

NILS HARTMANN

GraphQL

für Java-Entwickler

Slides: <https://bit.ly/javaland-graphql>

JAVALAND, BRÜHL | MÄRZ 2019 | @NILSHARTMANN

NILS HARTMANN

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Java
JavaScript, TypeScript
React

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@NILSHARTMANN

*"GraphQL is a **query language for APIs** and a **runtime for fulfilling those queries** with your existing data"*

- <https://graphql.org>

GraphQL

Spezifikation: <https://facebook.github.io/graphql/>

- 2015 von Facebook erstmals veröffentlicht
- Weitere Entwicklung seit 2018 in GraphQL Foundation
- Query Sprache und -Ausführung
- Schema Definition Language
- Nicht: Implementierung
 - Referenz-Implementierung: graphql-js

GraphQL != SQL

- kein SQL, keine "vollständige" Query-Sprache
 - z.B. keine Sortierung, keine (beliebigen) Joins etc
- keine Datenbank!
- kein Framework!

GraphQL != Mainstream

- Implementierungen und Einsatz noch "bleeding edge"
- Wenig erprobte Best-Practices

GraphQL != Mainstream

- Implementierungen und Einsatz noch "bleeding edge"
- Wenig erprobte Best-Practices
- ...dennoch wird es von einigen verwendet!



GitHub

@github

Folge ich



Announcing GitHub Marketplace and the official releases of GitHub Apps and our GraphQL API

Original (Englisch) übersetzen

GitHub

GitHub

GitHub is where people build software. More than 23 million people use GitHub to discover, fork, and contribute to over 64 million projects.

github.com

11:46 - 22. Mai 2017

<https://twitter.com/github/status/866590967314472960>

GITHUB

Sicher | https://docs.atlassian.com/atlassian-confluence/1000.18...

OVERVIEW PACKAGE CLASS USE TREE DEPRECATED INDEX HELP

PREV PACKAGE NEXT PACKAGE FRAMES NO FRAMES ALL CLASSES

Package com.atlassian.confluence.plugins.graphql.resource

Class Summary

Class	Description
ConfluenceGraphQLRestEndpoint	Provides the REST API endpoint for GraphQL.
GraphResource	REST API for GraphQL. ←



OVERVIEW PACKAGE CLASS USE TREE DEPRECATED INDEX HELP

PREV PACKAGE NEXT PACKAGE FRAMES NO FRAMES ALL CLASSES

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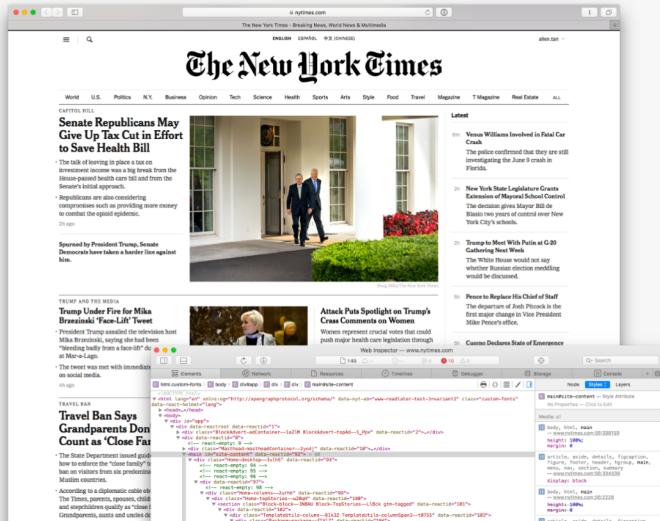
<https://docs.atlassian.com/atlassian-confluence/1000.1829.0/overview-summary.html>



Scott Taylor [Follow](#)

Musician. Sr. Software Engineer at the New York Times. WordPress core committer. Married to Allie. Jun 29 · 5 min read

