Lightweight Java in the Cloud

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Java ♥ Cloud

- Java SE is ideal for building lightweight applications and (micro)services
- Cloud platforms offer
  - High availability
  - Affordability
  - Ease of management
  - Access to supporting services like object storage, messaging, and databases

What do we mean by Cloud?

- A wonderfully amorphous word!
- Clouds offer a range of services including Iaas / SaaS / PaaS

- Application Platform as a Service—**APaaS**
  - Focused on running lightweight applications—not heavy weight services like database
  - Typically employ containers to run applications
  - Many vendors to choose from
  - Most, if not all, APaaS platforms support Java

Cloud Application Architecture

Configuration

Dev

Test

Prod

Configuration

- Application should be “parameterizable”—externalize all config data
- Configuration should be defined as environment variables and read by applications on start
- Makes it easy to deploy the application to any environment where configurations will differ
- Deployment configuration can be managed by Ops post Dev

This includes database and other backing service locations, third-party credentials like AWS or Twitter…such configuration should not be stored in the codebase…**exposes private resources in the version control** system.

heroku

Environment variables…useful when the values are likely to be different from one host system to the next…makes the application code more portable and flexible…**critical for writing applications that are easily deployed and scaled**

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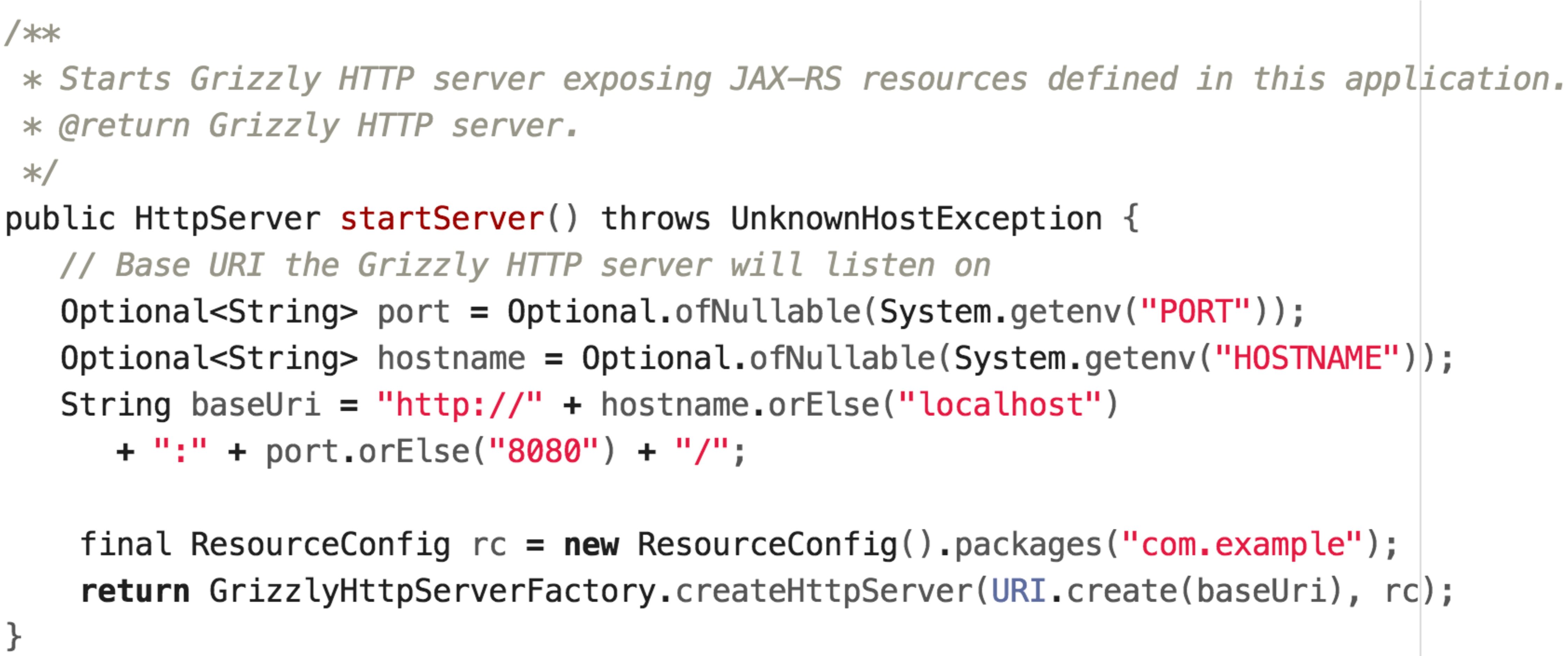
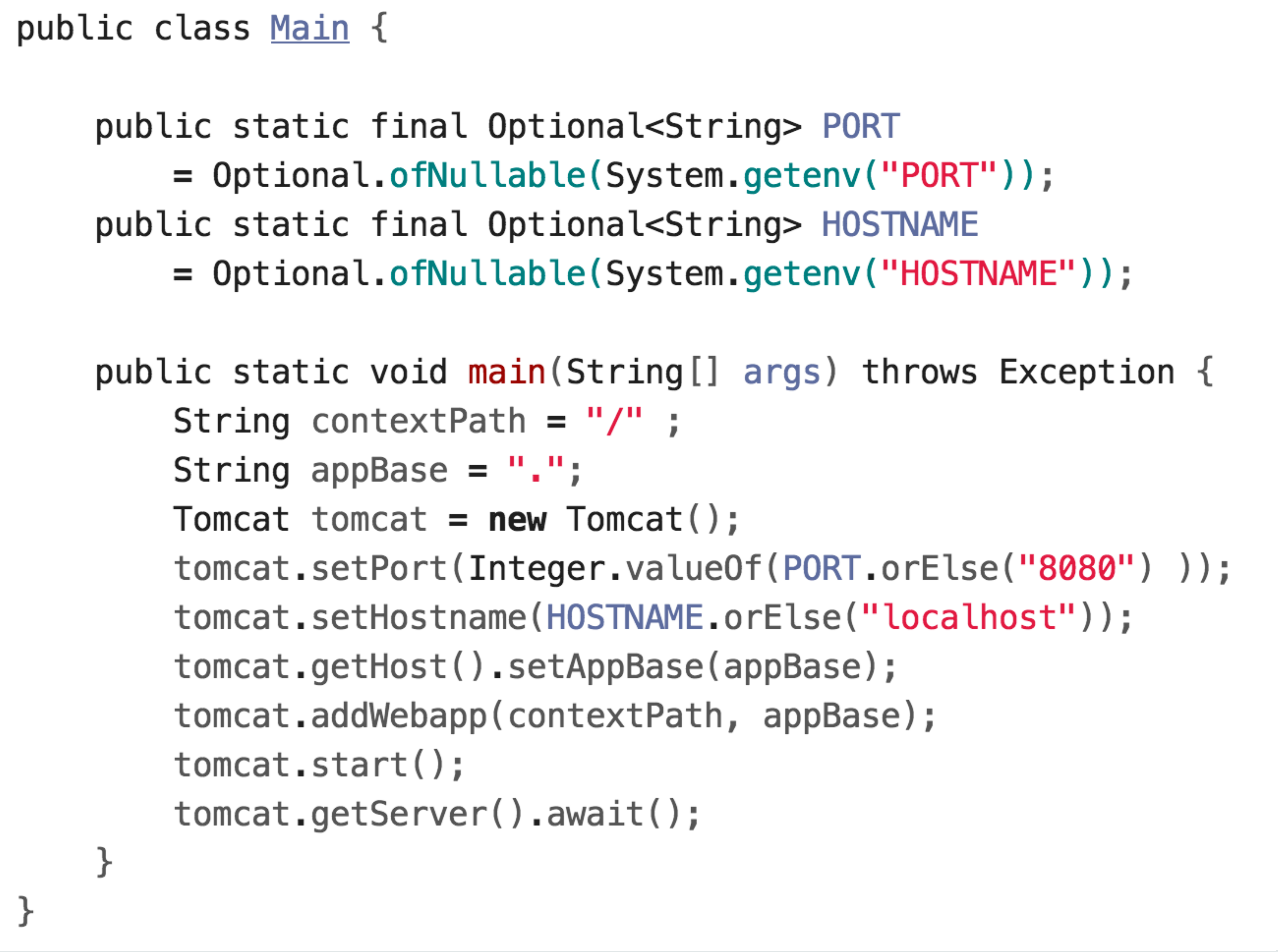
Grizzly / Jersey



```
/**
 * Starts Grizzly HTTP server exposing JAX-RS resources defined in this application.
 * @return Grizzly HTTP server.
 */
public HttpServer startServer() throws UnknownHostException {
   // Base URI the Grizzly HTTP server will listen on
   Optional<String> port = Optional.ofNullable(System.getenv("PORT"));
   Optional<String> hostname = Optional.ofNullable(System.getenv("HOSTNAME"));
   String baseUri = "http://" + hostname.orElse("localhost")
      + ":" + port.orElse("8080") + "/";

    final ResourceConfig rc = new ResourceConfig().packages("com.example");
    return GrizzlyHttpServerFactory.createHttpServer(URI.create(baseUri), rc);
}
```

