

Cloud-native business automation with Kogito for building open source intelligent applications

Eder Ignatowicz

Principal Software Engineer

@ederign



Kogito

Kogito is the next generation of business automation platforms focused on cloud-native development, deployment, and execution. Kogito is composed of the battle-tested projects of the KIE group: Drools, jbPM, and OptaPlanner.

[READ MORE →](#)



Drools is a business rule management system with a forward-chaining and backward-chaining inference based rules engine, allowing fast and reliable evaluation of business rules and complex event processing.

[READ MORE →](#)



jbPM is a flexible Business Process Management suite allowing you to model your business goals by describing the steps that need to be executed to achieve those goals.

[READ MORE →](#)



OptaPlanner is a constraint solver that optimizes use cases such as employee rostering, vehicle routing, task assignment and cloud optimization.

[READ MORE →](#)





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Red Hat



Some background...

Cloud Native

Cloud native technologies empower organizations to build and run **scalable** applications in modern, dynamic environments such as **public, private, and hybrid clouds**. **Containers, service meshes, microservices, immutable infrastructure**, and declarative APIs exemplify this approach.

These techniques enable loosely coupled systems that are resilient, **manageable**, and **observable**. Combined with **robust automation**, they allow engineers to make high-impact changes frequently and predictably with minimal toil.

*Emphasis mine

<https://github.com/cncf/foundation/blob/master/charter.md>

Cloud Native Applications

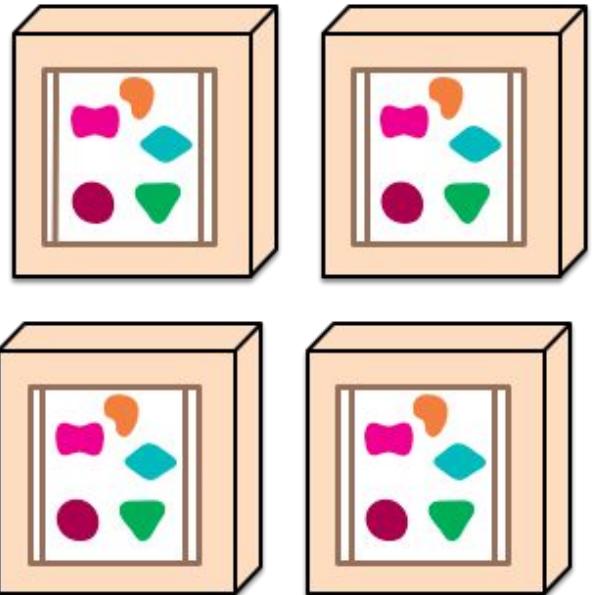
- ▶ Small, independent, and loosely coupled services
 - Microservices
- ▶ Container based
- ▶ Allows rapid iteration to deliver business value
- ▶ Private, public, and hybrid clouds
- ▶ Scalable, resource efficient

Microservices

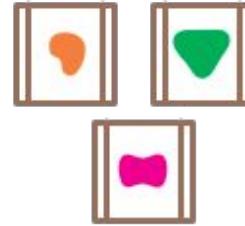
A monolithic application puts all its functionality into a single process...



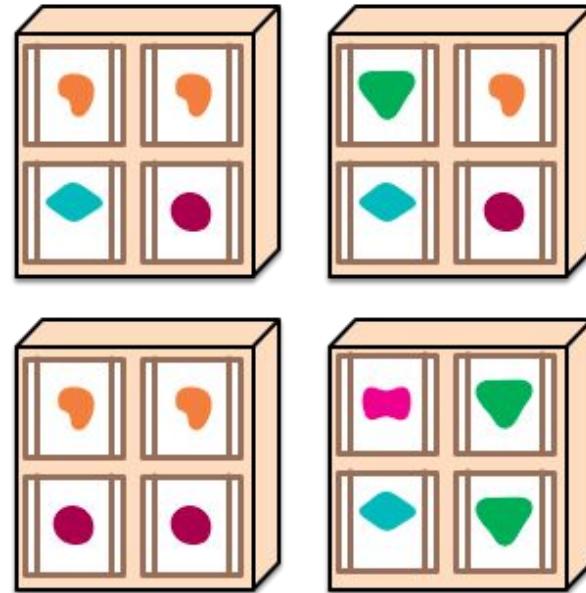
... and scales by replicating the monolith on multiple servers



A microservices architecture puts each element of functionality into a separate service...

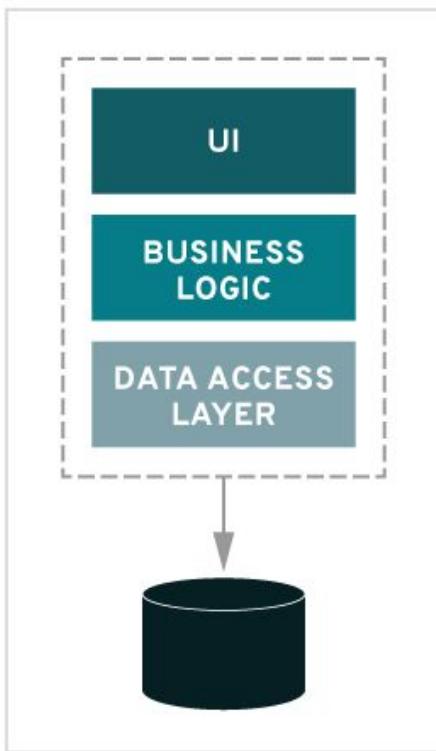


... and scales by distributing these services across servers, replicating as needed.



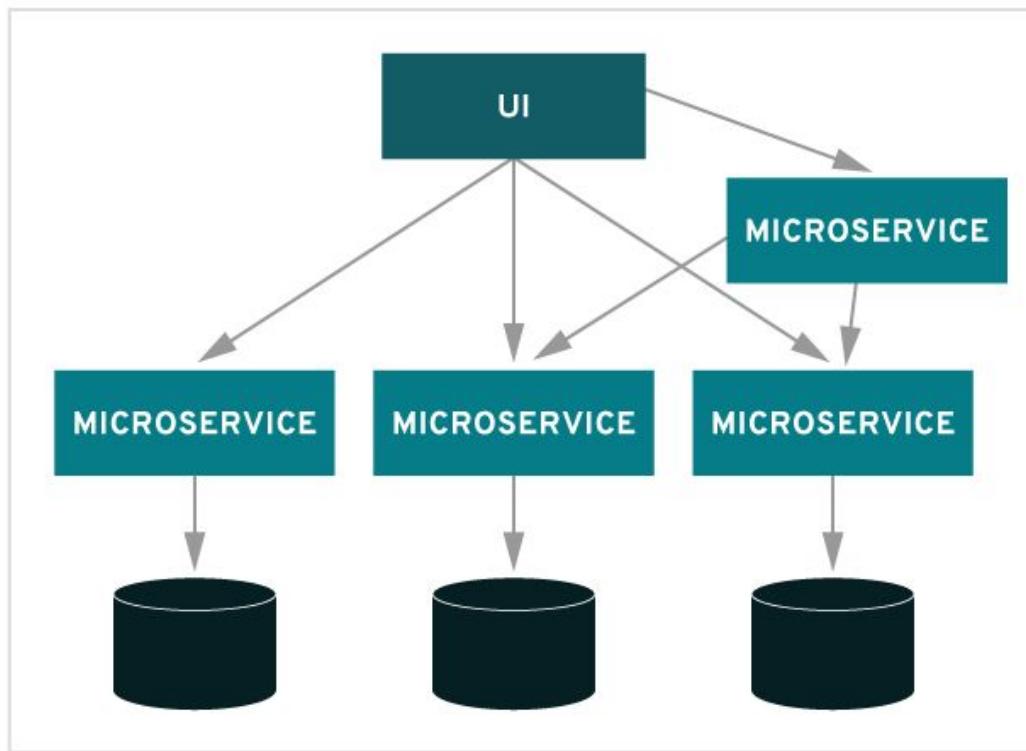
New Architectures

MONOLITHIC

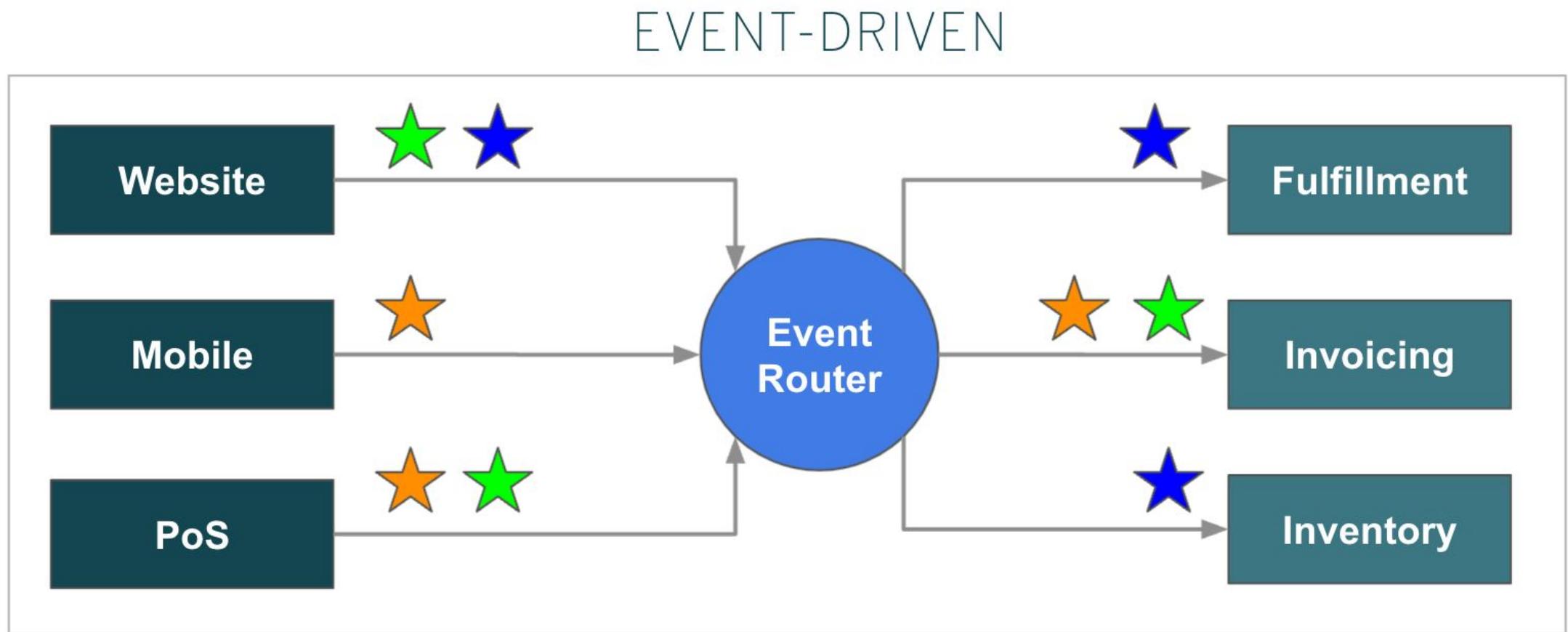


VS.

MICROSERVICES



New Architectures





Kogito

CLOUD-NATIVE BUSINESS AUTOMATION
FOR BUILDING INTELLIGENT APPLICATIONS,
BACKED BY BATTLE-TESTED CAPABILITIES

The Kogito Toolset

Design

Build

Deploy



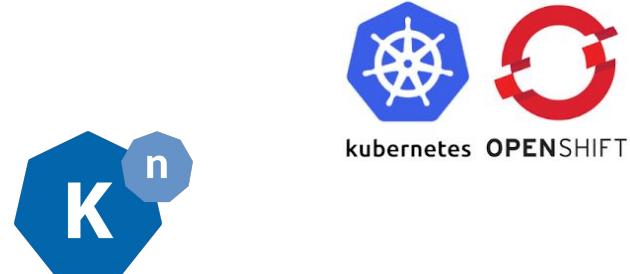


Cloud-native

Cloud Native

Why?

- ▶ Fit into how developers are building cloud-native applications
- ▶ Leveraging and integrating with other technologies out there



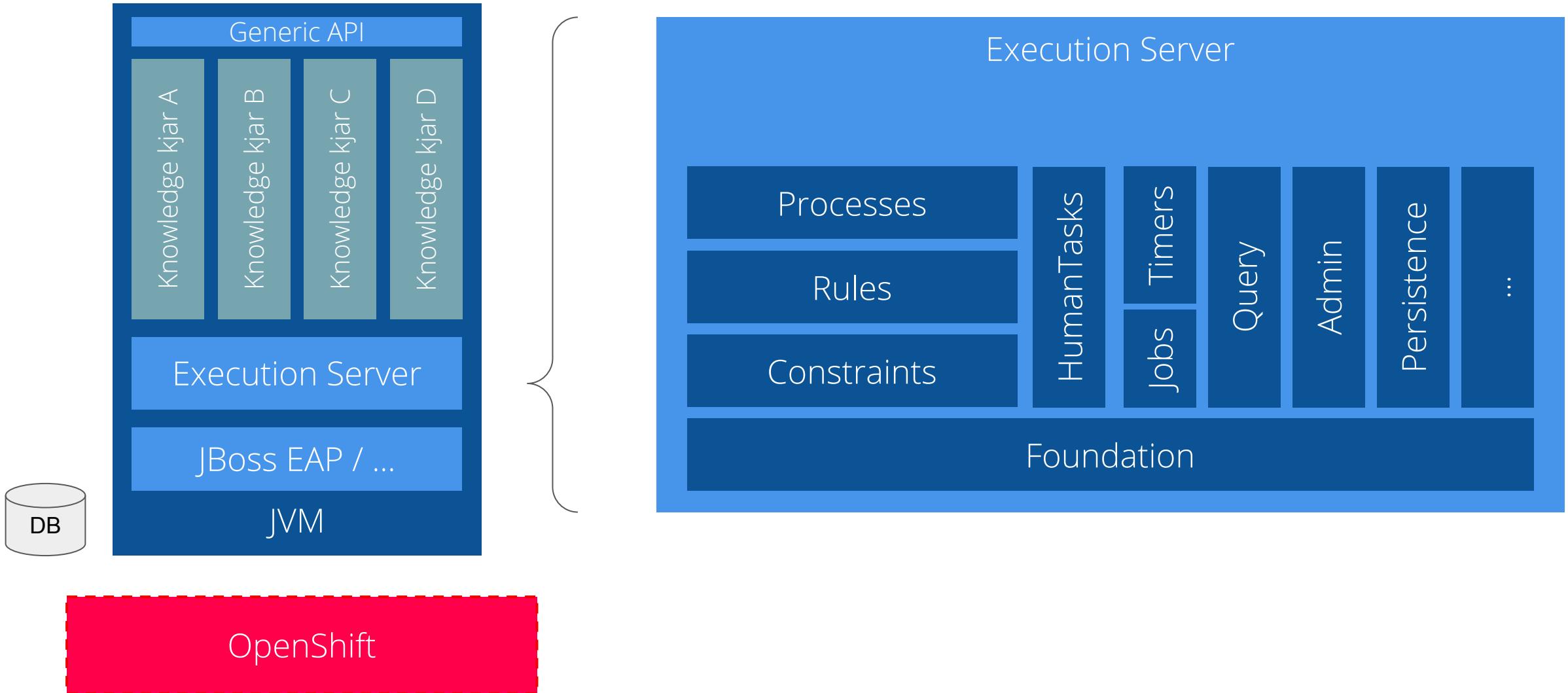
kubernetes OPENSHIFT

How?

