

DOES YOUR API NEED A REST?

Check out GraphQL

Dan Vega - Spring Developer Advocate @ Broadcom



A screenshot of a GitHub profile page for "danvega". The profile picture is a caricature of a smiling man with blonde hair. The bio reads: "Hi there! I'm a Husband, Father, Spring Developer Advocate and maker of things from Cleveland Ohio. I have a real passion for teaching and I hope that one of my blog posts, videos or courses helps you solve a problem or learn something new." Below the bio is a cartoon illustration of a desk with a computer monitor displaying "www.danvega.dev", a keyboard, a mouse, a coffee cup, and a small plant. The URL "www.danvega.dev" is also written at the bottom of the illustration. The "Connect with me:" section lists links to the user's website, Twitter, YouTube, and LinkedIn profiles. The "Latest Blog posts" section lists three recent articles. The GitHub interface shows 224 repositories and 59 stars.



<https://github.com/danvega/graphql-store>

ABOUT ME

Learn more at danvega.dev

👨‍👩‍👧 Husband & Father

🏠 Cleveland

☕ Java Champion

💻 Software Development 23 Years

🌿 Spring Developer Advocate

📝 Content Creator

🐦 @therealdanvega

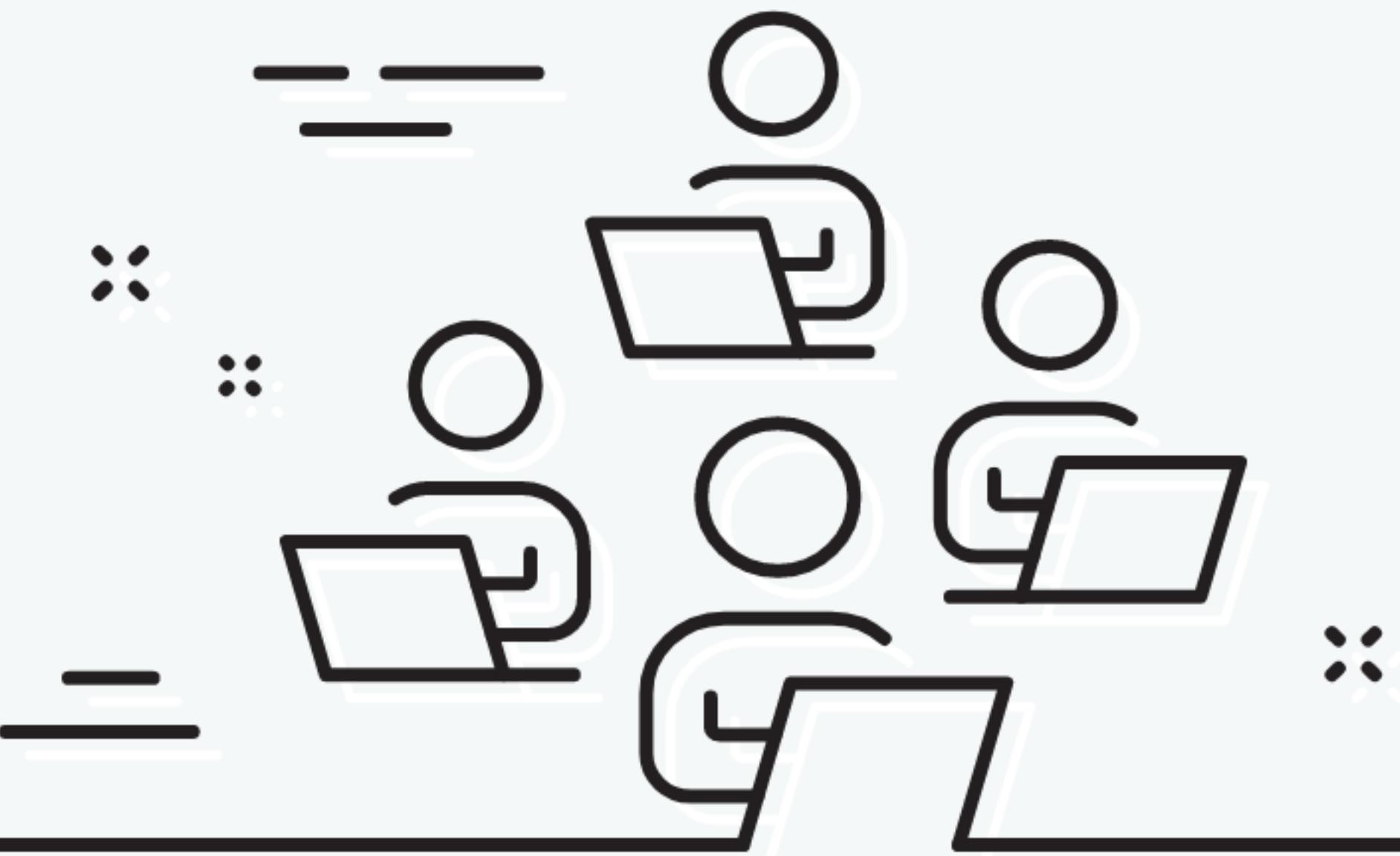
🏃 Running

🏌️ Golf





OFFICE HOURS



<https://www.springofficehours.io>

AGENDA

WHY GRAPHQL

What problems are we trying to solve.

WHAT IS GRAPHQL

A basic introduction to what GraphQL is.

GETTING START WITH GRAPHQL IN SPRING

How to build GraphQL APIs in Spring

FEATURES

Observability, Pagination, Security, Testing & More!

Q&A



WHY GRAPHQL?