React, Relay and GraphQL: Under the Hood of the Times Website Redesign

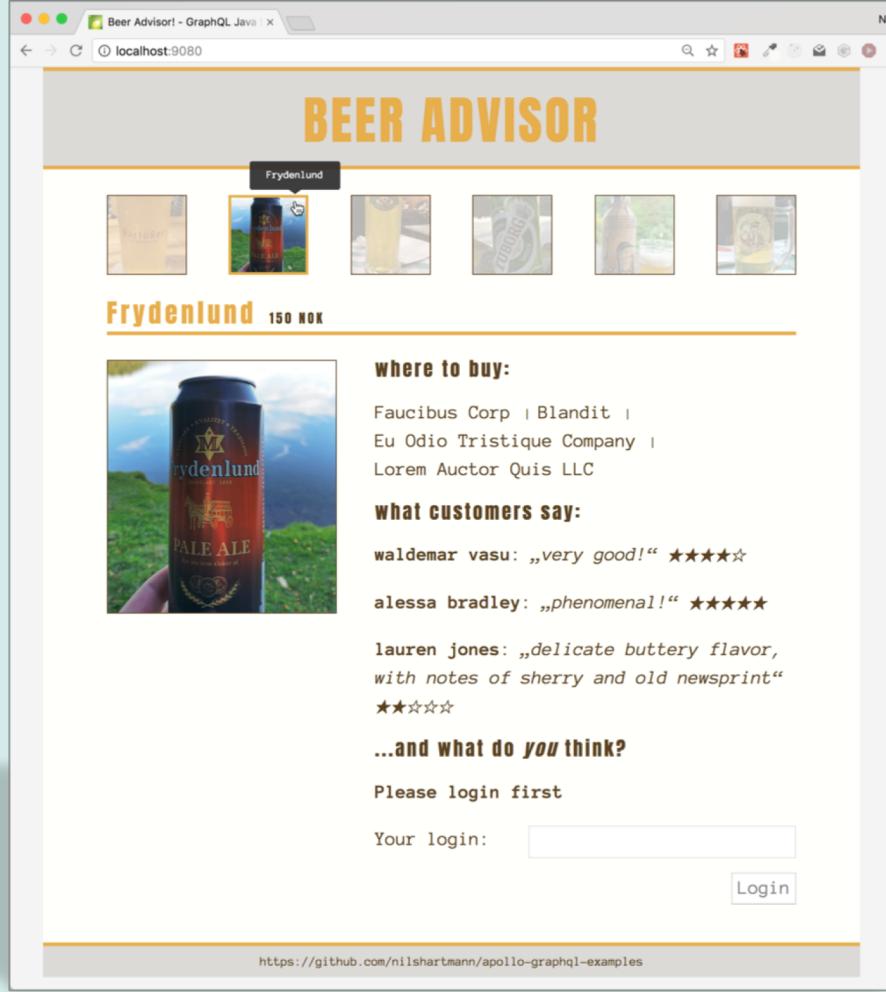


A look under the hood.

The New York Times website is changing, and the technology we use to run it is changing too.

<https://open.nytimes.com/react-relay-and-graphql-under-the-hood-of-the-times-website-redesign-22fb62ea9764>

