

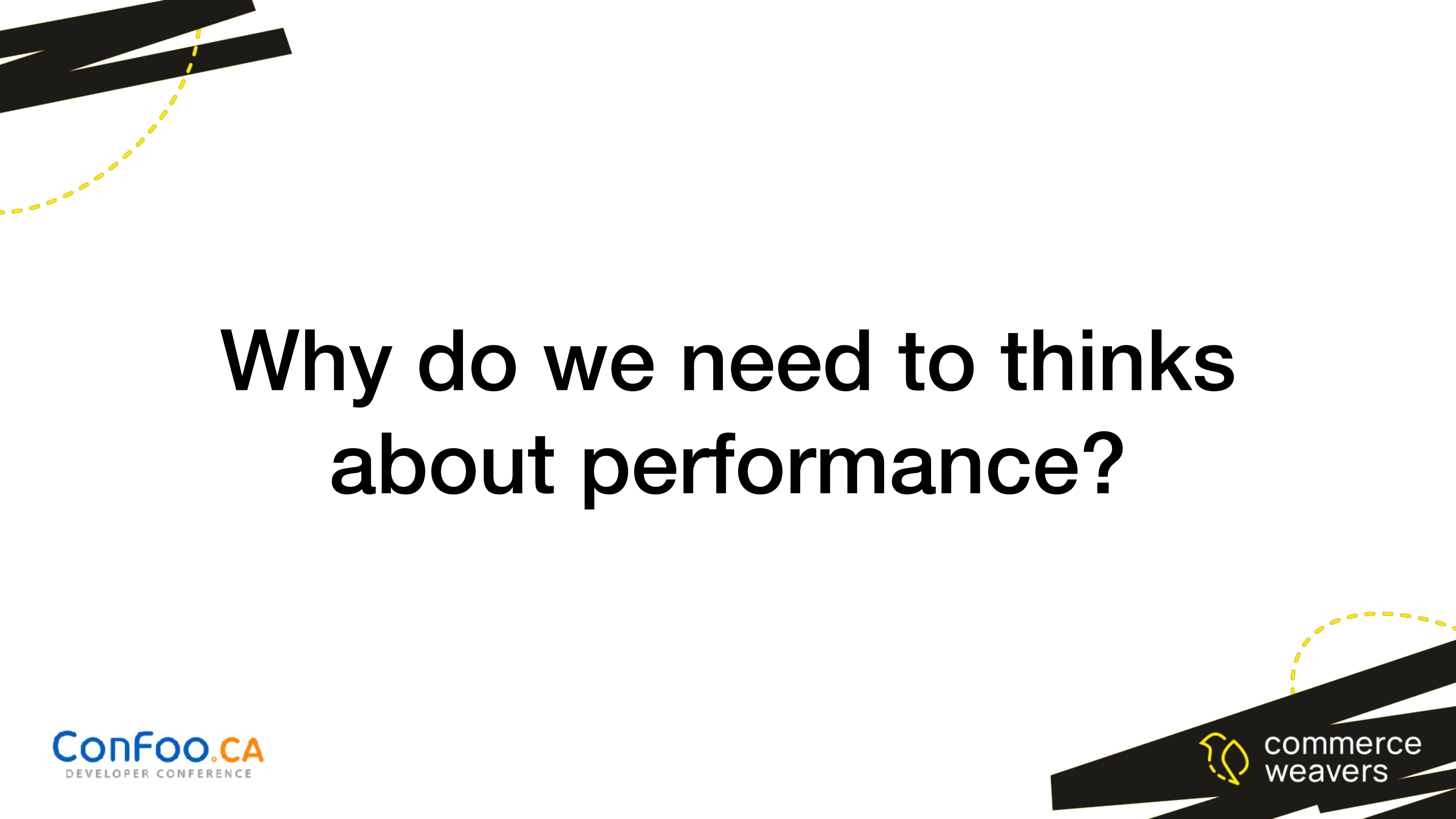
# Need for Speed

Removing speed bumps in API Projects

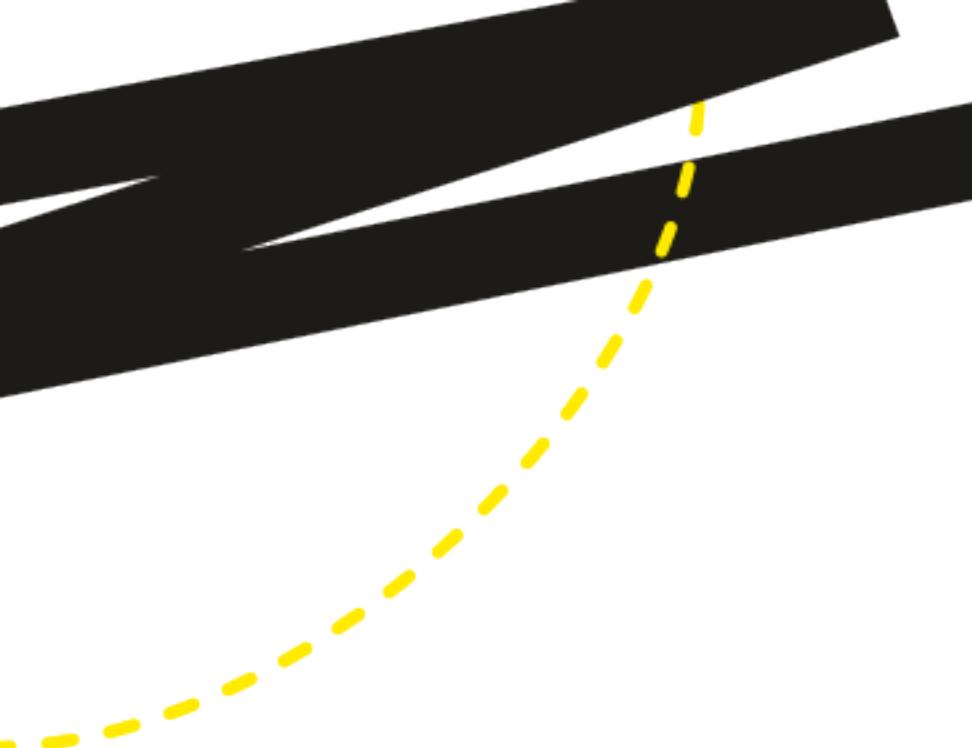
Łukasz Chruściel

# Introduction

# Weavers, Sylius



# Why do we need to thinks about performance?



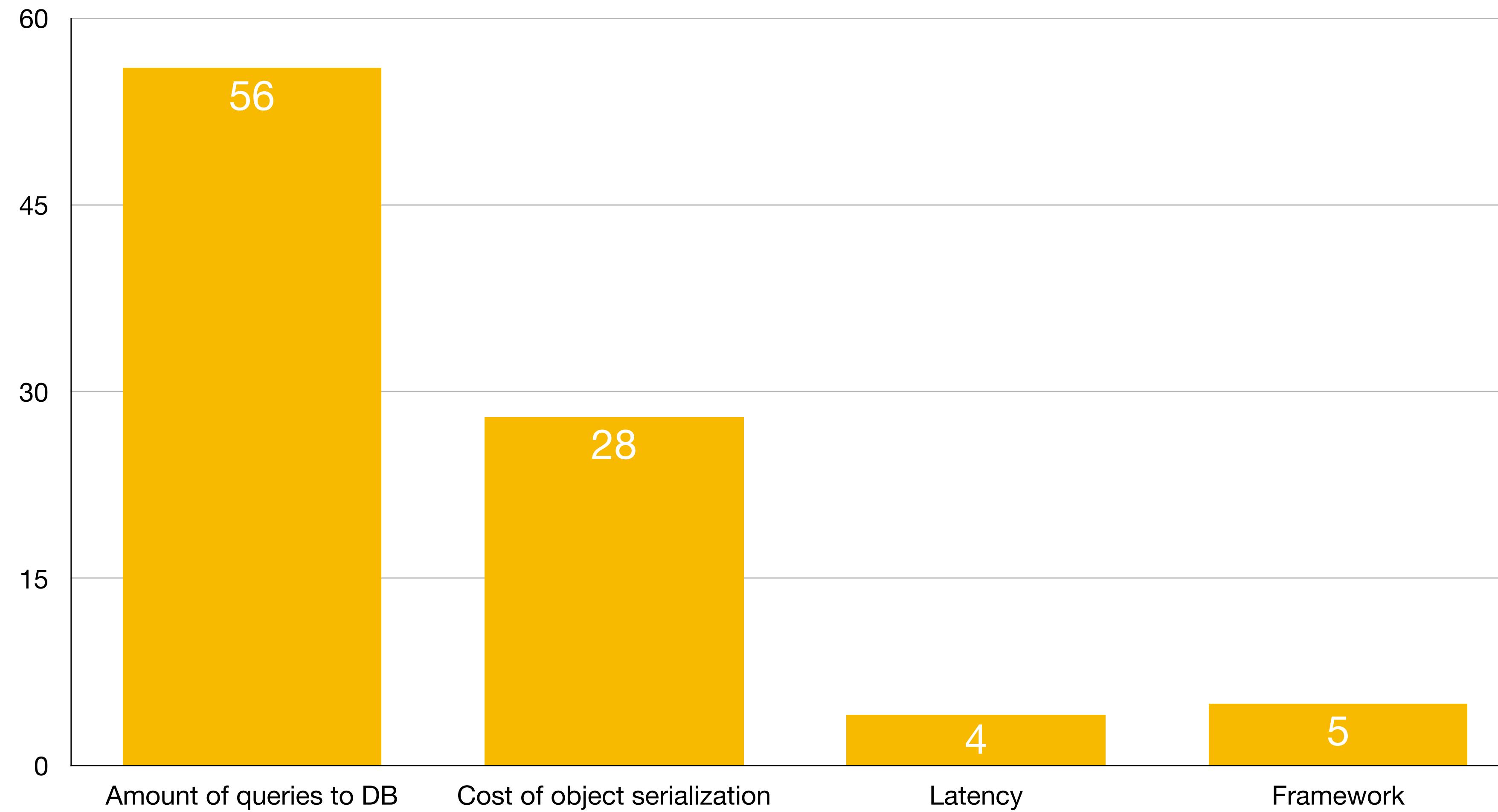
**“100ms Faster  
=  
1% More Revenue.”**