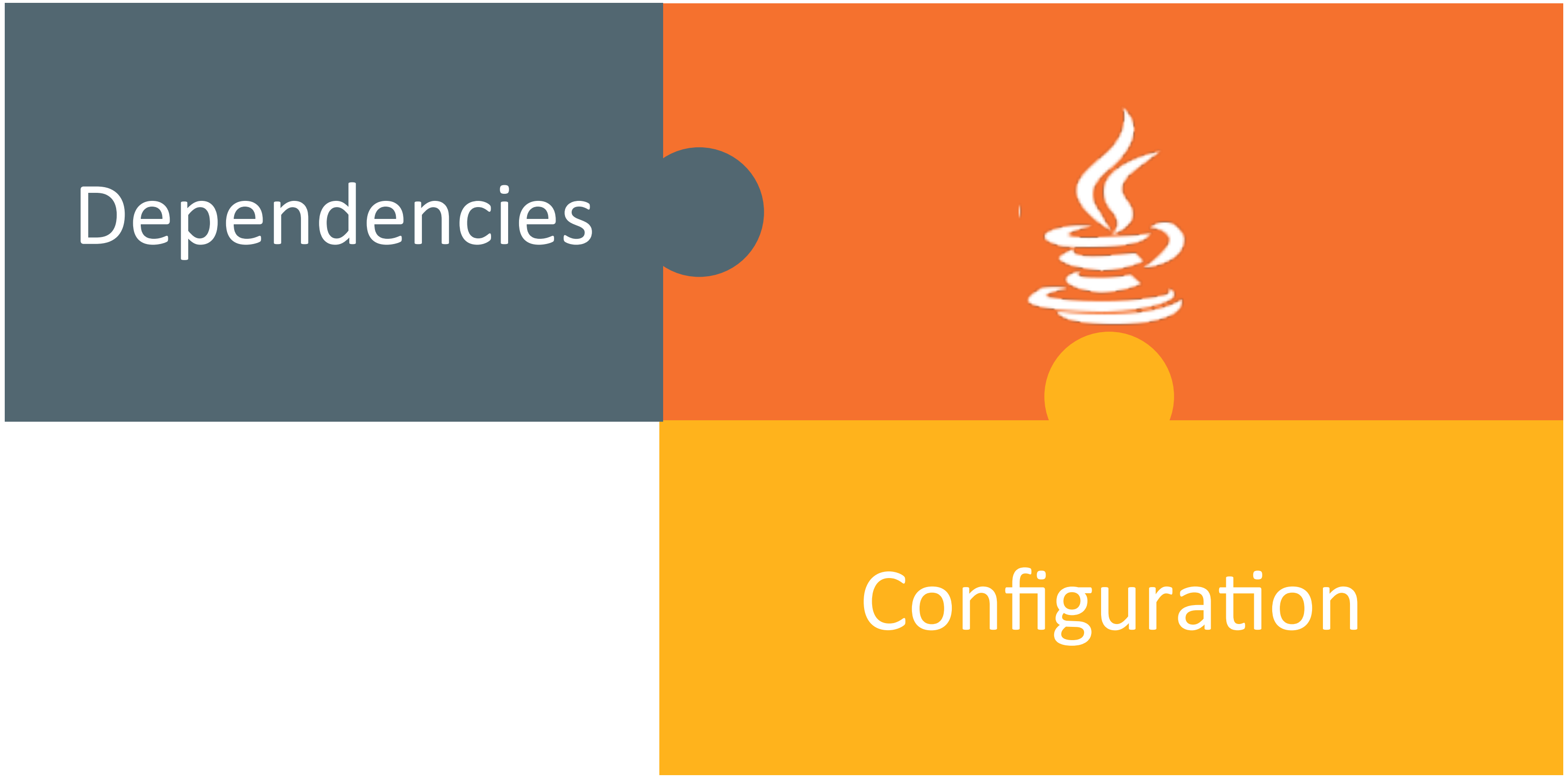
Embedded Tomcat



```
public class Main {

    public static final Optional<String> PORT
        = Optional.ofNullable(System.getenv("PORT"));
    public static final Optional<String> HOSTNAME
        = Optional.ofNullable(System.getenv("HOSTNAME"));

    public static void main(String[] args) throws Exception {
        String contextPath = "/" ;
        String appBase = ".";
        Tomcat tomcat = new Tomcat();
        tomcat.setPort(Integer.valueOf(PORT.orElse("8080") ));
        tomcat.setHostname(HOSTNAME.orElse("localhost"));
        tomcat.getHost().setAppBase(appBase);
        tomcat.addWebapp(contextPath, appBase);
        tomcat.start();
        tomcat.getServer().await();
    }
}
```

