

# Application Modernization and Rabbits

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Developer Advocate, IBM

@nheidloff

A white rabbit is positioned on the left side of the frame, facing towards the center. It is sitting in a patch of brown dirt. The background behind the rabbit is blurred, showing more of the dirt ground and some greenery in the distance.

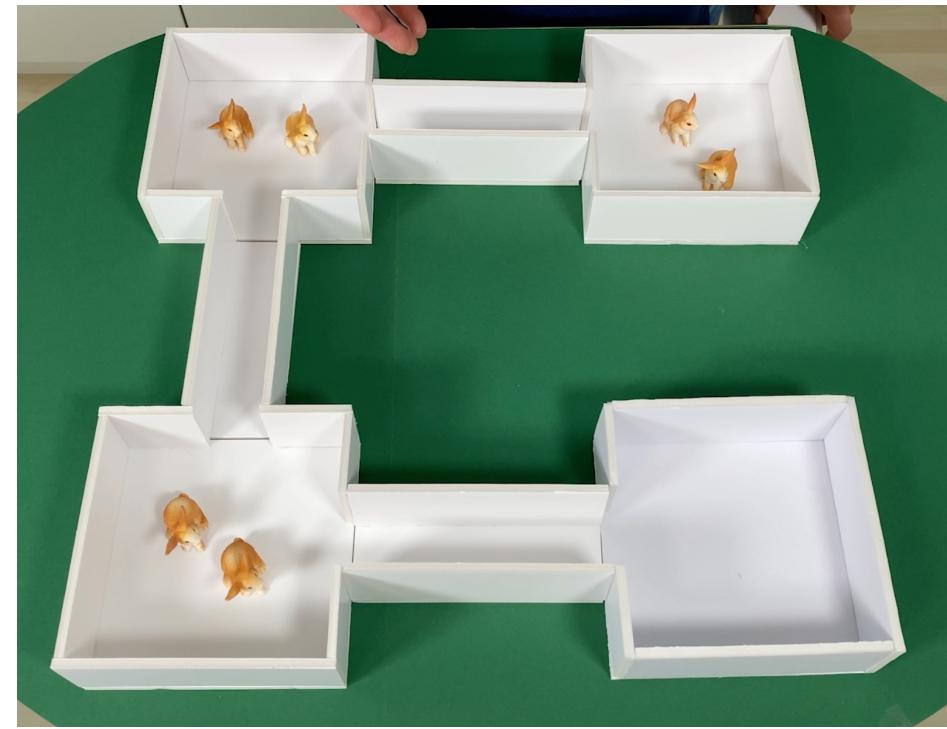
Developer Diaries:

# Cottontail Coding

IBM Developer

# Why ?

1. More Agility
2. Better User Experiences
3. Reduced Costs



# Strategies

# Strategies

## 1. Retire

# Strategies

1. Retire
2. Don't touch

# Strategies

1. Retire
2. Don't touch
3. Lift and shift

# Strategies

1. Retire
2. Don't touch
3. Lift and shift
4. Containerize
5. Refactor

# Sample Application

**Electronic and Movie Depot**

Shop Cart Order History Account

Entertainment ▾ Electronics

**Movies**

- Star Wars  
Episode VI:  
Return of the Jedi  
29.99
- Star Wars  
Episode V:  
The Empire Strikes Back  
29.99
- Star Wars  
Episode IV:  
A New Hope  
29.99
- Sony  
DVD Player  
100

Return of the Jedi  
29.99

Empire Strikes Back  
29.99

New Hope  
29.99

DVD Player  
100

**Current Shopping Cart**

- Empire Strikes Back (2)
- DVD Player (2)
- Return of the Jedi (4)
- BlackBerry Curve (1)
- Sony Ericsson (1)
- New Hope (1)

Order Total: 539.97

**Electronic and Movie Depot Catalog - Movies**

Catalog Entertainment Movies Music Games Electronics TV Cellphones DVD Players Shopping Cart (35) Account