What problems are we trying to solve

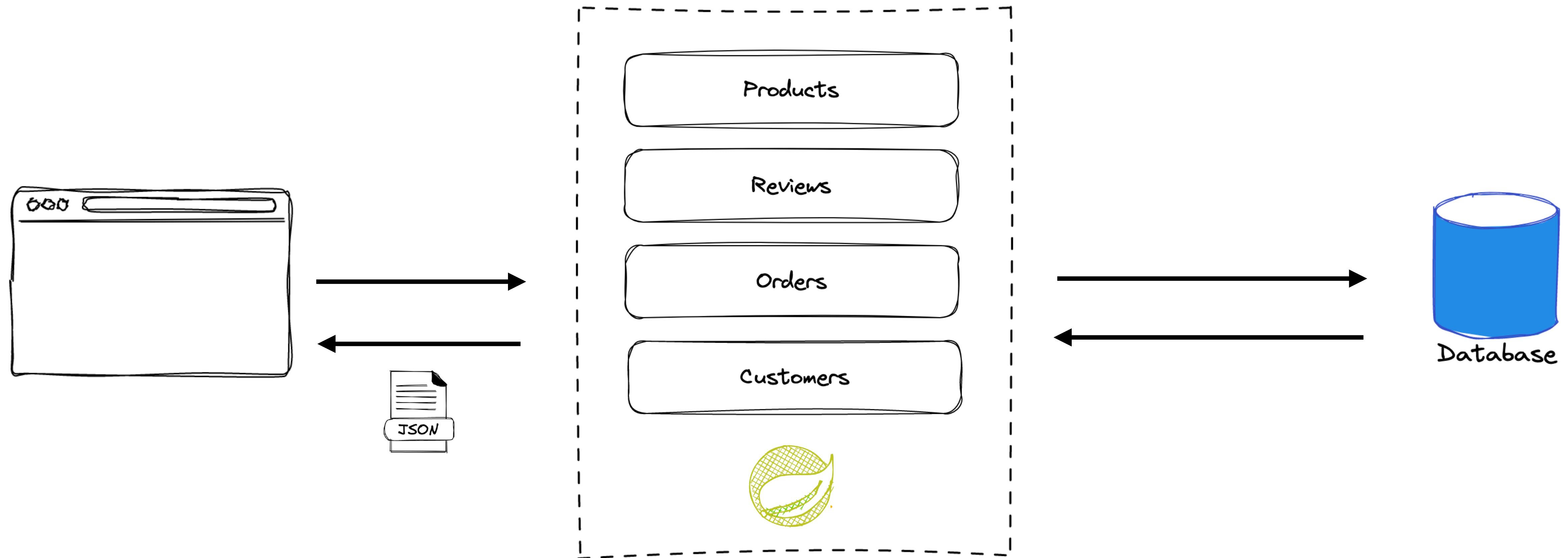


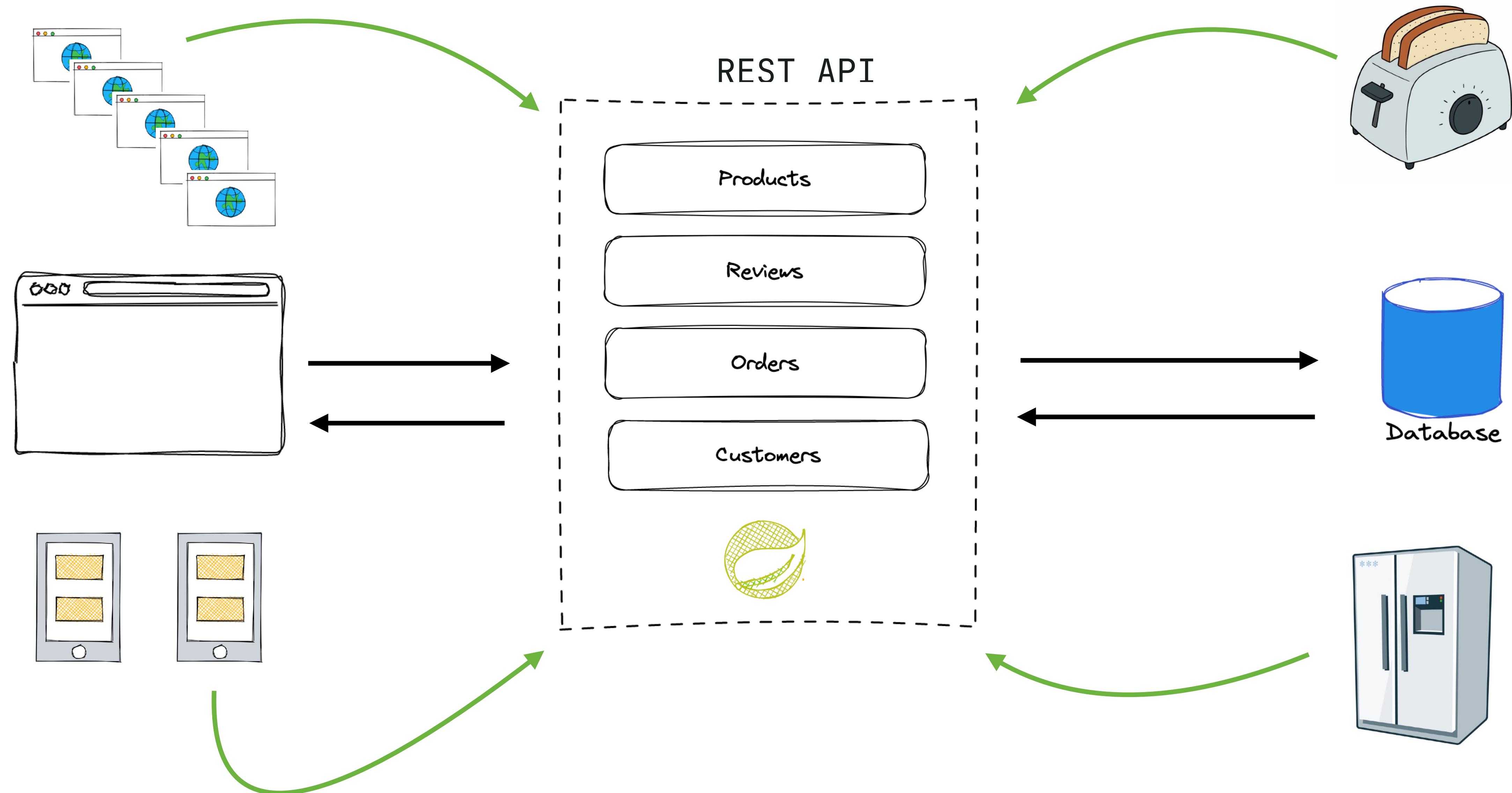
WHY GRAPHQL

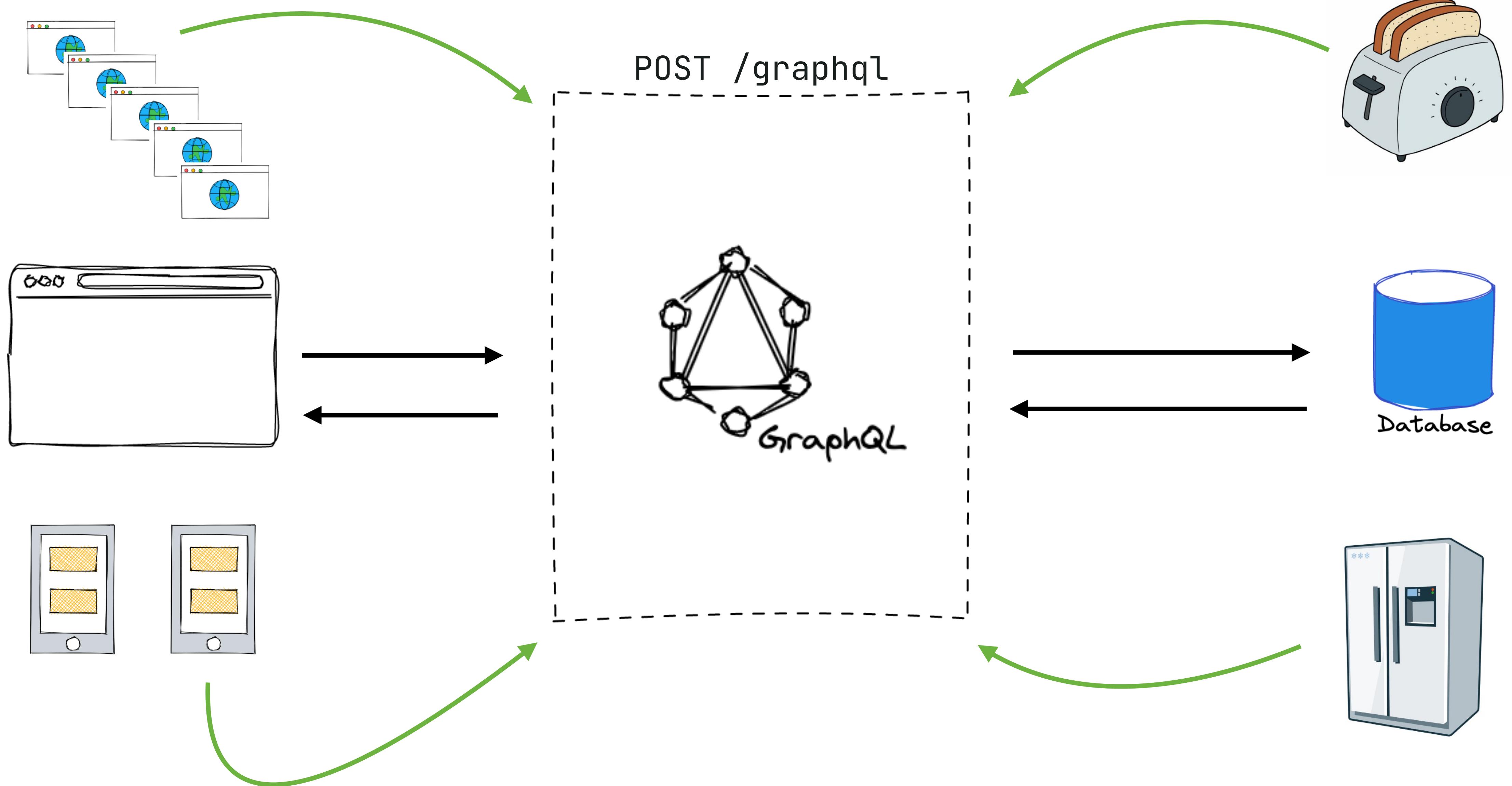
Reasons to make the move to GraphQL

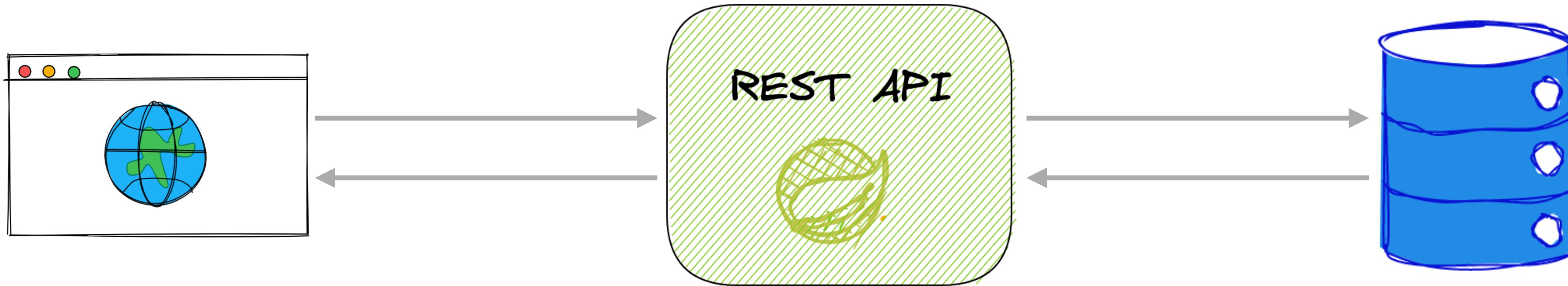
- No more over-fetching
- Multiple Request for multiple resources
- Avoid REST API Explosion of endpoints
- Strongly-typed Schema
 - Self Documenting
 - Developer Tooling
- Avoids API Versioning