- ▶ Kube-native, built for OpenShift
- ▶ Superfast boot time, low footprint (GraalVM native image)
- ▶ Highly distributed
- ▶ Targeting Quarkus and SpringBoot
- ▶ Operator-driven service lifecycle management
- ▶ Operator CLI
- ▶ Fit into Knative serverless
- ▶ Leveraging / integrating many other (cloud) technologies



From our traditional Execution Server

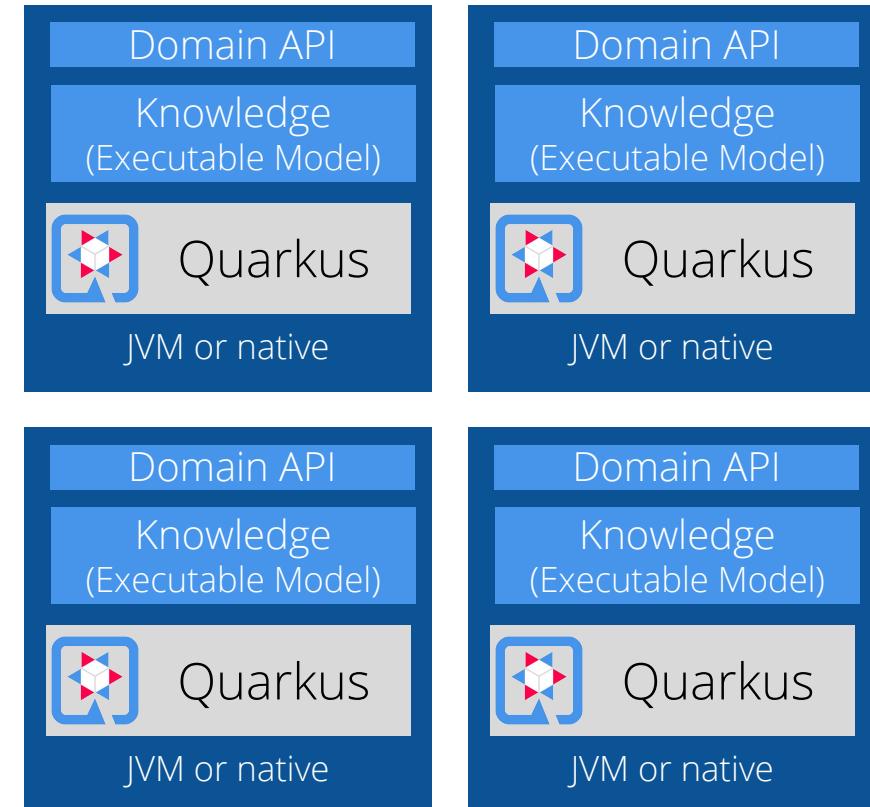


... to a new Cloud-Native Architecture

Before



After



OpenShift

OpenShift

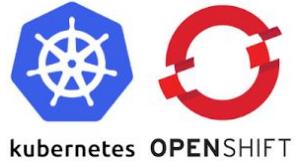
Cloud Native

Why?

- ▶ Distributed
 - Independent, part of application
 - No “centralized” orchestration
 - (Potentially) shared supporting services

- ▶ Dedicated runtime
 - Minimal set of features
 - Optimized
 - Domain-specific

- ▶ Leveraging and integrated into (massive) cloud-native ecosystem

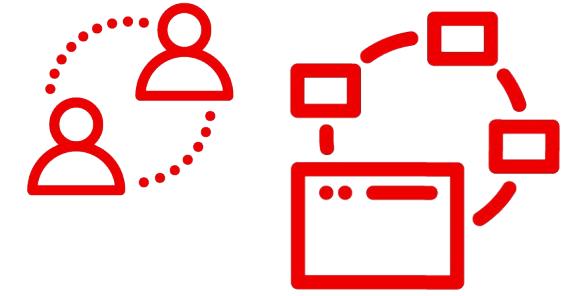




Battle-tested
Capabilities

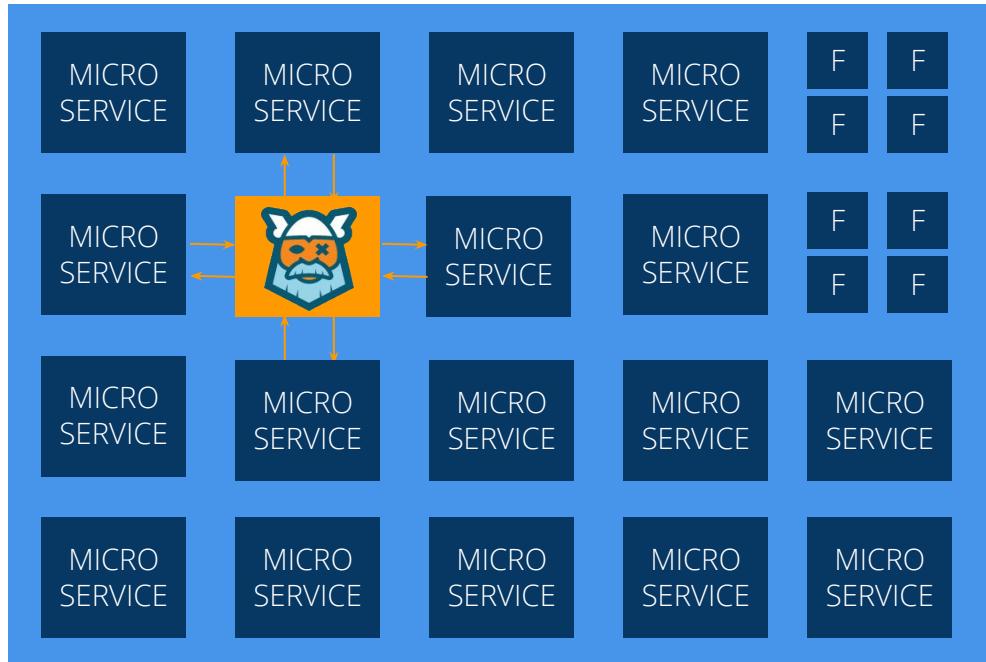
Battle-tested capabilities

Resolve split-packages: move everything from kie-api under ... 8 years ago	22 import org.kie.api.definition.process.Connection; 23 import org.jbpm.process.core.event.EventFilter; 24 import org.jbpm.process.core.event.EventTransformer; 25 import org.jbpm.process.core.event.EventTypeFilter; 26 import org.jbpm.workflow.core.impl.ExtendedNodeImpl; 27 28 public class EventNode extends ExtendedNodeImpl implements EventNodeInterface { 29 30 private static final long serialVersionUID = 510L; 31 32 private List<EventFilter> filters = new ArrayList<EventFilter>(); 33 private EventTransformer transformer; 34 private String variableName; 35 private String scope; 36 37 public String getVariableName() { 38 return variableName; 39 } 40 41 public void setVariableName(String variableName) { 42 this.variableName = variableName; 43 } 44 45 public void addEventFilter(EventFilter eventFilter) { 46 filters.add(eventFilter); 47 }
Adding initial commit 10 years ago	



For Building
Intelligent Applications

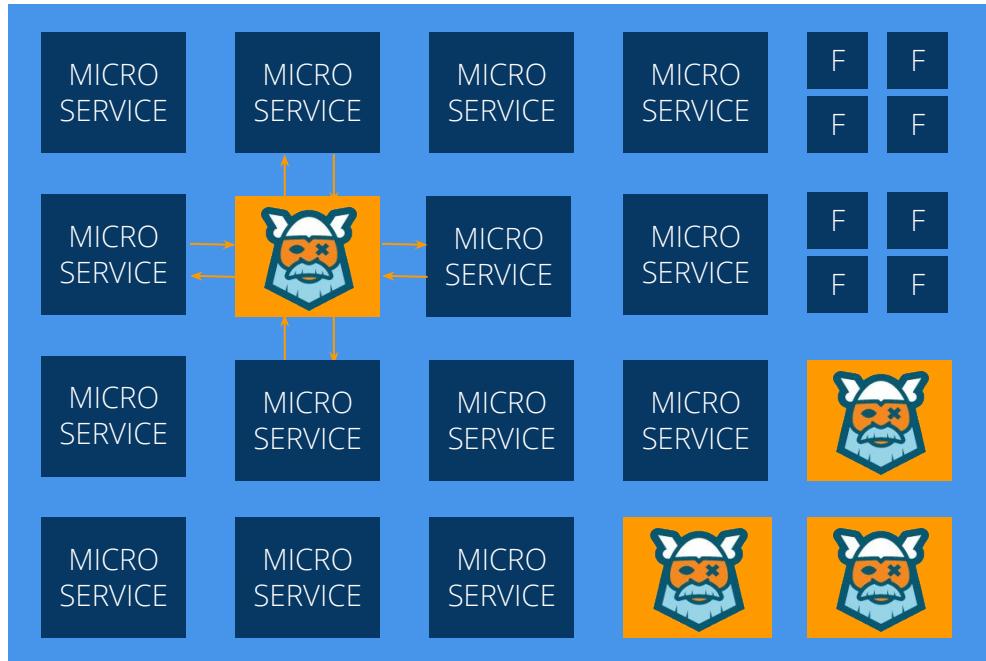
Cloud-native Applications



Application = large # of services

Kogito domain-specific services
Kogito supporting services

Cloud-native Applications



Application = large # of services

Kogito domain-specific services
Kogito supporting services



Kogito Process

Helps you author, execute, manager and
monitor business process

What is a Business Process?

A Business Process is a streamlined set of activities related to the production of a good or a service

Business

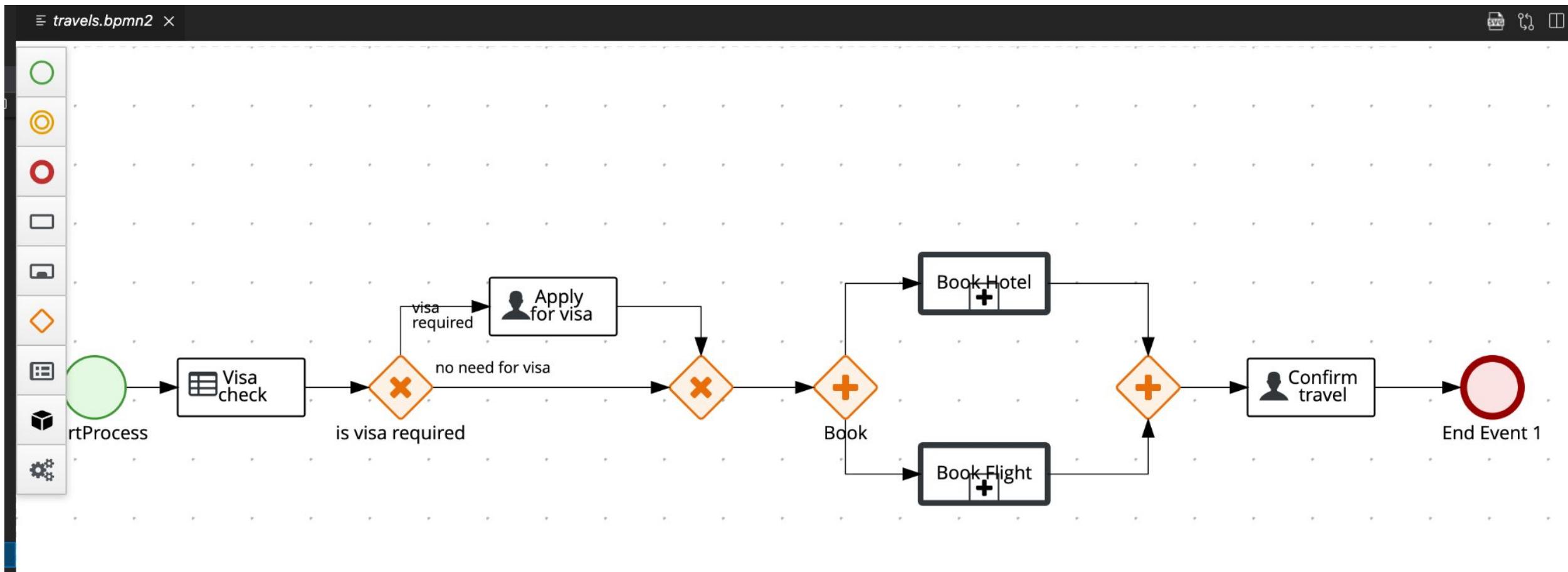
- ▶ Strictly connected to business revenue / profit

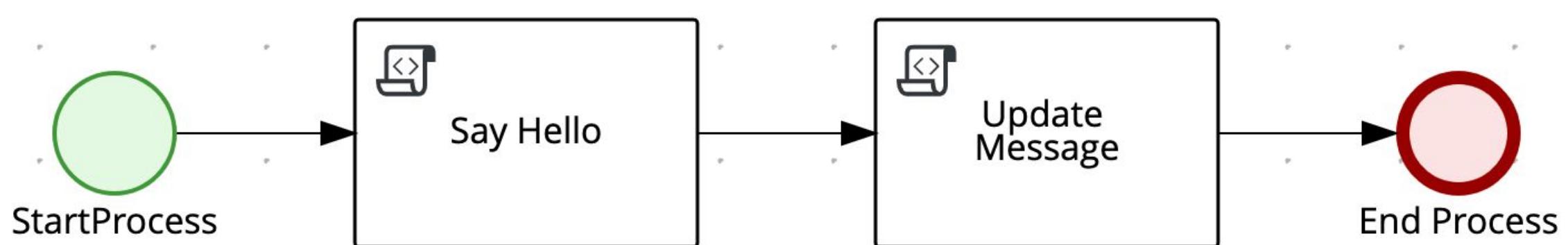
Technical

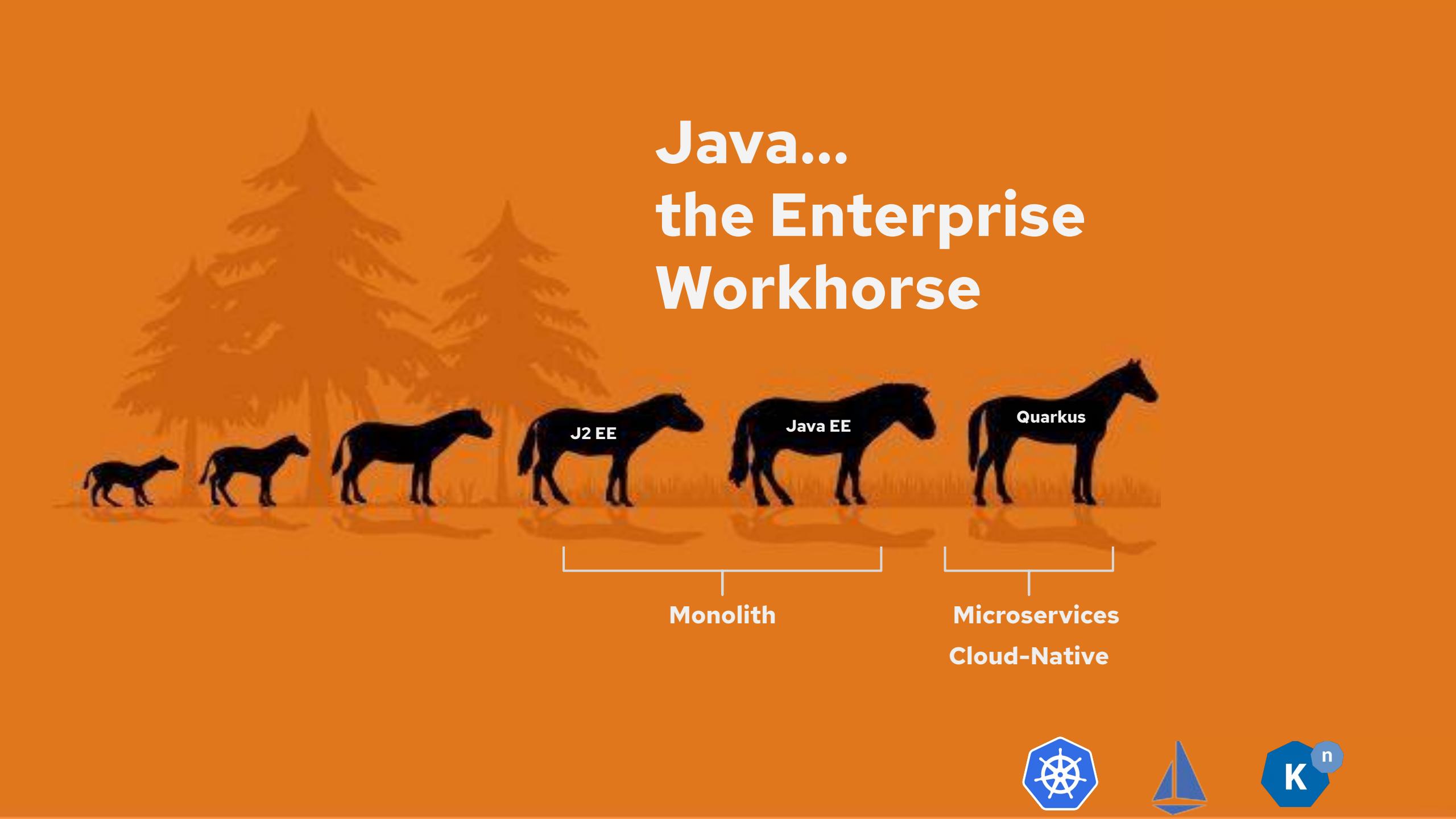
- ▶ Loosely connected to business objectives
- ▶ Could be modified without business implications
- ▶ Could be outsourced