*~ Amazon*



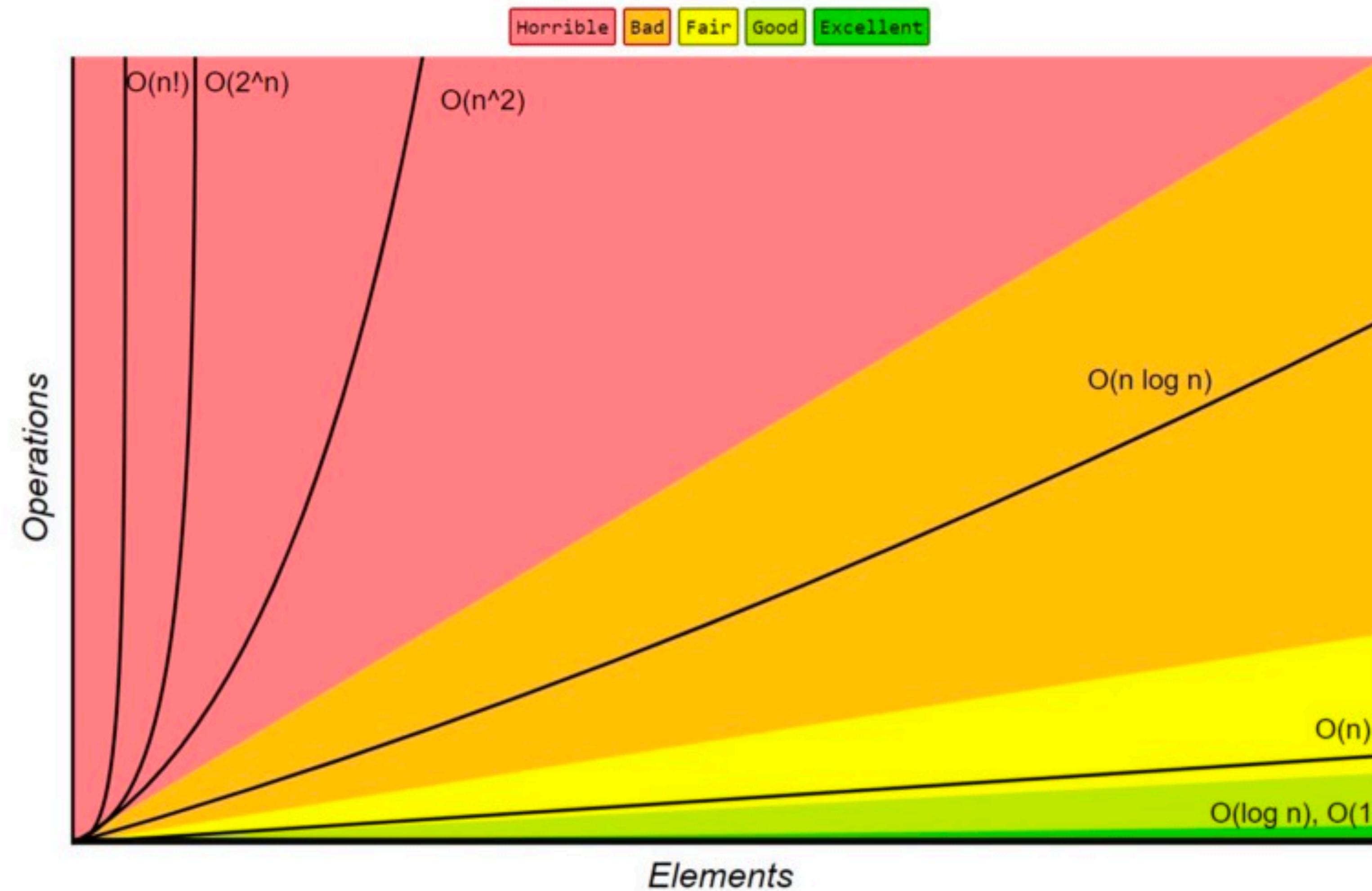
 commerce  
weavers

# The most common performance bottlenecks



# Algorithmic complexity

## Big-O Complexity Chart



# Project structure

Order

Items

Total() =>  $\sum \text{Items.Price}$

OrderItem

Quantity  
Product

Price() => Quantity \* Product.Price

OrderItem

Quantity  
Product

Price() => Quantity \* Product.Price

Product

Name  
Price

Product

Name  
Price

# Problems



N+1

# ORM anyone? 🤔

# Product list

# Let's start small

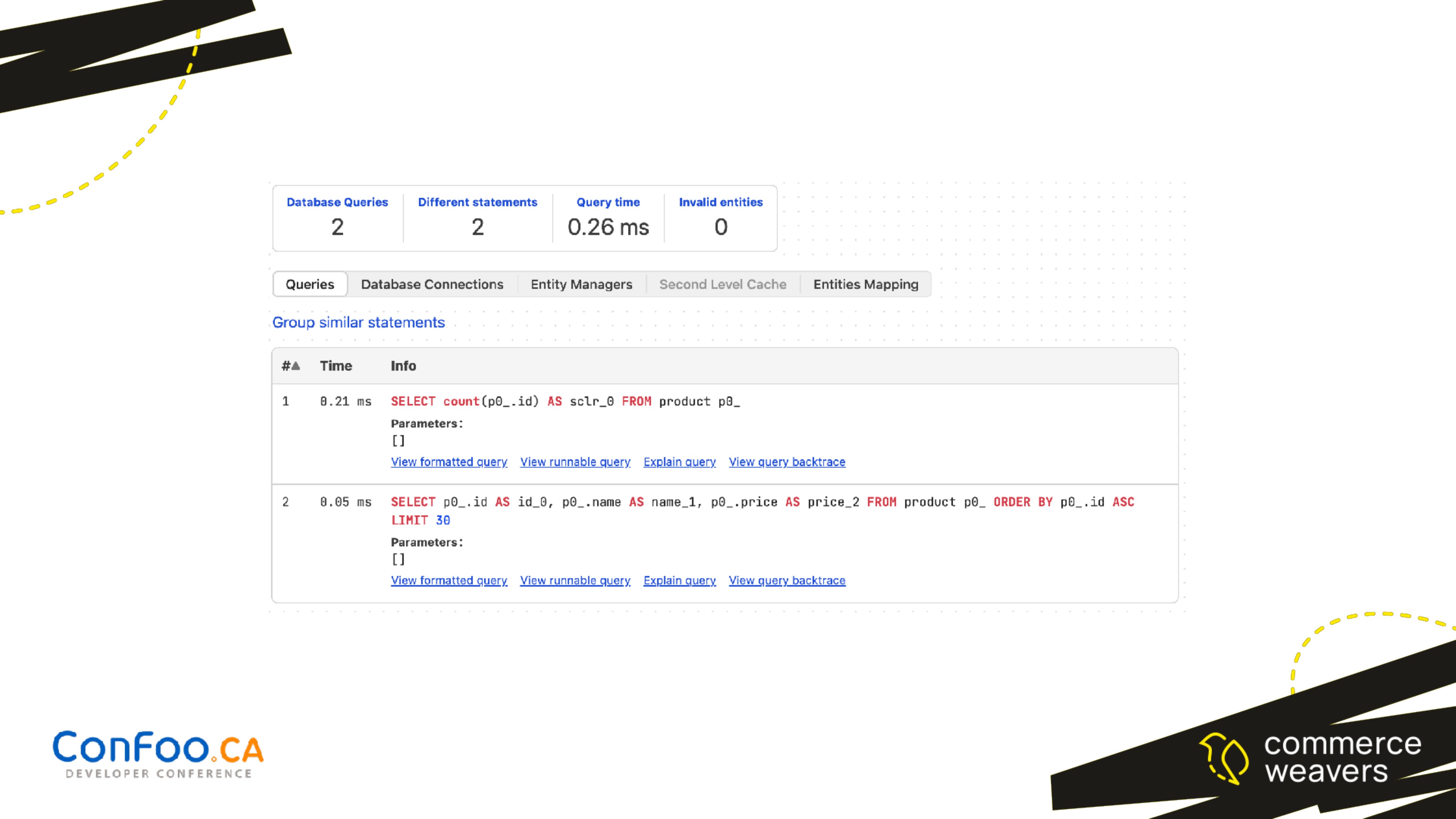
Amount of products: **6**

**No associations** between objects

Sample query on the left



```
{  
  "@context": "/api/contexts/Product",  
  "@id": "/api/products",  
  "@type": "hydra:Collection",  
  "hydra:totalItems": 6,  
  "hydra:member": [  
    {  
      "@id": "/api/products/1",  
      "@type": "Product",  
      "id": 1,  
      "name": "T-Shirt",  
      "price": 1000  
    },  
    {  
      "@id": "/api/products/2",  
      "@type": "Product",  
      "id": 2,  
      "name": "Trousers",  
      "price": 5000  
    },  
    {  
      "...": "..."  
    }  
  ]  
}
```



Database Queries	Different statements	Query time	Invalid entities
2	2	0.26 ms	0

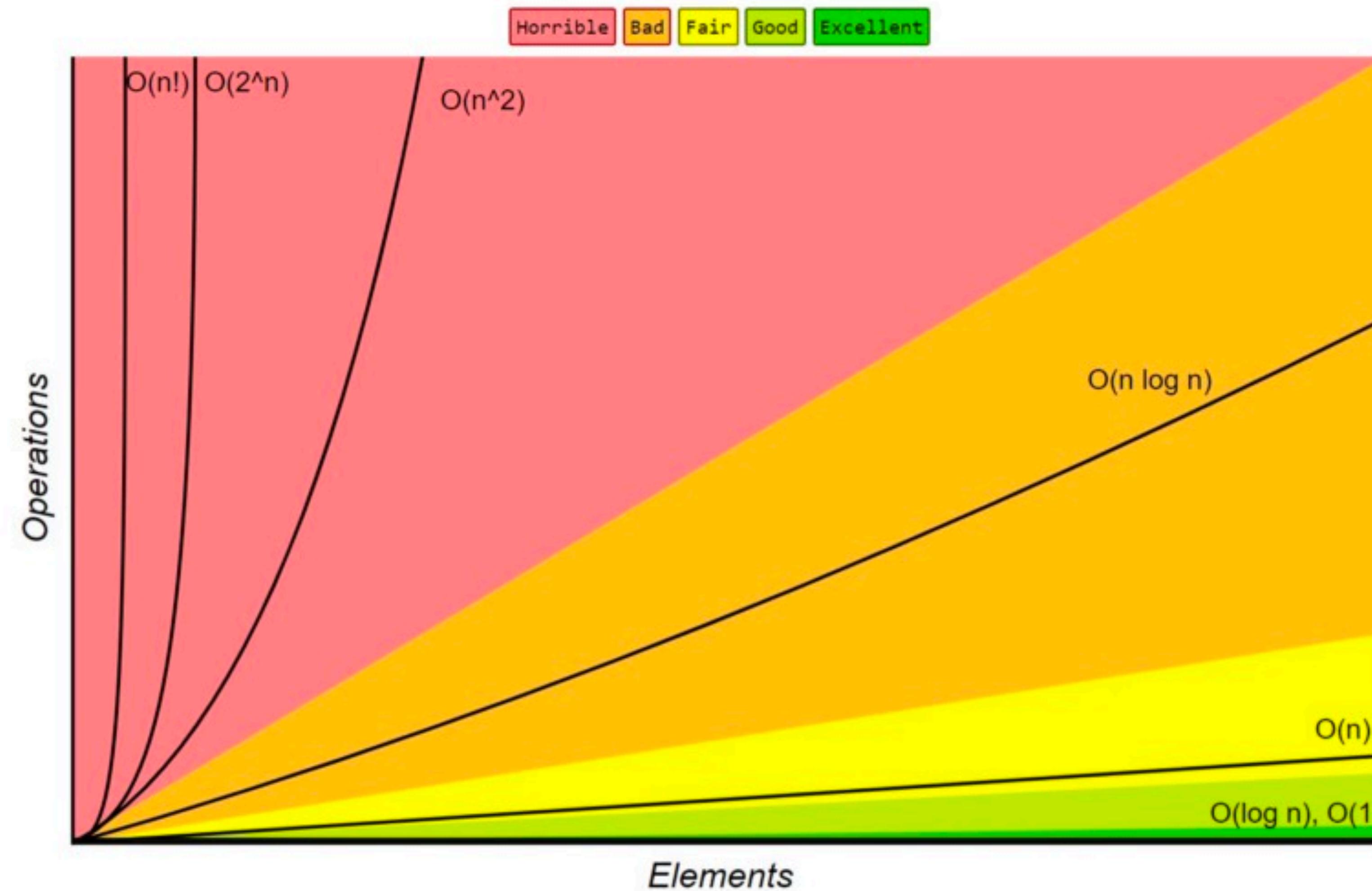
Queries   Database Connections   Entity Managers   Second Level Cache   Entities Mapping

[Group similar statements](#)

#▲	Time	Info
1	0.21 ms	<pre>SELECT count(p0_.id) AS sclr_0 FROM product p0_</pre> Parameters: [] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>
2	0.05 ms	<pre>SELECT p0_.id AS id_0, p0_.name AS name_1, p0_.price AS price_2 FROM product p0_ ORDER BY p0_.id ASC LIMIT 30</pre> Parameters: [] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>

$O(1)$

## Big-O Complexity Chart



# Order list

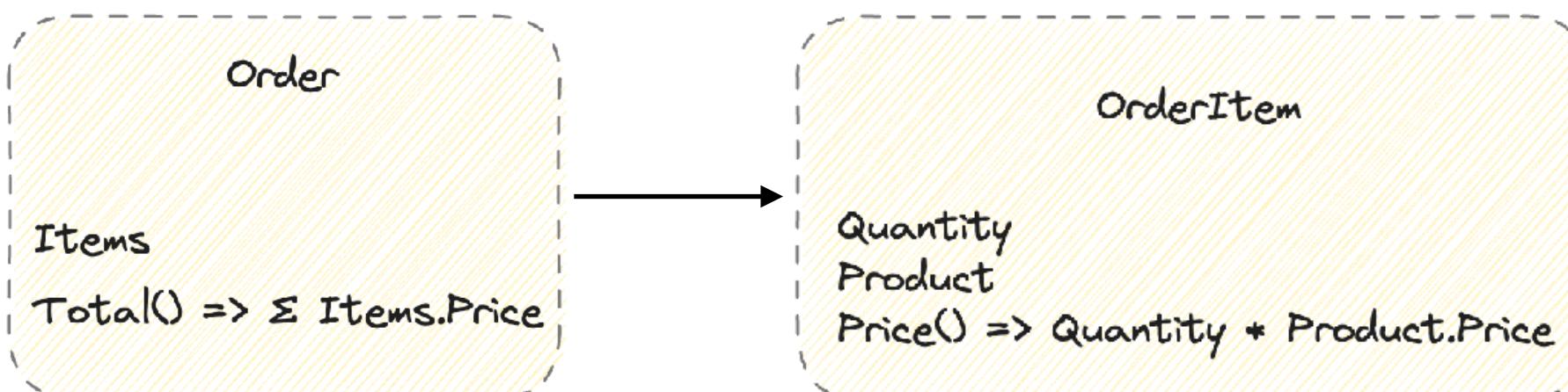
# How many queries are executed here?