NEW YORK TIMES



GraphQL praktisch

Source-Code: <http://bit.ly/bedcon-graphql-example>

The screenshot shows the GraphiQL interface running at localhost:9000/graphiql. The left pane displays a GraphQL query for a 'BeerAppQuery' that retrieves beers based on their ID, name, price, and ratings. The right pane shows the resulting JSON data, which includes a list of beers with their details like name, price, author, and comments. A sidebar on the right provides descriptions for each field in the schema.

```
query BeerAppQuery {
  beers {
    id
    name
    price
    ratings {
      id
      beerId
      author
      comment
    }
  }
}

beers
beer
ratings
ping
__schema
__type
>Returns all beers in our store
```

```
[{"id": "B1", "name": "Barfüßer", "price": "3,88 EUR", "ratings": [{"id": "R1", "beerId": "B1", "author": "Waldemar Vasu", "comment": "Exceptional!"}, {"id": "R7", "beerId": "B1", "author": "Madhukar Kareem", "comment": "Awwesome!"}, {"id": "R14", "beerId": "B1", "author": "Emily Davis", "comment": "Off-putting buttery nose, laced with a touch of caramel and hamster cage."}], {"id": "B2", "name": "Frydenlund", "price": "158 NOK", "ratings": [{"id": "R2", "beerId": "B2", "author": "Andrea Gouyen", "comment": "Very good!"}, {"id": "R8", "beerId": "B2", "author": "Marketta Glaukos", "comment": "phenomenal!"}, {"id": "R15", "beerId": "B2", "author": "Lauren Jones", "comment": "Delicate buttery flavor, with notes of sherry and old newsprint."}], {"id": "B3", "name": "Grieskirchner", "price": "3,28 EUR", "ratings": [{"id": "R3", "beerId": "B3", "author": "Nils", "comment": "Great beer, great price!"}]}
```

Demo: GraphiQL

<http://localhost:9000>

A screenshot of the IntelliJ IDEA code editor showing a GraphQL query. The code is as follows:

```
const BEER_RATING_APP_QUERY = gql`query BeerRatingAppQuery {
  backendStatus: ping {
    name
    nodeJsVersion
    uptime
  }
}

${/* This part is highlighted in yellow */}

  f beer - Returns the Beer with the specified Id      Beer
  f beers - Returns all beers in our store      [Beer!]!
  f ping - Returns health information about t...  ProcessInfo!
  f ratings - All ratings stored in our system  [Rating!]!
  f __schema - Access the current type schema of... __Schema!
  f __type - Request the type information of a sing... __Type
Dot, space and some other keys will also close this lookup and be inserted into editor
  ratings {
    id
    beerId
    author
    comment
  }
};`
```

The cursor is positioned at the start of the 'ratings' field. A tooltip is open over the 'ratings' field, listing several GraphQL scalar and object types: 'beer', 'beers', 'ping', 'ratings', '__schema', and '__type'. Each entry includes a brief description and its corresponding schema type (e.g., 'Beer!', '[Beer!]!', etc.). Below the list, a note states: "Dot, space and some other keys will also close this lookup and be inserted into editor".

Demo: IDE Support

Beispiel: IntelliJ IDEA

*"GraphQL is a **query language for APIs** and a runtime for fulfilling those queries with your existing data"*