**Star Wars**  
Episode VI:  
Return of the Jedi  
29.99

**Star Wars**  
Episode V:  
The Empire Strikes Back  
29.99

**Star Wars**  
Episode IV:  
A New Hope  
29.99

**Add To Shopping Cart**

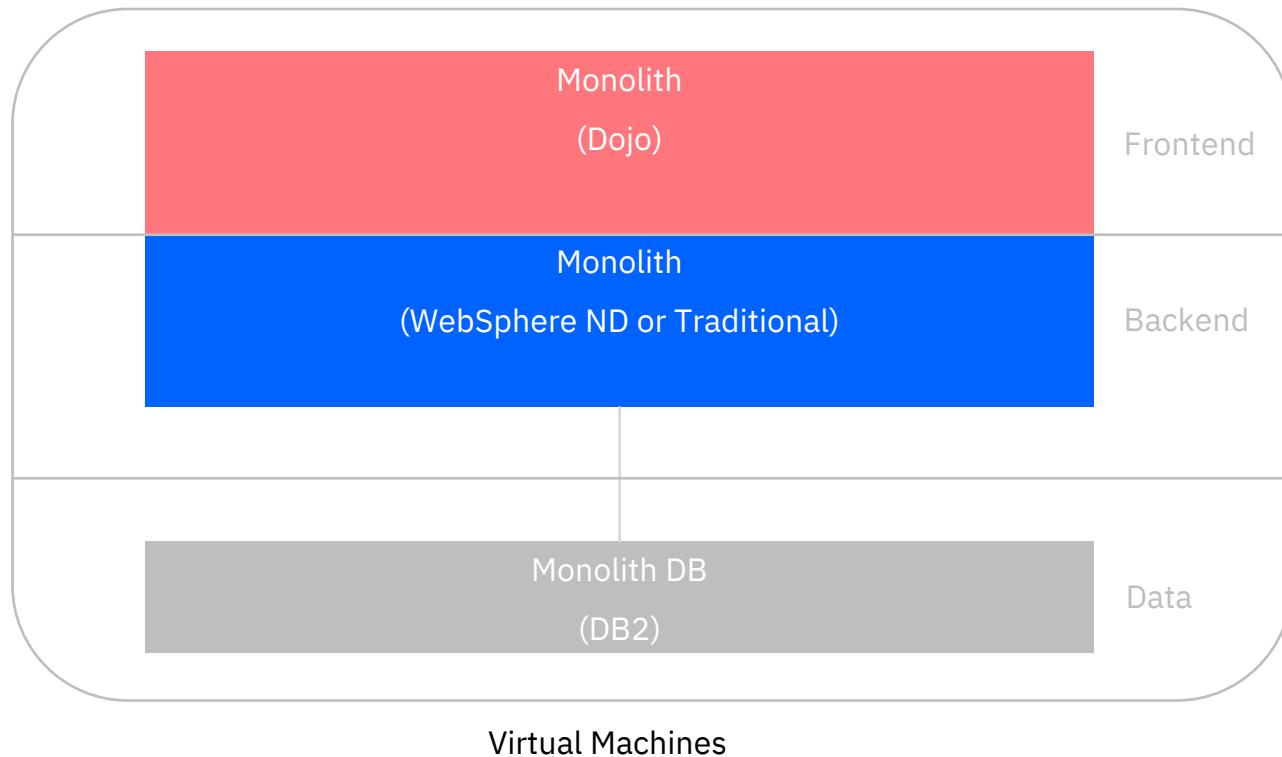
Application Modernization  
is a Journey.

Take Baby Steps!

# Steps - Sample Application

1. WebSphere Traditional 8.5.5 in VM
2. WebSphere Traditional 9 in container
3. WebSphere Liberty monolith
4. Separated frontend
5. Open Liberty monolith
6. Strangled Service and Open Liberty monolith
7. Strangled Service and Quarkus monolith
8. Micro Frontends

# Starting Point: Monolith running in VMs



# IBM Cloud Transformation Advisor



IBM Garage Methodology



Log in



## IBM Cloud Transformation Advisor

You can use IBM Cloud Transformation Advisor to analyze your on-premises workloads for modernization. Determine the complexity of your applications, estimate the development cost to move to the cloud, and get recommendations for the best target environment. Run Transformation Advisor Local on your desktop until you have a Red Hat OpenShift cluster deployed.

[Try Transformation Advisor Local](#)



## Connectivity Rules Summary

This table summarizes the flagged connectivity rules for each Java archive. Select the links in the column header to view all detailed results for that rule. Select the number links within this table to view the detailed results for that specific Java archive.

	Databases	Enterprise information systems (EIS)	Java EE security	Java Message Service (JMS)	JavaMail server	Message-Driven Beans (MDB)	Remote EJB lookups	Remote EJB providers	Remote web services	Third-party security	Vendor specific messaging
+ CustomerOrderServicesApp.ear	1		3								

## Detailed Results by Rule

[Expand all](#) | [Collapse all](#)

### Severe Rules

[WebSphere traditional to Liberty](#)


#### Behavior change on lookups for Enterprise JavaBeans (4)

[Show rule help](#) | [Close results](#)

##### Results

FILE NAME	REFERENCE DETAILS	MATCH CRITERIA	LINE NUMBER
<b>CustomerOrderServicesApp.ear/CustomerOrderServicesTest-0.1.0-SNAPSHOT.war</b>			
WEB-INF/libm-web-bnd.xml		ejb-ref.binding-name=ejblocal:org.pwte.example.service.ProductSearchService	10
<b>CustomerOrderServicesApp.ear/CustomerOrderServicesWeb-0.1.0-SNAPSHOT.war</b>			
WEB-INF/classes/org/pwte/example/resources/CategoryResource.class	Constructor	ejblocal:org.pwte.example.service.ProductSearchService	28
WEB-INF/classes/org/pwte/example/resources/CustomerOrderResource.class	Constructor	ejblocal:org.pwte.example.service.CustomerOrderServices	53
WEB-INF/classes/org/pwte/example/resources/ProductResource.class	Constructor	ejblocal:org.pwte.example.service.ProductSearchService	38

# Migration plan

The files included in your migration bundle help you migrate to IBM Open Liberty, create an image, and package your application as a Kubernetes Operator for easy deployment.

## Build type ⓘ

Select the type of application you want to build to help Transformation Advisor determine what files to include in the bundle.

Source code

Binary

## Migration Files

These files are generated by Transformation Advisor to assist in migrating this application:

[server.xml](#)

[pom.xml](#)

[Operator resources](#)

[Dockerfile](#)

Application name

CustomerOrderServicesApp.ear

Source environment

IBM WebSphere Application Server

Migration target

IBM Cloud Pak for Applications:  
Open Liberty

Send your bundle to Git to begin building and deploying your applications. You can also download the bundle below.