Amount of orders: **3**

Every order **associated with 2 items**

Sample query on the left

**No total field**



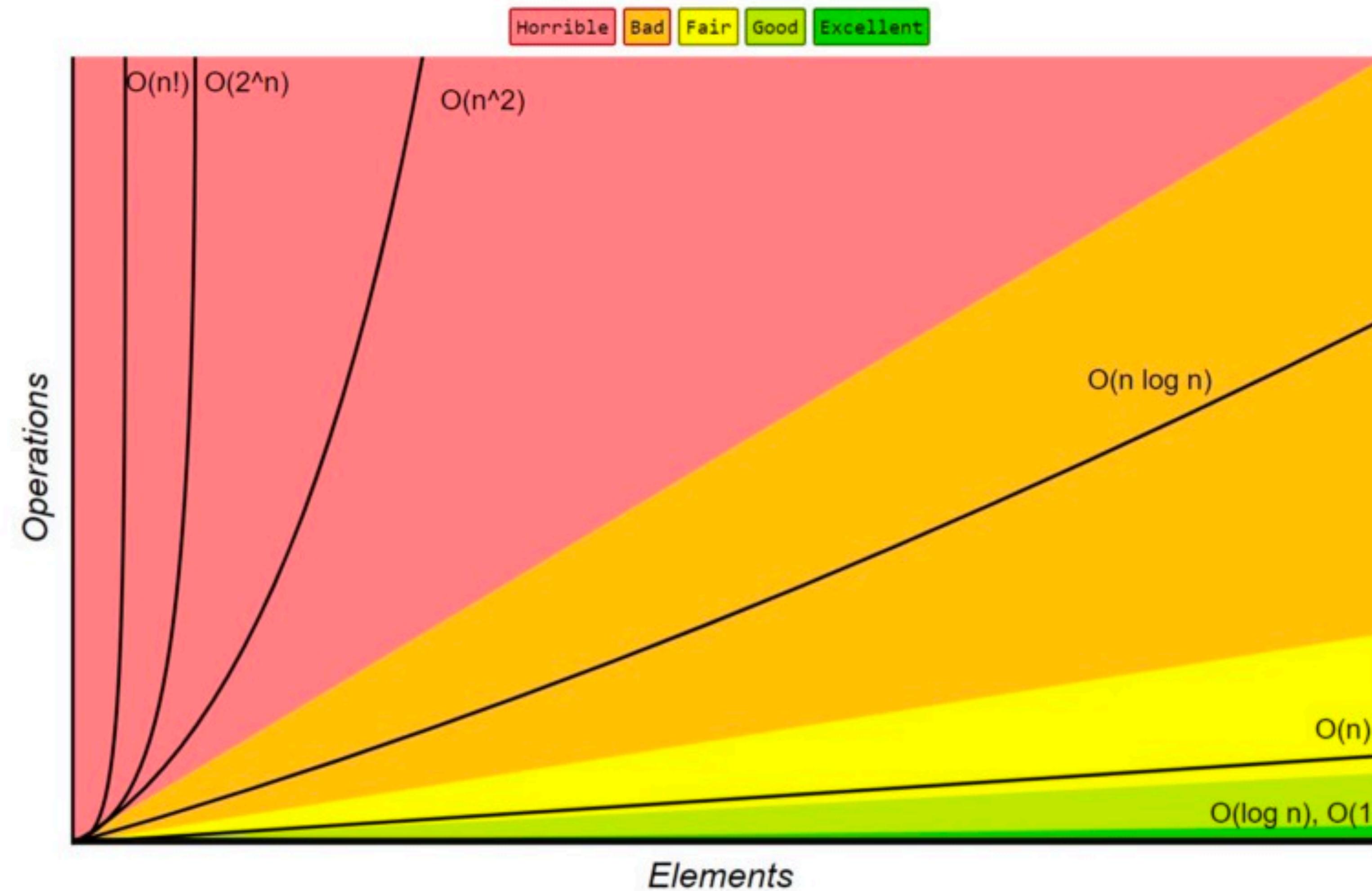
```
{  
  "@context": "/api-contexts/Order",  
  "@id": "/api/orders",  
  "@type": "hydra:Collection",  
  "hydra:totalItems": 3,  
  "hydra:member": [  
    {  
      "@id": "/api/orders/1",  
      "@type": "Order",  
      "id": 1,  
      "orderItems": [  
        "/api/order_items/1",  
        "/api/order_items/2"  
      ]  
    },  
    {  
      "...": "..."  
    }  
  ]  
}
```

Database Queries		Different statements	Query time	Invalid entities
5	3	0.88 ms	0	
#	Time	Info		
#▲	Time			
1	0.20 ms	<code>SELECT count(o0_.id) AS sclr_0 FROM "order" o0_</code>		
		Parameters:		
		[ ]		
		<a href="#">View formatted query</a>	<a href="#">View runnable query</a>	<a href="#">Explain query</a>
		<a href="#">View query backtrace</a>		
2	0.05 ms	<code>SELECT o0_.id AS id_0 FROM "order" o0_ ORDER BY o0_.id ASC LIMIT 30</code>		
		Parameters:		
		[ ]		
		<a href="#">View formatted query</a>	<a href="#">View runnable query</a>	<a href="#">Explain query</a>
		<a href="#">View query backtrace</a>		
3	0.51 ms	<code>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</code>		
		Parameters:		
		[▼]		
		<a href="#">1</a>		
		[ ]		
		<a href="#">View formatted query</a>	<a href="#">View runnable query</a>	<a href="#">Explain query</a>
		<a href="#">View query backtrace</a>		
4	0.07 ms	<code>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</code>		
		Parameters:		
		[▼]		
		<a href="#">2</a>		
		[ ]		
		<a href="#">View formatted query</a>	<a href="#">View runnable query</a>	<a href="#">Explain query</a>
		<a href="#">View query backtrace</a>		
5	0.05 ms	<code>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</code>		
		Parameters:		
		[▼]		
		<a href="#">3</a>		
		[ ]		
		<a href="#">View formatted query</a>	<a href="#">View runnable query</a>	<a href="#">Explain query</a>
		<a href="#">View query backtrace</a>		

Database Queries	Different statements	Query time	Invalid entities
5	3	0.88 ms	0
Queries Database Connections Entity Managers Second Level Cache Entities Mapping			
Group similar statements			
#	Time	Info	
1	0.20 ms	<code>SELECT count(o0_.id) AS sclr_0 FROM "order" o0_</code> Parameters: [] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>	
2	0.05 ms	<code>SELECT o0_.id AS id_0 FROM "order" o0_ ORDER BY o0_.id ASC LIMIT 30</code> Parameters: [] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>	
3	0.51 ms	<code>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</code> Parameters: [ 1 ] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>	
4	0.07 ms	<code>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</code> Parameters: [ 2 ] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>	
5	0.05 ms	<code>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</code> Parameters: [ 3 ] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>	

# O(N)

## Big-O Complexity Chart



# Order list with additional field

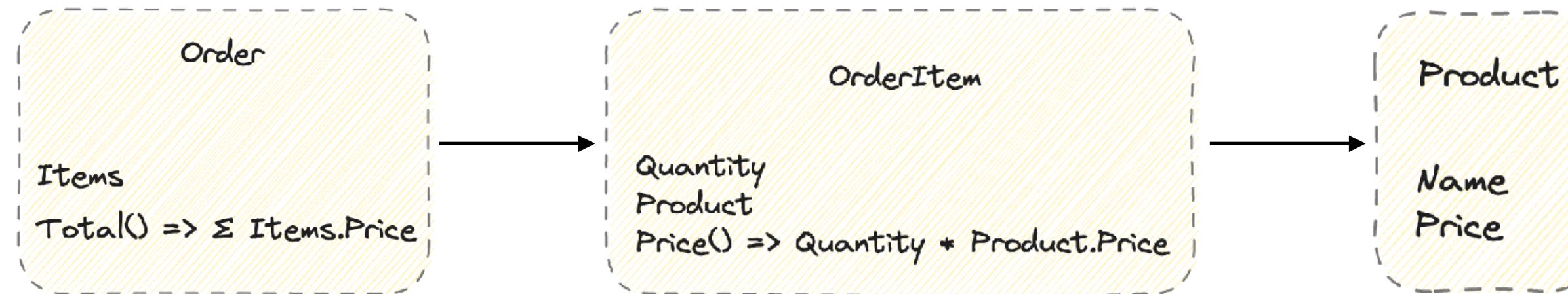
# How many queries are executed here?

Amount of orders: 3

Every order associated with 2 items

Sample query on the left

**Added “total()” as a function of product price and quantity of item**



```
{  
  "@context": "/api-contexts/Order",  
  "@id": "/api/orders",  
  "@type": "hydra:Collection",  
  "hydra:totalItems": 3,  
  "hydra:member": [  
    {  
      "@id": "/api/orders/1",  
      "@type": "Order",  
      "id": 1,  
      "orderItems": [  
        "/api/order_items/1",  
        "/api/order_items/2"  
      ],  
      "total": 7000  
    },  
    {  
      "...": "..."  
    }  
  ]  
}
```

## Query Metrics

Database Queries	Different statements	Query time	Invalid entities
11	4	1.25 ms	0

[Grouped Statements](#) [Database Connections](#) [Entity Managers](#) [Second Level Cache](#) [Entities Mapping](#)

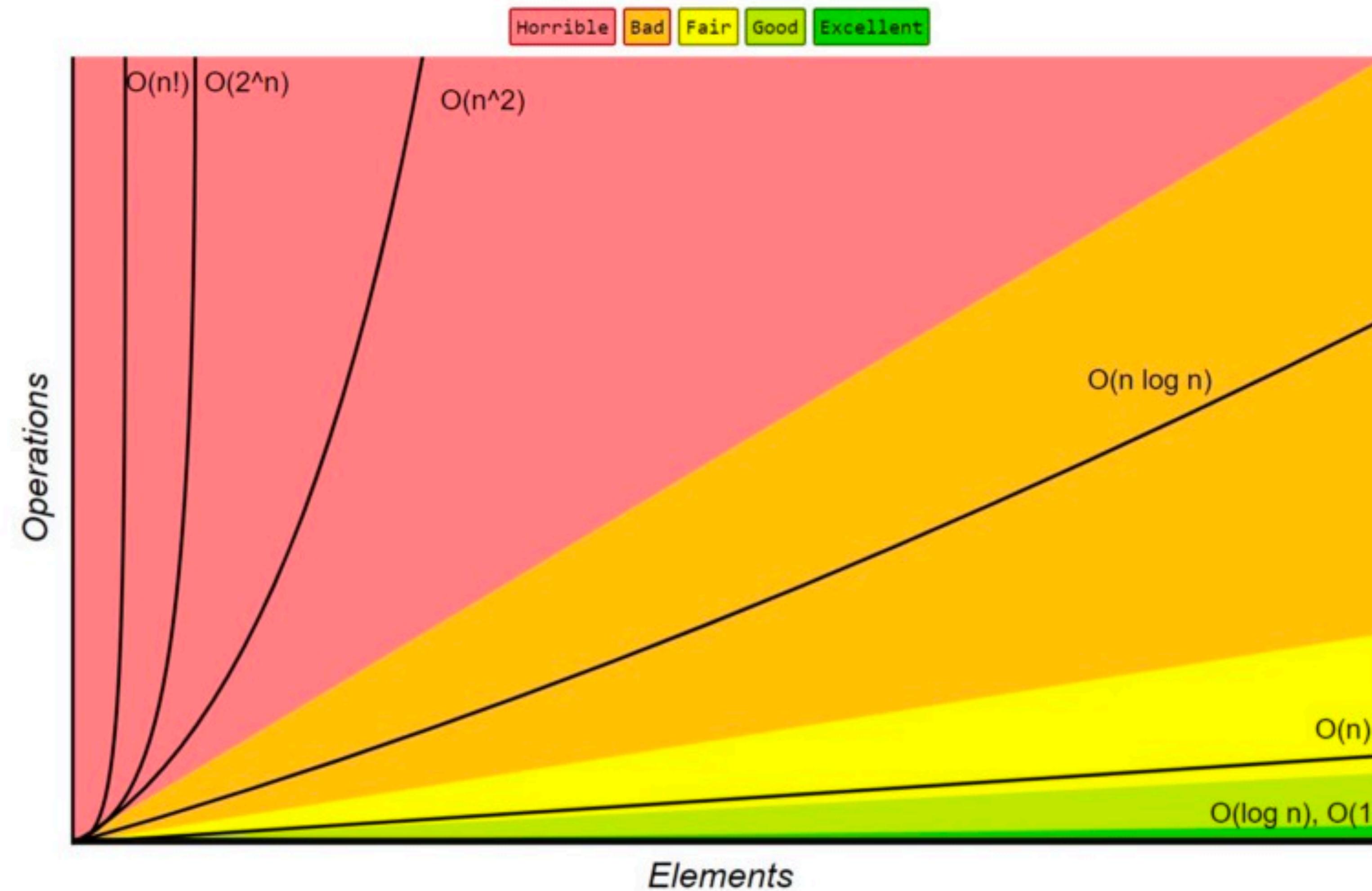
[Show all queries](#)