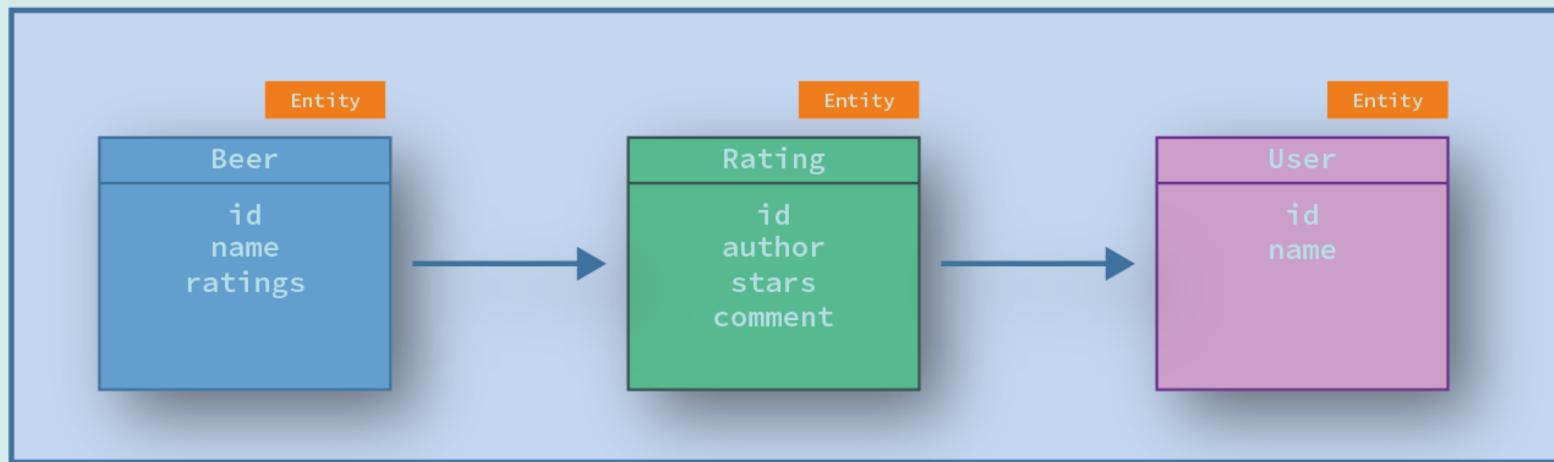
- <https://graphql.org>

GraphQL

TEIL 1: ABFRAGEN UND SCHEMA

BEERADVISOR DOMAINE

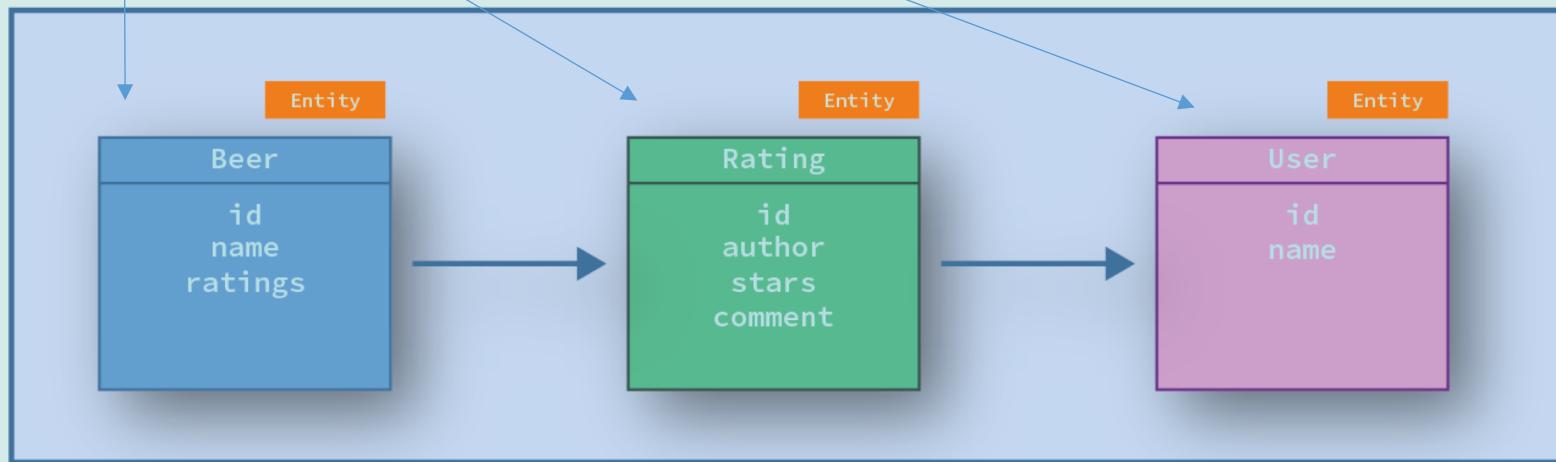
"Domain-Model"



ABFRAGEN MIT GRAPHQL

GraphQL

```
query {
  beer
  { name ratings(rid: "R1")
    { stars author { name } }
  }
}
```