REST API





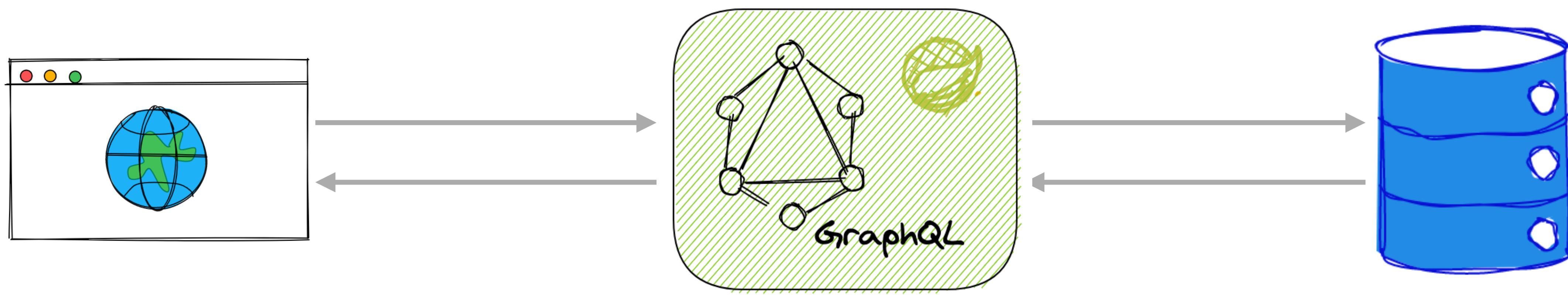




GET /products/123

GET /products/123/related

GET /products/123/reviews



POST /graphql

**AS LONG AS WE ARE TALKING
ABOUT REST VS GRAPHQL**

HTTP VERBS

STATUS CODES

RESOURCES / PATHS

API VERSIONING

DOCUMENTATION



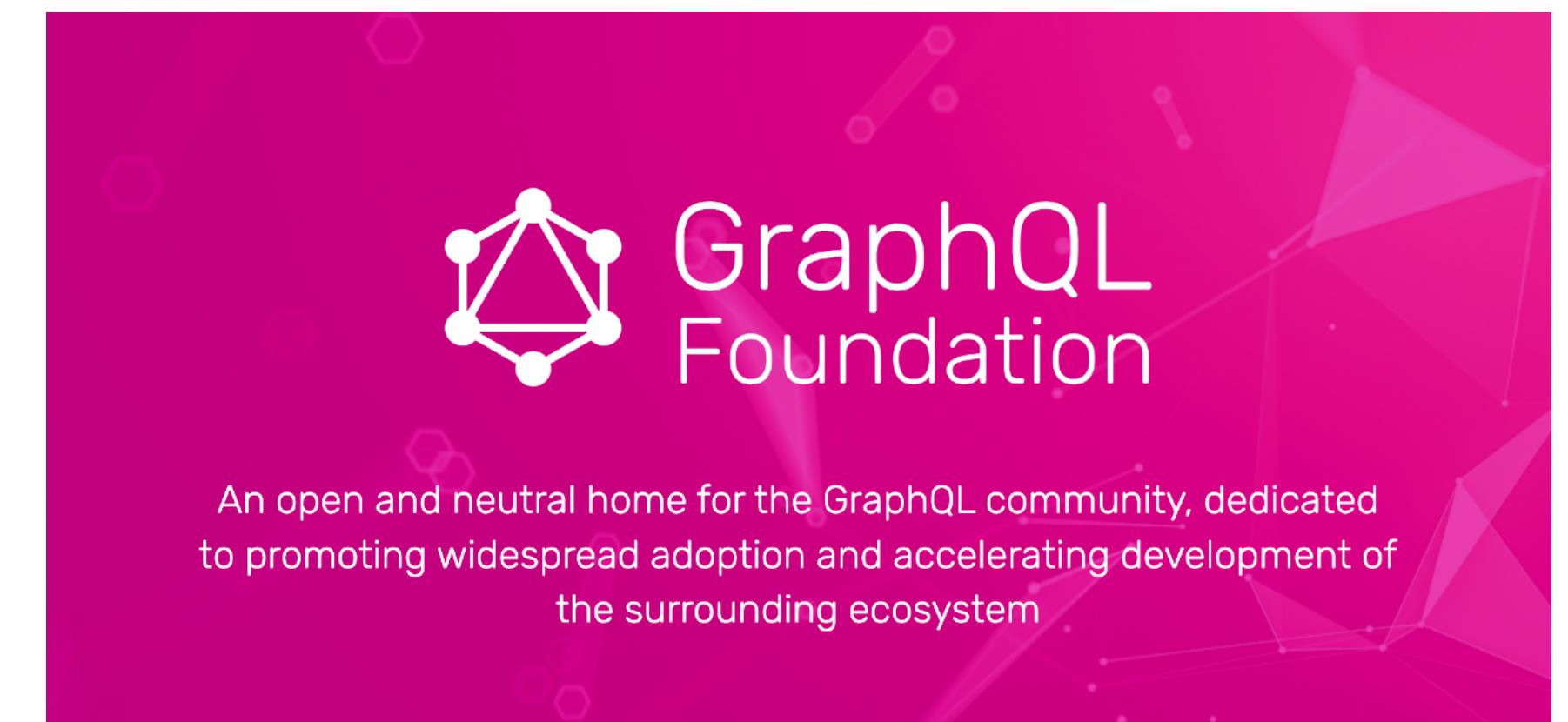
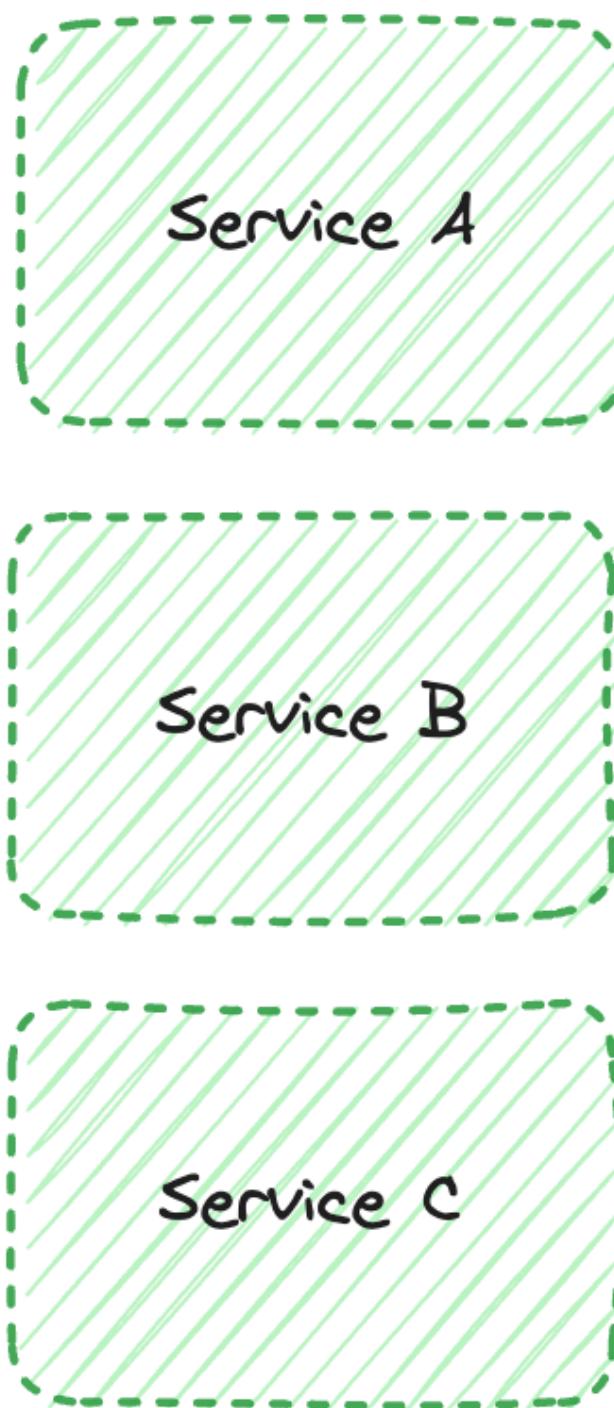
WHAT IS GRAPHQL

A basic Introduction to what GraphQL is



WHAT IS GRAPHQL

WHAT IS GRAPHQL



<https://graphql.org/foundation/>

GraphQL is a query language for your API, and a server-side runtime for executing queries using a type system you define for your data. GraphQL isn't tied to any specific database or storage engine and is instead backed by your existing code and data.

CLIENT + SERVER 

GraphQL x +

spec.graphql.org/October2021/ ☆ Incognito :

GraphQL

October 2021 Edition

Introduction

This is the specification for GraphQL, a query language and execution engine originally created at Facebook in 2012 for describing the capabilities and requirements of data models for client-server applications. The development of this open standard started in 2015. This specification was licensed under OWFa 1.0 in 2017. The [GraphQL Foundation](#) was formed in 2019 as a neutral focal point for organizations who support the GraphQL ecosystem, and the [GraphQL Specification Project](#) was established also in 2019 as the Joint Development Foundation Projects, LLC, GraphQL Series.

If your organization benefits from GraphQL, please consider [becoming a member](#) and helping us to sustain the activities that support the health of our neutral ecosystem.

The GraphQL Specification Project has evolved and may continue to evolve in future editions of this specification. Previous editions of the GraphQL specification can be found at permalinks that match their [release tag](#). The latest working draft release can be found at <https://spec.graphql.org/draft>.

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GraphQL

- 1 Overview
- ▶ 2 Language
- ▶ 3 Type System
- ▶ 4 Introspection
- ▶ 5 Validation
- ▶ 6 Execution
- ▶ 7 Response
- ▶ A Appendix: Notation Conventions
- ▶ B Appendix: Grammar Summary
- § Index

TYPE SYSTEM

OBJECT TYPES

```
Object Type → type Product {  
  Field → id: ID! ← non-nullable  
  Field → title: String ← Built-in scalar types  
  Field → desc: String  
}  
}
```

```
type Order {  
  id: ID!  
  product: Product ← Object Type  
  qty: Int  
  customer: Customer  
  orderedOn: Date ← Custom scalar type  
  status: OrderStatus ← Enum  
}  
}
```

GRAPHQL SCHEMA: SCALAR TYPES

GraphQL comes with a set of default scalar types out of the box:

- Int: A signed 32-bit Integer.
- Float: A signed double-precision floating point value.
- String: A UTF-8 character sequence.
- Boolean: true or false.
- ID: The ID scalar type represents a unique identifier, often used to refetch an object or as the key for a cache. The ID type is serialized in the same way as a String; however, defining it as an ID signifies that it is not intended to be human-readable.