[Send to Git](#)

Download

Send

# IBM WebSphere Application Migration Toolkit



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★ 17

3



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- IBM WebSphere

## IBM WebSphere Application Server Migration Toolkit



Details

Screenshots

Metrics

Errors

External Install Button

The IBM® WebSphere® Application Server Migration Toolkit is a suite of tools and knowledge collections that enables your organization to quickly and cost-effectively migrate to WAS Liberty and WebSphere Application Server V8, V8.5.5 or V9, whether from a previous version of WebSphere Application Server or competitive application servers including Apache Tomcat Server, JBoss Application Server, Oracle Application Server, and Oracle® WebLogic Server. It features cloud migration rules for running your application on Liberty for Java on IBM Bluemix and other third-party PaaS environments such as Cloud Foundry. This Eclipse Marketplace solution combines all our Eclipse-based migration tools in one easy installation. The WebSphere Version to Version Application Migration Tool enables organizations deploying to Liberty or traditional WebSphere Application Server to more easily migrate applications from WebSphere Application Server V5.1 and later. Upgrading to a more recent version of WebSphere Application Server is of course less time-consuming than migrating from another application server, given that IBM has made significant investments in upward compatibility, configuration, and management process upgrades, as well as API preservation and consistency between versions. However, in some cases, applications must be changed in order to support or exploit new levels of industry standard specifications delivered with new versions of WebSphere Application Server. Go to the [WebSphere migration tools download page](#) to download this tool and the command line binary scanner.

**Create, manage, and run configurations**

Select a range of inputs from the scope tab and at least one rule from the rules tab to create an analysis configuration.



Name: was-to-lib

Scope Rules

Rule Sets: WebSphere Application Server Version Migration Set... Import... Export...

Analysis Domains and Rules

Rule set configuration

WebSphere Application Server Migration Tool rule selection details

Source application server: WebSphere Application Server traditional V8.5.5

Target application server: Liberty

Source Java EE version: Java EE 6

Target Java EE version: Java EE 8

Java EE 8 Technologies

BeanValidation    CDI    EL  
 JAX-RS    JMS    JPA  
 JSF    Servlet

Target cloud runtime: None

Source Java version: IBM Java 6

Target Java version: IBM Java 8

?

Cancel OK

Filter matched 2 of 2 items

Close Analyze

eclipse-workspace3 - CustomerOrderServices/ejbModule/org/pwte/example/domain/AbstractCustomer.java - Eclipse IDE

Project Explorer

```
11 import javax.persistence.Entity;
12 import javax.persistence.FetchType;
13 import javax.persistence.Id;
14 import javax.persistence.Inheritance;
15 import javax.persistence.InheritanceType;
16 import javax.persistence.JoinColumn;
17 import javax.persistence.OneToMany;
18 import javax.persistence.OneToOne;
19 import javax.persistence.Table;
20
21 import org.codehaus.jackson.annotate.JsonIgnore;
22
23 @Entity
24 @Table(name = "CUSTOMER")
25 @Inheritance(strategy = InheritanceType.SINGLE_TABLE)
26 @DiscriminatorColumn(name = "TYPE", discriminatorType = DiscriminatorType.STRING)
27 public abstract class AbstractCustomer implements Serializable {
28
29     private static final long serialVersionUID = -4988539679853665972L;
30
31     public AbstractCustomer() {
32
33     }
34 }
```

Markers Properties Servers Data Source Snippets Problems Annotations Software An

Java Code Review

View as: Tree

was-to-lib (21/01/20 14:11:26) [24]

- Java EE 7 [10 results in 14ms]
  - CDI [2 results in 10ms]
    - CDI recognizes implicit bean archives [2 results in 1ms]
  - JAX-RS 2.0 [8 results in 0ms]
    - org.codehaus.jackson packages are not available [8 results in 0ms]
      - AbstractCustomer.java:21 org.codehaus.jackson packages are not available
      - Category.java:16 org.codehaus.jackson packages are not available
      - Category.java:17 org.codehaus.jackson packages are not available
      - LineItem.java:19 org.codehaus.jackson packages are not available
      - Order.java:21 org.codehaus.jackson packages are not available
      - Product.java:16 org.codehaus.jackson packages are not available
      - Product.java:17 org.codehaus.jackson packages are not available
      - CustomerServicesApp.java:23 org.codehaus.jackson packages are not available

Java EE 8 [1 result in 19ms]

JAX-RS 2.1 [1 result in 10ms]
  - The com.ibm.json packages are not available in the jaxrs-2.1 feature [[CustomerOrderResource.java:41](#)]

Liberty migration [3 results in 32ms]
  - WebSphere traditional to Liberty [3 results in 32ms]
    - Behavior change on lookups for Enterprise JavaBeans [3 results in 0ms]
      - CategoryResource.java:29 Behavior change on lookups for Enterprise JavaBeans
      - CustomerOrderResource.java:53 Behavior change on lookups for Enterprise JavaBeans
      - ProductResource.java:38 Behavior change on lookups for Enterprise JavaBeans