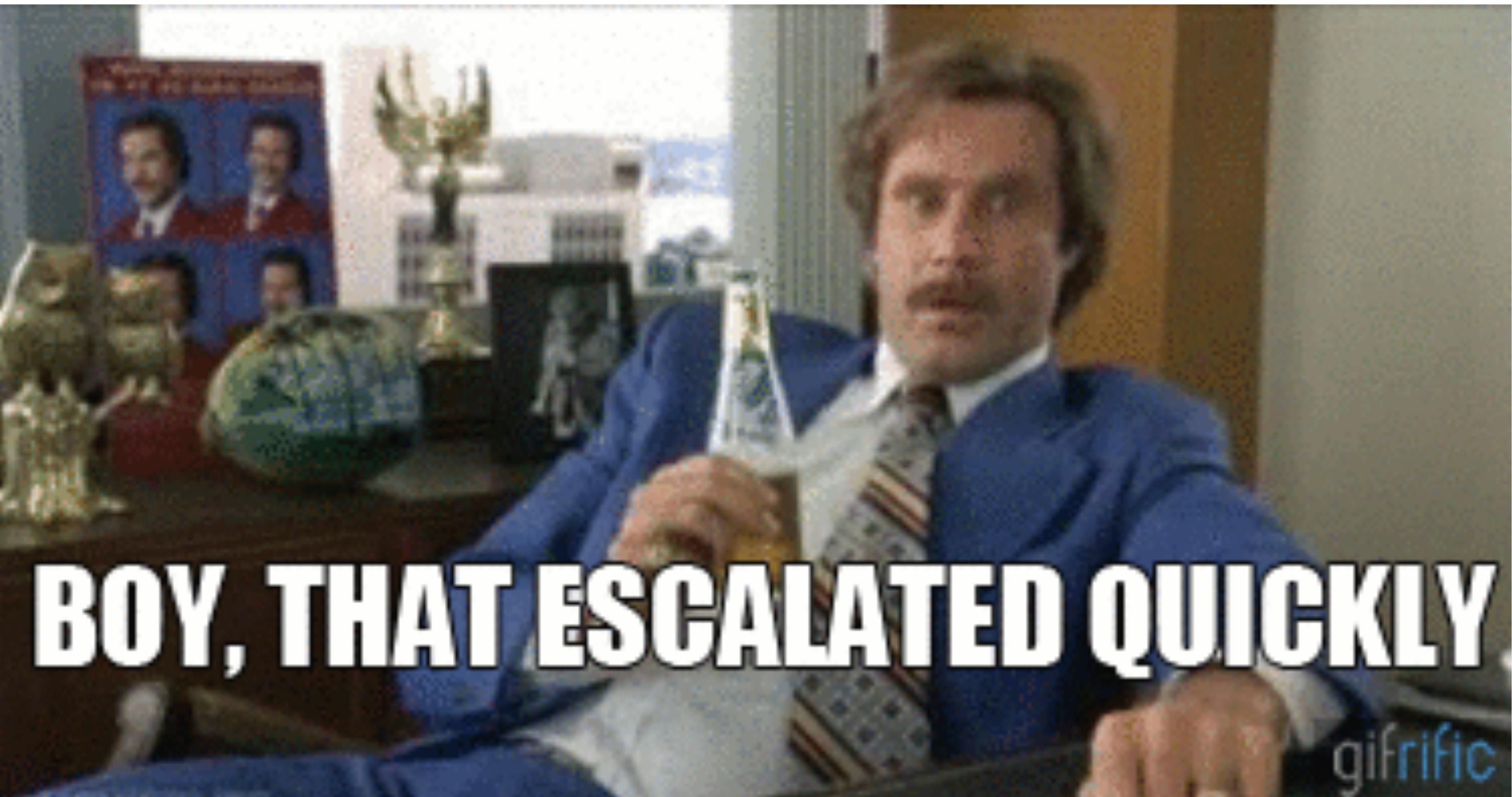
Time▼	Count	Info
0.79 ms (63.51%)	3	<pre>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</pre> <p>Parameters:</p> <p>[▼</p> <p>    1</p> <p>]</p> <p><a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a></p>
0.25 ms (20.28%)	6	<pre>SELECT t0.id AS id_1, t0.name AS name_2, t0.price AS price_3 FROM product t0 WHERE t0.id = ?</pre> <p>Parameters:</p> <p>[▼</p> <p>    1</p> <p>]</p> <p><a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a></p>
0.16 ms (13.00%)	1	<pre>SELECT count(o0_.id) AS sclr_0 FROM "order" o0_</pre> <p>Parameters:</p> <p>[]</p> <p><a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a></p>
0.04 ms (3.21%)	1	<pre>SELECT o0_.id AS id_0 FROM "order" o0_ ORDER BY o0_.id ASC LIMIT 30</pre> <p>Parameters:</p> <p>[]</p> <p><a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a></p>

$O(N*M)$  or  $O(N^2)$



## Big-O Complexity Chart







**Nikola Poša**  
@nikolaposa

...

Throughout my career, the most common issue I encounter and fix in legacy apps is N+1 query problem.

What SQL injection is to security, N+1 query problem is to performance. Unfortunately, the latter is not given enough attention in education, learning resources, interviews, etc.

2:37 pm · 30 Dec 2023 · 1,518 Views

# How to spot it?

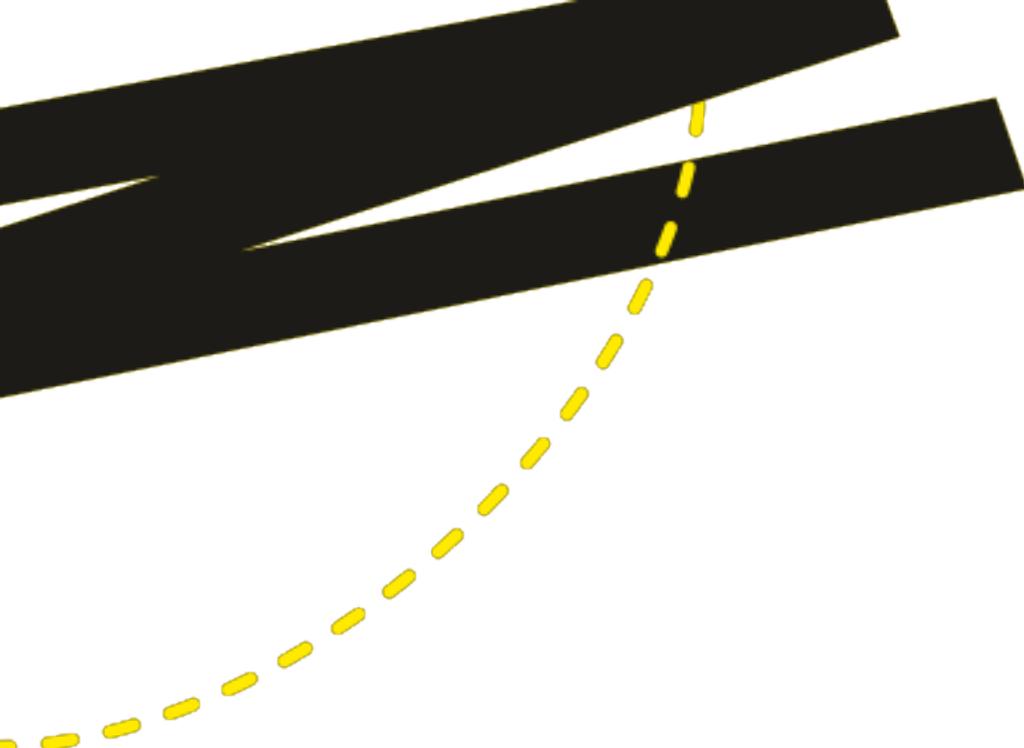
## Query Metrics

Database Queries   Different statements   Query time   Invalid entities  
11                  4                  1.25 ms                  0

[Grouped Statements](#)   [Database Connections](#)   [Entity Managers](#)   [Second Level Cache](#)   [Entities Mapping](#)

[Show all queries](#)

Time▼	Count	Info
0.79 ms (63.51%)	3	<pre>SELECT t0.id AS id_1, t0.quantity AS quantity_2, t0.product_id AS product_id_3, t0.origin_order_id AS origin_order_id_4 FROM order_item t0 WHERE t0.origin_order_id = ?</pre> Parameters: [ 1 ] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>
0.25 ms (20.28%)	6	<pre>SELECT t0.id AS id_1, t0.name AS name_2, t0.price AS price_3 FROM product t0 WHERE t0.id = ?</pre> Parameters: [ 1 ] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>
0.16 ms (13.00%)	1	<pre>SELECT count(o0_.id) AS sclr_0 FROM "order" o0_</pre> Parameters: [] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>
0.04 ms (3.21%)	1	<pre>SELECT o0_.id AS id_0 FROM "order" o0_ ORDER BY o0_.id ASC LIMIT 30</pre> Parameters: [] <a href="#">View formatted query</a> <a href="#">View runnable query</a> <a href="#">Explain query</a> <a href="#">View query backtrace</a>