OPERATION TYPES

Object Types

Query

Mutation

Subscription

QUERY OPERATION

```
type Product {  
    id: ID!  
    title: String  
    desc: String  
}
```

```
type Query {  
    allProducts: [Product]!  
    getProduct(id: ID!): Product  
}
```

Field



Return Type

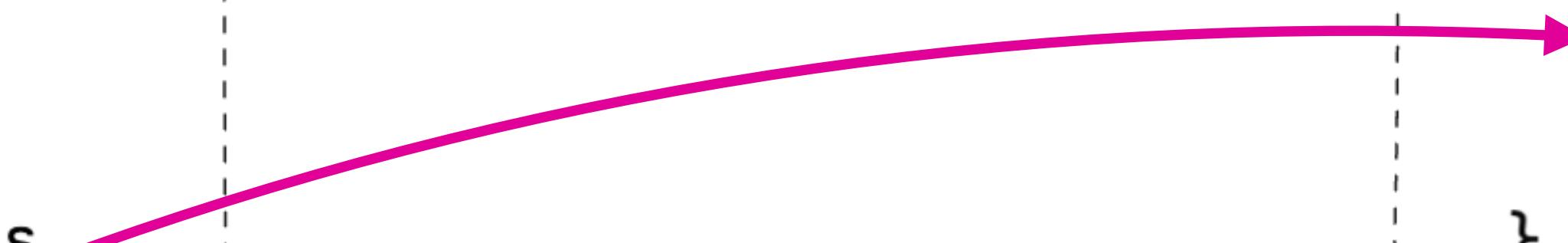


Argument

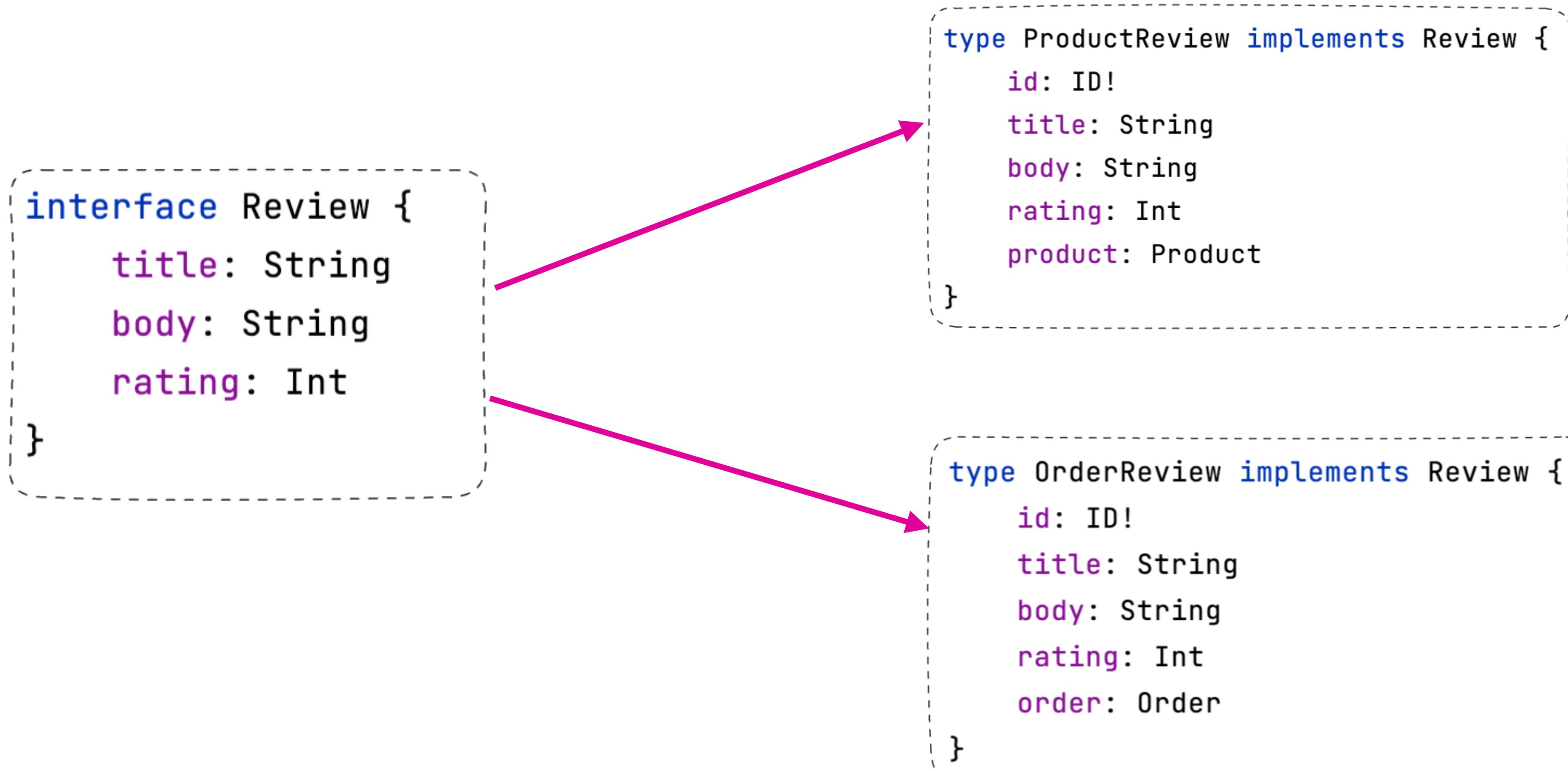
ENUMERATION TYPES

```
type Order {  
    id: ID!  
    product: Product  
    qty: Int  
    customer: Customer  
    orderedOn: Date  
    status: OrderStatus  
}
```

```
enum OrderStatus {  
    CANCELED,  
    PENDING,  
    ORDERED,  
    SHIPPED,  
    DELIVERED  
}
```



INTERFACES



ARGUMENTS

```
type Query {  
    getProduct(id: ID): Product  
    getOrder(id: ID) : Order  
    searchCustomersByLastName(last: String) : [Customer]  
    searchCustomersByFullName(first: String, last: String): [Customer]  
}
```

ARGUMENTS

Required Arguments

```
type Query {  
    getProduct(id: ID!): Product  
    getOrder(id: ID!): Order  
    searchCustomersByLastName(last: String!): [Customer]  
    searchCustomersByFullName(first: String!, last: String!): [Customer]  
}
```

ARGUMENTS

```
type Query {  
  findCustomerById(id: ID!): Customer  
}
```

```
type Customer {  
  id: ID!  
  firstName: String  
  lastName: String  
  email: String  
  orders(first:Int): [Order]  
}
```

```
type Order {  
  id: ID!  
  product: Product  
  qty: Int  
  customer: Customer  
  orderedOn: Date  
  status: OrderStatus  
}
```

```
query {  
  findCustomerById(id: 99) {  
    firstName  
    lastName  
    email  
    orders(first: 5) {  
      id  
      product {  
        title  
      }  
      qty  
      orderedOn  
      status  
    }  
  }  
}
```

VARIABLES

```
query {  
  findCustomerById(id: 99) {  
    firstName  
    lastName  
    email  
    orders(first: 5) {  
      id  
      product {  
        title  
      }  
      qty  
      orderedOn  
      status  
    }  
  }  
}
```

```
1▼ query CustomerDetails($customerID:ID!) {  
2▼   findCustomerById(id: $customerID) {  
3     firstName  
4     lastName  
5     email  
6▼       orders(first: 5) {  
7       id  
8▼         product {  
9           title  
10          }  
11         qty  
12         orderedOn  
13         status  
14       }  
15     }  
16   }  
17  
18
```

Variables Headers

```
1▼ {  
2   "customerID": 99  
3 }
```



INPUT TYPES

```
type Mutation {  
    createProduct(title: String, desc: String) : Product  
}
```

```
type Mutation {  
    createProduct()  
}  
  
type Product {  
    id: ID!  
    title: String  
    desc: String  
}  
  
type Mutation {  
    createProduct(product: ProductInput) : Product  
}  
  
input ProductInput {  
    title: String  
    desc: String  
}
```

ERROR HANDLING

```
{  
  "errors": [  
    {  
      "message": "Product with id 99 not found.",  
      "locations": [  
        {  
          "line": 2,  
          "column": 3  
        }  
      ],  
      "path": [  
        "getProduct"  
      ]  
    }  
  ],  
  "data": {  
    "getProduct": null  
  }  
}
```