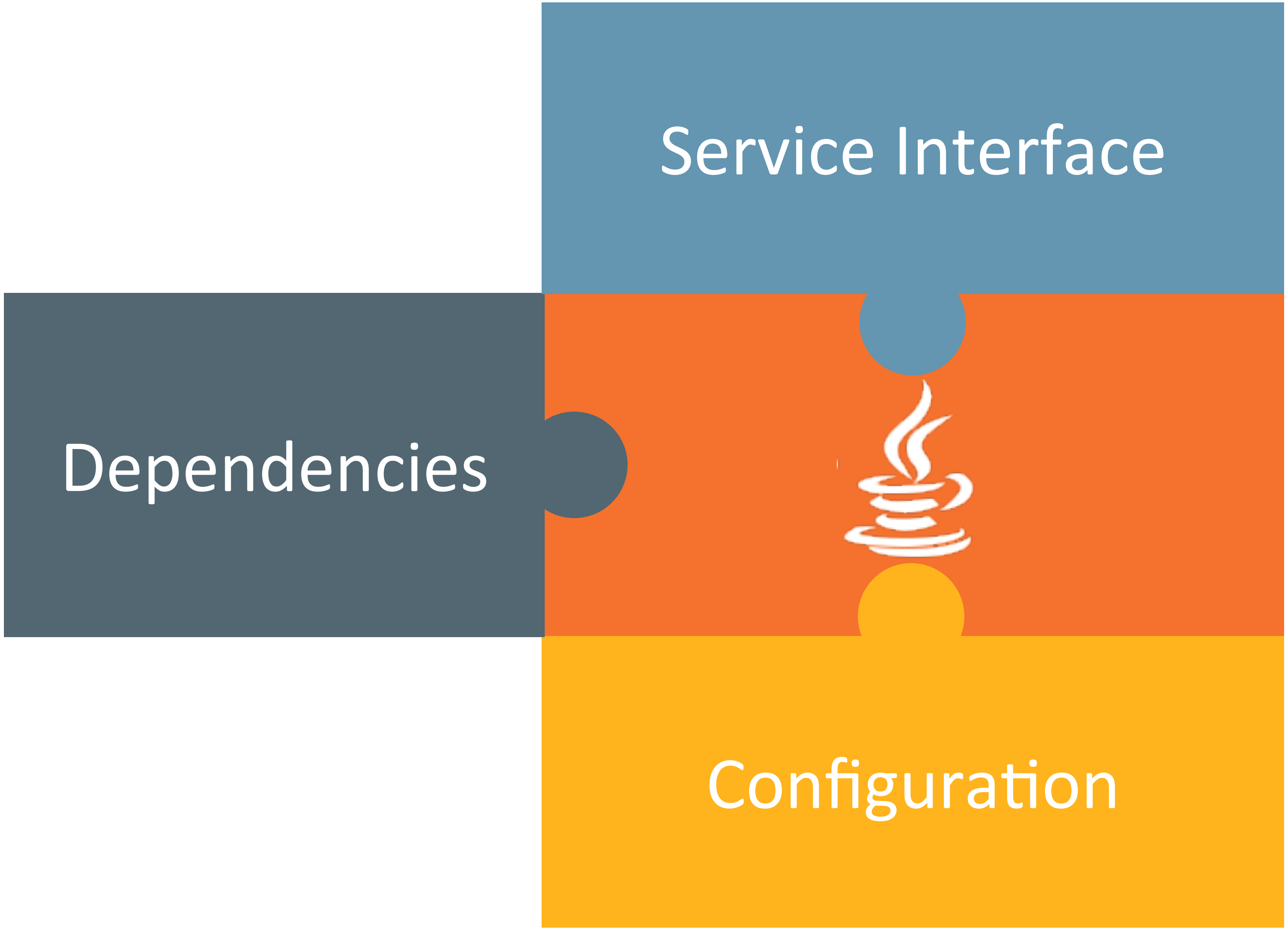


Dependencies

Configuration

Dependencies

- Application dependencies must be explicitly declared
- Relying on the availability of **system wide libraries** in the runtime environment can lead problems that are to hard to diagnose
- Applications with explicit dependencies are easy to move between environments
- Maven & Gradle provide a nice way to declare application dependencies