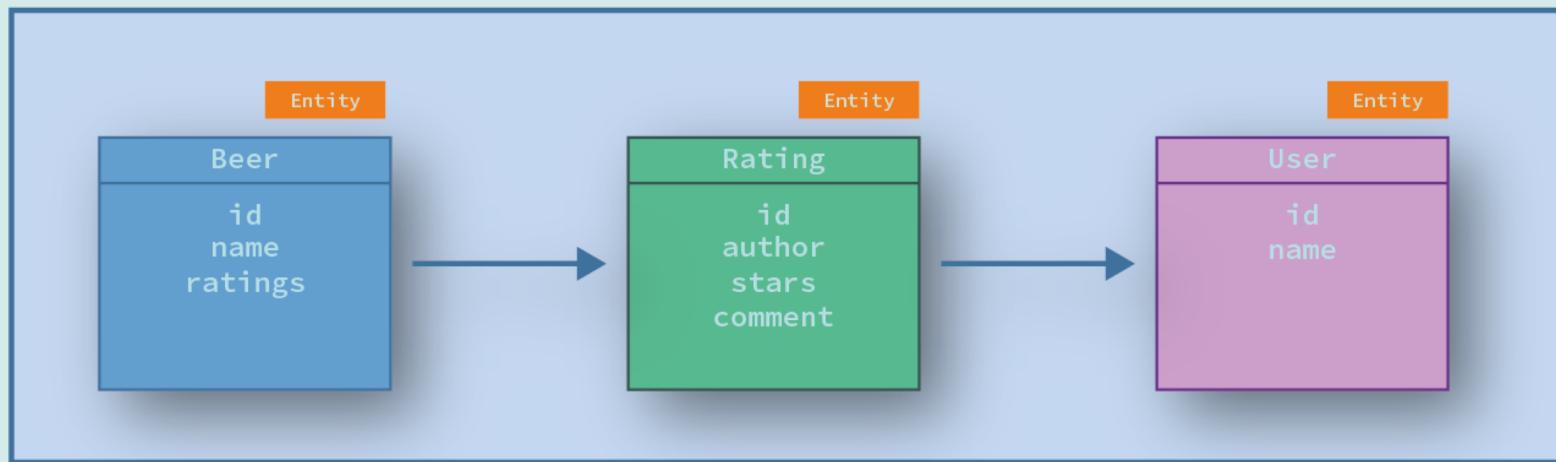


```
{
  "name": "Barfüßer",
  "ratings": {
    "stars": 3,
    "comment": "good",
    "author": { "name": "Klaus" }
  }
}
```

ABFRAGEN MIT GRAPHQL

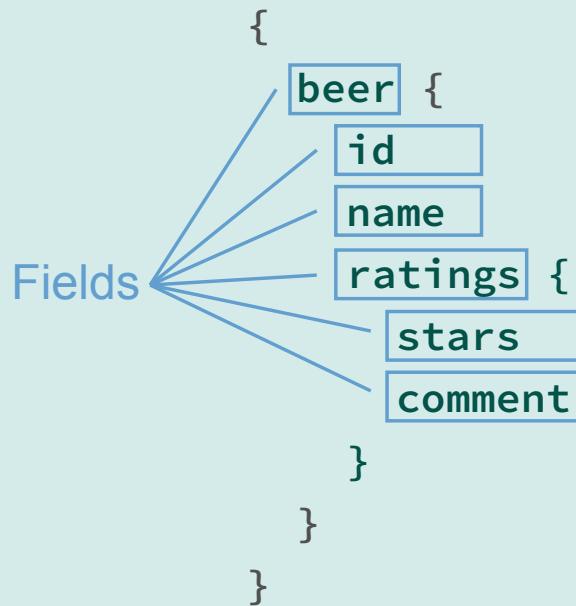
GraphQL

- Beliebige Abfragen über veröffentlichte API
- Kein Widerspruch zu REST, kann als Ergänzung genutzt werden
 - z.B. Login oder File Upload