200 OK
STATUS



GRAPHIQL DEMO

GETTING STARTED WITH GRAPHQL IN SPRING

How to build GraphQL APIs in Spring





GRAPHQL JAVA



SPRING FOR GRAPHQL

GRAPHQL JAVA

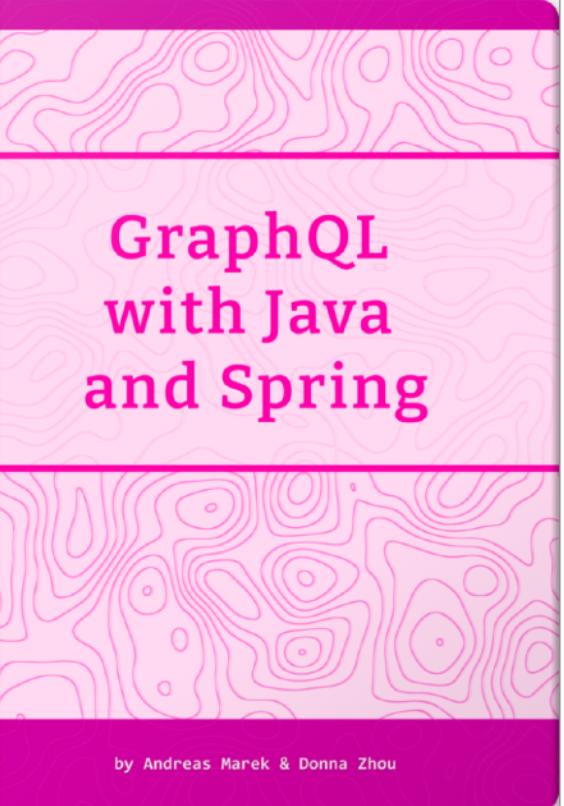
Implementation of the GraphQL Spec in Java

- Facebook Open Sourced GraphQL in 2015
- Started mid 2015
 - Andreas Marek, Software Architect at Atlassian
 - Bootiful Podcast with Josh Long
- Pure Execution Engine: No HTTP or IO. No high level abstractions
- Active on Github
- Adds Custom Scalar Types
- <https://www.graphql-java.com/>



GraphQL with Java and Spring by Andreas Marek & Donna Zhou

GraphQL with Java and Spring



LAST UPDATED ON 2023-05-14

by [Andreas Marek](#) & [Donna Zhou](#)

Learn first-hand from the founder of GraphQL Java and co-author of Spring for GraphQL how to develop GraphQL services in Java.

See the Table of Contents below for a full chapter listing.

60 DAYS GUARANTEE

ENGLISH

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Table Of Contents

GRAPHQL JAVA EXECUTION ENGINE

```
query {
  findCustomerByLastName(last:"Vega") {
    id
    firstName
    lastName
    email
    orders(first: 5) {
      id
      product {
        id
        title
        desc
      }
      qty
      orderedOn
      status
    }
  }
}
```

GraphQL Java Engine



Application

WHAT IS SPRING FOR GRAPHQL

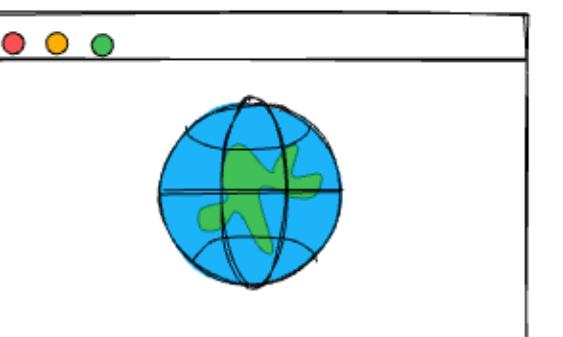
Spring for GraphQL provides support for Spring applications built on GraphQL Java

- Joint collaboration between both teams
- GraphQL Java is “limited” on purpose
- Spring Programming model
- Spring Boot Starter
- Requirements
 - 1.0.x (May 2022)
 - Spring Boot 2.7+ / JDK 8 / GraphQL Java 18
 - 1.1.x (Nov 2022)
 - Spring Boot 3.0 / JDK 17 / GraphQL Java 19
 - 1.2.x (May 2023)
 - Spring Boot 3.1 / JDK 17 / GraphQL Java 20



SPRING FOR GRAPHQL TRANSPORT LAYER

```
query {  
  findCustomerByLastName(last:"Vega") {  
    id  
    firstName  
    lastName  
    email  
    orders(first: 5) {  
      id  
      product {  
        id  
        title  
        desc  
      }  
      qty  
      orderedOn  
      status  
    }  
  }  
}
```



Spring for GraphQL

HTTP, WebSocket, RSocket

GraphQL Java Engine

@Controller

@Controller

@Controller

@Controller

Application

CREATING YOUR FIRST *GRAPHQL* API

**Project**

- Gradle - Groovy Gradle - Kotlin
 Maven

Spring Boot

- 3.3.0 (SNAPSHOT) 3.2.2 (SNAPSHOT) 3.2.1 3.1.8 (SNAPSHOT)
 3.1.7

Project Metadata

Group	com.wafflecorp
Artifact	store
Name	store
Description	Wafflecorp GraphQL API
Package name	com.wafflecorp.store
Packaging	<input checked="" type="radio"/> Jar <input type="radio"/> War
Java	<input checked="" type="radio"/> 21 <input type="radio"/> 17

Language

- Java Kotlin Groovy

Dependencies**ADD DEPENDENCIES...** ⌘ + B**Spring Web** WEB

Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

Spring for GraphQL WEB

Build GraphQL applications with Spring for GraphQL and GraphQL Java.

Spring Data JPA SQL

Persist data in SQL stores with Java Persistence API using Spring Data and Hibernate.

H2 Database SQL

Provides a fast in-memory database that supports JDBC API and R2DBC access, with a small (2mb) footprint. Supports embedded and server modes as well as a browser based console application.

GENERATE ⌘ + ↵**EXPLORE** CTRL + SPACE**SHARE...**

SPRING BOOT STARTERS

spring-boot-starter-graphql / spring-graphql-test

- Dependency Management
- Auto-configuration
- Properties
- Metrics
- GraphiQL UI and Schema Pages
- Testing Support

CREATE THE SCHEMA

```
package com.wafflecorp.store.model;

import ...

@Entity
public class Product {

    @Id
    @GeneratedValue
    private Integer id;
    private String title;
    private String desc;

    public Product() {}}
```

```
type Query {
    allProducts: [Product]
}

type Product {
    id: ID!
    title: String
    desc: String
}
```

/src/main/resources/graphal/schema.graphqls

CONTROLLER

```
type Query {  
    allProducts: [Product]  
}  
  
type Product {  
    id: ID!  
    title: String  
    desc: String  
}
```

```
package com.wafflecorp.store.controller;  
  
import ...  
  
@Controller  
public class ProductController {  
  
    private final ProductRepository repository;  
  
    public ProductController(ProductRepository repository) {  
        this.repository = repository;  
    }  
  
    @SchemaMapping(typeName = "Query", field = "allProducts")  
    public List<Product> findAll() {  
        return repository.findAll();  
    }  
}
```

CONTROLLER

```
type Query {  
    allProducts: [Product]  
}  
  
type Product {  
    id: ID!  
    title: String  
    desc: String  
}
```

```
package com.wafflecorp.store.controller;  
  
import ...  
  
@Controller  
public class ProductController {  
  
    private final ProductRepository repository;  
  
    public ProductController(ProductRepository repository) {  
        this.repository = repository;  
    }  
  
    @QueryMapping  
    @SchemaMapping(typeName = "Query", field = "allProducts")  
    public List<Product> allProducts() {  
        return repository.findAll();  
    }  
}
```

SCHEMA MAPPING INSPECTION REPORT

```
type Product {  
    id: ID!  
    title: String  
    desc: String  
    dateCreated: DateTime  
    price: BigDecimal
```

```
2023-07-26T15:17:34.659-04:00  INFO 26970 --- [           main] c.wafflecorp.store.config.GraphQlConfig : GraphQL schema inspection:  
| Unmapped fields: {Product=[dateCreated, price]}  
| Unmapped registrations: {}  
| Skipped types: []
```