# How to fix it?

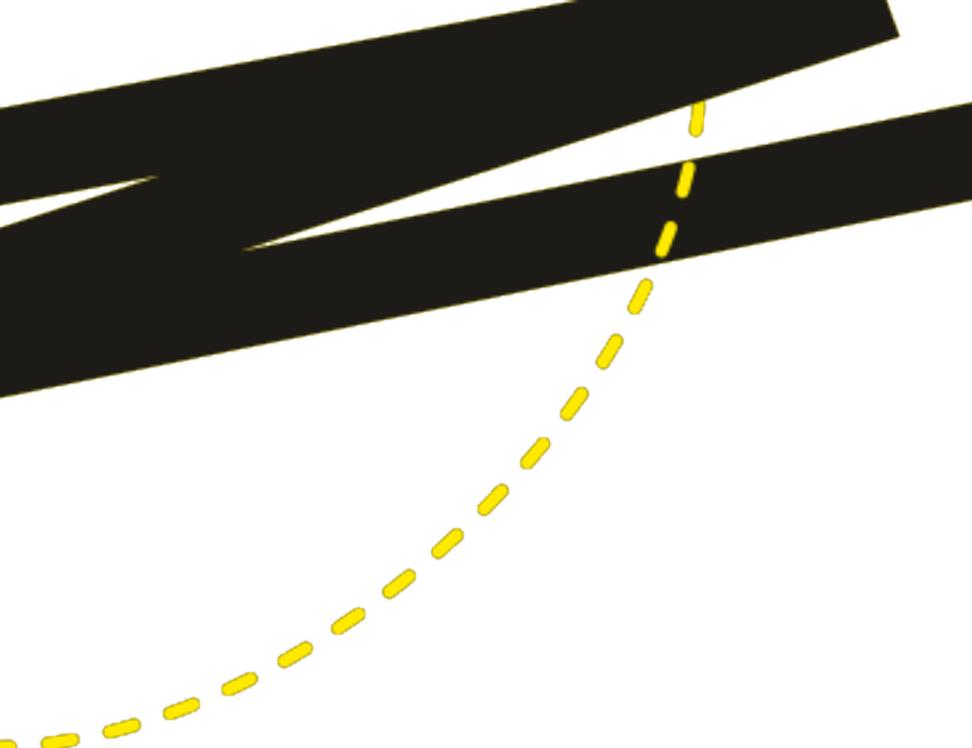
# Upfront data loading

# Eager loading

```
#[ ORM\OneToMany( fetch: 'EAGER' ) ]
```

# Custom query

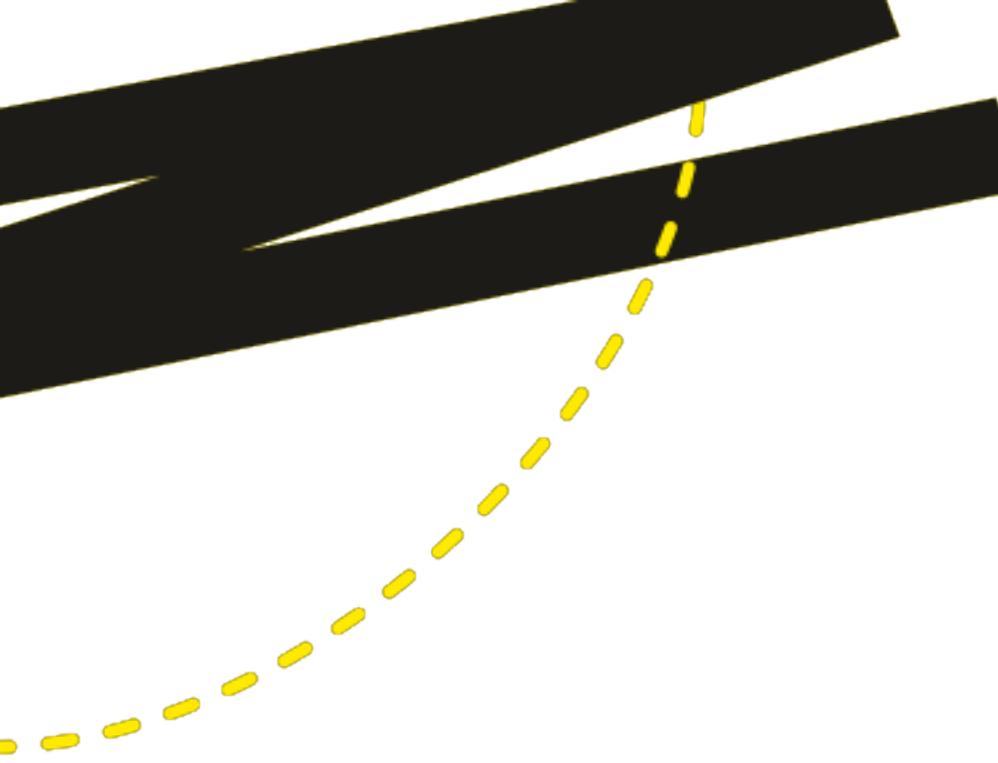
```
final class LoadItemsAndProductsExtension implements QueryCollectionExtensionInterface,  
QueryItemExtensionInterface  
{  
    private function apply(QueryBuilder $queryBuilder): void  
    {  
        $queryBuilder  
            ->addSelect('oi', 'p')  
            ->join(OrderItem::class, 'oi', Join::WITH, 'oi.originOrder = o')  
            ->join(Product::class, 'p', Join::WITH, 'oi.product = p')  
    ;  
    }  
}
```



# So is single query an ultimate solution?



! Not so fast !



# Joins are expensive 💰

# Serialisation

# Problem vectors

Process of  
serialisation

Size of data

# Process of serialisation

# Serialisation process oversimplified

# Application

```
[  
  'id' => 1,  
  'name' => 'T-Shirt',  
  'price' => '1000'  
]
```

Database

# Application

```
[  
  'id' => 1,  
  'name' => 'T-Shirt',  
  'price' => '1000'  
]
```

Database

Hydration 

`new Product()`

# Application

```
[  
  'id' => 1,  
  'name' => 'T-Shirt',  
  'price' => '1000'  
]
```

Database

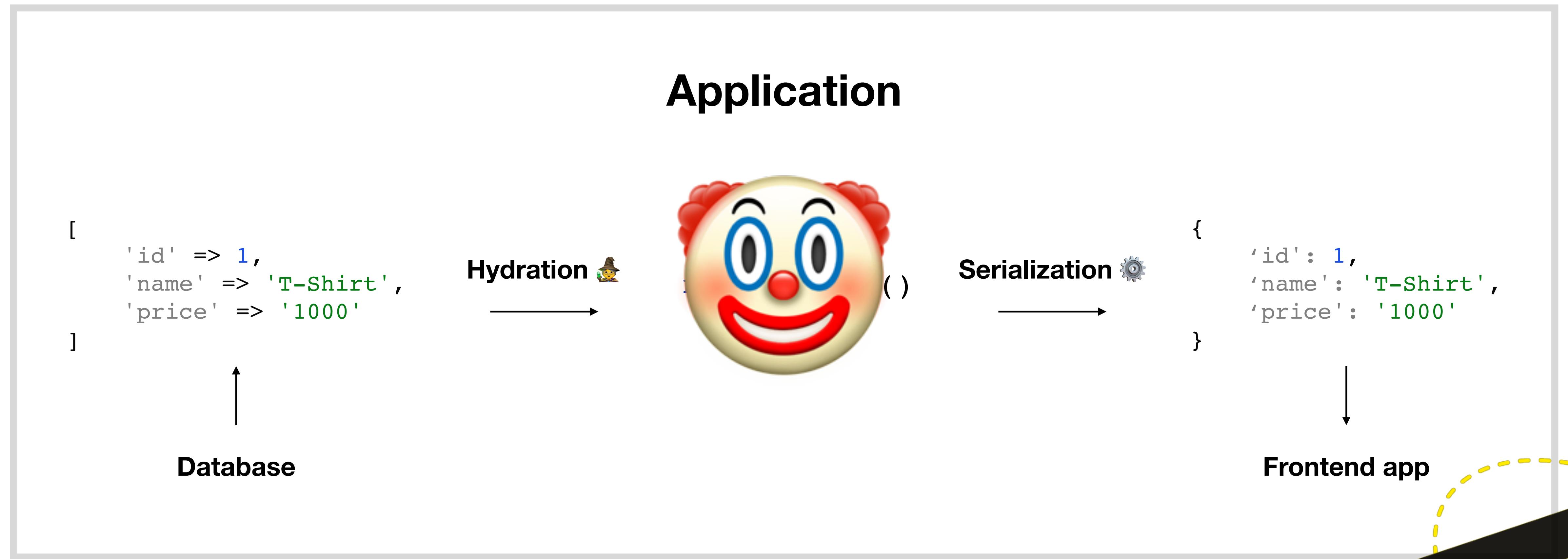
Hydration 

`new Product()`

Serialization 

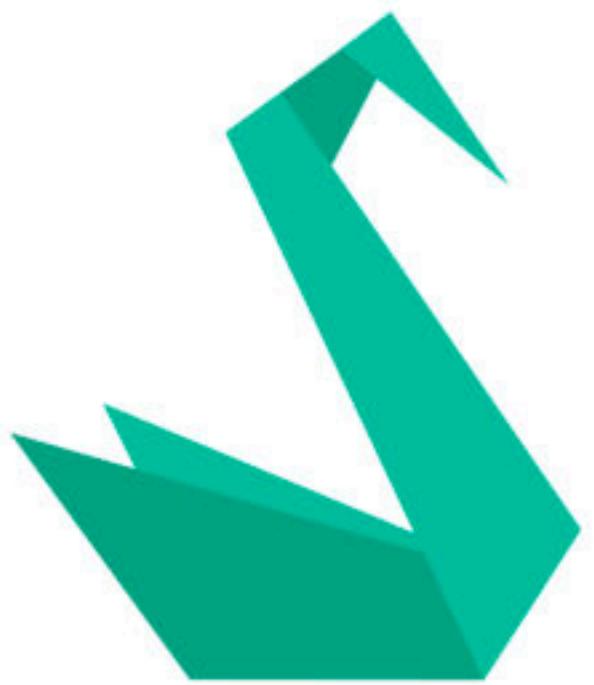
```
{  
  'id': 1,  
  'name': 'T-Shirt',  
  'price': '1000'  
}
```

Frontend app



# Full stack vs API

# Solution - Pre-computing



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 commerce  
weavers

**master.demo.sylius.com/en\_US/cart/**

Sign up to our newsletter and grab -20% off

Login Register

\$65.18, 1 item

**Sylius**

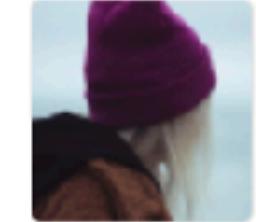
T-shirts Caps Dresses Jeans

**Success**  
Item has been added to cart

**Your shopping cart**

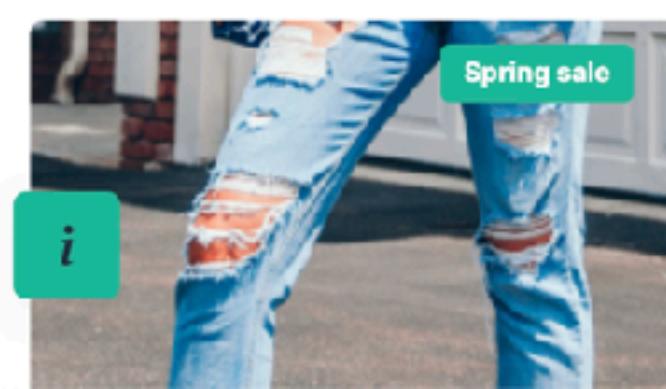
Edit your items, apply coupon or proceed to the checkout

**Clear cart**

Item	Unit price	Qty	Total	Summary
 <b>Cashmere-blend violet beanie</b> Cashmere_blend_violet_beanie-variant-0	\$65.18	<input type="button" value="−"/> <input checked="" type="button" value="X"/> <input type="button" value="+"/>	<b>\$65.18</b>	Items total: \$65.18 Estimated shipping cost: \$3.59 Taxes total: \$0.00 <b>Order total: \$68.77</b>

Enter your code...

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**commerce weavers**

**master.demo.sylius.com/en\_US/cart/**

**Sylius**

**Your shopping cart**

**Success**  
Item has been added to cart

**Your shopping cart**

Edit your items, apply coupon or proceed to the checkout

**Clear cart**

**Order total: \$68.77**

**Checkout**

**PayPal Checkout**

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**commerce weavers**

**Edit product**  
Manage your product catalog

Administration > Products > Cashmere-blend violet beanie > Edit

**Details**

**Taxonomy**

**Attributes**

**Associations**

**Media**

**Inventory**

**Code\***  
Cashmere\_blend\_violet\_beanie

**Enabled**

**Is shipping required?**

**Channels\***  
Fashion Web Store

**Pricing**

**Fashion Web Store**

**Price**  
\$ 65.18

**Original price**  
\$

**Minimum price**  
\$ 0.00

**English (United States)**

**Name\***  
Cashmere-blend violet beanie

**Slug\***  
cashmere-blend-violet-beanie

**Description**

Search products...

Get support John

Your shopping cart | Fashion W X

Sign up to our newsletter and grab -20% off

Login Register

\$ 65.18, 1 item

Items total: \$68.77

Estimated shipping cost: \$3.59

Taxes total: \$0.00

Order total: \$68.77

Checkout

PayPal Checkout

You may also like >

i Spring sale

Commerce weavers

Thu 21 Sep 11:49

History Bookmarks Profiles Tab Window Help

Edit product

master.demo.sylius.com/admin/products/104838/edit

View your store Search products... Get support John

## Edit product

Manage your product catalog

Administration > Products > Cashmere-blend violet beanie > Edit

Details

Taxonomy

Attributes

Associations

Media

Inventory

Details

Code: Cashmere\_blend\_violet\_beanie

Channels:  Fashion Web Store

Enabled:

Is shipping required?:

Pricing

Fashion Web Store

Price: \$ 65.18

Original price: \$

Minimum price: \$ 0.00

English (United States)

Name: Cashmere-blend violet beanie

Slug: cashmere-blend-violet-beanie

Description:

Your shopping cart | Fashion W X

master.demo.sylius.com/en\_US/cart/

Sign up to our newsletter and grab -20% off

Login Register

\$65.18, 1 item

# Sylius

T-shirts Caps Dresses Jeans

Success Item has been added to cart

## Your shopping cart

Edit your items, apply coupon or proceed to the checkout

Clear cart

Item	Unit price	Qty	Total	Summary
 Cashmere-blend violet beanie Cashmere_blend_violet_beanie-variant-0	\$65.18	<input type="button" value="+"/> <input type="button" value="X"/>	<b>\$65.18</b>	Items total: \$65.18
				Estimated shipping cost: \$3.59
				Taxes total: \$0.00