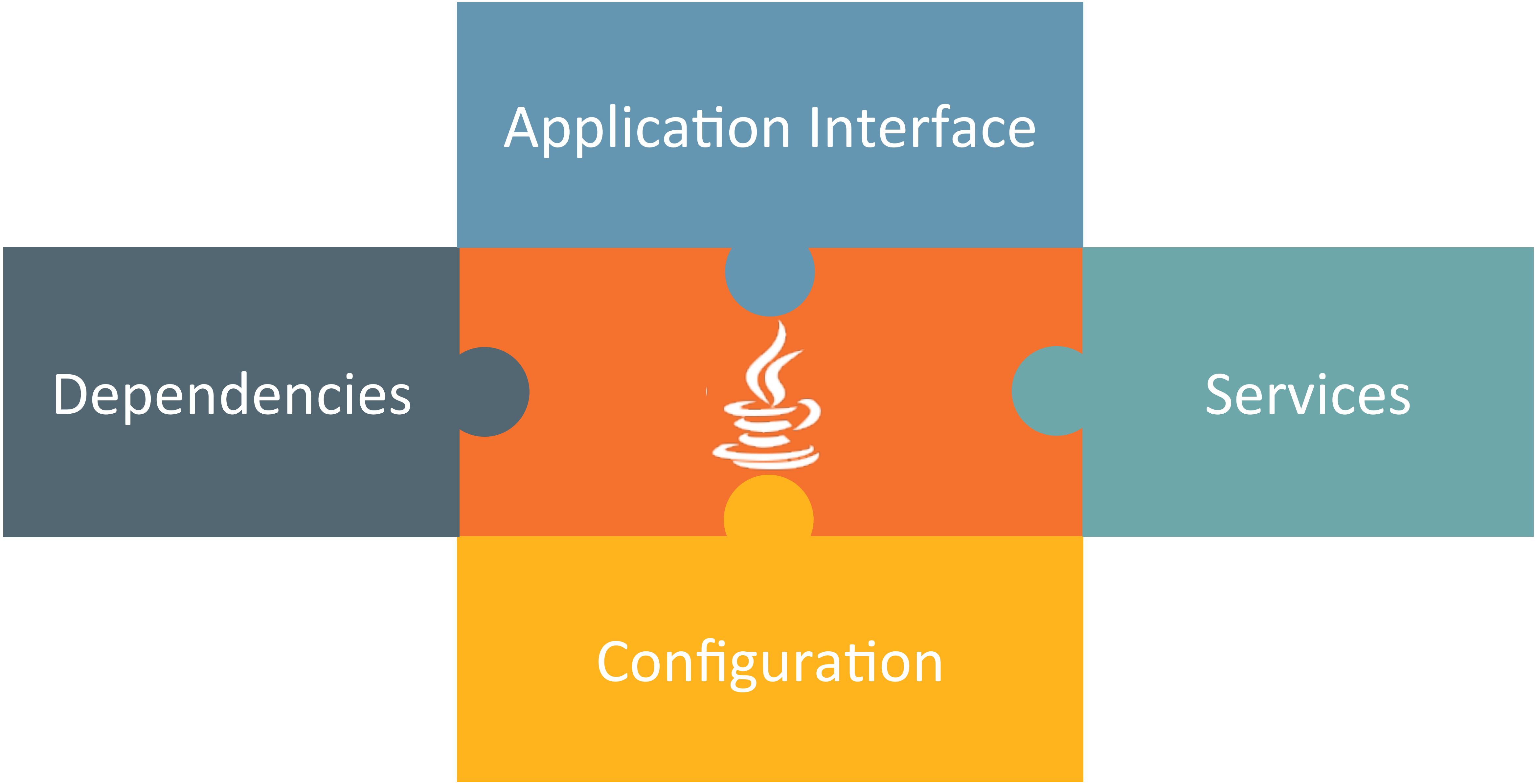
Service Interface

Dependencies

Configuration

Service Interface

- Cloud applications typically expose Web/REST/Websocket services using embedded servers like Tomcat, Jetty, or Grizzly/Jersey/Tyrus.
- Embedded servers must bind to the hostname and port defined by the runtime environment, typically in an environment variable like $PORT
- Applications running in containers will likely bind to a local port that is receiving load balanced traffic forwarded from a pubic port
- By exposing functionality over REST, applications can be provide services to other applications (the core of the microservices approach)



Application Interface

Dependencies

Services

Configuration

Service Dependencies

- Service coordinates published in the runtime environment for consumption by application
- Backing services should be pluggable
- Easy to change services—restart application to pick up changes
- Treat 3rd party or platform services the same as your own services

DEMO

Cloud Application Qualities

Stateless / Disposable

- Applications should be stateless with all persistent data stored in external services like database or key/value stores
- Stateless applications makes scaling easy (esp. when scaling in by disposing of instances)
- Configuration changes will result in the restarting (disposing & creating) of application instances
- Ephemeral disk is useful but there is no guarantee a subsequent request will be handled by the same instance

Share Nothing

- Ideally, applications should be stateless and share-nothing
- Horizontal scaling of stateless applications by adding instances to handle increased load is simple and reliable
- Not everyone agrees on this point…

Why We Aren’t Joining the Cloud Foundry Foundation

…we are also working hard to support both stateless and stateful applications inside those containers…