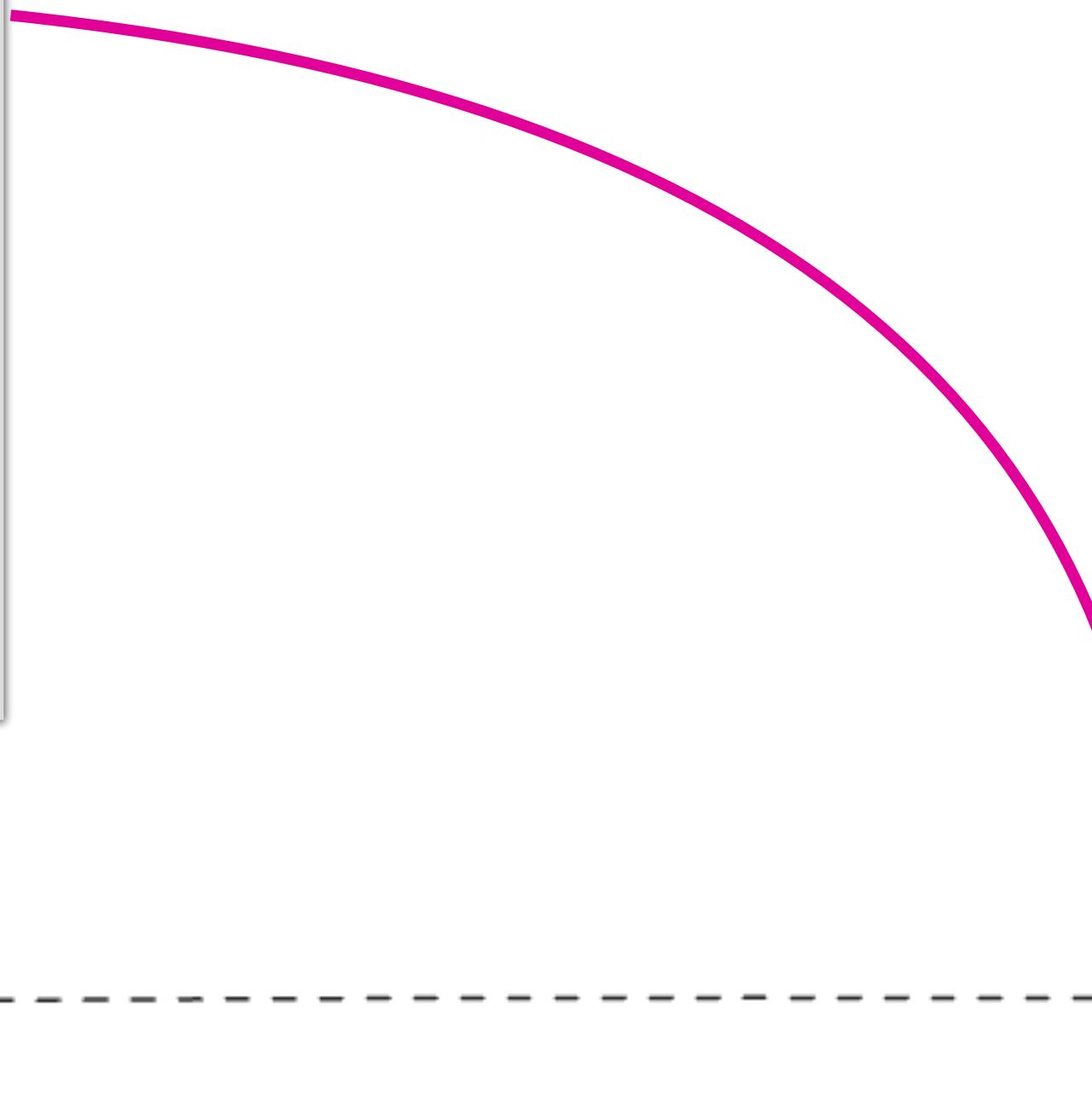
GRAPHQL REQUEST ARGUMENTS

```
query {  
  getProduct(id:1){  
    id  
    title  
    desc  
  }  
}
```

```
@QueryMapping  
public Optional<Product> getProduct(@Argument Integer id) {  
  return repository.findById(id);  
}
```

COMPLEX GRAPHQL ARGUMENTS

```
query {  
  findOrders(criteria:{orderedOn:"10/05/2022",status:"PENDING"}) {  
    id  
    product {  
      id  
      title  
      desc  
    }  
    qty  
    orderedOn  
    status  
  }  
}
```



```
@QueryMapping  
public List<Order> findOrders(@Argument OrderCriteria criteria) {  
  // ...  
}
```

SUPPORTS VALIDATION

```
@QueryMapping  
public List<Order> findOrders(@Argument @Valid OrderCriteria criteria) {  
    // ...  
}
```

REGISTERING DATA FETCHERS

```
type Query {  
    allCustomers: [Customer]  
}
```

```
type Customer {  
    id: ID!  
    firstName: String  
    lastName: String  
    email: String  
    orders: [Order]  
}
```

```
type Order {  
    id: ID!  
    product: Product  
    qty: Int  
    customer: Customer  
    orderedOn: Date  
    status: OrderStatus  
}
```

```
@Entity  
public class Customer {  
  
    @Id  
    @GeneratedValue  
    private Integer id;  
    private String firstName;  
    private String lastName;  
    private String email;  
    @OneToMany(mappedBy = "customer")  
    private Set<Order> orders = new HashSet<>();
```

REGISTERING DATA FETCHERS

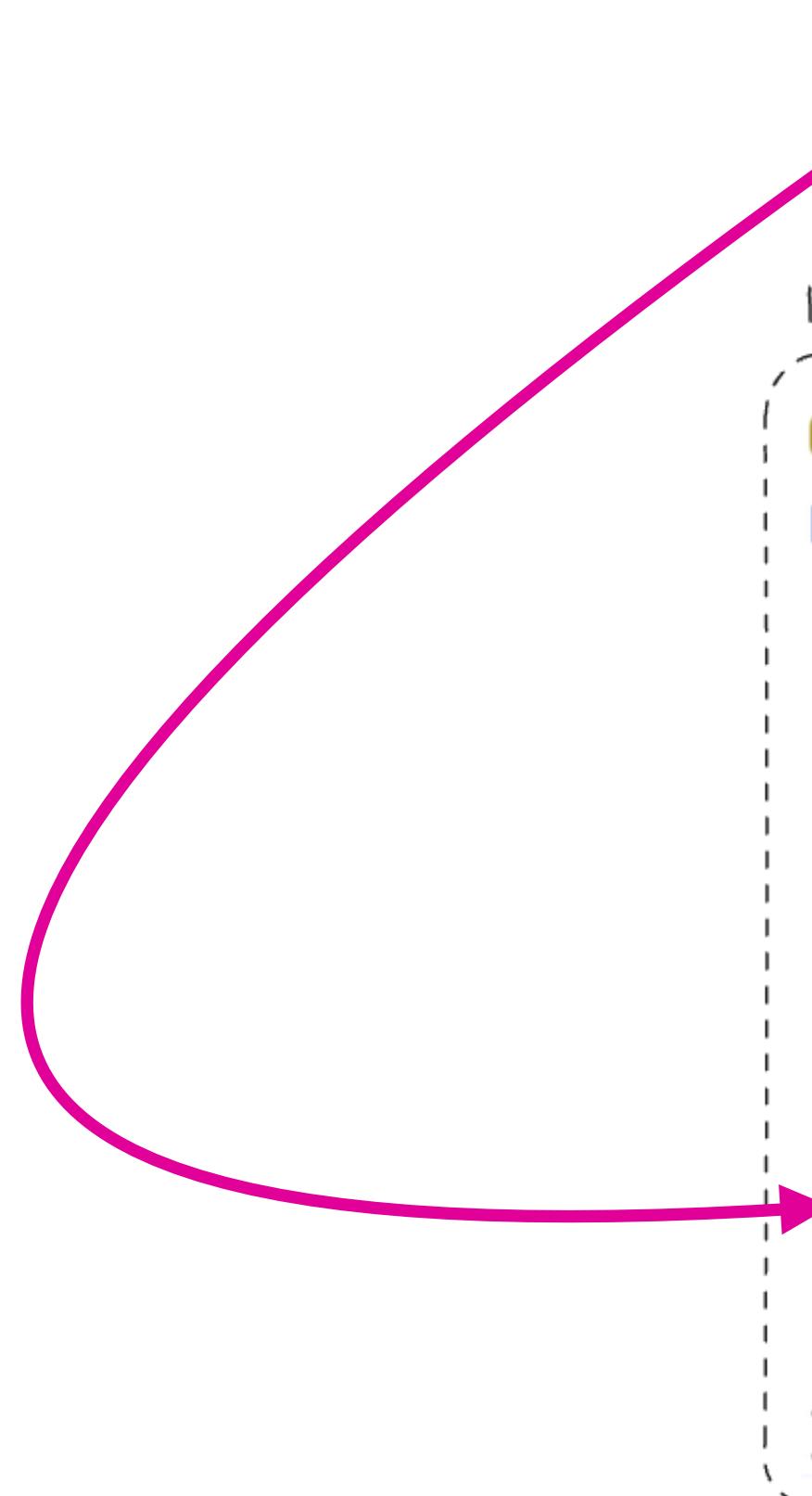
```
type Query {  
    allCustomers: [Customer]  
}
```

```
type Customer {  
    id: ID!  
    firstName: String  
    lastName: String  
    email: String  
    orders: [Order]  
}
```

```
type Order {  
    id: ID!  
    product: Product  
    qty: Int  
    customer: Customer  
    orderedOn: Date  
    status: OrderStatus  
}
```

```
@SchemaMapping  
public List<Order> orders(Customer customer) {  
    // this could be an HTTP call to another microservice  
    return orderRepository.findByCustomer(customer);  
}
```

MUTATION MAPPING



```
@Controller
public class ProductController {

    private final ProductRepository repository;

    public ProductController(ProductRepository repository) { this.repository = repository; }

    @MutationMapping
    public Product createProduct(@Argument String title, @Argument String desc) {
        return repository.save(new Product(title,desc));
    }
}
```

MUTATION MAPPING

```
type Mutation {  
    createProduct(product: ProductInput) : Product  
}  
  
type Product {  
    id: ID!  
    title: String  
    desc: String  
}  
  
input ProductInput {  
    title: String  
    desc: String  
}
```

```
@Controller  
public class ProductController {  
  
    private final ProductRepository repository;  
  
    public ProductController(ProductRepository repository) {  
        this.repository = repository;  
    }  
  
    @MutationMapping  
    public Product createProduct(@Argument ProductInput product) {  
        return repository.save(new Product(product.title(), product.desc()));  
    }  
}
```

MUTATION MAPPING

```
type Mutation {  
  createProduct(product: ProductInput) : Product  
}  
  
type Product {  
  id: ID!  
  title: String  
  desc: String  
}  
  
input ProductInput {  
  title: String  
  desc: String  
}
```

```
mutation {  
  createProduct(product: {title: "Belgium Waffle", desc: "mmmm soo good!" }) {  
    id  
    title  
    desc  
  }  
}
```

```
{  
  "data": {  
    "createProduct": {  
      "id": "5",  
      "title": "Belgium Waffle",  
      "desc": "mmmm soo good!"  
    }  
  }  
}
```

```
@Controller  
public class ProductController {  
  
  private final ProductRepository repository;  
  
  public ProductController(ProductRepository repository) {  
    this.repository = repository;  
  }  
  
  @Mutation  
  public Product createProduct(@Argument ProductInput product) {  
    return repository.insert(product.title(), product.desc());  
  }  
}
```