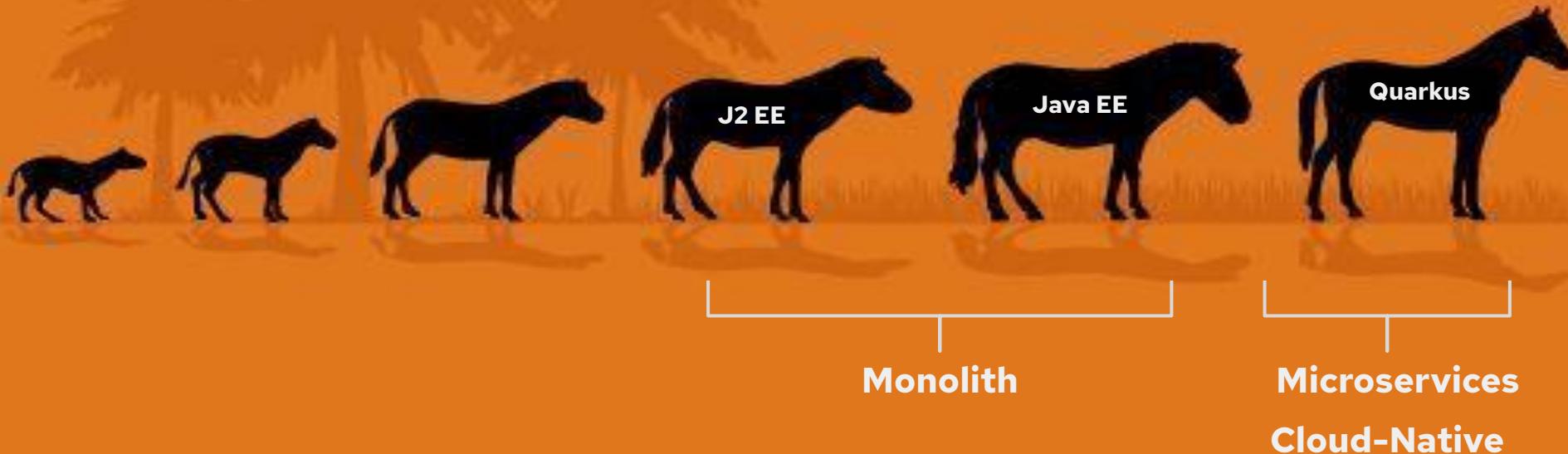
Business Process







Java... the Enterprise Workhorse





QUARKUS

Supersonic. Subatomic. Java.

Differentiators

Compared to traditional Java stack

- 1/10 RAM usage
- 300x faster startup time



Container first

Tailors your app for HotSpot & GraalVM
Fast boot time and low RSS memory
Serverless fit



Developer joy

Live coding
Unified configuration



Unifies imperative and reactive

Combines blocking and non-blocking
Built-in event bus



Best of breed libraries and standards

Over 90 extensions
“Powered by Quarkus” applications

“Quarkus has introduced a new paradigm that puts things upside down on the way things are run under the covers – supporting native, all reflection done at compile time and not runtime is just amazing!” - Talkdesk

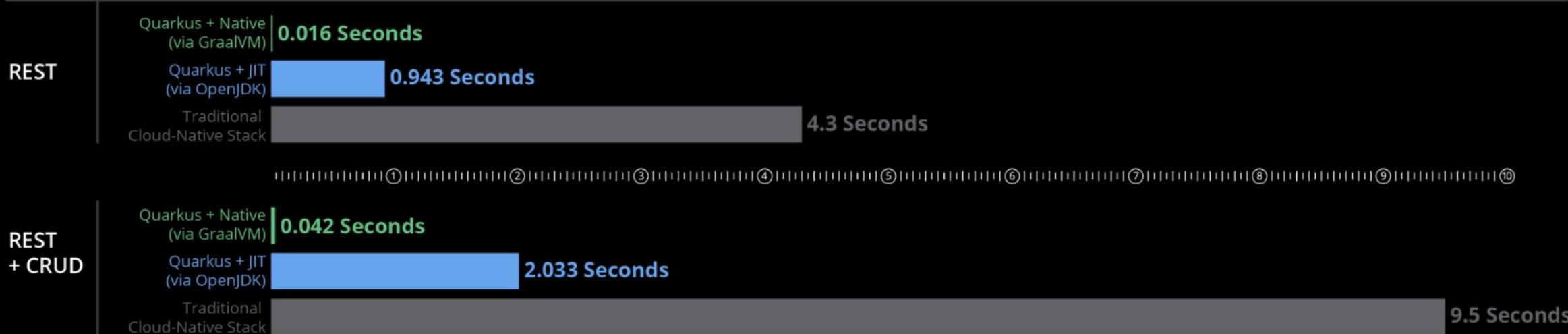
```
$ ./my-native-java-rest-app  
Quarkus started in 0.008s
```

Memory (RSS) in Megabytes*

*Tested on a single-core machine



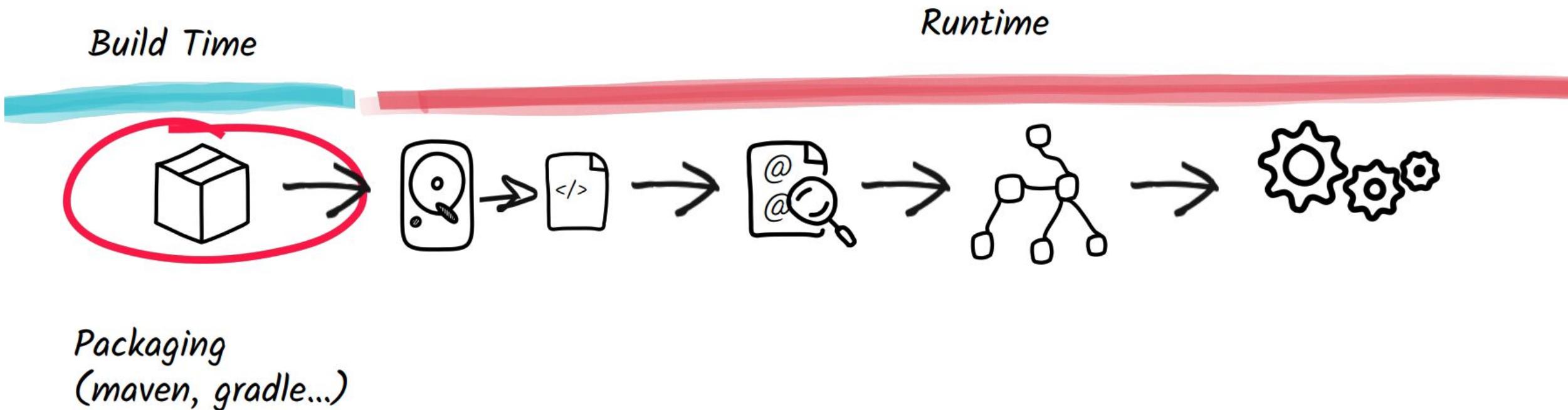
BOOT + First Response Time



Compile-Time vs Run-Time

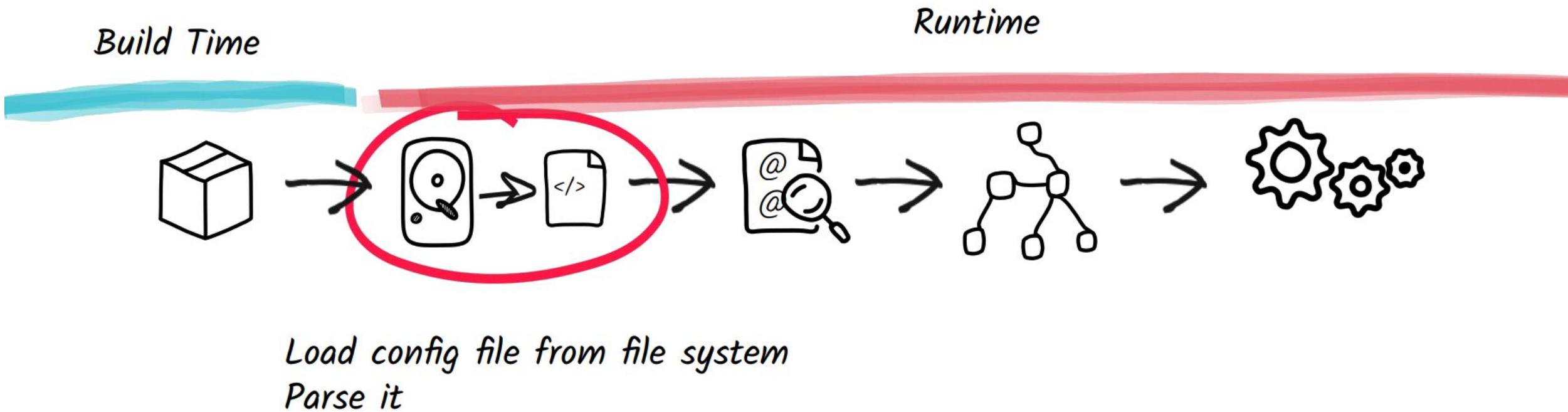
Compile-Time vs Run-time

How does a *framework* start?



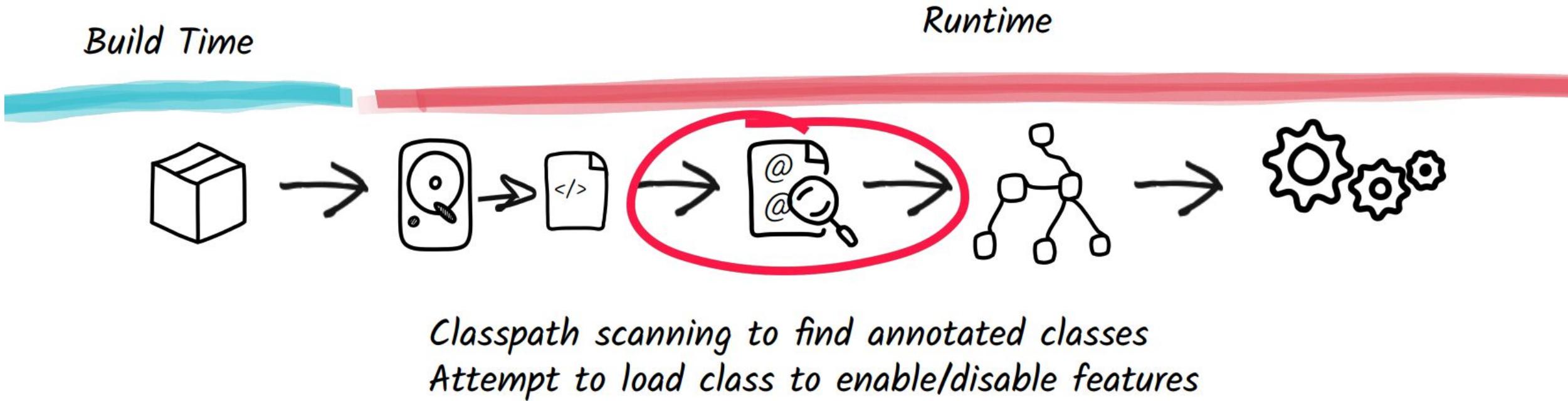
Compile-Time vs Run-time

How does a *framework* start?



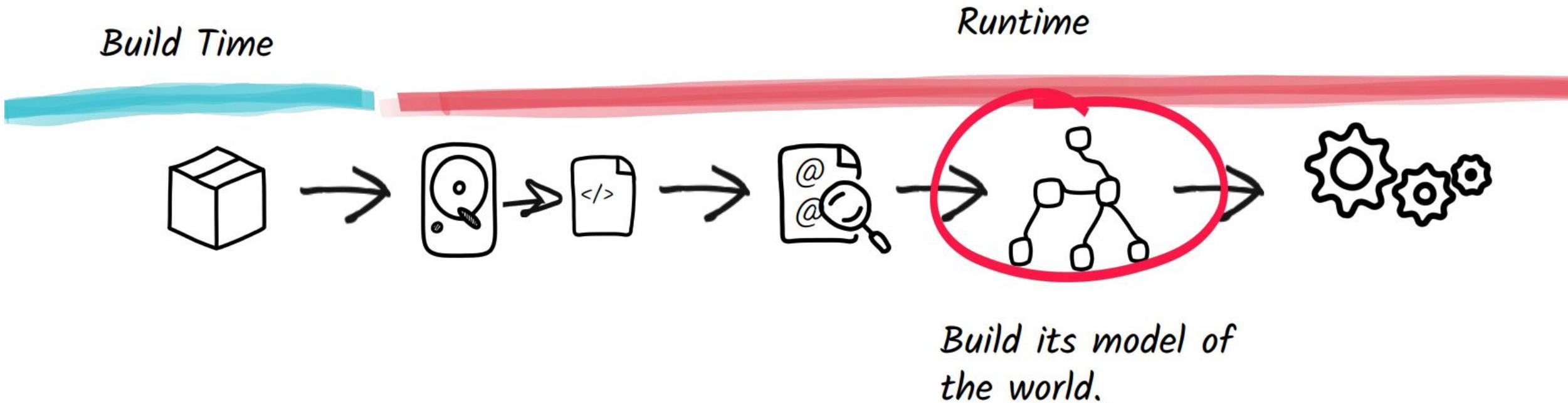
Compile-Time vs Run-time

How does a framework start?