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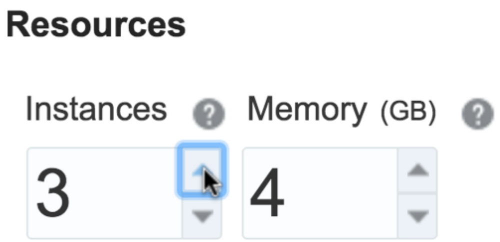
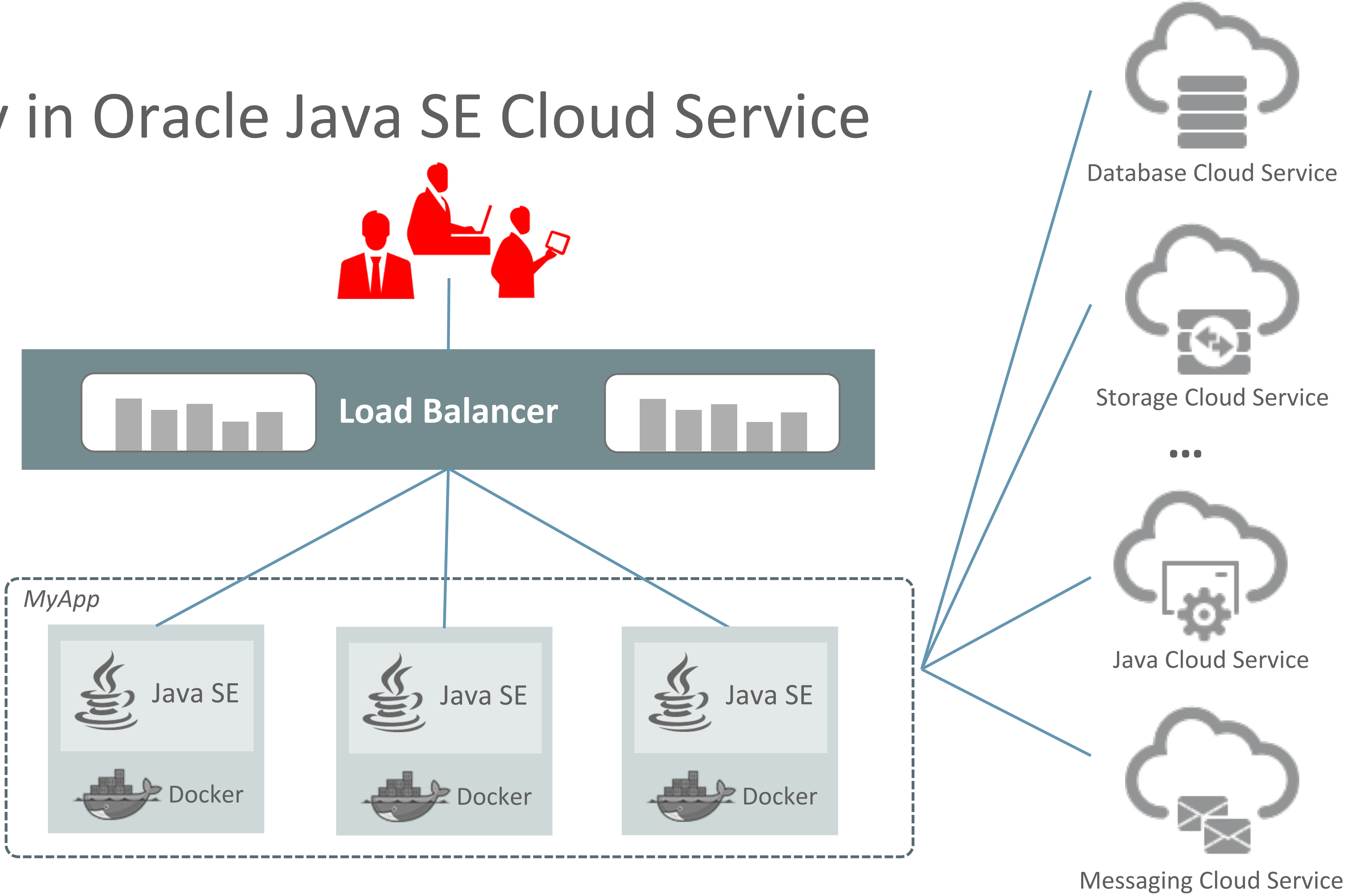
Concurrency in Oracle Java SE Cloud Service



Resources

Instances	Memory (GB)
3	4



Practical Matters

Development vs. Deployment

- APaaS platforms are deployment platforms—you run apps on them
- Development happens where?
- How to develop and debug applications targeting APaaS?

Java APaaS Debug Options

Debug locally in emulated environment

- Define environment variables to match target
- Use same JDK release and version as in target
- Use tools like Foreman
- Challenge—”emulated” not identical