@ARGUMENTS

```
-----  
@MutationMapping  
public void createProduct(@Arguments Map<String, Object> args) {  
    log.info(args.toString());  
}  
-----
```

```
[nio-8080-exec-1] o.a.c.c.C.[Tomcat].[localhost].[/]      : Initializing Spring DispatcherServlet 'dispatcherServlet'  
[nio-8080-exec-1] o.s.web.servlet.DispatcherServlet   : Initializing Servlet 'dispatcherServlet'  
[nio-8080-exec-1] o.s.web.servlet.DispatcherServlet   : Completed initialization in 1 ms  
[nio-8080-exec-1] c.w.store.controller.ProductController : {product={title=Belgium Waffle, desc=mmmm sooo good!}}
```

Schema mapping handler methods can have any of the following method arguments:

Method Argument	Description
<code>@Argument</code>	For access to a named field argument bound to a higher-level, typed Object. See @Argument .
<code>@Argument Map<String, Object></code>	For access to the raw argument value. See @Argument .
<code>ArgumentValue</code>	For access to a named field argument bound to a higher-level, typed Object along with a flag to indicate if the input argument was omitted vs set to <code>null</code> . See ArgumentValue .
<code>@Arguments</code>	For access to all field arguments bound to a higher-level, typed Object. See @Arguments .
<code>@Arguments Map<String, Object></code>	For access to the raw map of arguments.
<code>@ProjectedPayload Interface</code>	For access to field arguments through a project interface. See @ProjectedPayload Interface .
<code>"Source"</code>	For access to the source (i.e. parent/container) instance of the field. See Source .
<code>Subrange</code> and <code>ScrollSubrange</code>	For access to pagination arguments. See Pagination , Scroll , Subrange .
<code>Sort</code>	For access to sort details. See Pagination , Sort .
<code>DataLoader</code>	For access to a <code>DataLoader</code> in the <code>DataLoaderRegistry</code> . See DataLoader .
<code>@ContextValue</code>	For access to an attribute from the main <code>GraphQLContext</code> in <code>DataFetchingEnvironment</code> .
<code>@LocalContextValue</code>	For access to an attribute from the local <code>GraphQLContext</code> in <code>DataFetchingEnvironment</code> .
<code>GraphQLContext</code>	For access to the context from the <code>DataFetchingEnvironment</code> .
<code>java.security.Principal</code>	Obtained from the Spring Security context, if available.
<code>@AuthenticationPrincipal</code>	For access to <code>Authentication#getPrincipal()</code> from the Spring Security context.
<code>DataFetchingFieldSelectionSet</code>	For access to the selection set for the query through the <code>DataFetchingEnvironment</code> .
<code>Locale, Optional<Locale></code>	For access to the <code>Locale</code> from the <code>DataFetchingEnvironment</code> .
<code>DataFetchingEnvironment</code>	For direct access to the underlying <code>DataFetchingEnvironment</code> .



SPRING FOR GRAPHQL DEMO

<https://github.com/danvega/graphql-store>

start-here branch

FEATURES

Spring for GraphQL Features



OBSERVABILITY

Insights into how your APIs are performing

OBSERVABILITY

Spring Framework 6 & Spring Boot 3

Observability is the ability to observe the internal state of a running system from the outside. It consists of the three pillars **logging**, **metrics** and **traces**.

Spring projects now have their own, built-in instrumentation for metrics and traces based on the [new Observation API](#) from [Micrometer](#)

GraphQL is a good use case for Observability in general, as the GraphQL engine can fan out data fetching across REST APIs, data stores, caches, and more.

Spring Initializr + Incognito

Meet the Spring team this August at SpringOne.

spring initializr

Project

- Gradle - Groovy
- Gradle - Kotlin
- Maven

Language

- Java
- Kotlin
- Groovy

Spring Boot

- 3.2.0 (SNAPSHOT)
- 3.2.0 (M1)
- 3.1.3 (SNAPSHOT)
- 3.1.2
- 3.0.10 (SNAPSHOT)
- 3.0.9
- 2.7.15 (SNAPSHOT)
- 2.7.14

Project Metadata

Group: com.example

Artifact: demo

Name: demo

Description: Demo project for Spring Boot

Package name: com.example.demo

Packaging: Jar War

Java: 20 17 11 8

Dependencies

Spring Web WEB

Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

Spring for GraphQL WEB

Build GraphQL applications with Spring for GraphQL and GraphQL Java.

Spring Boot Actuator OPS

Supports built in (or custom) endpoints that let you monitor and manage your application - such as application health, metrics, sessions, etc.

Docker Compose Support DEVELOPER TOOLS

Provides docker compose support for enhanced development experience.

Zipkin OBSERVABILITY

Enable and expose span and trace IDs to Zipkin.

GENERATE ⌘ + ↩ **EXPLORE** CTRL + SPACE **SHARE...**

```
query {  
  allCustomers {  
    id  
    firstName  
    lastName  
    email  
    orders {  
      id  
      qty  
      status  
      orderedOn  
      product {  
        title  
      }  
    }  
  }  
}
```



+ RUN QUERY

1 Result

EXPAND ALL COLLAPSE ALL

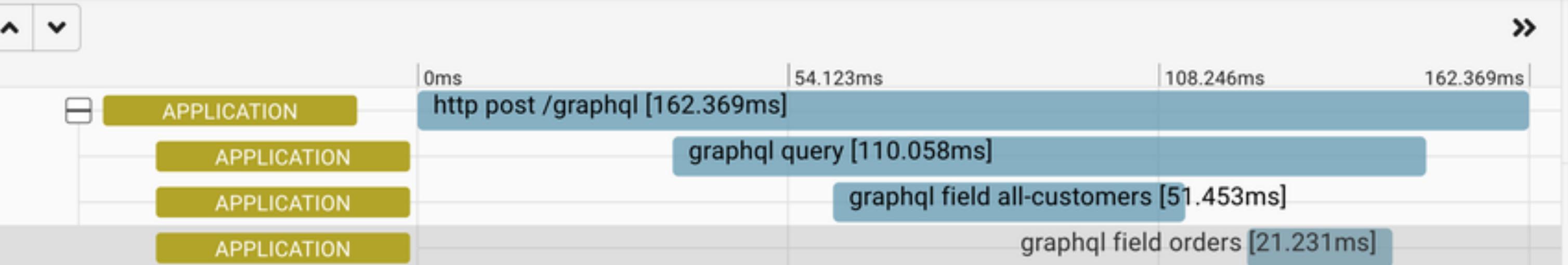
Service filters ▾

Root	Start Time	Spans	Duration	
application: http post /graphql	a few seconds ago (07/27 14:03:00:275)	4	162.369ms	SHOW



APPLICATION: http post /graphql

Duration: 162.369ms Services: 1 Depth: 2 Total Spans: 4 Trace ID: 64c2b1545a0939d303438ee64519efd4

[DOWNLOAD JSON](#)**APPLICATION**
graphql field orders

Span ID: e91ae4178edefec1 Parent ID: 03438ee64519efd4

Annotations[SHOW ALL ANNOTATIONS](#)**Tags**

graphql.error.type	NONE
graphql.field.name	orders
graphql.field.path	/allCustomers[0]/orders
graphql.outcome	SUCCESS

PAGINATION

Pagination support using the Cursor Connection Specification

PAGINATION

Spring for GraphQL 1.2 adds support for pagination

The GraphQL Cursor Connection specification defines a way to navigate large result sets by returning a subset of items at a time where each item is paired with a cursor that clients can use to request more items before or after the referenced item.

The specification calls the pattern “Connections”

A schema type with a name that ends in Connection is a *Connection Type* that represents a paginated result set.

All *~Connection* types contain an “edges” field where *~Edge* type pairs the actual item with a cursor, as well as a “pageInfo” field with boolean flags to indicate if there are more items forward and backward.