Order total: **\$68.77**

Checkout

You may also like >

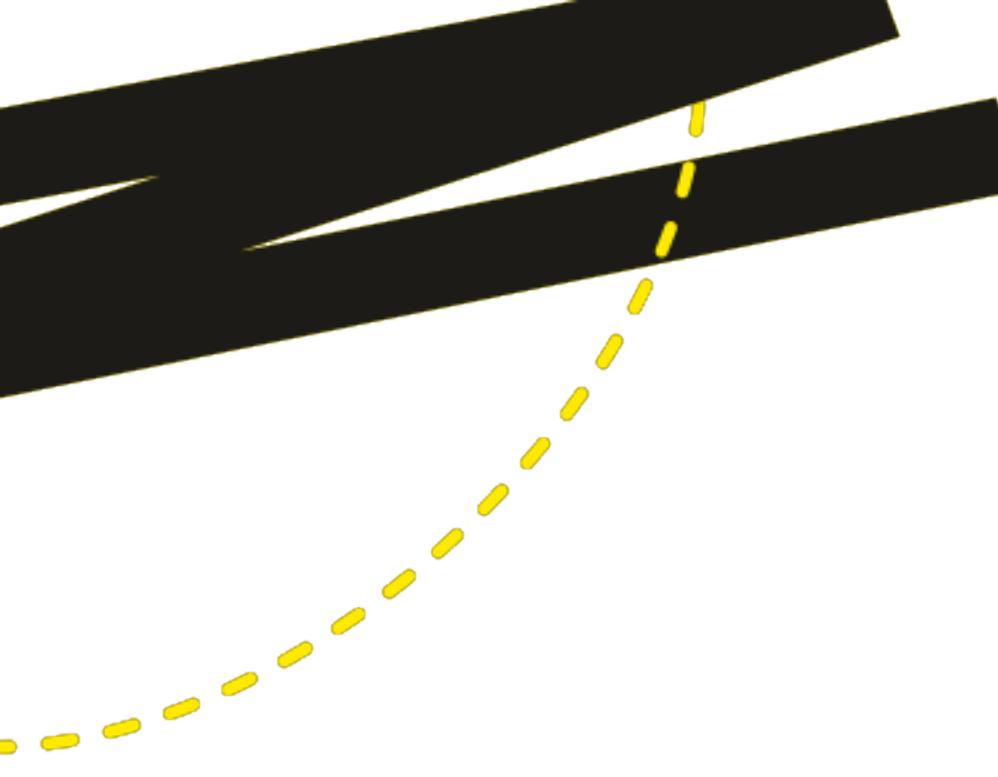


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# Saving serialised objects

View models doesn't have to  
be models 😱

- 
- 
1. Store read models in **key-value storage**
  2. Restore it by indexed key

# Size of data

# Entity lifecycle oversimplified

# Order

## 1. Cart

```
{  
  "items": [  
    {  
      "productName": "Mug",  
      "quantity": 3,  
    }  
  ]  
}
```

# Order

1. Cart
2. Product details

```
{  
    "items": [  
        {  
            "variant": "\/api\/v2\/admin\/product-variants\/MU  
            "productName": "Mug",  
            "id": @integer@,  
            "quantity": 3,  
            "unitPrice": 2000,  
            "originalUnitPrice": 2000,  
            "total": 6000,  
            "units": [  
                "\/api\/v2\/admin\/order-item-units\/@integer@  
                "\/api\/v2\/admin\/order-item-units\/@integer@  
                "\/api\/v2\/admin\/order-item-units\/@integer@  
            ],  
            "fullDiscountedUnitPrice": 2000,  
            "subtotal": 6000  
        }  
    ]  
}
```

# Order

1. Cart
2. Product details
3. Address

```
{  
    "shippingAddress": {  
        "@id": "\/api\/v2\/admin\/addresses\/@integer@",  
        "@type": "Address",  
        "firstName": "John",  
        "lastName": "Doe",  
        "countryCode": "US",  
        "street": "Avenue",  
        "city": "New York",  
        "postcode": "90000"  
    },  
    "billingAddress": {  
        "@id": "\/api\/v2\/admin\/addresses\/@integer@",  
        "@type": "Address",  
        "firstName": "John",  
        "lastName": "Doe",  
        "countryCode": "US",  
        "street": "Avenue",  
        "city": "New York",  
        "postcode": "90000"  
    },  
    "items": [  
        {  
            "productName": "Mug"  
        }  
    ]  
}
```

# Order

1. Cart
2. Product details
3. Address
4. Payments

```
{  
  "payments": [  
    {  
      "@id": "\/api\/v2\/admin\/payments\/@integer@",  
      "@type": "Payment",  
      "id": @integer@,  
      "method": "\/api\/v2\/admin\/payment-methods\/CASH"  
    }  
  ],  
  "shippingAddress": {  
    "@id": "\/api\/v2\/admin\/addresses\/@integer@",  
    "@type": "Address",  
    "firstName": "John",  
    "lastName": "Doe",  
    "countryCode": "US",  
    "street": "Avenue",  
    "city": "New York",  
    "postcode": "90000"  
  },  
  "billingAddress": {  
    "@id": "\/api\/v2\/admin\/addresses\/@integer@",  
    "@type": "Address",  
    "firstName": "John",  
    "lastName": "Doe",  
    "street": "Avenue",  
    "city": "New York",  
    "countryCode": "US",  
    "postcode": "90000"  
  }  
}
```

# Order

1. Cart
2. Product details
3. Address
4. Payments
5. Shipments

```
{  
  "shipments": [  
    {  
      "@id": "\/api\/v2\/admin\/shipments\/@integer@",  
      "@type": "Shipment",  
      "id": @integer@,  
      "method": "\/api\/v2\/admin\/shipping-methods\/UPS"  
    }  
  ],  
  "payments": [  
    {  
      "@id": "\/api\/v2\/admin\/payments\/@integer@",  
      "@type": "Payment",  
      "id": @integer@,  
      "method": "\/api\/v2\/admin\/payment-methods\/CASH"  
    }  
  ],  
  "shippingAddress": {  
    "@id": "\/api\/v2\/admin\/addresses\/@integer@",  
    "@type": "Address",  
    "firstName": "John",  
    "lastName": "Doe",  
    "countryCode": "US",  
    "street": "Avenue",  
    "city": "Montreal",  
    "state": "QC",  
    "zip": "H3A 1A1",  
    "phone": "(514) 123-4567",  
    "email": "john.doe@example.com",  
    "notes": "Special instructions for delivery"  
  }  
}
```

# Order

1. Cart
2. Product details
3. Address
4. Payments
5. Shipments
6. Available shippings
7. Available payments
8. Product categories
9. Images
- 10....

```
{  
  "shipments": [  
    {  
      "@id": "\/api\/v2\/admin\/shipments\/@integer@",  
      "@type": "Shipment",  
      "id": @integer@,  
      "method": "\/api\/v2\/admin\/shipping-methods\/UPS"  
    }  
  ],  
  "payments": [  
    {  
      "@id": "\/api\/v2\/admin\/payments\/@integer@",  
      "@type": "Payment",  
      "id": @integer@,  
      "method": "\/api\/v2\/admin\/payment-methods\/CASH"  
    }  
  ],  
  "shippingAddress": {  
    "@id": "\/api\/v2\/admin\/addresses\/@integer@",  
    "@type": "Address",  
    "firstName": "John",  
    "lastName": "Doe",  
    "countryCode": "US",  
    "street": "Avenue",  
    "city": "Montreal",  
    "state": "QC",  
    "zip": "H3A 1A1",  
    "phone": "514-123-4567",  
    "email": "john.doe@example.com",  
    "notes": "Special instructions for delivery"  
  }  
}
```

# Order

1. Cart
2. Product details
3. Address
4. Payments
5. Shipments
6. Available shippings
7. Available payments
8. Product categories
9. Images
- 10....

# Performance



```
{  
  "shipments": [  
    {  
      "@id": "\/api\/v2\/admin\/shipments\/@integer@",  
      "@type": "Shipment",  
      "id": @integer@,  
      "method": "\/api\/v2\/admin\/payment-methods\/UPS"  
    },  
    {  
      "@id": "\/api\/v2\/admin\/payments\/@integer@",  
      "@type": "Payment",  
      "id": @integer@,  
      "method": "\/api\/v2\/admin\/payment-methods\/CASH"  
    }  
  "shippingAddress": {  
    "@id": "\/api\/v2\/admin\/addresses\/@integer@",  
    "@type": "Address",  
    "firstName": "John",  
    "lastName": "Doe",  
    "countryCode": "US",  
    "street": "Avenue",  
    "city": "Montreal",  
    "state": "QC",  
    "zip": "H3A 1A1",  
    "phone": "(514) 555-1234",  
    "email": "john.doe@example.com",  
    "notes": "Special instructions: Please hold package until I arrive."  
  }  
}
```