Help

Contents Search Related Topics Bookmarks Index

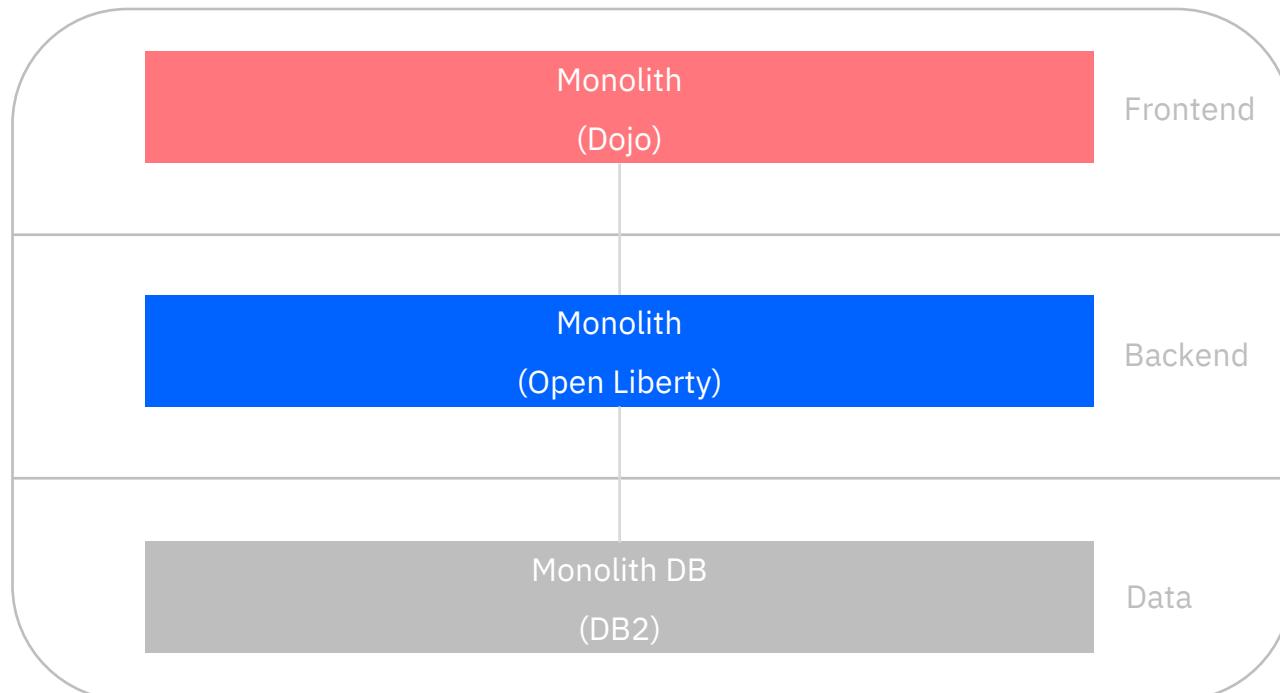
org.codehaus.jackson packages are not available

The org.codehaus.jackson packages that are exposed as a third-party API in JAX-RS 1.1 are no longer exposed in the WebSphere Application Server Java Platform, Enterprise Edition (Java EE) 7 JAX-RS 2.0 implementation. If you want to use any org.codehaus.jackson APIs in your application, you must package the Jackson packages with your application.

When you are migrating to JAX-RS 2.1, it is recommended to first migrate from JAX-RS 1.1 to JAX-RS 2.0. In the source scanner, this can be done by selecting the "JAX-RS 2.0" rules under the Java EE 7 category. In the binary scanner, run the report with the --targetJavaEE option set to ee7 and resolve issues that are flagged under the "JAX-RS 2.0" category.

For more information on JAX-RS 2.0 behavior changes, see [JAX-RS 2.0 behavior changes](#).

# Step 5: Open Liberty Monolith



OpenShift / Kubernetes

# Huge Advantage of Jakarta Enterprise Edition:

## Upwards Compatibility!

# Monoliths are not always evil !

Use the Strangler Pattern  
to modernize Applications  
in Stages !