Spring for GraphQL provides *ConnectionTypeDefinitionConfigurer* to add these types on startup.

```
type Customer {  
    id: ID!  
    firstName: String  
    lastName: String  
    email: String  
    orders: [Order]  
    paginatedOrders(first: Int, last: Int, before: String, after: String): OrderConnection  
}
```

```
-----  
@SchemaMapping  
Window<Order> paginatedOrders(Customer customer, ScrollSubrange subrange) {  
    ScrollPosition scrollPosition = subrange.position().orElse(ScrollPosition.offset());  
    Limit limit = Limit.of(subrange.count().orElse( other: 10));  
    Sort sort = Sort.by( ...properties: "orderedOn").descending();  
    return orderRepository.findByCustomer(customer, scrollPosition, limit, sort);  
}  
-----
```

```
-->----->
public interface OrderRepository extends CrudRepository<Order, Integer> {

    List<Order> findByCustomer(Customer customer);

    Window<Order> findByCustomer(Customer customer, ScrollPosition position, Limit limit, Sort sort);
}

-----<-----
```

```
query {
  allCustomers {
    id
    firstName
    lastName
    email
    paginatedOrders(first:3){
      pageInfo {
        hasNextPage
        hasPreviousPage
        startCursor
        endCursor
      }
      edges {
        node {
          id
          qty
          orderedOn
          status
          product {
            title
            desc
          }
        }
      }
    }
  }
}
```

```
{
  "data": {
    "allCustomers": [
      {
        "id": "1",
        "firstName": "Dan",
        "lastName": "Vega",
        "email": "danvega@gmail.com",
        "paginatedOrders": {
          "pageInfo": {
            "hasNextPage": true,
            "hasPreviousPage": true,
            "startCursor": "T18x",
            "endCursor": "T18z"
          },
          "edges": [
            {
              "node": {
                "id": "2",
                "qty": 6,
                "orderedOn": "2023-07-27",
                "status": "DELIVERED",
                "product": {
                  "title": "Chocolate Chip Waffle",
                  "desc": "Sweet Cream Waffle covered in Chocolate Chips"
                }
              }
            },
            {
              "node": { }
            },
            {
              "node": { }
            }
          ]
        }
      }
    ]
  }
}
```

SECURITY

Securing GraphQL APIs

```
@Configuration
@EnableWebSecurity
@EnableMethodSecurity(securedEnabled = true)
public class SecurityConfig {

    @Bean
    SecurityFilterChain securityFilterChain(HttpSecurity http) throws Exception {
        return http
            .authorizeHttpRequests( auth → {
                auth.anyRequest().authenticated();
            })
            .sessionManagement(session → session.sessionCreationPolicy(SessionCreationPolicy.STATELESS))
            .csrf(AbstractHttpConfigurer::disable)
            .httpBasic(Customizer.withDefaults())
            .build();
    }

    @Bean
    public UserDetailsService userDetailsService() {
        var user = User.withUsername("user")
            .password("{noop}password")
            .roles("USER")
            .build();

        var admin = User.withUsername("admin")
            .password("{noop}password")
            .roles("ADMIN")
            .build();

        return new InMemoryUserDetailsManager(user,admin);
    }
}
```

```
-----  
@QueryMapping  
public List<Product> allProducts() { return repository.findAll(); }  
  
@QueryMapping  
public Optional<Product> getProduct(@Argument Integer id) {  
    return repository.findById(id);  
}  
  
@Secured("ROLE_ADMIN")  
@MutationMapping  
public Product createProduct(@Argument ProductInput productInput) {  
    return repository.save(new Product(productInput.title(), productInput.desc()));  
}
```

```
mutation {
  createProduct(product:{title:"New Product",|  
    id  
    title  
    desc  
  })
}
```

```
{
  "errors": [
    {
      "message": "Forbidden",
      "locations": [
        {
          "line": 31,
          "column": 3
        }
      ],
      "path": [
        "createProduct"
      ],
      "extensions": {
        "classification": "FORBIDDEN"
      }
    ],
    "data": {
      "createProduct": null
    }
  }
}
```

```

1 ▼ query {
2   ▼ allCustomers {
3     id
4     firstName
5     lastName
6     email
7   ▼ paginatedOrders(first:3){
8     pageInfo {
9       hasNextPage
10    hasPreviousPage
11    startCursor
12    endCursor
13  }
14   ▼ edges {
15     node {
16       id
17       qty
18       orderedOn
19       status
20     ▼ product {
21       title
22       desc
23     }
24   }
25 }
26 }
27 }
28 }
```

Variables

```

1 ▼ {
2   "Authorization": "Basic dXNlcjpwYXNzd29yZA=="
3 }
```

Headers

```

{
  "data": {
    "allCustomers": [
      {
        "id": "1",
        "firstName": "Dan",
        "lastName": "Vega",
        "email": "danvega@gmail.com",
        "paginatedOrders": {
          "pageInfo": {
            "hasNextPage": true,
            "hasPreviousPage": true,
            "startCursor": "T18x",
            "endCursor": "T18z"
          },
          "edges": [
            {
              "node": {
                "id": "19",
                "qty": 1,
                "orderedOn": "2023-08-24",
                "status": "PENDING",
                "product": {
                  "title": "Chocolate Chip Waffle",
                  "desc": "Sweet Cream Waffle covered in Chocolate Chips"
                }
              }
            },
            {
              "node": {
                "id": "7",
                "qty": 4,
                "orderedOn": "2023-08-24",
                "status": "CANCELED",
                "product": {
                  "title": "Peanut Butter Chip Waffle",
                  "desc": "Sweet Cream Waffle covered in Peanut Butter Chips"
                }
              }
            },
            {
              "node": {
                "id": "10",
                "qty": 2,
                "orderedOn": "2023-08-24",
                "status": "PENDING",
                "product": {
                  "title": "Strawberry Shortcake Waffle",
                  "desc": "Sweet Cream Waffle covered in Strawberry Shortcake Filling"
                }
              }
            }
          ]
        }
      }
    ]
  }
}
```

CONTEXT PROPAGATION FROM TRANSPORT

```
@Service
public class ProductService {

    private final ProductRepository productRepository;

    public ProductService(ProductRepository productRepository) {
        this.productRepository = productRepository;
    }

    @PreAuthorize("hasRole('ADMIN')")
    public Product create(Product product) {
        return productRepository.save(product);
    }
}
```

ACCESS TO THE AUTHENTICATED PRINCIPAL

```
@QueryMapping  
public List<Order> allOrders(Principal principal) {  
    log.info("Authenticated Principal: " + principal);  
    return repository.findAll();
```

```
] o.a.c.c.C.[Tomcat].[localhost].[/]      : Initializing Spring DispatcherServlet 'dispatcherServlet'  
] o.s.web.servlet.DispatcherServlet       : Initializing Servlet 'dispatcherServlet'  
] o.s.web.servlet.DispatcherServlet       : Completed initialization in 1 ms  
:] c.w.store.controller.OrderController   : Authenticated Principal: UsernamePasswordAuthenticationToken [Principal=org.springframework.security.core.userdetails.User [Username=user, Password=[PROTECTED],
```

TESTING

How to test your GraphQL APIs

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-graphql</artifactId>
</dependency>
<dependency>
    <groupId>org.springframework.graphql</groupId>
    <artifactId>spring-graphql-test</artifactId>
    <scope>test</scope>
</dependency>
```

GRAPHQL SLICE TEST

```
@Import({GraphQLConfig.class})
@GraphQLTest(ProductController.class)
class ProductControllerTest {

    @Autowired
    private GraphQLTester graphQLTester;

    @MockBean
    private ProductRepository productRepository;

    private final List<Product> products = new ArrayList<>();

    @Test
    public void contextLoads() {
        assertNotNull(graphQLTester);
        assertNotNull(productRepository);
    }
}
```

GRAPHQL TESTER FLUENT API

```
@Test
void shouldGetAllProductsQueryReturnsAllProducts() {
    // language=GraphQL
    String document = """
        query {
            allProducts {
                id
                title
                desc
            }
        }
    """;

    when(productRepository.findAll()).thenReturn(products);

    graphQLTester.document(document)
        .execute()
        .path("allProducts")
        .entityList(Product.class)
        .hasSize(4);
}
```

src/test/resources/graphal-test/product.graphql

```
@Test  
void shouldReturnValidProductWithDocumentName() {  
    when(productRepository.findById(1)).thenReturn(java.util.Optional.ofNullable(products.get(0)));  
  
    graphQlTester.documentName("product") Request<capture of ?>  
        .variable(name: "id", value: 1) capture of ?  
        .execute() Response  
        .path("getProduct") Path  
        .entity(Product.class) Entity<Product, capture of ?>  
        .satisfies(product → {  
            assertEquals(expected: "Classic Waffle", product.getTitle());  
            assertEquals(expected: "Classic Sweet Cream Waffle", product.getDesc());  
        });  
}
```

© ProductControllerTest.java  product.graphql ×

    Default GraphQL Endpoint - http://localhost:8080/graphql    

```
1 query findProduct($id:ID) {  
2     getProduct(id:$id) {  
3         id  
4         title  
5         desc  
6     }  
7 }
```

TEST OVER HTTP

```
@SpringBootTest
@AutoConfigureHttpGraphQLTester
public class ProductControllerHttpTest {

    @Autowired
    private HttpGraphQLTester graphQLTester;
    @Autowired
    private ProductRepository productRepository;

    @Test
    @WithMockUser
    void shouldFindAllProducts() {
        graphQLTester.documentName("products") Request<capture of ?>
            .execute() Response
            .path("allProducts") Path
            .entityList(Product.class) EntityList<Product>
            .hasSize(productRepository.findAll().size());
    }
}
```

FULL INTEGRATION TEST

```
@SpringBootTest(webEnvironment = SpringBootTest.WebEnvironment.RANDOM_PORT)
class OrderControllerIntTest {

    private HttpGraphQLTester graphQLTester;
    @Autowired
    private OrderRepository orderRepository;

    @LocalServerPort
    int port;

    @BeforeEach
    void setUp() {
        WebTestClient client = WebTestClient.bindToServer()
            .defaultHeaders(httpHeaders → httpHeaders.setBasicAuth(username: "user", password: "password"))
            .baseUrl(String.format("http://localhost:%s/graphql", port))
            .build();

        graphQLTester = HttpGraphQLTester.create(client);
    }

    @Test
    void contextLoads() { assertNotNull(graphQLTester); }
```

GRAPHQL FEATURES

But wait there's more!

- **Batch Loading (n+1)**
- **Error Handling**
- **GraphQL Client**
- **GraalVM Native Image Support**
- **Data Integration**
- **DSG Code Generation**
- **And More!**

STAY CONNECTED

Let's continue the conversation

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THANK YOU