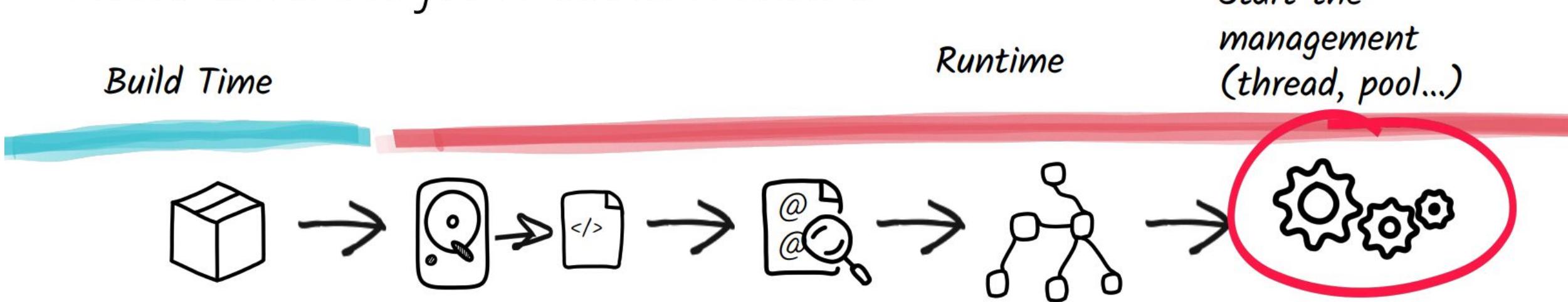
Compile-Time vs Run-time

How does a *framework* start?



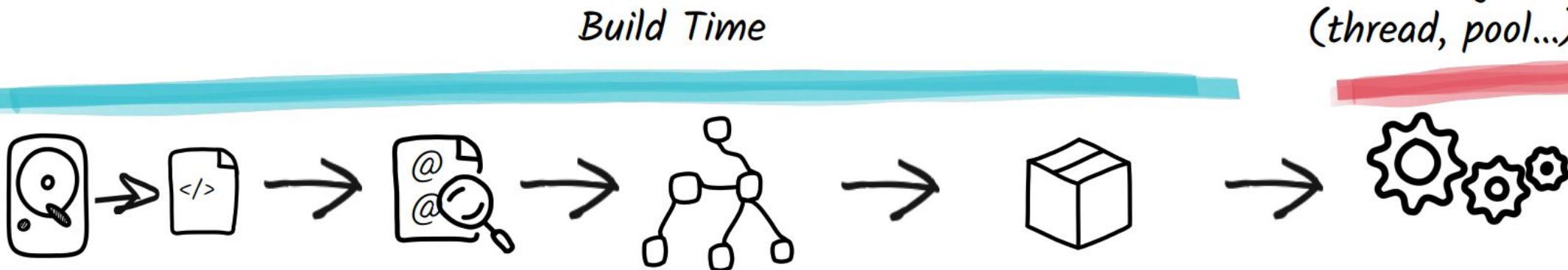
Compile-Time vs Run-time

How does a *framework* start?



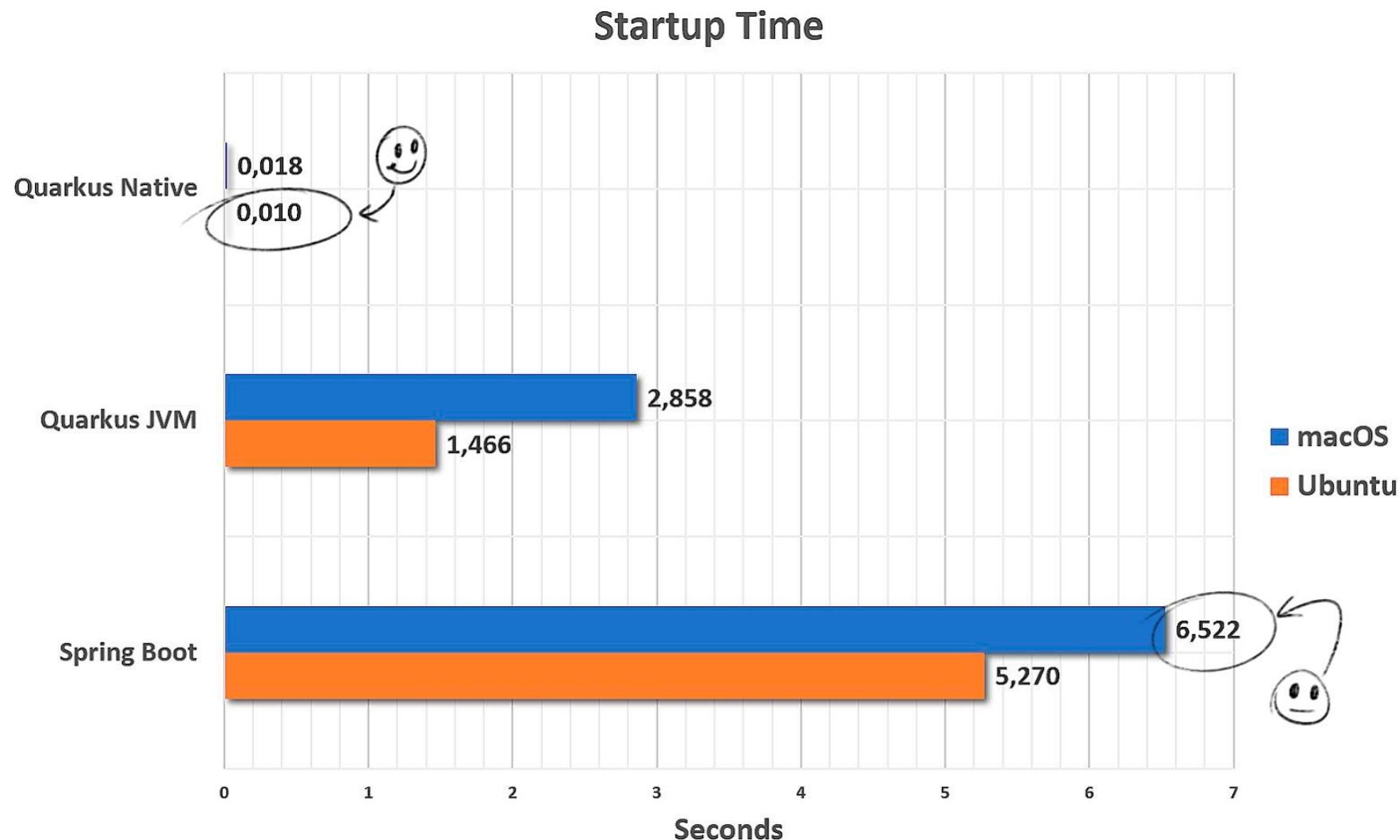
Compile-Time vs Run-time

How does a Quarkus start?

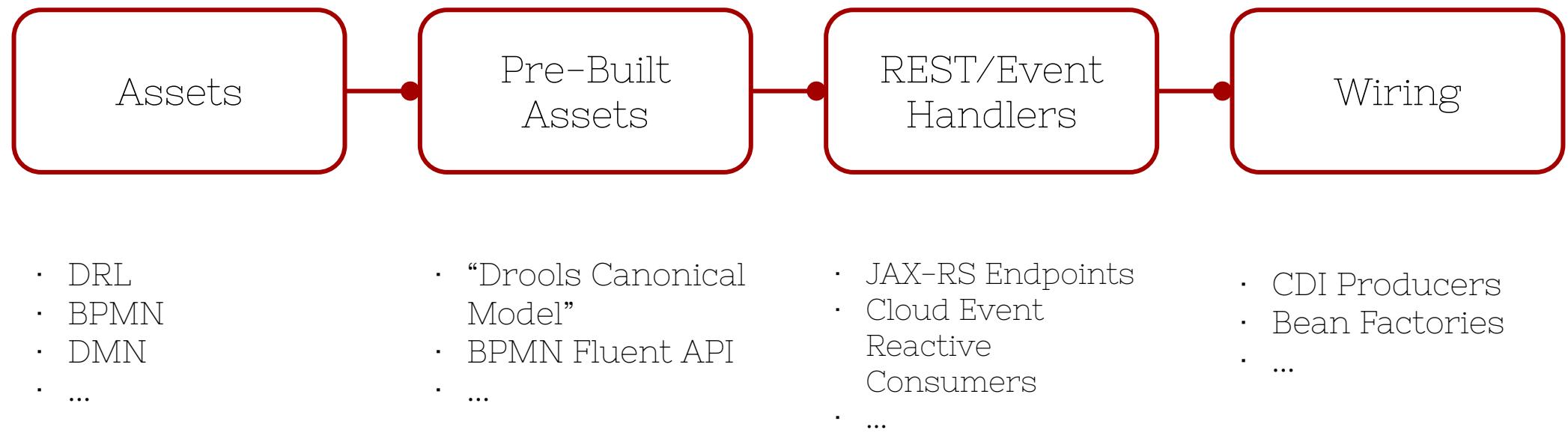


*Runtime. Start
the management
(thread, pool...)*

Compile-Time vs Run-time

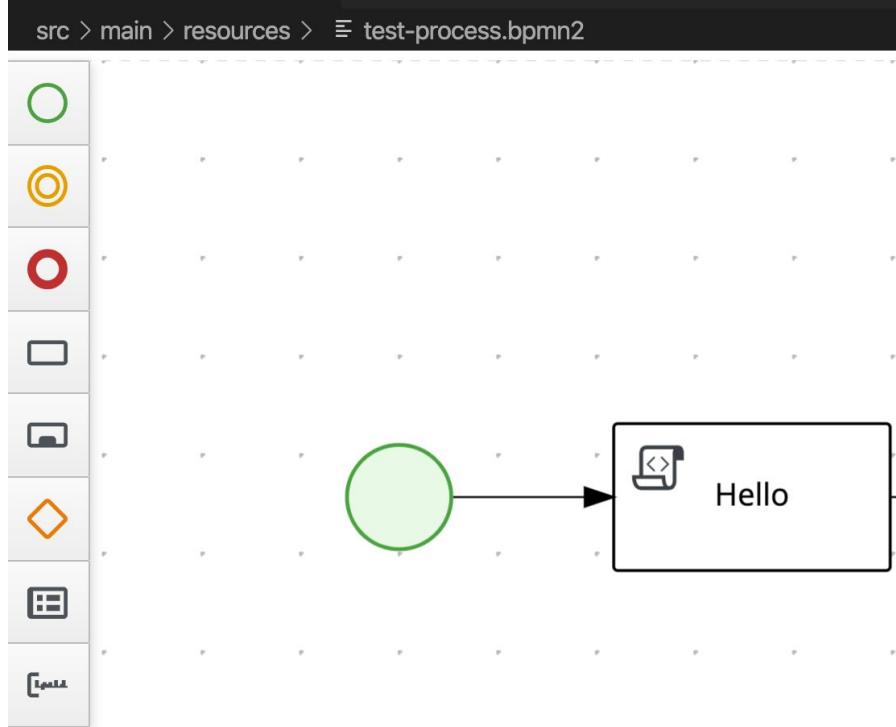


kogito-codegen





Introspection & Code Generation



Swagger
Supported by SMARTBEAR

/docs/openapi.json

Explore

Generated API 1.0 OAS3

/docs/openapi.json

default

Method	Path
GET	/greetings
POST	/greetings
GET	/greetings/{id}
POST	/greetings/{id}
DELETE	/greetings/{id}
GET	/greetings/{id}/tasks



Introspection & Code Generation

```
src > main > resources > org > kie > ┌ personunit.drl
1 package org.kie;
2 unit PersonUnit;
3
4 import org.kie.model.Person;
5
6 rule "Is Adult"
7 when
8 | $p: /persons[age >= 18];
9 then
10 | $p.setAdult(true);
11 end
12
13 query "GetAdults"
14 | $p:/persons[adult == true];
15 end
```

The screenshot shows the Swagger UI interface for a generated API. At the top, it displays the title "Generated API 1.0 OAS3" and the URL "/docs/openapi.json". The main content area is titled "default". It shows a POST method for the endpoint "/get-adults". The "Parameters" section indicates "No parameters". The "Request body" section specifies "application/json". Below this, there is an "Example Value" and a "Schema" section containing the JSON object: { "persons": {} }. The "Responses" section lists a single entry: "Code 200 Description OK". The "Links" section is noted as "No links".



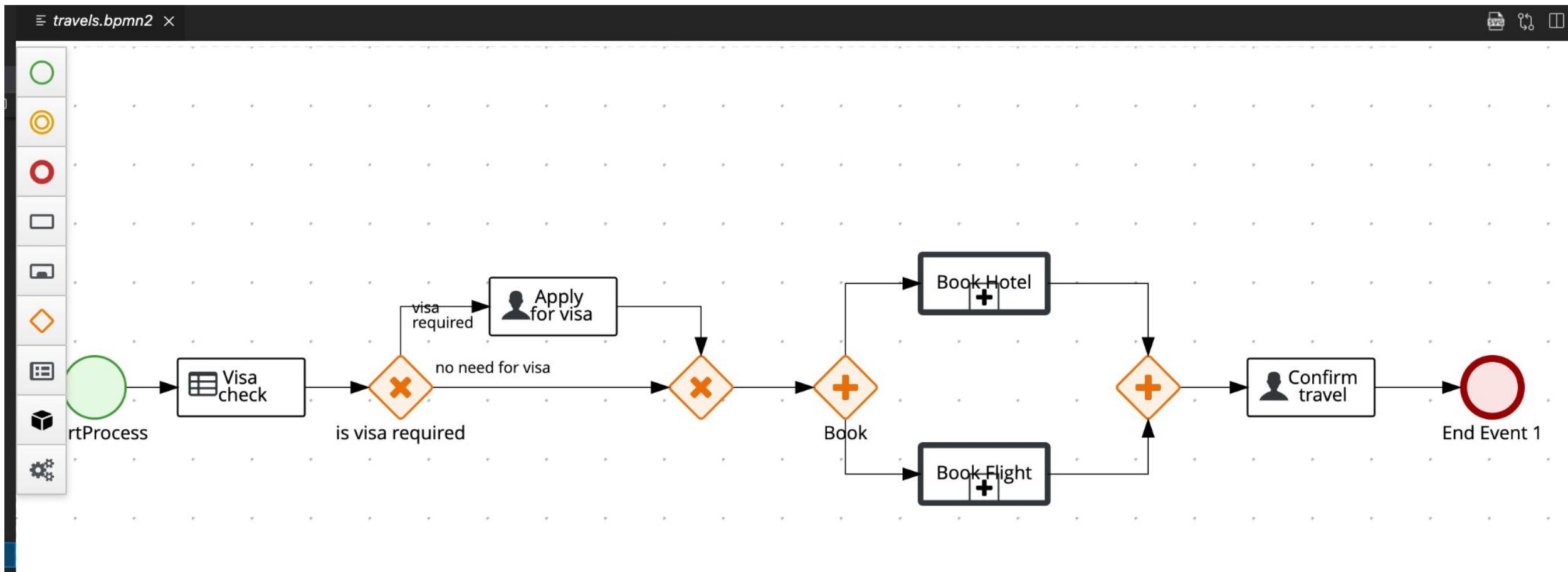
Hot-Reload

```
src > main > resources > org > kie > ┌ personunit.drl
  1 package org.kie;
  2 unit PersonUnit;
  3
  4 import org.kie.model.Person;
  5
  6 rule "Is Adult"
  7 when
  8 | $p: /persons[age >= 18];
```

```
2020-06-23 10:44:16,820 INFO [io.quarkus] (Quarkus Main Thread) Profile dev activated. Live Coding activated.
2020-06-23 10:44:16,820 INFO [io.quarkus] (Quarkus Main Thread) Installed features: [cdi, kogito, resteasy, resteasy-jackson, smallrye-openapi, swagger-ui]
2020-06-23 10:44:16,836 INFO [io.qua.dep.dev] (vert.x-worker-thread-0) Hot replace total time: 0.299s
```

```
 13 query "GetAdults"
 14 | $p:/persons[adult == true];
 15 end
```

