                 SELF
withFileSystemBind(String hostPath, S…                 SELF
withImagePullPolicy(ImagePullPolicy i…                 SELF
```


Flow
channel
Anxiety
Challenges
Boredom
Low
Low
High
Skills


If it’s not in the docs
— it doesn’t exist!

The problem with docs

(a) people will never read external docs;

(b) people will rarely read inline docs/help strings/tooltips;

(c) people will most likely only read the information that is shown to them

The IDE is your only friend!

```
new PostgreSQLContainer<>(
    dockerImageName: "postgresql:14-alpine").
```

```
getDatabaseName()                                   String
getDriverClassName()                                String
getJdbcUrl()                                        String
getPassword()                                       String
getTestQueryString()                                String
getUsername()                                       String
withDatabaseName(String databaseName)               SELF
withPassword(String password)                       SELF
withUsername(String username)                       SELF
```

```
kafka.
```

```
getBootstrapServers()                               String
withEmbeddedZookeeper()                             KafkaContainer
withExternalZookeeper(Strin…                        KafkaContainer
close()                                             void
getFirstMappedPort()                                Integer
getHost()                                           String
```

Our clients’ clients love us

Private registries

Local API:

```
final PostgreSQLContainer<?> mysql = new PostgreSQLContainer<>(
  DockerImageName.parse("registry.mycompany.com/mirror/mysql:8.0.24")
    .asCompatibleSubstituteFor("mysql")
);
```

Configuration:

```
TESTCONTAINERS_HUB_IMAGE_NAME_PREFIX=registry.mycompany.com/mirror/
```

Programmatic API:

```
public abstract class ImageNameSubstitutor
                implements Function<DockerImageName, DockerImageName>
```

Chaos engineering

```
public Network network = Network.newNetwork();

public GenericContainer<?> redis = new
GenericContainer<>(DockerImageName.parse("redis:6-alpine"))
  .withExposedPorts(6379)
  .withNetwork(network);
```

Chaos engineering

```
public Network network = Network.newNetwork();

public GenericContainer<?> redis = new
GenericContainer<>(DockerImageName.parse("redis:6-alpine"))
  .withExposedPorts(6379)
  .withNetwork(network);


public ToxiproxyContainer toxiproxy = new
ToxiproxyContainer(DockerImageName.parse("shopify/toxiproxy:2.1.0"))
  .withNetwork(network)
  .withNetworkAliases("toxiproxy");
```

Chaos engineering

```
final ToxiproxyContainer.ContainerProxy proxy =
                                        toxiproxy.getProxy(redis, 6379);

proxy.toxics()
   .latency(“latency", ToxicDirection.DOWNSTREAM, 1_100)
   .setJitter(100);
```

- **bandwidth** - Limit a connection to a maximum number of kilobytes per second.
- **latency** - Add a delay to all data going through the proxy. The delay is equal to latency +/- jitter.
- **slicer** - Slices TCP data up into small bits, optionally adding a delay between each sliced "packet".
- **slowClose** - Delay the TCP socket from closing until delay milliseconds has elapsed.
- **timeout** - Stops all data from getting through, and closes the connection after timeout
- **limitData** - Closes connection when transmitted data exceeded limit.

Reusable containers

Extending the lifecycle of the containers

Local API:

```
static KafkaContainer kafka = new KafkaContainer()
  .withReuse(true);
```

Configuration:

File: /Users/shelajev/.testcontainers.properties

```
1  testcontainers.reuse.enable = true
```

Changing local development

```
git clone https://github.com/shelajev/primes-kafka.git && cd primes-kafka

./mvnw quarkus:dev
```

Clone & Run!

Test Infected: Programmers Love Writing Tests

“Every programmer knows they should write tests for their code. Few do. The universal response to "Why not?" is "I'm in too much of a hurry." This quickly becomes a vicious cycle- the more pressure you feel, the fewer tests you write. The fewer tests you write, the less productive you are and the less stable your code becomes. The less productive and accurate you are, the more pressure you feel.

Programmers burn out from just such cycles. Breaking out requires an outside influence. **We found the outside influence we needed in a simple testing framework that lets us do a little testing that makes a big difference.”**

Test Infected: Programmers Love Writing Tests, Java Report, July 1998, Volume 3, Number 7

K. Beck and E. Gamma, “TEST-INFECTED: PROGRAMMERS LOVE WRITING TESTS,” in More Java Gems, D. Deugo, Ed. Cambridge: Cambridge University Press, 2000, pp. 357–376.

Testcontainers

testcontainers / testcontainers-java
Public
Sponsor | Unwatch 135 | Fork 1.1k | Starred 5.7k
Code | Issues 387 | Pull requests 143 | Discussions | Actions | Security | Insights
master | Go to file | Add file | Code
meistermeier Enable Neo4j labs plugin definition. (#5035) ... yesterday 3,400
.circleci Remove ciMate (#3631) 15 months ago
.github Use collapse-after for dependencies category ... 9 days ago
About
Testcontainers is a Java library that supports JUnit tests, providing lightweight, throwaway instances of common databases, Selenium web browsers, or anything else that can run in a Docker container.
org
docker
jvm
junit

testcontainers / testcontainers-go
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main | Go to file | Code
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.github Merge pull request #401 from testco... 16 days ago
docs chore: update branding 23 hours ago
scripts
testresou
About
Testcontainers is a Golang library that providing a friendly API to run Docker container. It is designed to create runtime environment to use during your automatic tests.

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.husky Refactor components into smaller m... 9 months ago
fixtures Migrate to official @balena/dockerig... 24 days ago
src Make Kafka containers reusable (#3... 5 days ago
.eslintrc.js Load registry auth information (#179) 15 months ago
About
TestContainers is a NodeJS library that supports tests, providing lightweight, throwaway instances of common databases, Selenium web browsers, or anything else that can run in a Docker container.
docker | node | testcontainers
Readme
MIT License

testcontainers / testcontainers-python
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master | Go to file | Code
tillahoffmann and naomielst Update do... 10 days ago 439
.github/workflows General maintenance and tidying to ... 24 days ago
docs Added ClickHouse support (#173) 17 days ago
requirements Update docker version. (#203) 10 days ago
testcontainers Reduce log level to prevent log file p... 12 days ago
tests Add compose exec_in_container me... 17 days ago
About
Testcontainers is a Python library that providing a friendly API to run Docker container. It is designed to create runtime environment to use during your automatic tests.
testcontainers-python.readthed...
python | testing | database
selenium | python3
testcontainers