# StranglerFigApplication

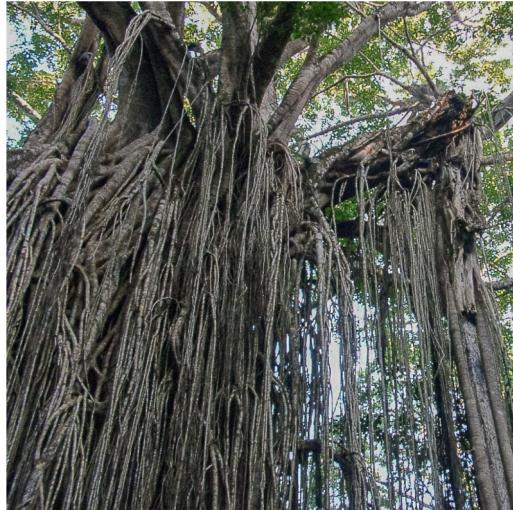
29 June 2004



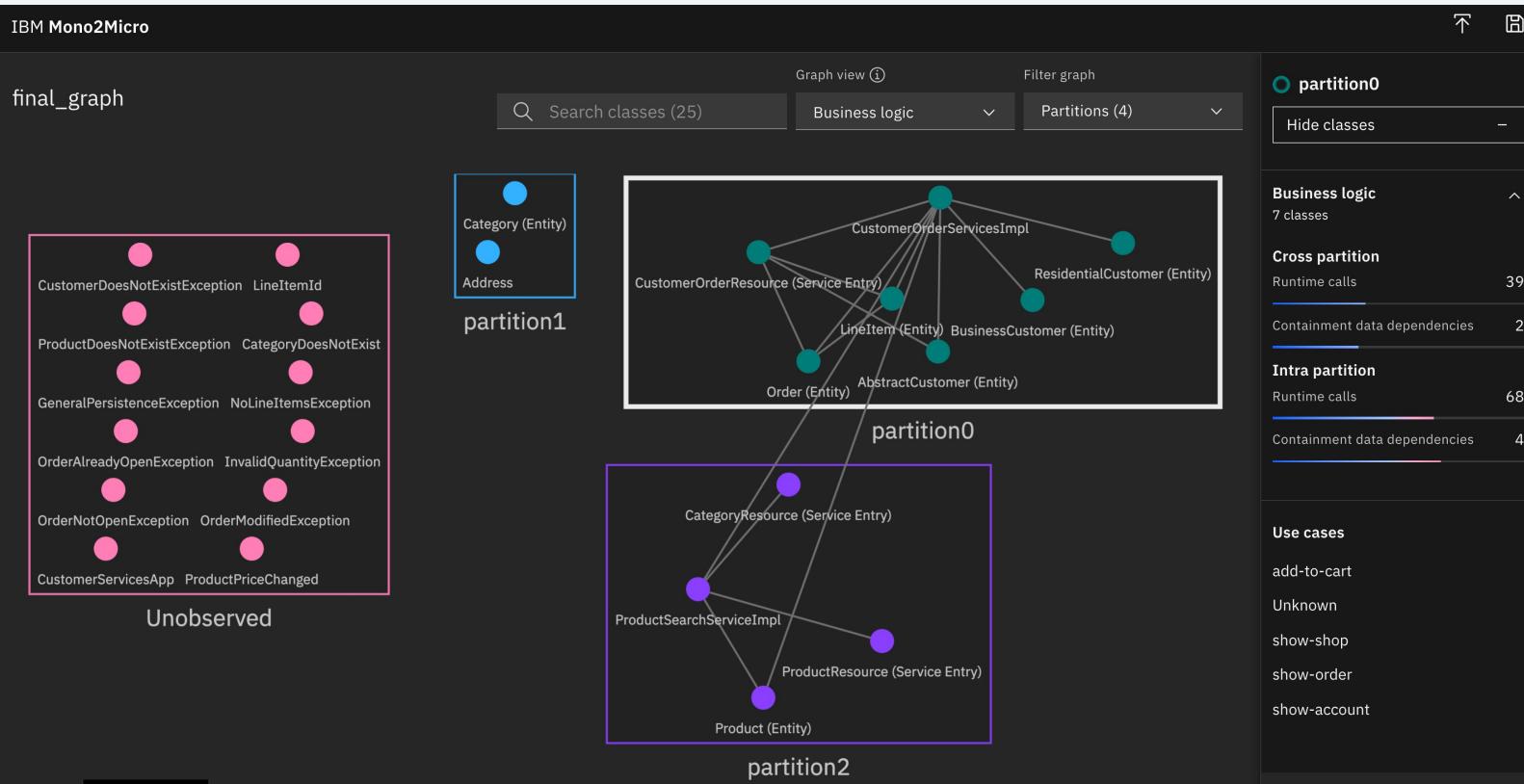
Martin Fowler

- ❖ APPLICATION ARCHITECTURE
- ❖ LEGACY REHAB

When Cindy and I went to Australia, we spent some time in the rain forests on the Queensland coast. One of the natural wonders of this area are the huge strangler figs. They seed in the upper branches of a tree and gradually work their way down the tree until they root in the soil. Over many years they grow into fantastic and beautiful shapes, meanwhile strangling and killing the tree that was their host.



# IBM Mono2Micro



# Don't build distributed Monoliths !

Use event driven  
architectures to de-couple  
microservices !



Catalog

Entertainment

Movies

Music

Games

Electronics

TV

Cellphones

DVD Players

Shopping Cart (2)

Account

## Catalog - Movies



Star Wars

Episode VI:  
Return of the Jedi

Return of the Jedi

29.99

Episode 6, Luke has the final confrontation with his fa...



Star Wars

Episode V:  
The Empire Strikes Back

Empire Strikes Back

29.99

Episode 5, Luke finds out a secret that will change hi...