Business Process

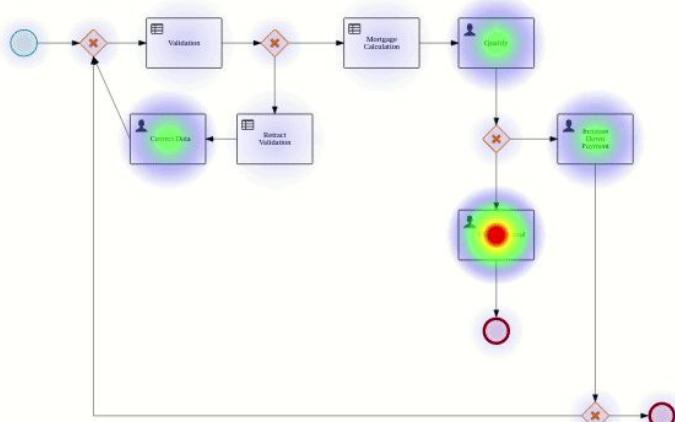


Business Process

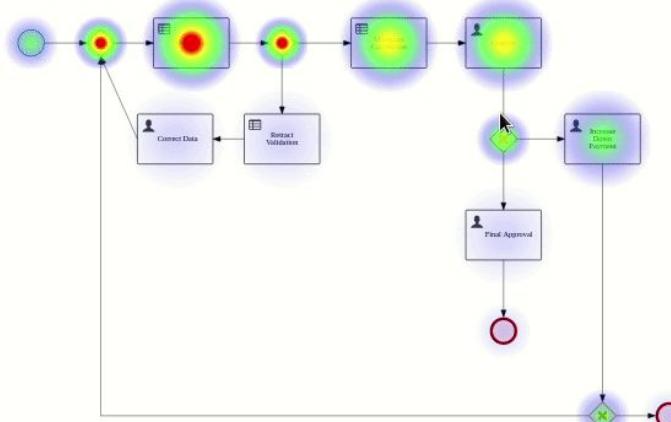
Filter by Node type

EndNode HumanTaskNode Join RuleSetNode Split StartNode

Average Execution Time

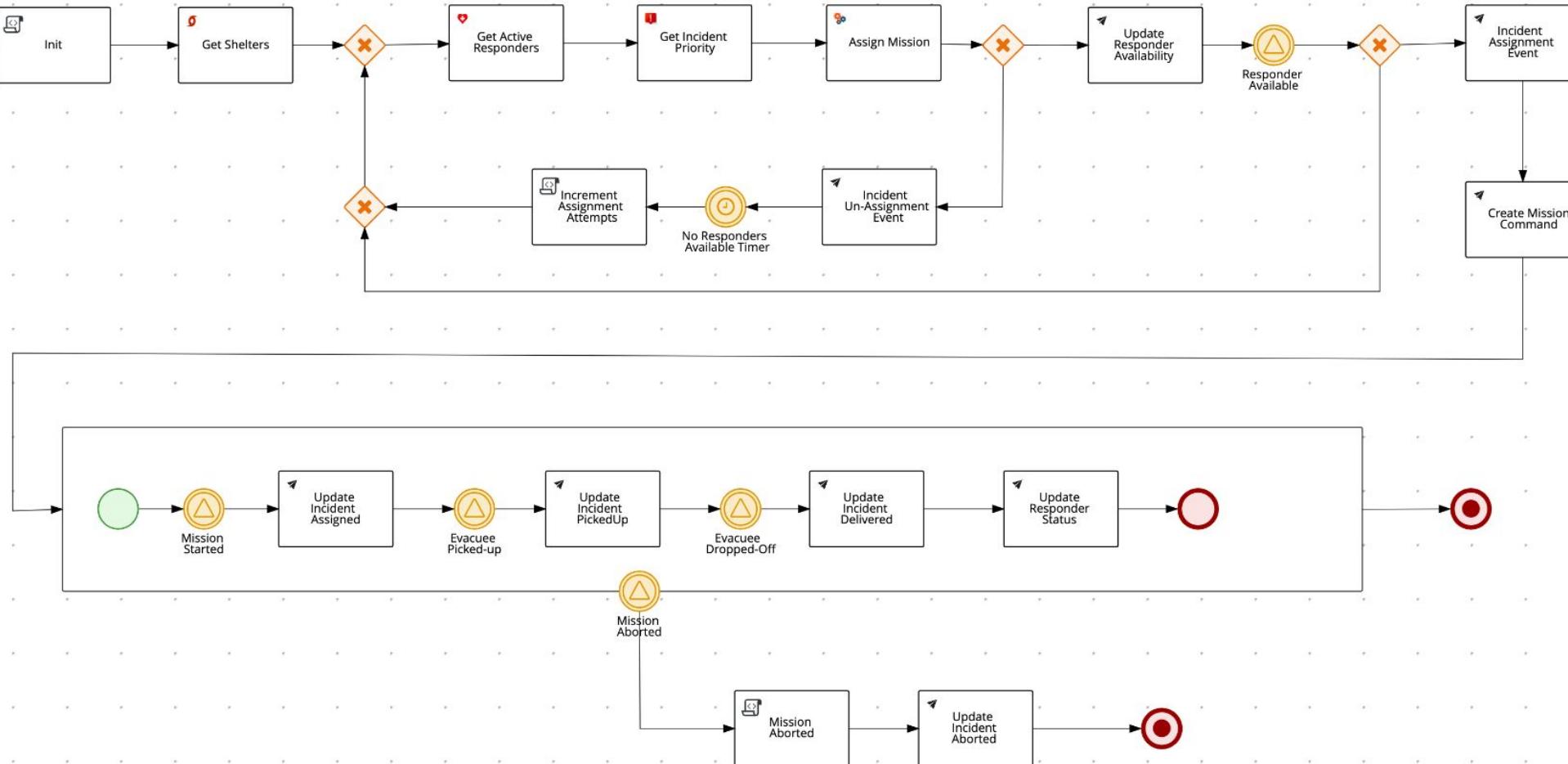


Number of Hits



Execution Time Statistics





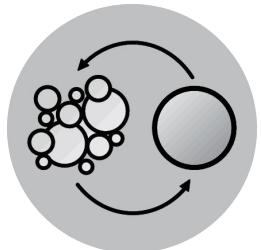


Kogito Decisions

Helps you author, execute, manager and
monitor business process

Business Decisions

An Overview



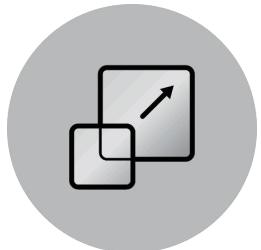
Separate decision logic from application code

Write once, use anywhere. Agile rule lifecycle management.



Decision logic defined in business terminology and language

Domain experts directly involved in rule definition and writing.



Performance and scalability

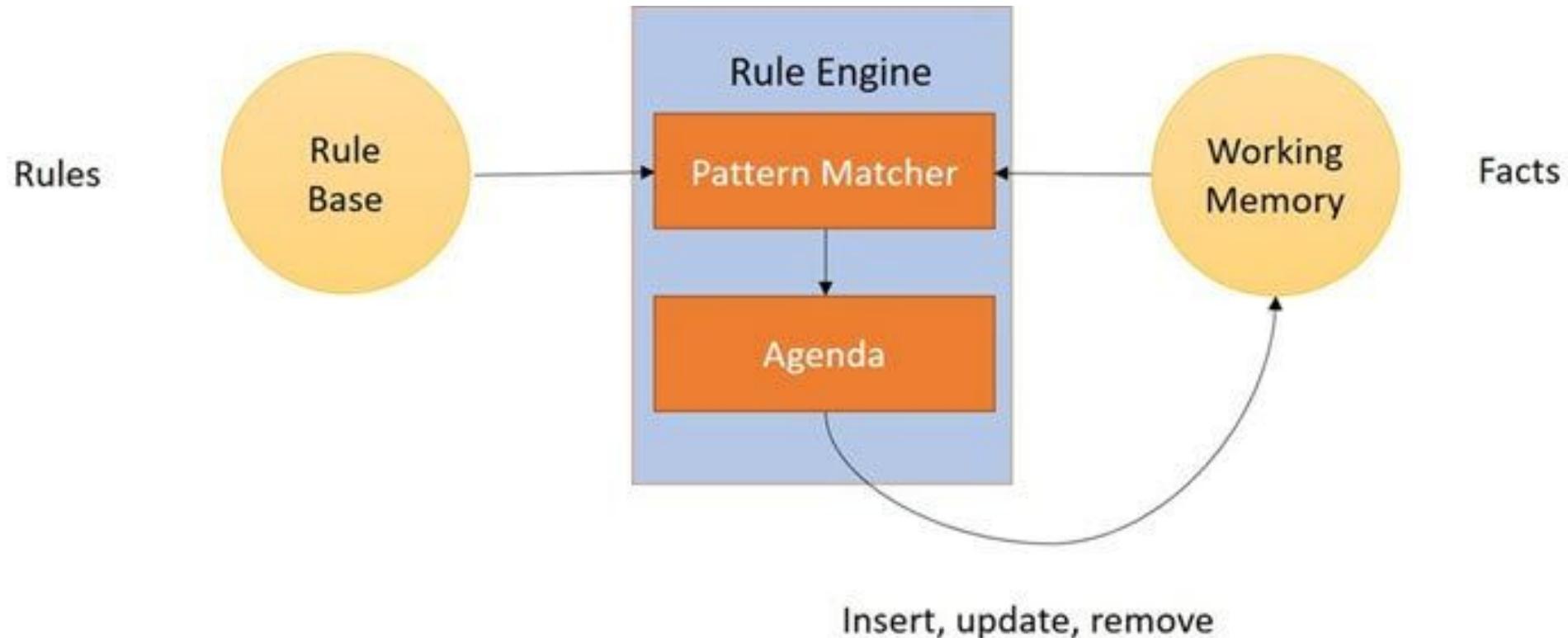
From 10 to 100,000 rules.

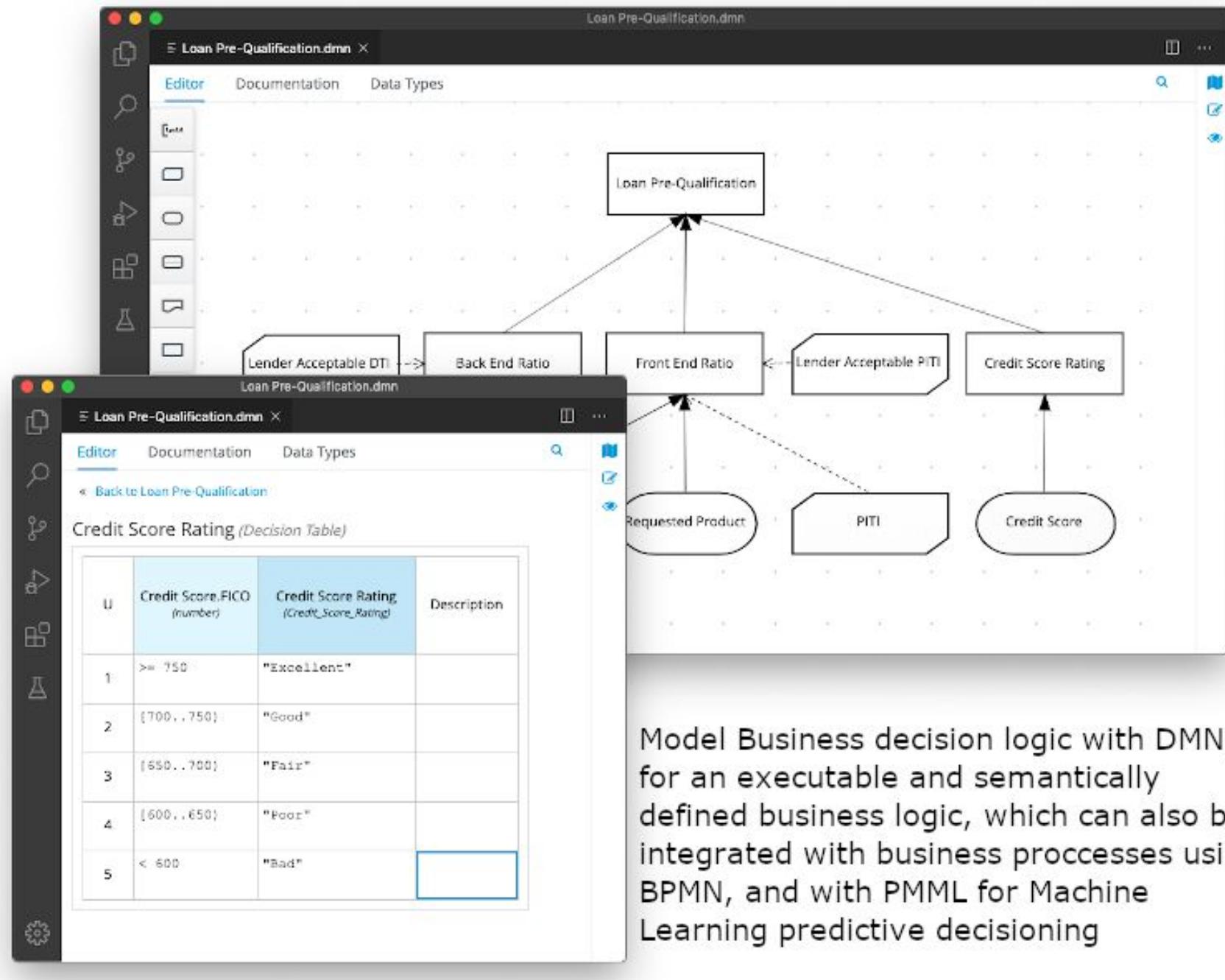
```
rule PatientIsAChild
when
    $p: /patients[ assignedDoctor == null && CalendarHelper.calculateAge(dateOfBirth) < 18 ]
        $d: /doctors[ specialty == "Pediatrics" ]
then
    modify($p) { setAssignedDoctor($d) }
end

rule SymptomHasAMatch
when
    $p: /patients[ assignedDoctor == null && !symptoms.isEmpty() ]
        $s: /symptomSpecialties[ !Collections.disjoint(symptoms, $p.symptoms) ]
        $d: /doctors[ specialty == $s.specialty ]
then
    modify($p) { setAssignedDoctor($d) }
end

rule SymptomNotFound
when
    $p: /patients[ assignedDoctor == null ]
        $d: /doctors[ specialty == "Family medicine" ]
then
    modify($p) { setAssignedDoctor($d) }
end

query AssignDoctor
    $patients : /patients[ assignedDoctor != null ]
end
```





Model Business decision logic with DMN, for an executable and semantically defined business logic, which can also be integrated with business processes using BPMN, and with PMML for Machine Learning predictive decisioning