Debug in Cloud

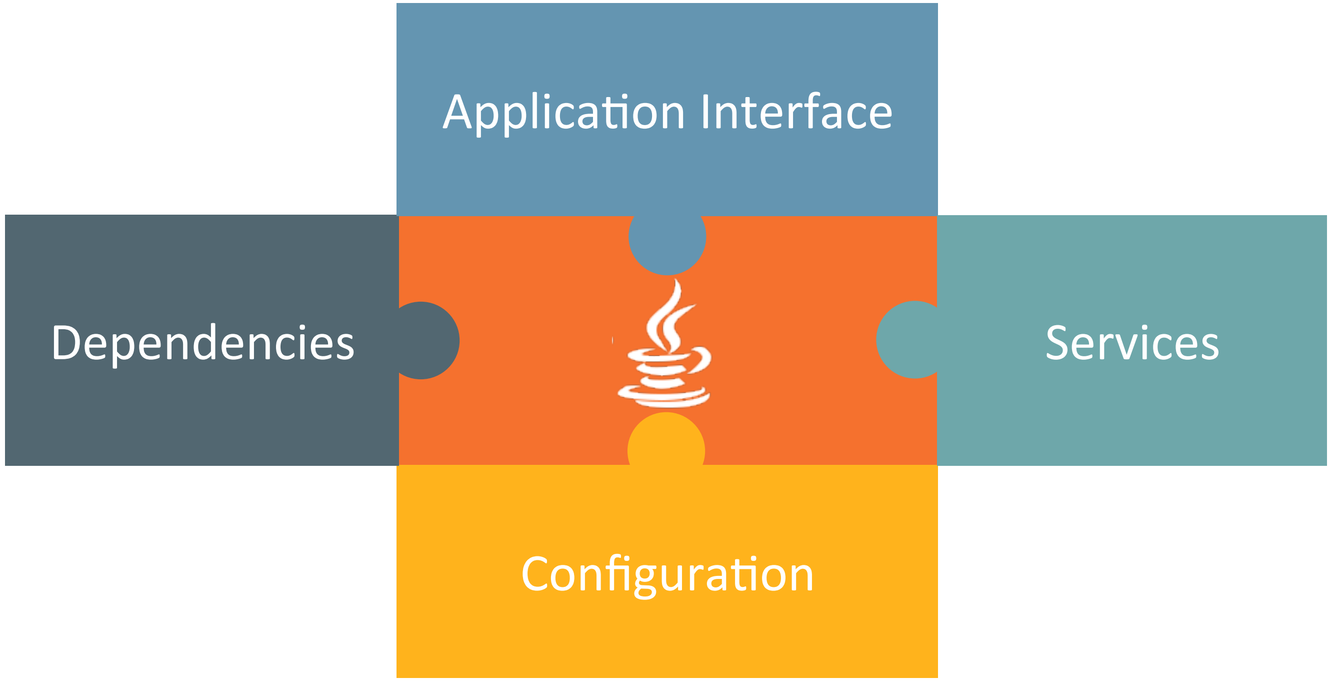
- Restrict to single instance
- Remote test & debug
- E.g., Spring Tools (experimental afaik)
- Challenge—opening up ports and supporting breakpoint callbacks from cloud to desktop

Debug locally using same Docker image as on APaaS

- Same runtime environment as Cloud
- Challenge—dependency on cloud services
- E.g. Heroku (not exactly the same since not Docker in cloud)

Summary

- Java is one of the best choices for Cloud application development
- Java has broad support from APaaS vendors
- Most of the architectural principals of Cloud apps are simply good practice