Star Wars

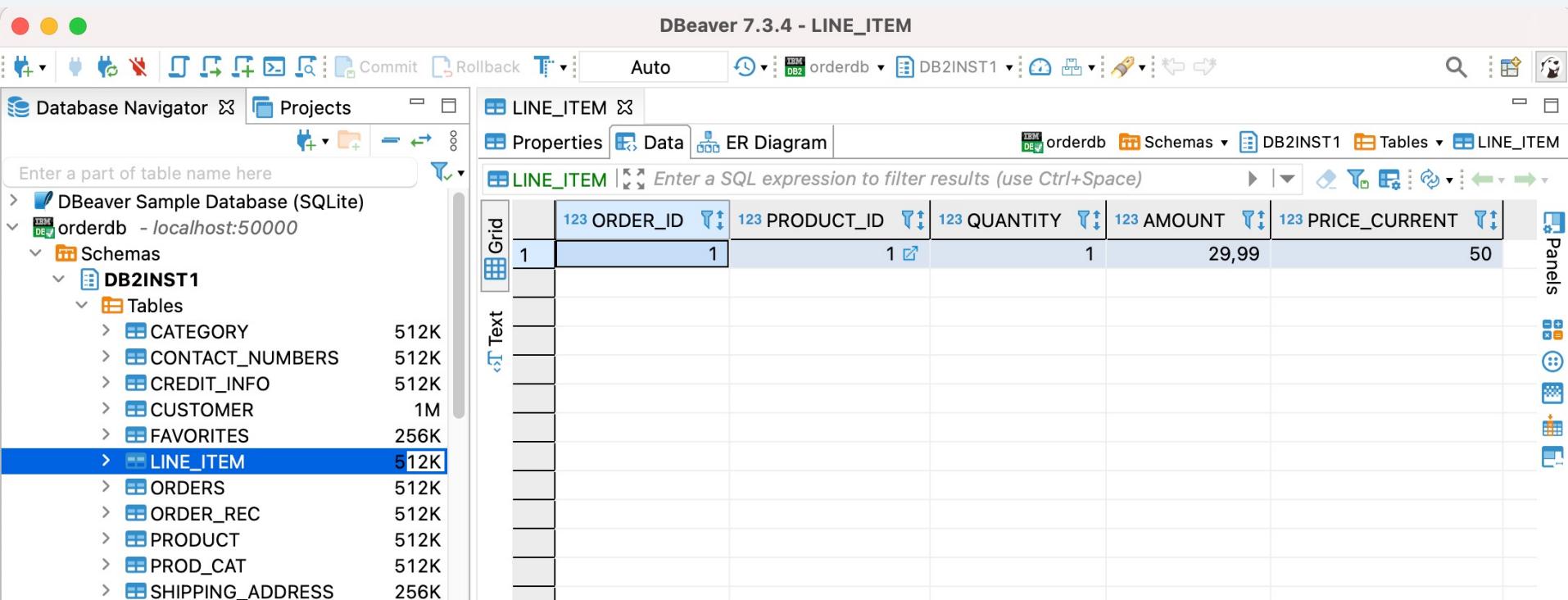
Episode IV:  
A New Hope

New Hope

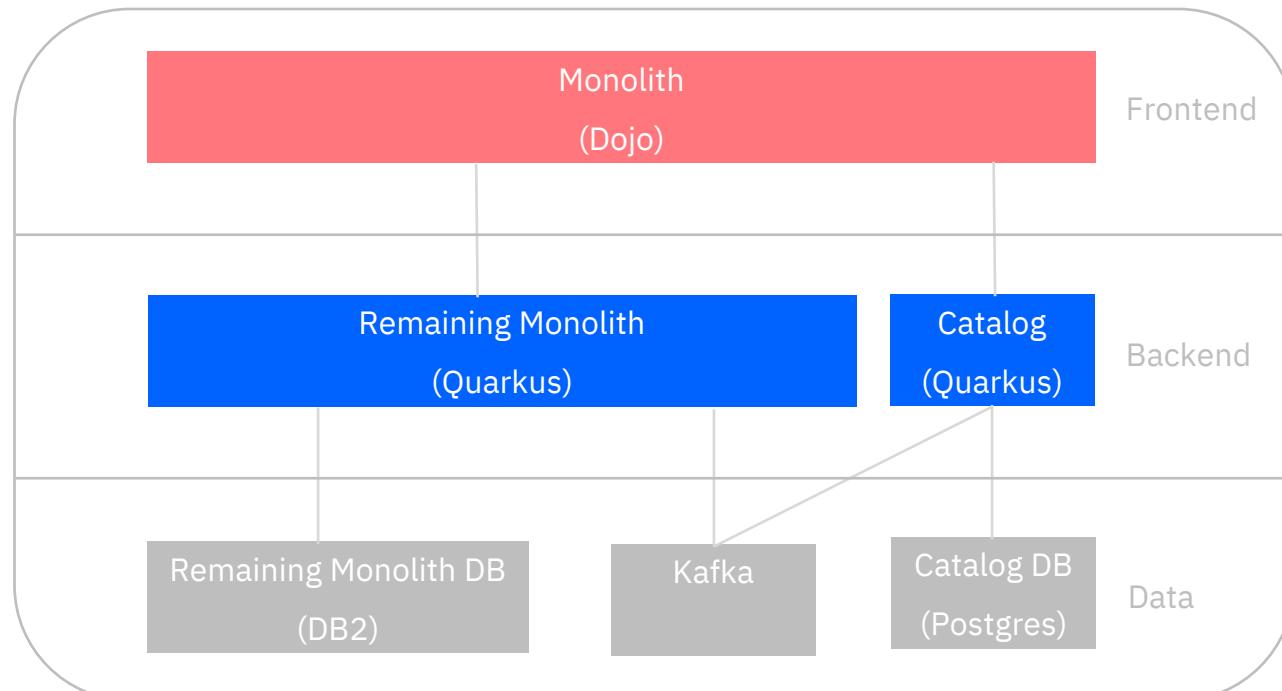
29.99

Episode 4, after years of oppression, a band of rebels...

ADD TO SHOPPING CART



# Step 7: Strangled Catalog Service and Quarkus Monolith



OpenJ9 uses less memory.

Reactive technologies  
require less resources.

00:00:45 0 0/100

Test Plan

Thread Group

- HTTP Request
- HTTP Header Manager
- Summary Report - Reactive Endpoint**
- Response Time Graph
- View Results Tree
- View Results in Table

**Summary Report**Name: **Summary Report - Reactive Endpoint**

Comments:

 Write results to file / Read from fileFilename  Browse...

Log/Display Only:

 Errors Successes Configure

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB...	Sent KB/sec	Avg. Bytes
HTTP Req...	30000	150	5	774	70.11	0.00%	660.7/sec	46.46	101.94	72.0
TOTAL	30000	150	5	774	70.11	0.00%	660.7/sec	46.46	101.94	72.0

00:01:18 0 0/100

Test Plan

Thread Group

- HTTP Request
- HTTP Header Manager
- Summary Report - Synchronous Endpoint**
- Response Time Graph
- View Results Tree
- View Results in Table

**Summary Report**Name: **Summary Report - Synchronous Endpoint**

Comments:

 Write results to file / Read from fileFilename  Browse...