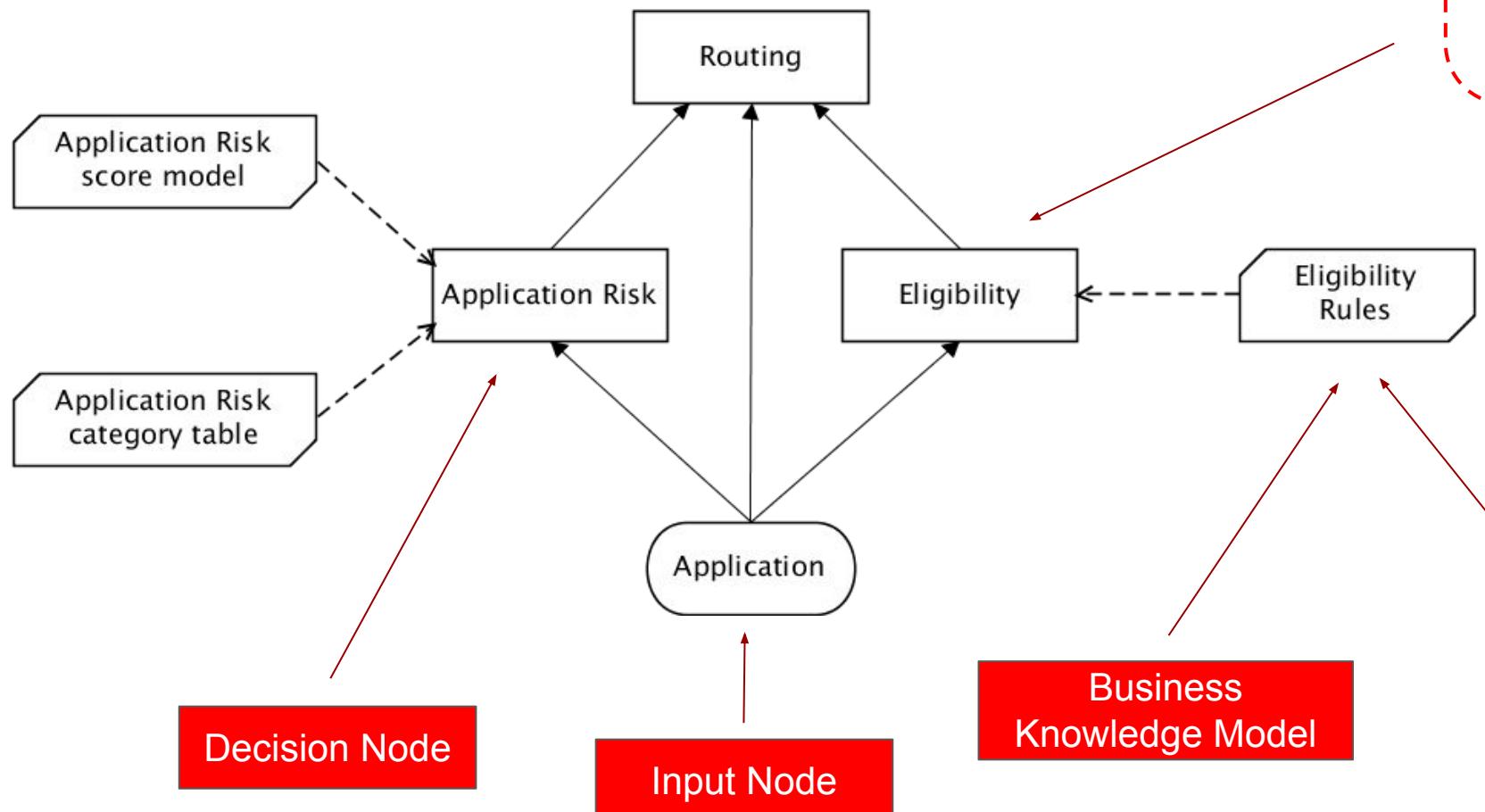
What is DMN?

DMN, which stands for Decision Model and Notation, is a relatively new standard managed by OMG, the organization behind BPMN. It is trying to do for Business Decision Management what BPMN did for Business Process Management a decade ago: empower the business to take charge of the logic that drives its operations, through a vendor-independent diagramming language.

– Bruce Silver, <http://methodandstyle.com/what-is-dmn>

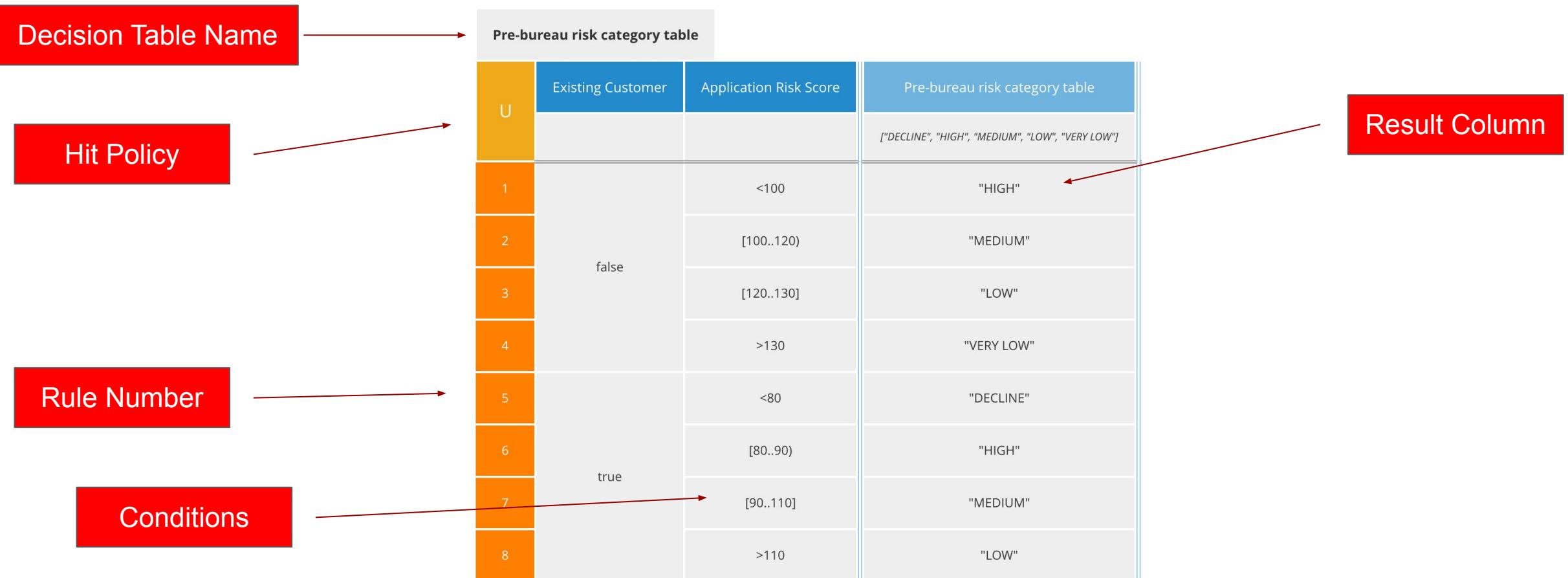
Decision Model & Notation

Decision Requirements Diagram (DRD)



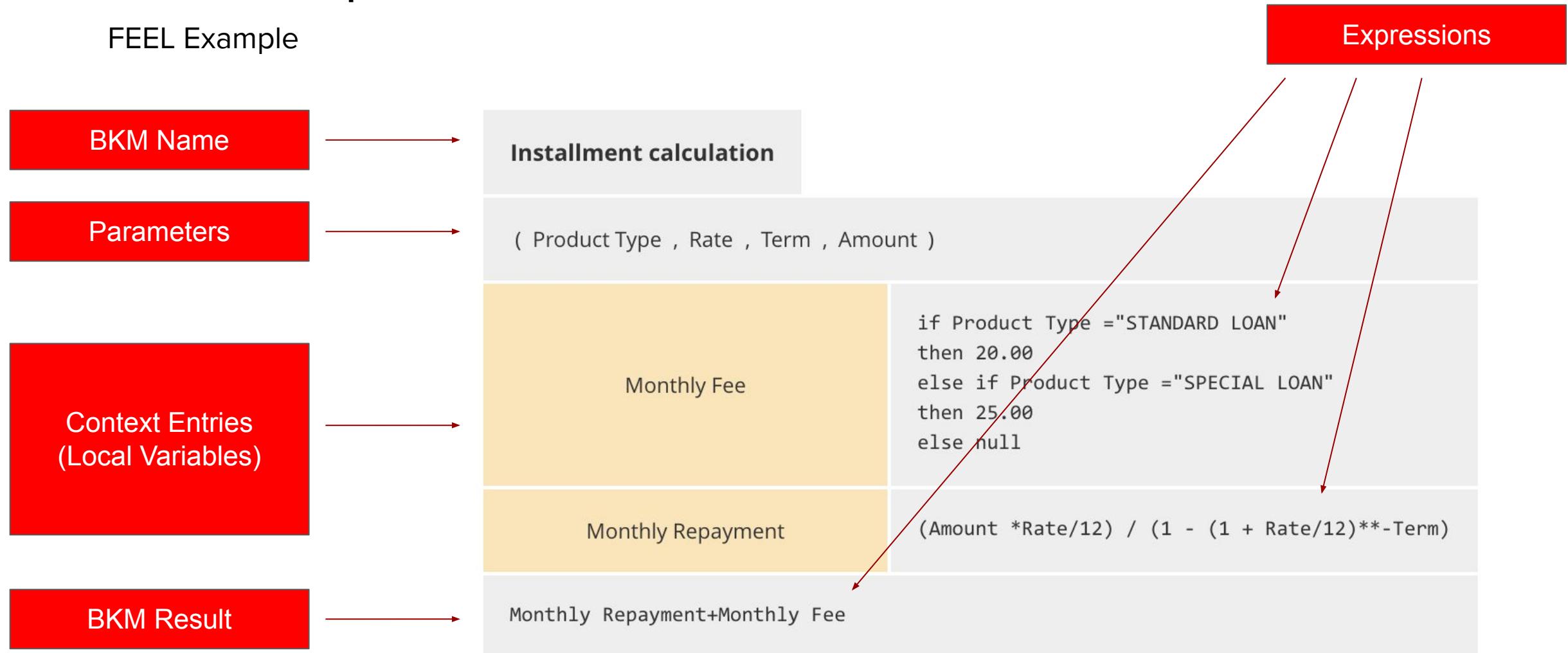
Decision Model & Notation

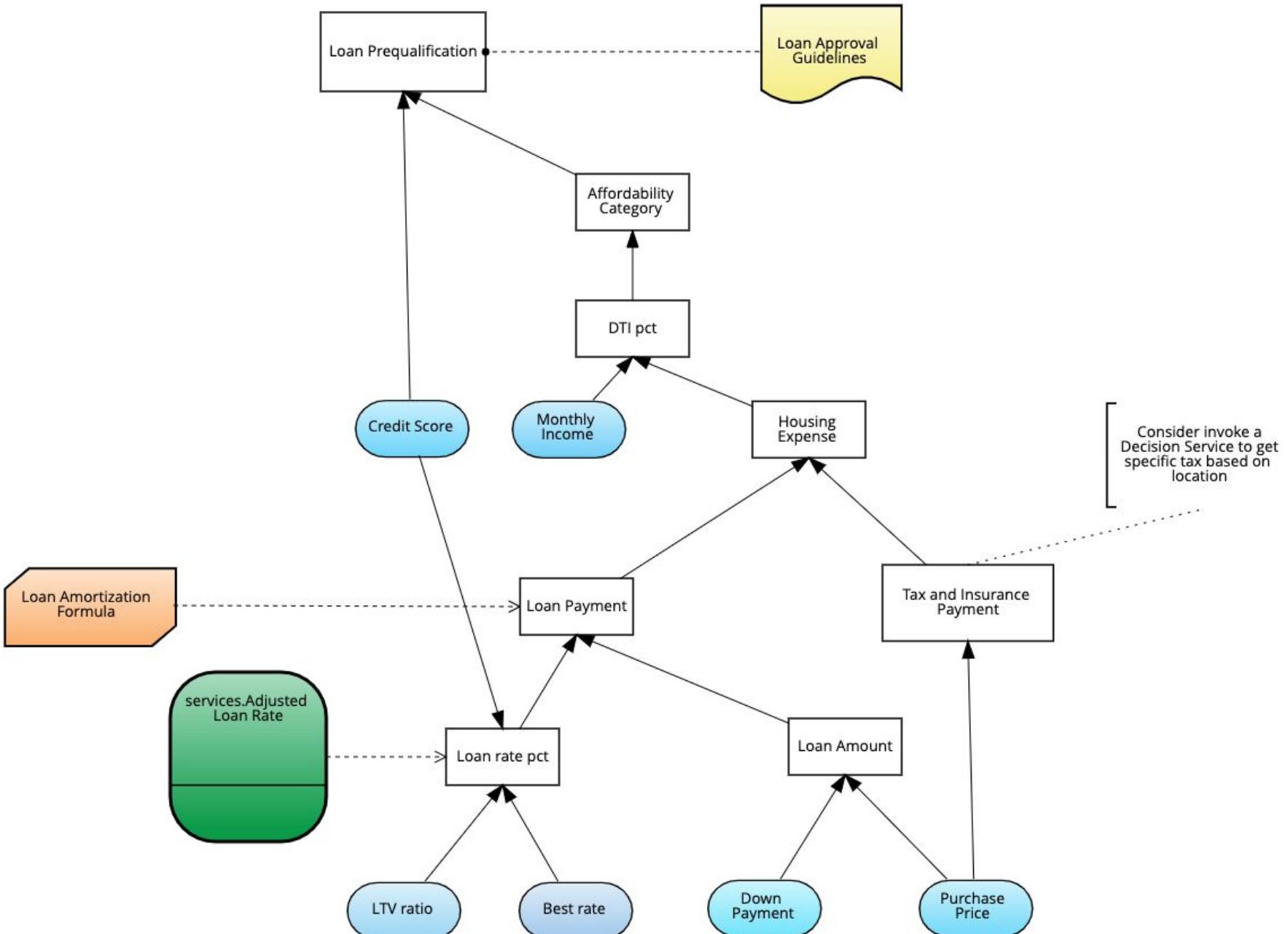
Decision Requirements Diagram (DRD)