  - – Configurable
  - – Declared Dependencies
  - – Pluggable Service
  - – …



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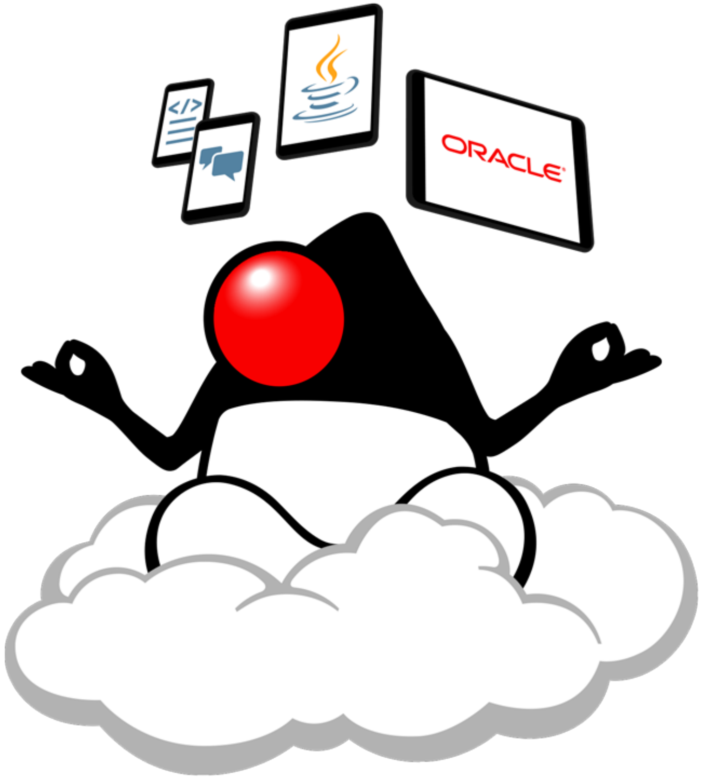
Java is the Platform!

- Focus on your Java application and not on proprietary platform features
- Architect for platform independence
- Own the stack—don't let vendors dictate
- Use embedded servers, not containers to stay light
- Consider the microservices approach of many small services assembled to provide a complete solution



Integrated Cloud

Applications & Platform Services