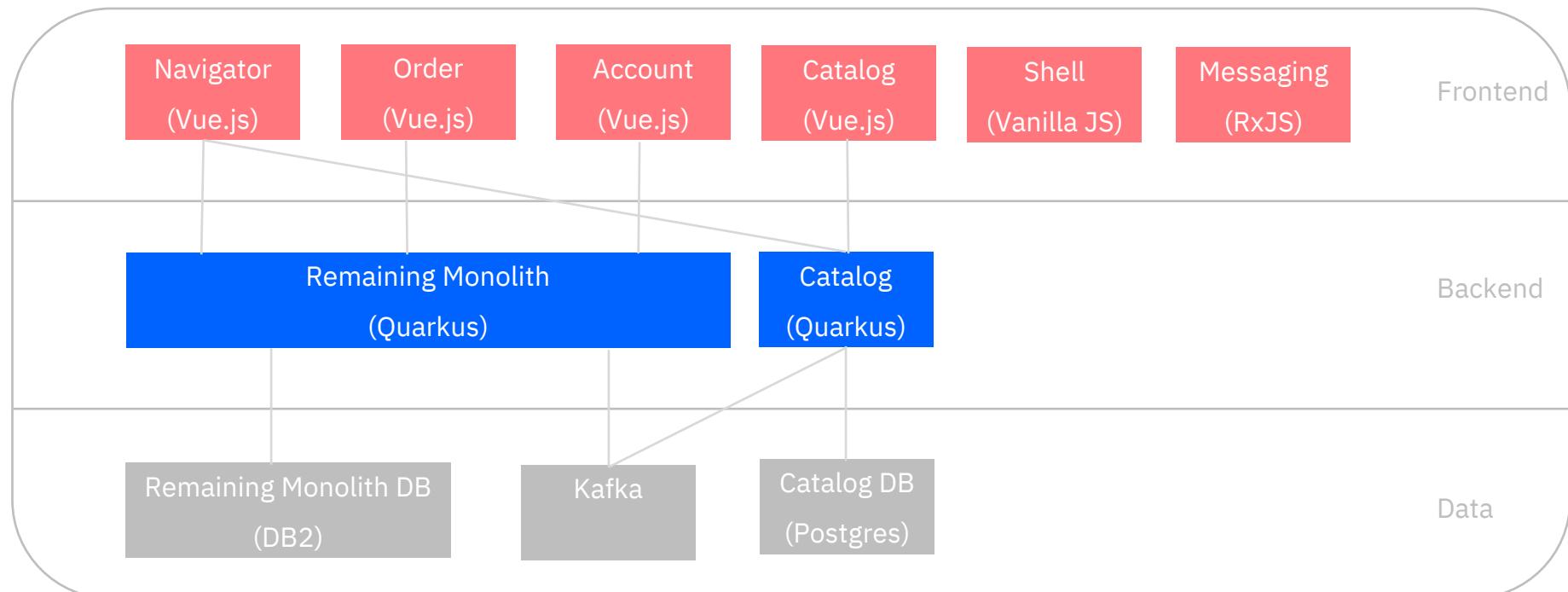
Log/Display Only:

 Errors Successes Configure

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB...	Sent KB/sec	Avg. Bytes
HTTP Req...	30000	258	1	1399	83.96	0.00%	383.2/sec	760.78	59.13	2033.0
TOTAL	30000	258	1	1399	83.96	0.00%	383.2/sec	760.78	59.13	2033.0

# Don't build microservices with monolithic frontends

# Step 8: Micro Frontends



# Electronic and Movie Depot



Catalog

Entertainment



Movies



Music



Games

Electronics



TV



Cellphones

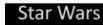


Navigator  
(Vue.js)



Account

## Catalog - Movies



Episode VI:  
Return of the Jedi

**Return of the Jedi**  
Episode 6, Luke has the final confrontation with his fa...

29.99



Episode V:  
The Empire Strikes Back

**Empire Strikes Back**  
Episode 5, Luke finds out a secret that will change hi...

29.99



Episode IV:  
A New Hope

**New Hope**  
Episode 4, after years of oppression, a band of rebels...

29.99

Catalog

INCOMING  
(Vue.js)

Order

(Vue.js)

Account

(Vue.js)

Shell  
(Vanilla JS)

Messaging  
(RxJS)

## Catalog

Entertainment

Movies

Music

Games

Electronics

TV

Cellphones

## Catalog - Movies



**Return of the Jedi**  
Episode 6, Luke has the final confrontation with his fa...



**Empire Strikes Back**  
Episode 5, Luke finds out a secret that will change hi...

## @vue-app-mod/navigator

Default URL: Override URL:  (X)Cancel Reset to default

override. See documentation for more info.

ADD TO SHOPPING CART

Search modules Add new module Add import map Reset all overrides

Module Status	Module Name	Domain	Filename
Inline Override	single-spa	cdn.jsdelivr.net	single-spa.dev.js
Inline Override	vue	cdn.jsdelivr.net	vue.js
Inline Override	vue-router	cdn.jsdelivr.net	vue-router.js
Default	rxjs	cdnjs.cloudflare.com	rxjs.umd.min.js
Default	@vue-app-mod/shell	localhost:8080	vue-app-mod-shell.js
Default	@vue-app-mod/messaging	localhost:9001	vue-app-mod-messaging.js
Default	@vue-app-mod/navigator	localhost:8501	app.js

Filter Hide data URLs All XHR JS CSS Img Media Font Doc WS Manifest Other Has blocked cookies  Blocked Requests

Name	S...	Domain	Type	Initiator	Size	T...	Waterfall
catalog	304	localhost	docu...	Other	431 B	6...	
import-map-overrides.js	200	cdn.jsdelivr...	script	catalog	(mem... 0...		
system.js	200	cdn.jsdelivr...	script	catalog	(mem... 0...		
amd.js	200	cdn.jsdelivr...	script	catalog	(mem... 0...		
named-exports.js	200	cdn.jsdelivr...	script	catalog	(mem... 0...		
material-components-web.mi...	302	unpkg.com	styles...	catalog	70 B	3...	
material-components-web.mi...	302	unpkg.com	script	catalog	94 B	2...	
icon?family=Material+Icons	200	fonts.go...	styles...	catalog	(disk ... 2...		
material-components-web.mi...	200	unpkg.com	script	material-co...	(disk ... 2...		
material-components-web.mi...	200	unpkg.com	styles...	material-co...	(disk ... 3...		
vue-app-mod-shell.js	200	localhost	script	system.js:654	(disk ... 1...		
f1UhRq6tzZclQEJ-Vdg-luaDs...	200	fonts.gst...	font	icon?family...	(mem... 0...		
single-spa.min.js	200	cdn.jsdelivr...	script	system.js:654	(disk ... 1...		
app.js	200	localhost	script	system.js:654	(disk ... 9...		
app.js	200	localhost	script	system.js:654	(disk ... 2...		
app.js	200	localhost	script	system.js:654	(disk ... 3...		
vue-router.min.js	200	cdn.jsdelivr...	script	system.js:654	(disk ... 1...		
vue.min.js	200	cdn.jsdelivr...	script	system.js:654	(disk ... 3...		
vue-app-mod-messaging.js	200	localhost	script	system.js:654	(disk ... 3...		
?categoryId=2	200	localhost	fetch	Home.vue:1...	640 B	1...	
Category	200	localhost	fetch	App.vue:113	499 B	1...	
Orders	200	localhost	fetch	App.vue:82	550 B	1...	
Return.jpg	200	localhost	jpeg	vue.min.js:6	(mem... 0...		
Empire.jpg	200	localhost	jpeg	vue.min.js:6	(mem... 0...		
NewHope.jpg	200	localhost	jpeg	vue.min.js:6	(mem... 0...		