Boxed Expressions

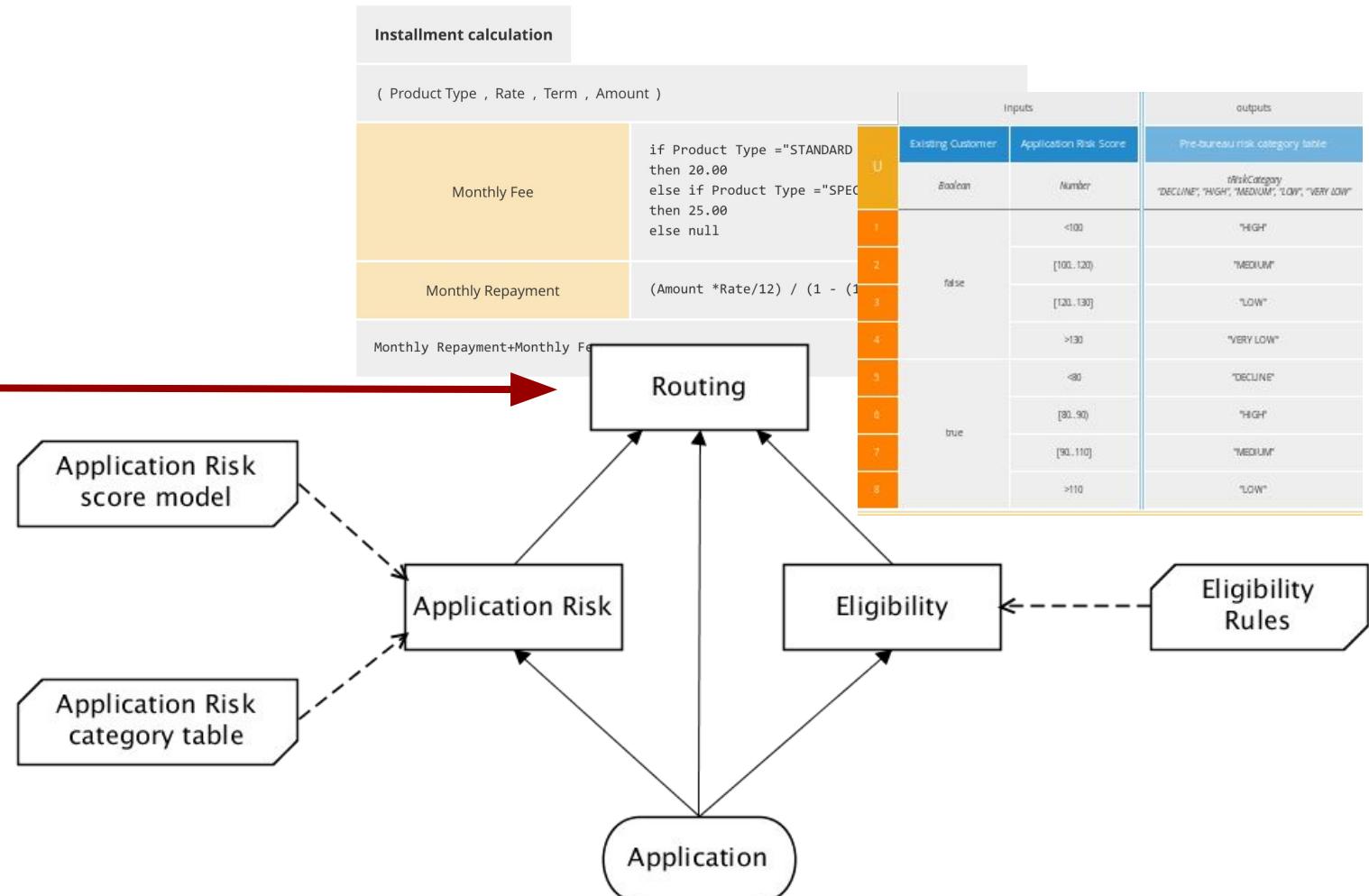
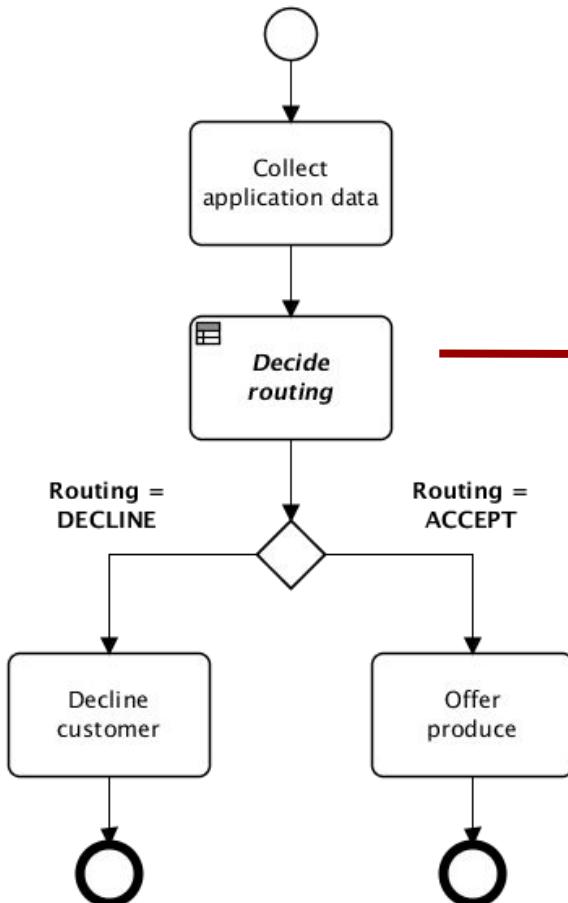
FEEL Example





DMN Big Picture

DMN in context of BPMN

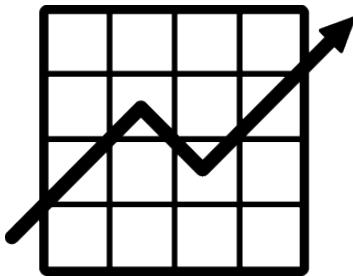




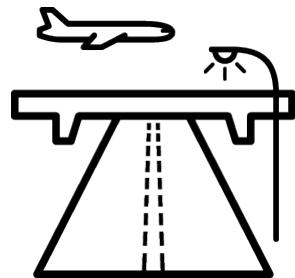
Optaplanner

Do more business with less resources

What is a Planning Problem?



Optimize **Goals**

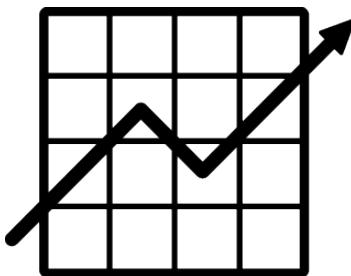


With limited **Resources**



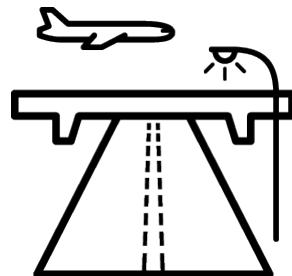
Under **Constraints**

Vehicle Routing



Goals

- Minimize fuel consumption
- Minimize driving time
- Minimize required vehicles



Resources

- Vehicles (capacity, fuel)
- Deliveries (location, packages)

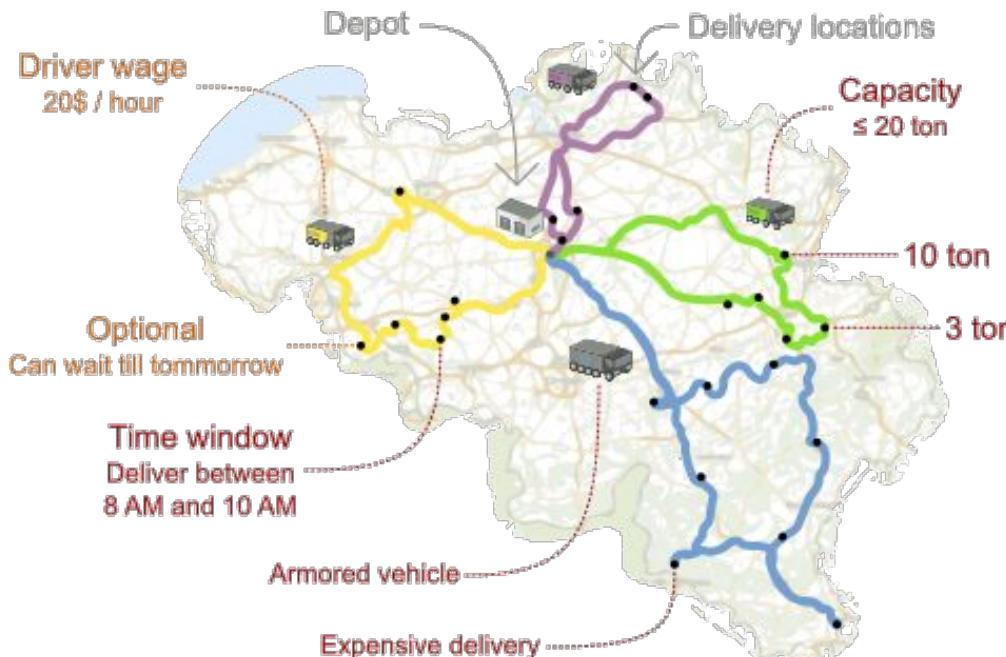


Constraints

- Max 8 hrs consecutive driving
- Arrive before due time
- Max vehicle capacity

Vehicle Routing

Assign the delivery order more efficiently



Business Value

-15% Driving Time

(based on real benchmark versus traditional algorithms, Belgium datasets)

Users:

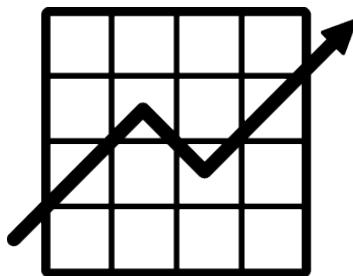
Supermarket & Retail Stores

Freight Transportation

Buses, Taxi's & Airlines

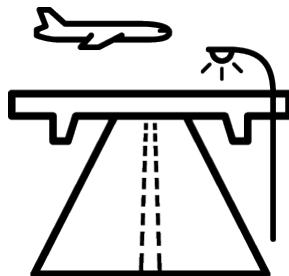
Technicians on the road

Employee Rostering



Goals

Increase Employee well-being



Resources

Nurses

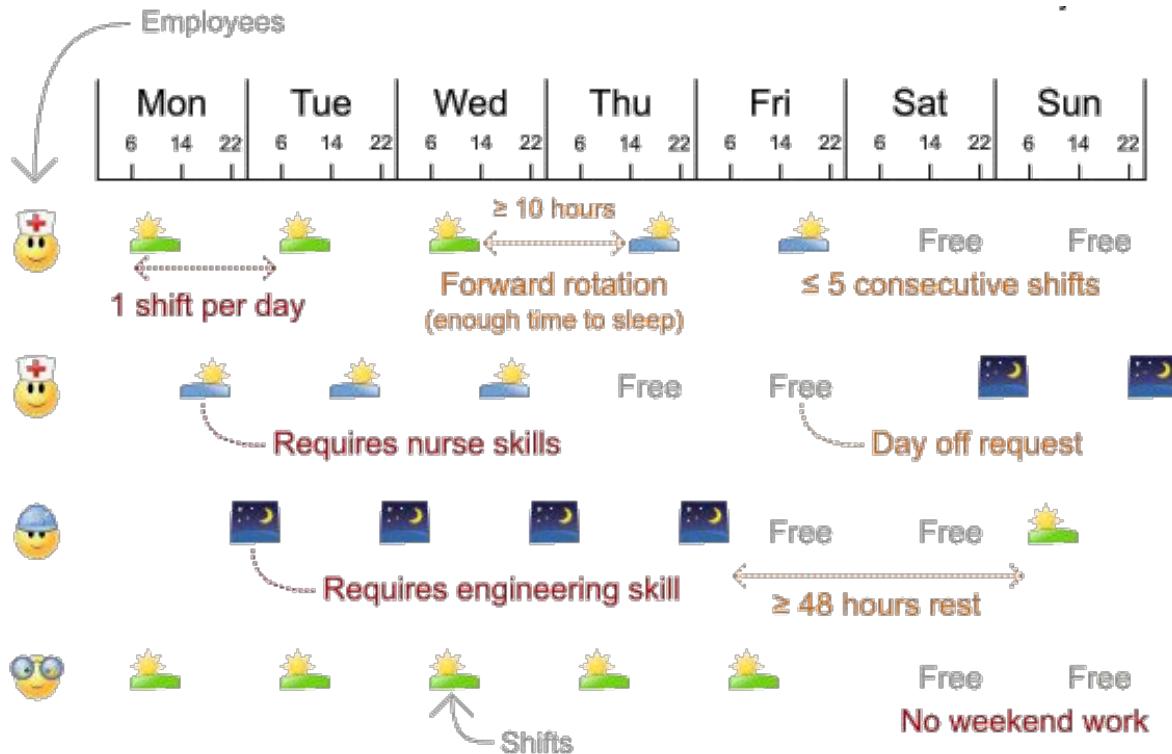


Constraints

Work 1 shift per day
Max consecutive working days
Requested days off

Employee Rostering

Assign shifts to employees more efficiently



Business Value

+53% Employee well-being

(average on real benchmark versus traditional algorithms, Nurses case)

Users:

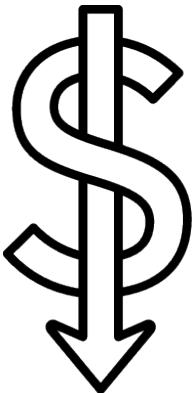
Hospitals

Call Centers

Police and Fire Departments

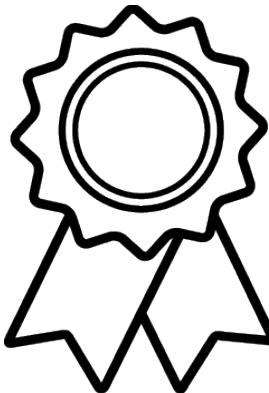
Courts of Justice

Where is the potential?



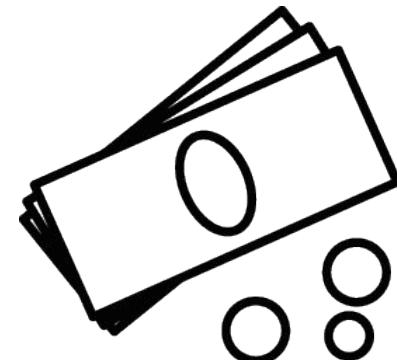
Lower Costs

Less wages
Less fuel consumption
Less vehicles required



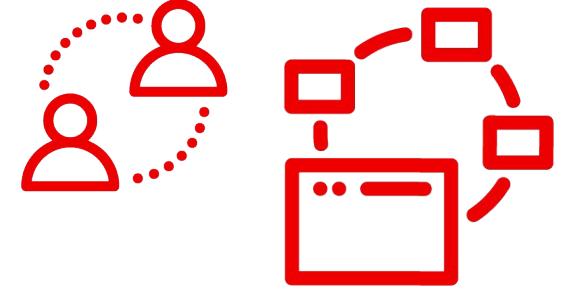
Improve Customer Satisfaction

Better consecutive rest time
Reduced waiting time
Comply with requests (holidays)



Increase Turnover

More deliveries
More flights/busses/trains
More passengers



Optaplanner

Vaccination appointment scheduling

<https://www.optaplanner.org/learn/slides/optaplanner-presentation/index.html#/10>