# Order

1. Cart

2. Product details

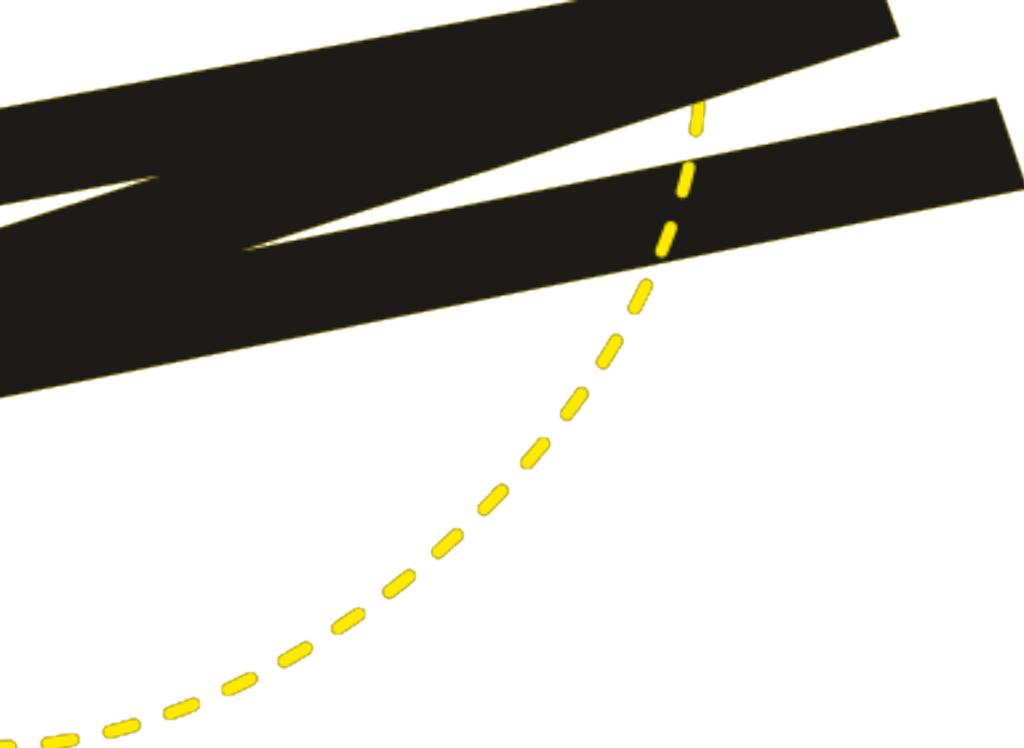
## Query Metrics

**Database Queries**  
**3420**

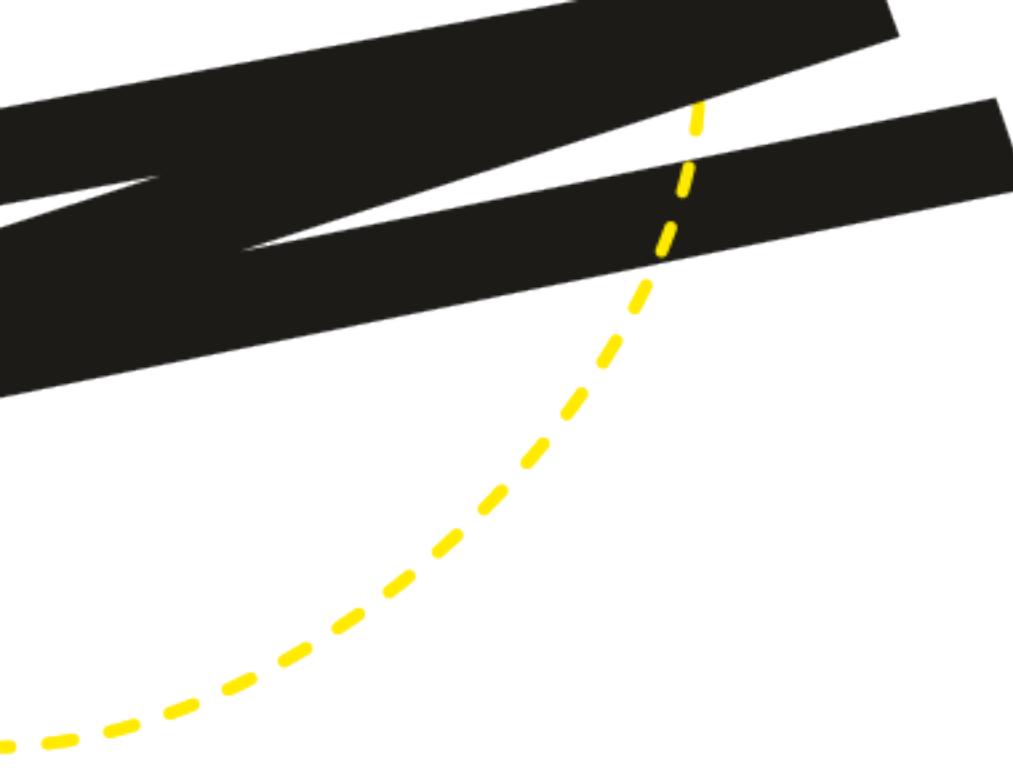
**Different statements**  
**34**

**Query time**  
**2570.53 ms**

**Invalid entities**  
**0**



# Size do matter



**“BUT I NEED ALL THAT DATA 😡”**

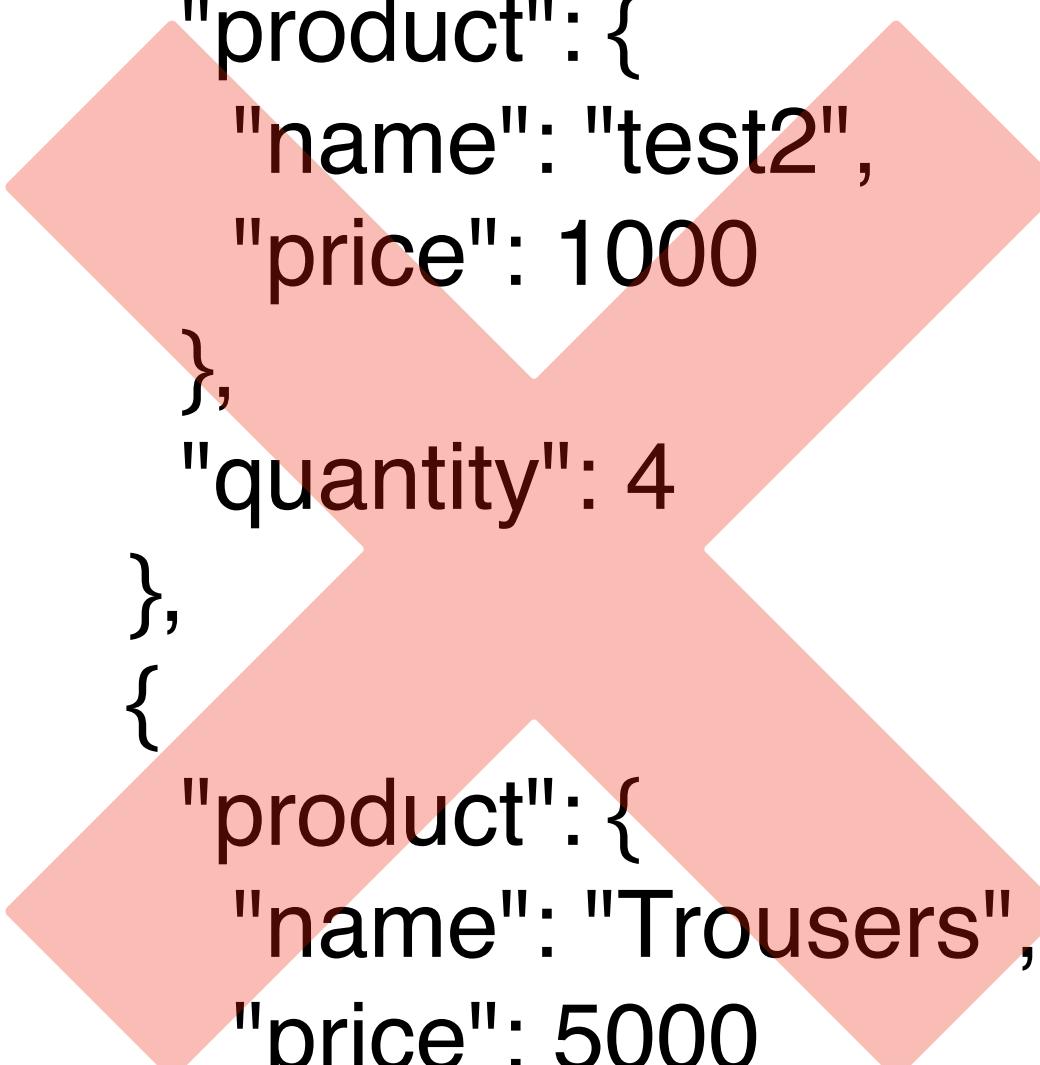
*-ANGRY DEVELOPER*

Do you? 🤔

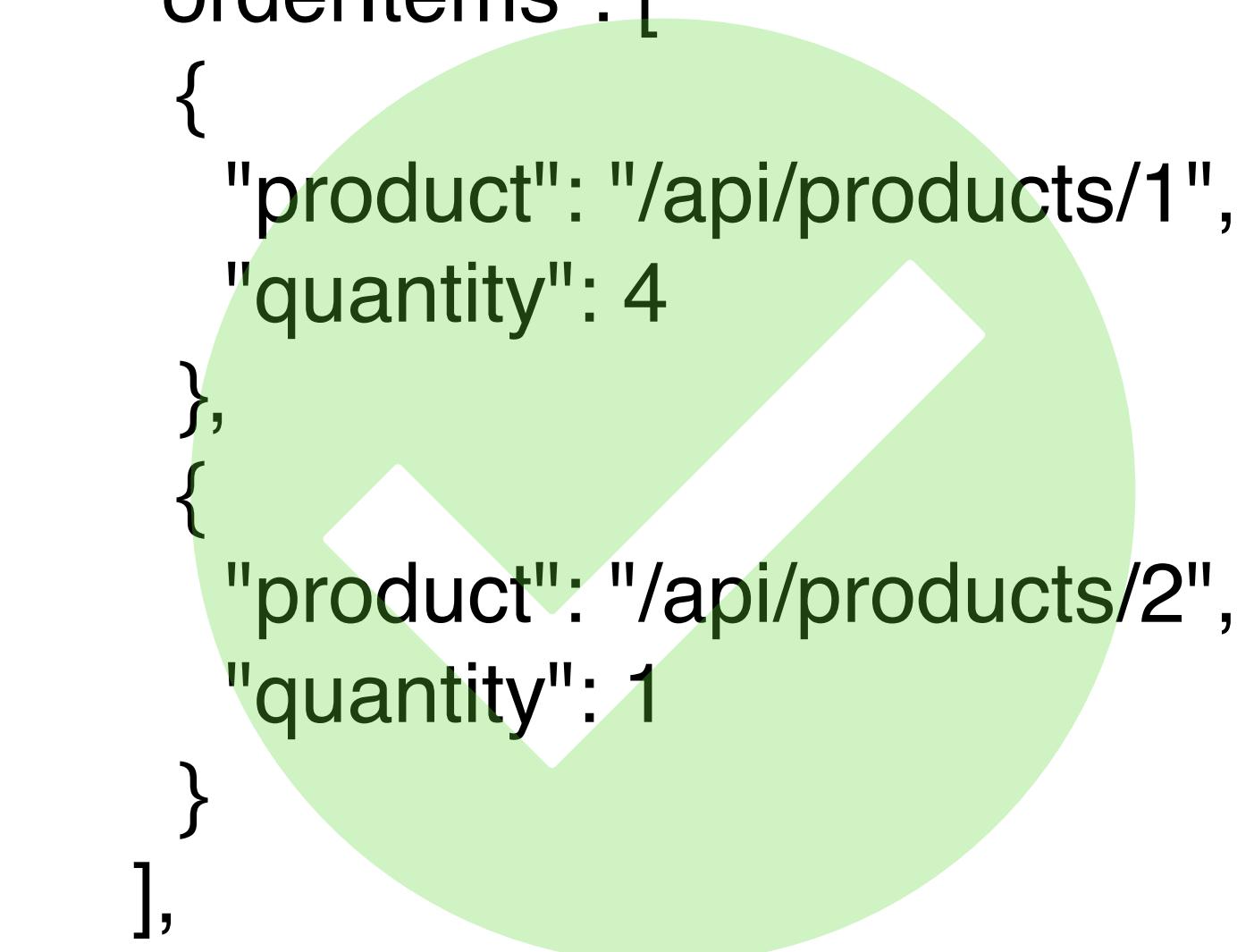
# Solution - split data

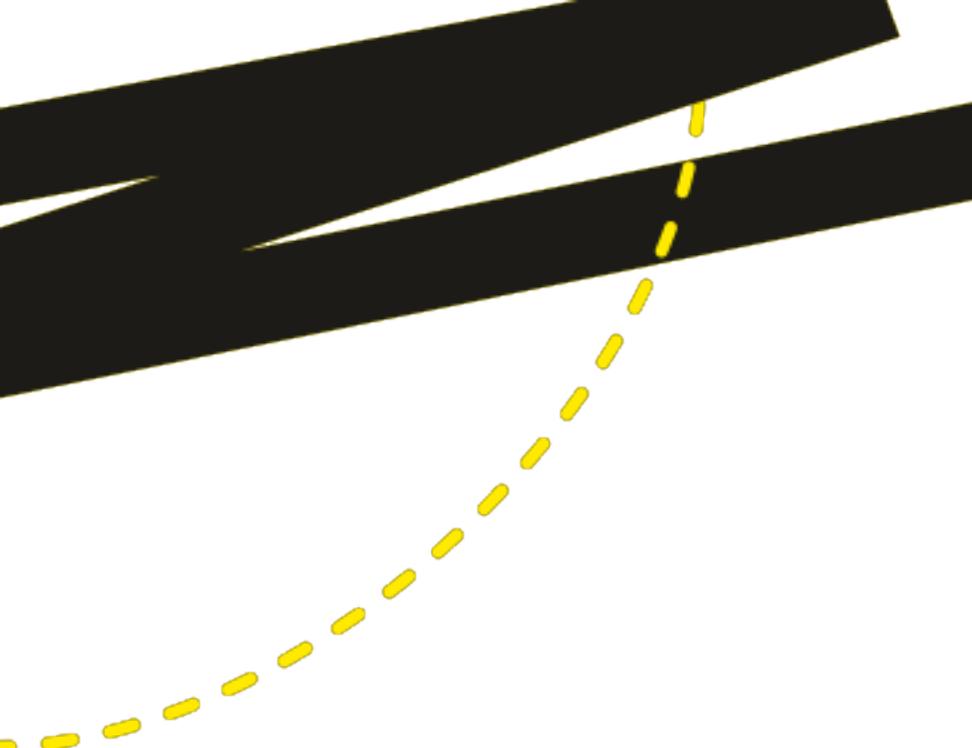
# Atomic objects (Edge Side API)

```
{  
  "orderItems": [  
    {  
      "product": {  
        "name": "test2",  
        "price": 1000  
      },  
      "quantity": 4  
    },  
    {  
      "product": {  
        "name": "Trouzers",  
        "price": 5000  
      },  
      "quantity": 1  
    }  
  ],  
  "total": 9000
```



```
{  
  "orderItems": [  
    {  
      "product": "/api/products/1",  
      "quantity": 4  
    },  
    {  
      "product": "/api/products/2",  
      "quantity": 1  
    }  
  ],  
  "total": 9000
```