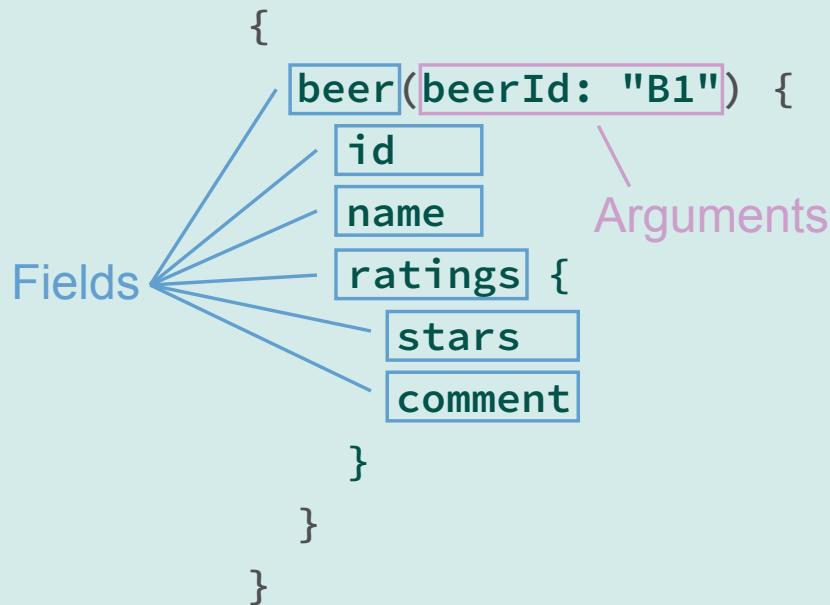
```
{  
  "name": "Barfüßer",  
  "ratings": {  
    "stars": 3,  
    "comment": "good",  
    "author": { "name": "Klaus" }  
  }  
}
```

QUERY LANGUAGE



- Strukturierte Sprache, um Daten von der API abzufragen
- Abgefragt werden **Felder** von (verschachtelten) Objekten

QUERY LANGUAGE



- Strukturierte Sprache, um Daten von der API abzufragen
- Abgefragt werden **Felder** von (verschachtelten) Objekten
- Felder können **Argumente** haben

QUERY LANGUAGE

Ergebnis

```
{  
  beer(beerId: "B1") {  
    id  
    name  
    ratings {  
      stars  
      comment  
    }  
  }  
}
```



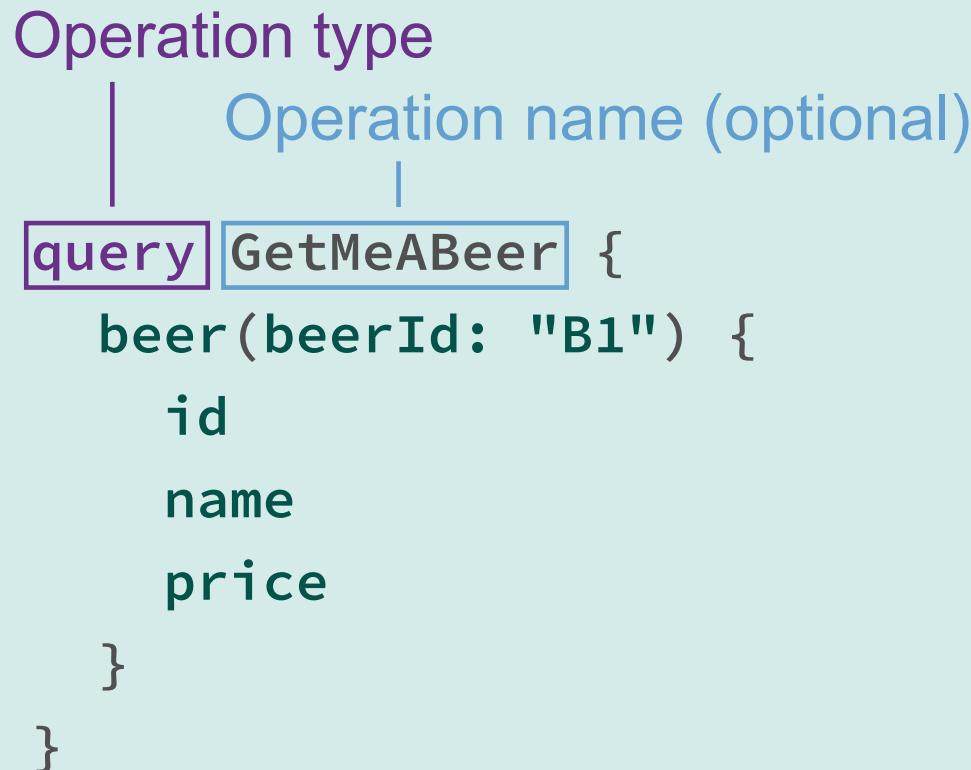
```
"data": {  
  "beer": {  
    "id": "B1"  
    "name": "Barfüßer"  
    "ratings": [  
      {  
        "stars": 3,  
        "comment": "grate taste"  
      },  
      {  
        "stars": 5,  
        "comment": "best beer ever!"  
      }  
    ]  
  }  
}
```