Check out the Repo !

[https://github.com/IBM/  
application-modernization-  
javaee-quarkus](https://github.com/IBM/application-modernization-javaee-quarkus)

# Documentation

The screenshot shows a web browser window with the URL [github.com/IBM/application-modernization-javaee-quarkus](https://github.com/IBM/application-modernization-javaee-quarkus). The page title is "Documentation". Below the title, there is a paragraph of text followed by a bulleted list of links.

I've written a series of blogs about this project:

- [Application Modernization and Rabbits](#)
- [Project Overview Slides](#)
- [10 Reasons why Enterprises should modernize Applications](#)
- [Improving operational Efficiency through Application Modernization](#)
- [Modernizing Java EE Applications with WebSphere Liberty](#)
- [Step-by-Step Instructions how to use Transformation Advisor](#)
- [Modernizing Applications with new User Experiences](#)
- [Moving from WebSphere Liberty to Open Source with Open Liberty](#)
- [Increasing Productivity for legacy Liberty Applications](#)
- [Don't build distributed Monoliths!](#)
- [Strangler Pattern Example](#)
- [Step-by-Step Instructions for Mono2Micro](#)
- [Event driven Architectures for loosely coupled Microservices](#)
- [Using Quarkus for building reactive Applications](#)
- [Using Micro Frontends in Microservices based Architectures](#)
- [Developing Micro Frontends with Single-Spa](#)
- [Developing loosely coupled Micro Frontends via RxJS](#)
- [Workshop: Modernizing IBM WebSphere Applications](#)
- [Running Liberty Applications with Db2 locally](#)
- [Running legacy Java Applications locally](#)
- [Application Modernization Resources on IBM Developer](#)

# Get Started

← → ⌂ [github.com/IBM/application-modernization-javaee-quarkus](https://github.com/IBM/application-modernization-javaee-quarkus)

## TL;DR

If you want to run the modernized application locally, you can invoke the following commands. All you need is a local Docker installation and the git CLI.

Notes:

- Docker requires 12 GB memory and 8 CPUs
- It takes roughly 15 - 20 minutes to start everything

```
$ git clone https://github.com/nheidloff/application-modernization-javaee-quarkus.git && cd application-modernization-javaee-quarkus
$ ROOT_FOLDER=$(pwd)
$ sh ${ROOT_FOLDER}/scripts-docker/build-and-run.sh
```

The 'build-and-run.sh' script will launch the following containers.

CONTAINER ID	IMAGE	STATUS	NAMES\PORTS
c3312ecd5dd3	storefront-mf-navigator	Up 2 minutes	storefront-mf-navigator@0.0.0:8501->80/tcp
053446cf8b69	storefront-mf-catalog	Up 2 minutes	storefront-mf-catalog@0.0.0:8502->80/tcp
9149015f94a9	storefront-mf-account	Up 2 minutes	storefront-mf-account@0.0.0:8502->80/tcp
d71a15f941a3	storefront-mf-messaging	Up 2 minutes	storefront-mf-messaging@0.0.0:9001->80/tcp
7bae069e9ec0	storefront-mf-order	Up 2 minutes	storefront-mf-order@0.0.0:8504->80/tcp
883226a3c884	storefront-mf-shell	Up 2 minutes	storefront-mf-shell@0.0.0:8800->80/tcp
8819989980d7	storefront-frontend	Up 41 minutes	storefront-frontend@0.0.0:9081->9080/tcp, 0.0.0.0:9444->9443/tcp
e8ddbb6d1bc1	proxy-nginx	Up 41 minutes	proxy-nginx@0.0.0:80->80/tcp, 0.0.0.0:443->443/tcp
977fe986e6e7	storefront-backend-quarkus	Up 41 minutes	storefront-backend-quarkus@0.0.0:9082->8080/tcp, 0.0.0.0:9445->9443/tcp
e45993f1b7a3	storefront-catalog-reactive	Up 45 minutes	storefront-catalog-reactive@0.0.0:9778/tcp, 9779/tcp, 0.0.0.0:9803->8082/tcp
f8693fb7b6	storefront-db2	Up 45 minutes	storefront-db2@0.0.0:5000->5000/tcp, 22/tcp, 0.0.0.0:50000->50000/tcp, 55000/tcp, 60006-60007/tcp, 0.0.0.0:60000->60000/tcp
f5b2a8bf4a97	strimzi/kafka:0.19.0-kafka-2.5.0	Up About an hour	kafka@0.0.0:9092->9092/tcp
37244d91652d	strimzi/kafka:0.19.0-kafka-2.5.0	Up About an hour	zookeeper@0.0.0:2181->2181/tcp
6166623645f1	postgres	Up About an hour	postgres@0.0.0:5432->5432/tcp

Check out the Repo !

[https://github.com/IBM/  
application-modernization-  
javaee-quarkus](https://github.com/IBM/application-modernization-javaee-quarkus)