Deploying Kogito Services on Kubernetes

The Kogito Toolset

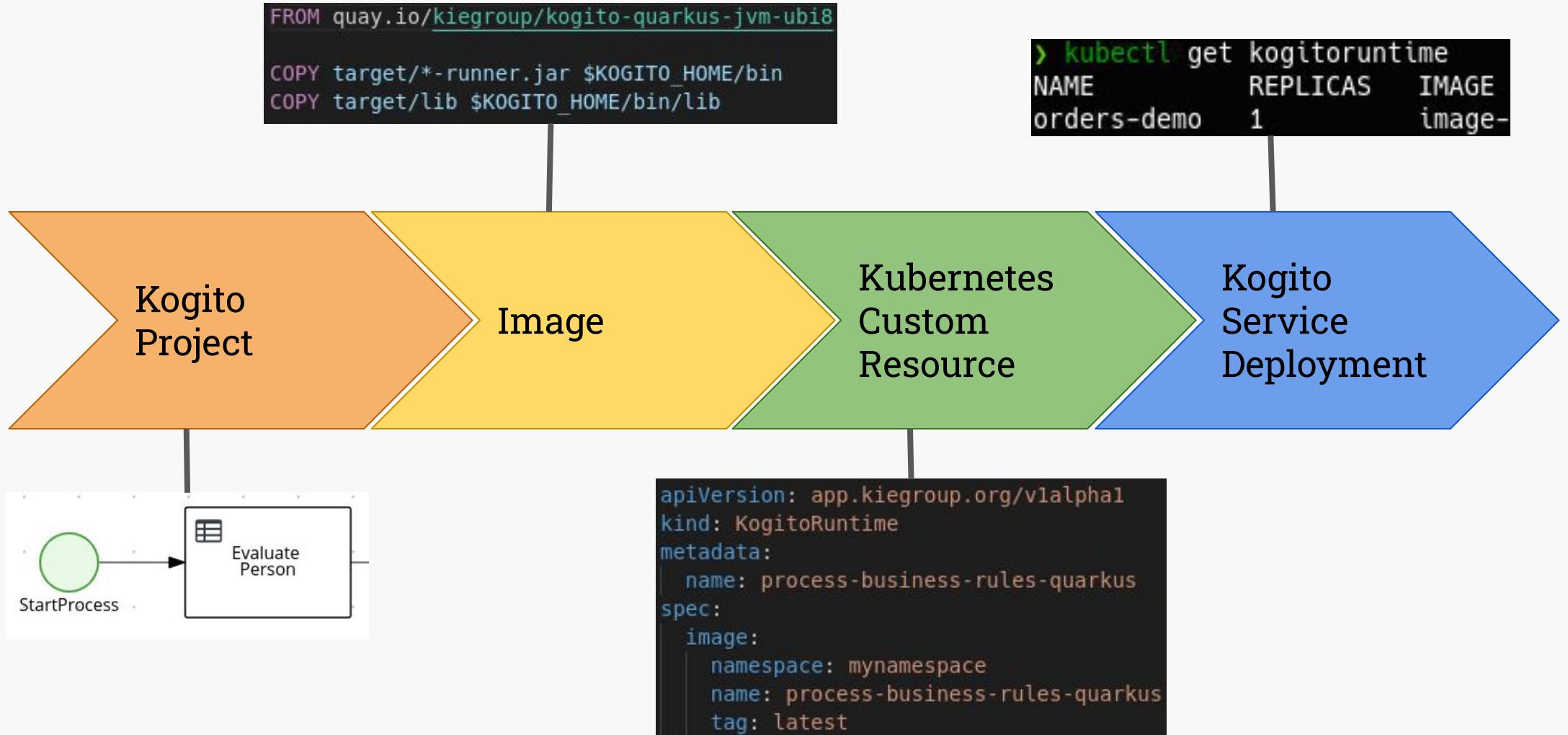
Design

Build

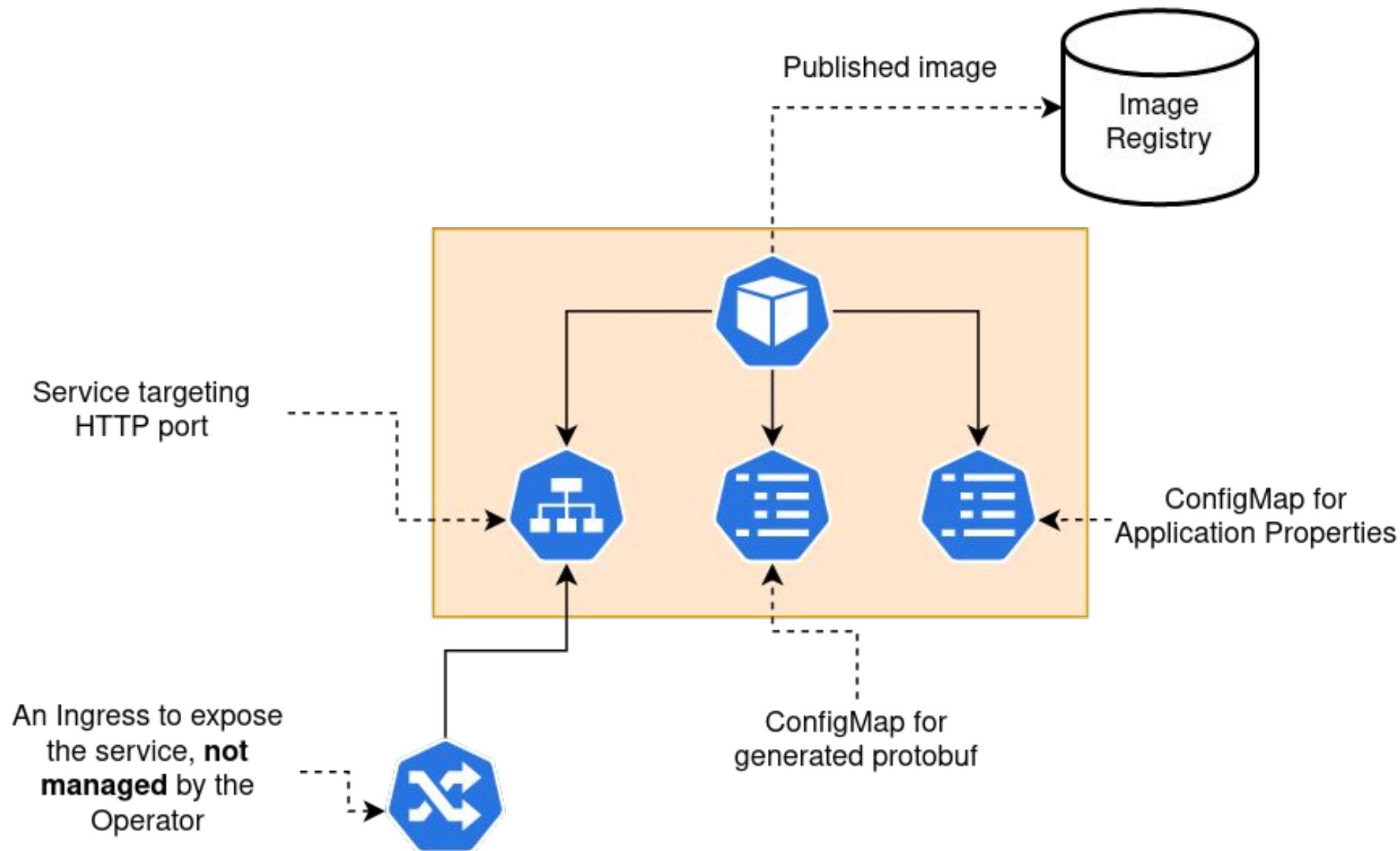
Deploy

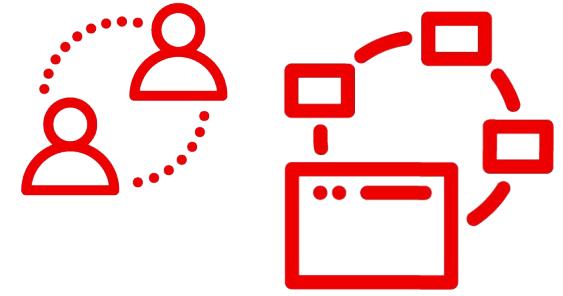


Kogito on Kubernetes



Anatomy of a Kogito Service





Trusty AI

Do more business with less resources

TrustyAI



Explainable



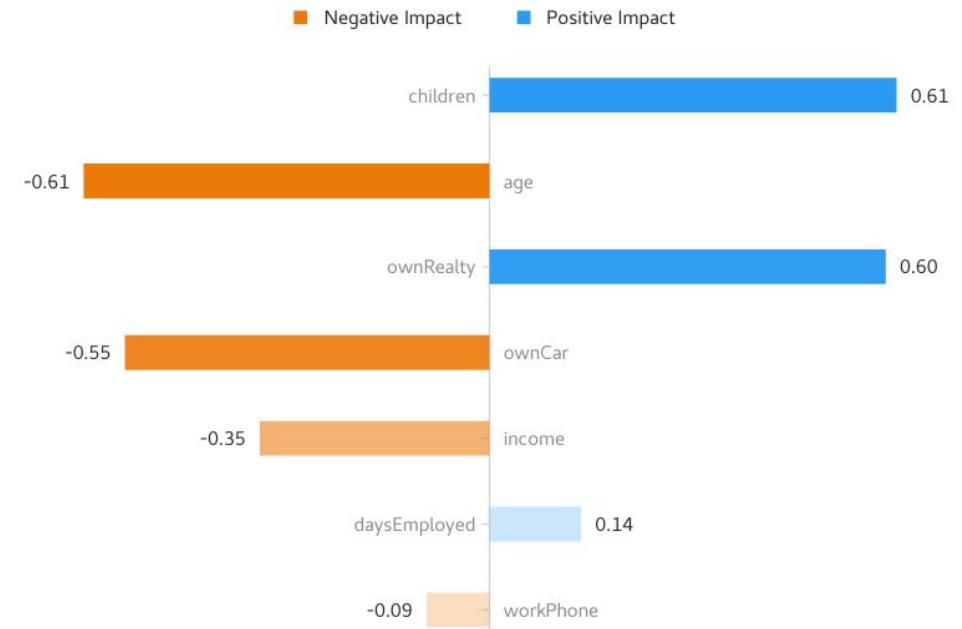
Trustworthy

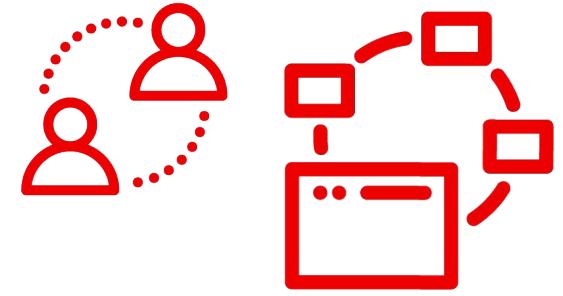
Offer value-added services for Kogito

- **Runtime Monitoring Service**
- **Tracing and Accountability Service**
- **Explanation Service**

Explanation

Features Score Chart





Serverless Workflow

Serverless Workflow

A specification that defines a **declarative** and **domain-specific** workflow language for orchestrating events and services.

CNCF Sandbox project

- Vendor-neutral, portable specification
- YAML / JSON

Kogito-based implementation

- Based on same core capabilities
- Serverless ecosystem
- As a service experience

<https://serverlessworkflow.io>



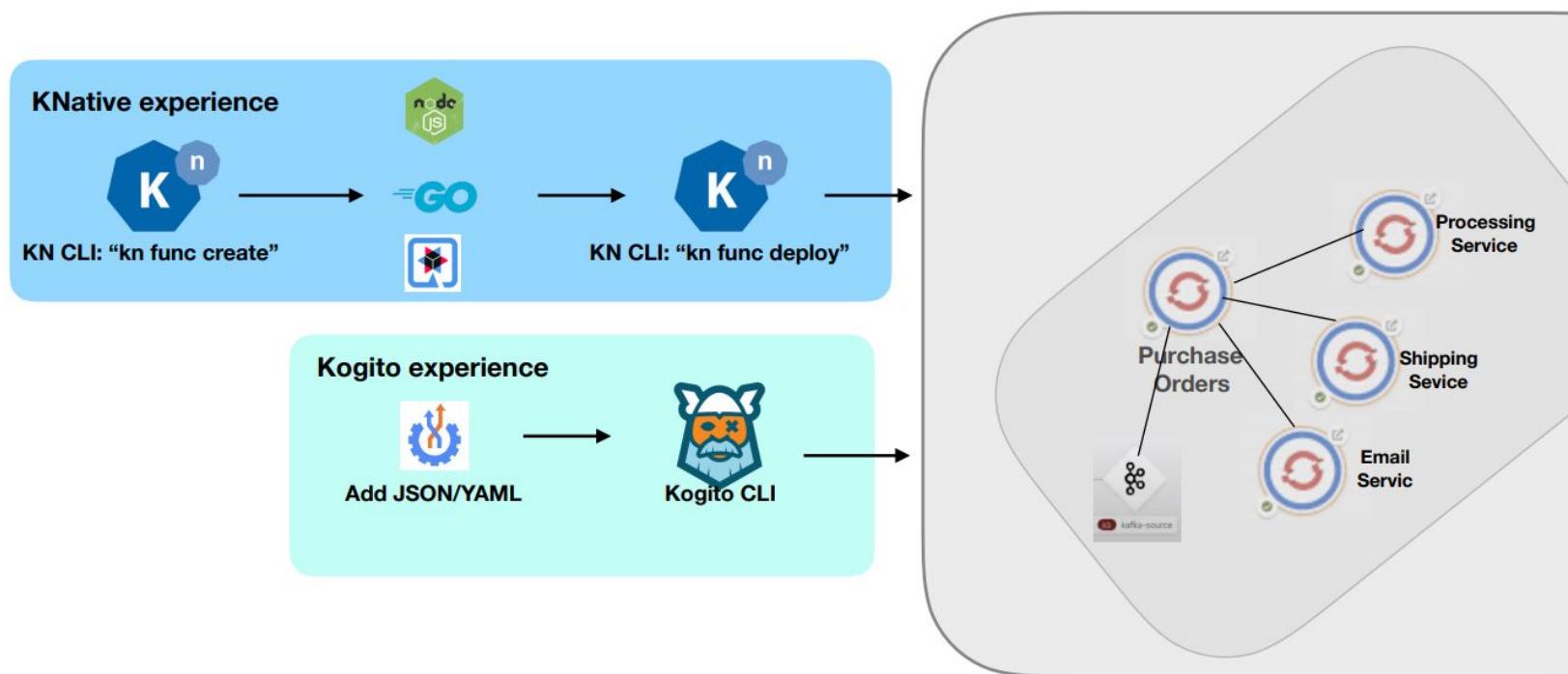
**Serverless
Workflow**



CLOUD NATIVE
COMPUTING FOUNDATION

Serverless Workflow

- Targeting Knative ecosystem
- Targeting (OpenShift) Developer
- Add-on to support event-driven (stateful) orchestration



```
1 id: mvworkflow
2   Workflow name
3 name: DemoWorkflow
4   description: My Demo Workflow
5 states:
6   - name: ExecuteFirstFunc
7     type: operation
8     start:
9       kind: default
10    actions:
11      - functionRef:
12        refName: First Funqy Function
13        parameters:
14          input: First Input
15      transition:
16        nextState: ExecuteSecondAndThirdFunc
17    - name: ExecuteSecondAndThirdFunc
18      type: parallel
19      start:
20        kind: default
21      branches:
22        - name: Second Func
23        actions:
24          - functionRef:
25            refName: Second Funqy Function
26            parameters:
27              input: Second Input
28        - name: Third Func
29        actions:
30          - functionRef:
31            refName: Third Funqy Function
32            parameters:
33              input: Third Input
34      end:
35        kind: default
```



<http://kogito.kie.org>

- ▶ Getting started
 - Kogito-examples
 - Create your own project
 - Kogito Travel Agency Workshop
- ▶ Community
 - Chat <http://kie.zulipchat.com/>
 - Mailing list kogito-development@googlegroups.com
 - Twitter [@Kogito_kie](#) [@KieCommunity](#)
 - Blog <https://blog.kie.org/>
- ▶ Github, JIRA
- ▶ Documentation
- ▶ Events

TRY IT
NOW !!!

Thank you

Eder Ignatowicz.

Principal Software Engineer
@ederign

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