# Do you need it all the time? 🤔



# Solution - more variations

# Property filtration

?properties[]=<property>&properties[<relation>][]=<property>

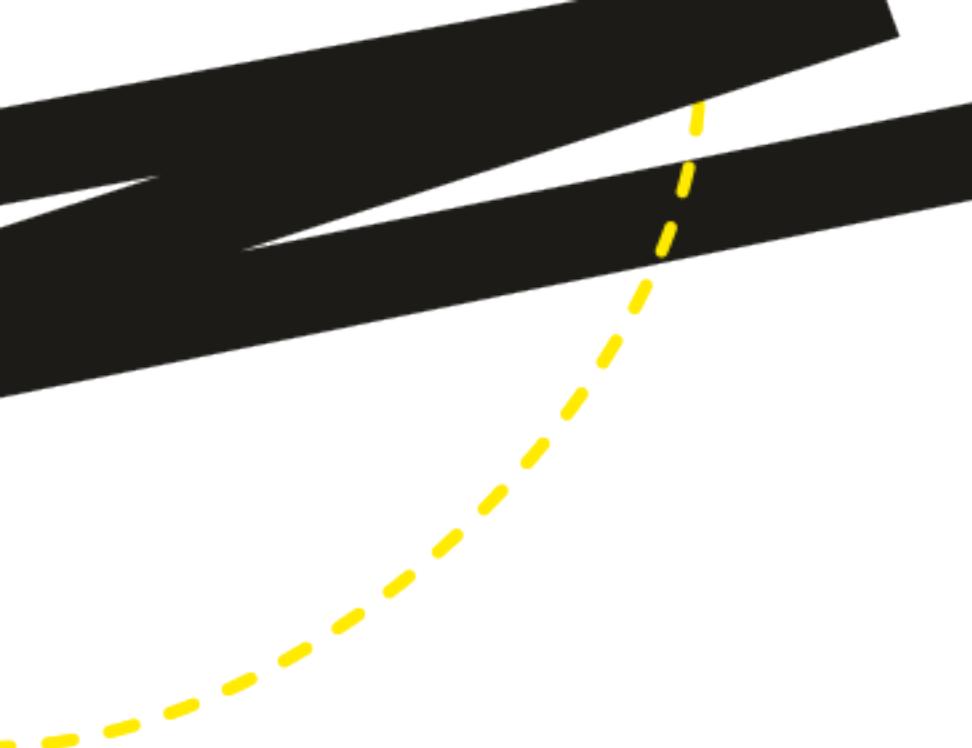
# Property filtration

## GraphQL

# Property filtration

## GraphQL

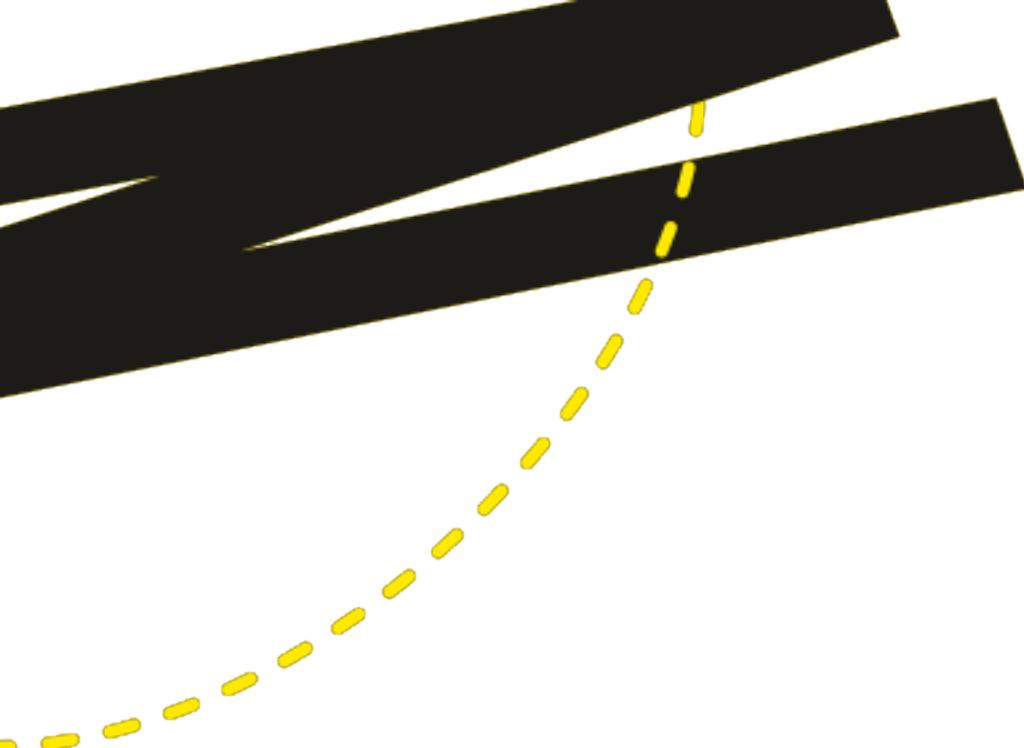
### Vary header



“The **Vary** HTTP response header describes the parts of the request message aside from the method and URL that influenced the content of the response it occurs in. Most often, this is used to create a cache key when content negotiation is in use.”

*-mdm web docs*

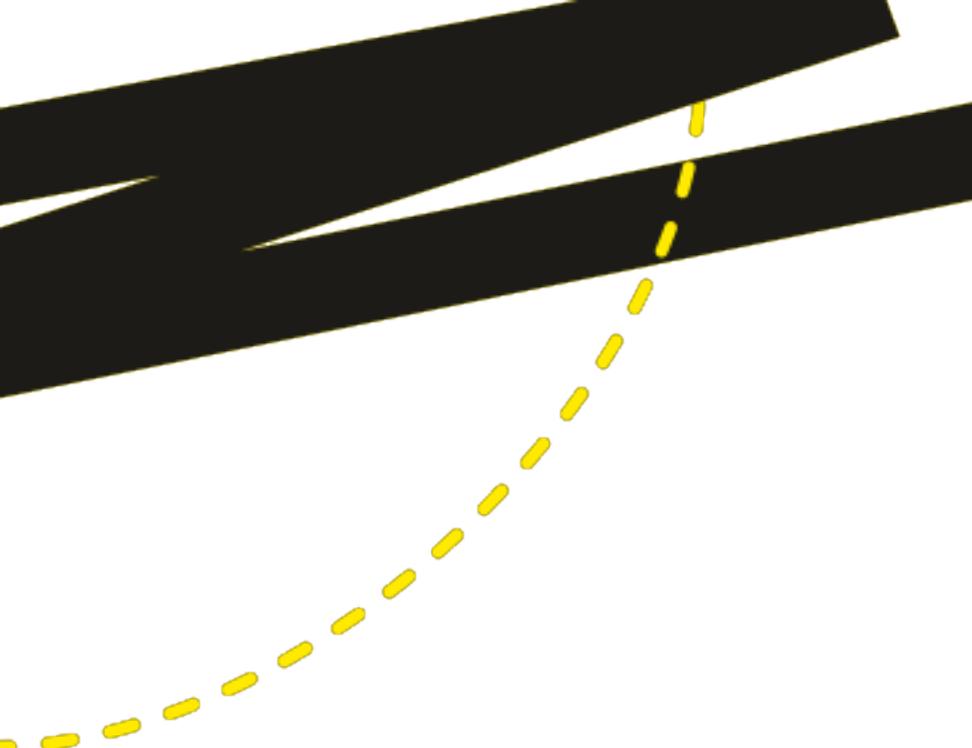
# Summary



# Measure, measure, measure...



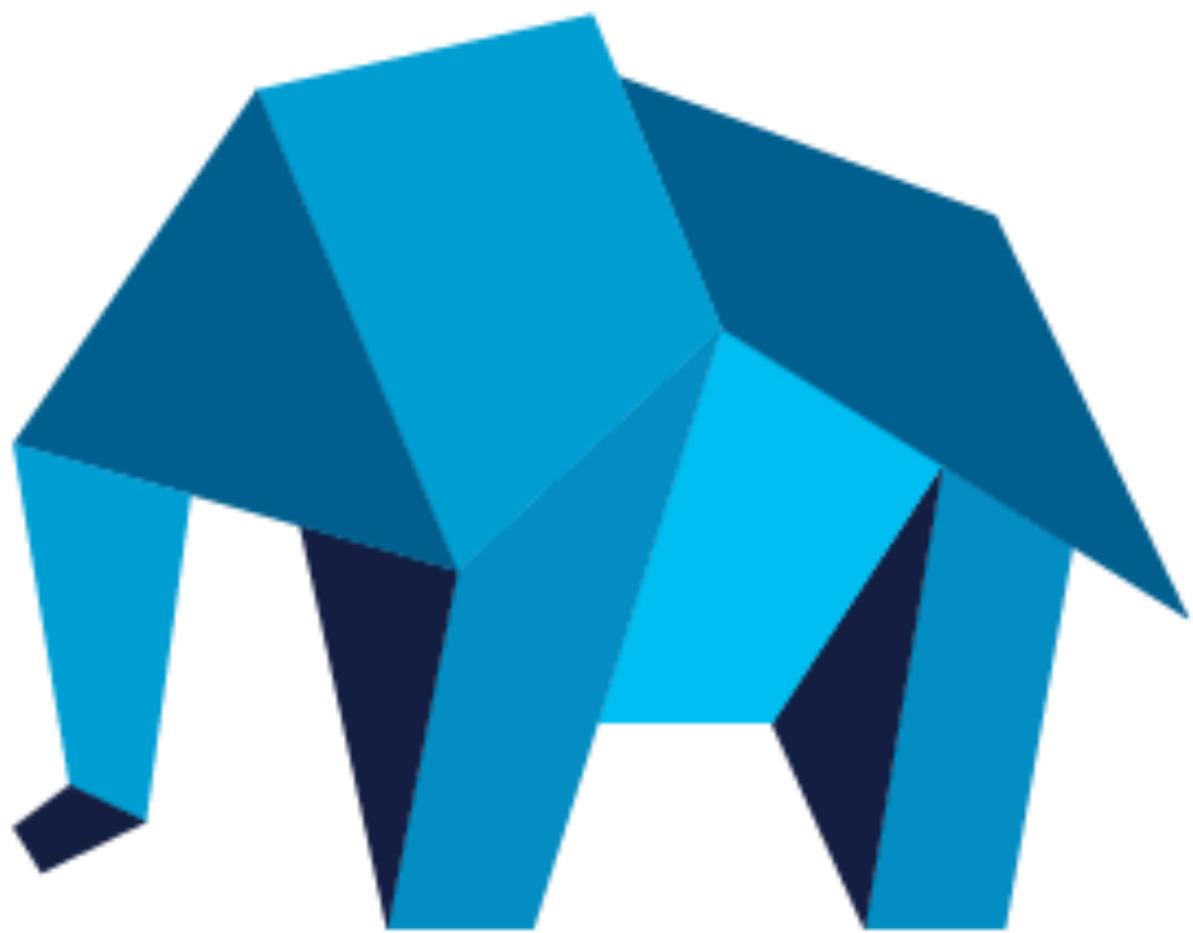
Top Gun: Maverick



**Remember about algorithmic complexity of your queries**

**Do not hydrate too much data**

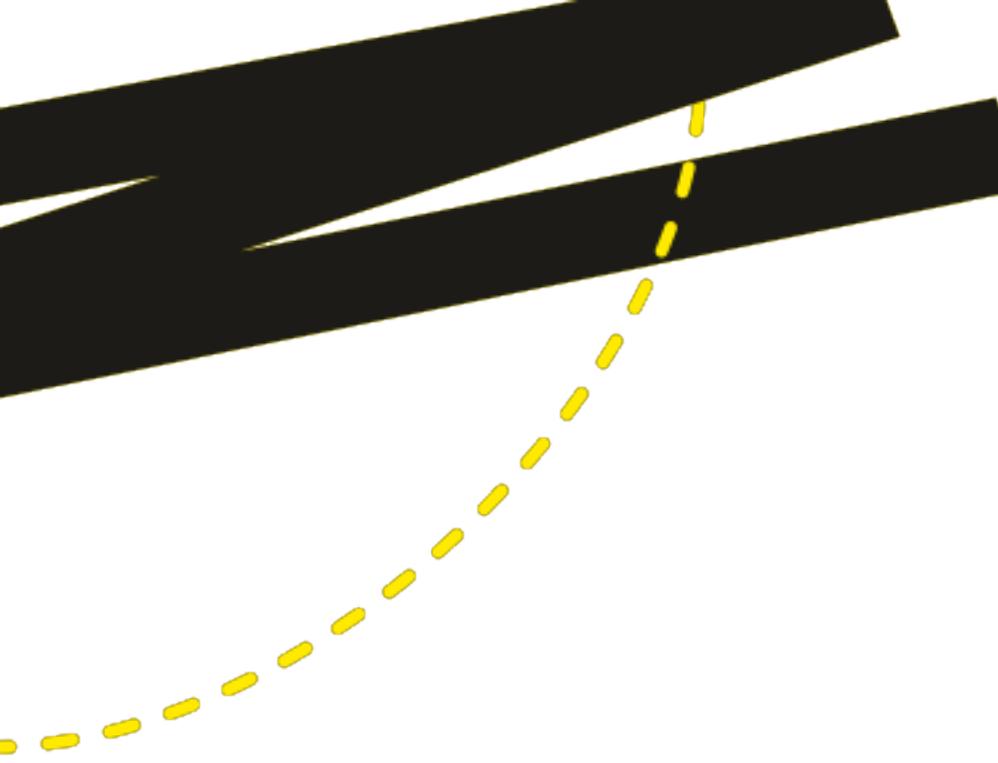
**Think out-of-the box of your “entities”**



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**2024**

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 commerce  
weavers



# Thank you!