- Identische Struktur wie bei der Abfrage

QUERY LANGUAGE: OPERATIONS

Operation: beschreibt, was getan werden soll

- query, mutation, subscription



QUERY LANGUAGE: OPERATIONS

Operation: Variablen

```
query GetMeABeer($bid: ID!) {  
  beer(beerId: $bid) {  
    id  
    name  
    price  
  }  
}
```

Variable Definition
|
query GetMeABeer(**\$bid: ID!**) {
 beer(beerId: **\$bid**) {
 id
 name
 price
 }
}
Variable usage

QUERY LANGUAGE: MUTATIONS

Mutations

- Mutation wird zum Verändern von Daten verwendet
- Entspricht POST, PUT, PATCH, DELETE in REST
- Rückgabe Wert kann frei definiert werden (z.B. neue Entität)

Operation type
| Operation name (optional) Variable Definition
|
`mutation AddRatingMutation($input: AddRatingInput!) {
 addRating(input: $input) {
 id
 beerId
 author
 comment
 }
}`

`"input": {
 beerId: "B1",
 author: "Nils", — Variable Object
 comment: "YEAH!"
}`

QUERY LANGUAGE: MUTATIONS

Subscription

- Automatische Benachrichtigung bei neuen Daten

```
Operation type
  |
  |     Operation name (optional)
  |
  |     subscription NewRatingSubscription {
  |       newRating: onNewRating {
  |         id
  |         beerId
  |         author
  |         comment
  |       }
  |     }
  |   }
```

Field alias

QUERIES AUSFÜHREN

Queries werden über HTTP ausgeführt

- Üblicherweise per POST
- Ein einzelner Endpoint, z.B. /graphql

```
$ curl -X POST -H "Content-Type: application/json" \
  -d '{"query":"{ beers { name } }"}' \
  http://localhost:9000/graphql
```

```
{"data":  
  {"beers": [  
    {"name": "Barfüßer"},  
    {"name": "Frydenlund"},  
    {"name": "Grieskirchner"},  
    {"name": "Tuborg"},  
    {"name": "Baltic Tripple"},  
    {"name": "Viktoria Bier"}  
  ]}  
}
```

Schema

- Eine GraphQL API *muss* mit einem Schema beschrieben werden
- Schema legt fest, welche Types und Fields es gibt
- **Schema Definition Language** (SDL)
 - In der GraphQL Spec seit 2018

GRAPHQL SCHEMA

Schema Definition per SDL

```
Object Type ----- type Rating {  
  Fields      id: ID!  
                comment: String!  
                stars: Int  
 }  
 }  
 }
```

GRAPHQL SCHEMA

Schema Definition per SDL

```
type Rating {  
    id: ID! ----- Return Type (non-nullable)  
    comment: String!  
    stars: Int ----- Return Type (nullable)  
}  
}
```

GRAPHQL SCHEMA

Schema Definition per SDL

```
type Rating {  
    id: ID!  
    comment: String!  
    stars: Int  
    author: User! ----- Referenz auf anderen Typ  
}  
  
type User {  
    id: ID!  
    name: String!  
}
```



GRAPHQL SCHEMA

Schema Definition per SDL

```
type Rating { ←  
  id: ID!  
  comment: String!  
  stars: Int  
  author: User!  
}  
  
type User {  
  id: ID!  
  name: String!  
}  
  
type Beer {  
  name: String!  
  ratings: [Rating!]! ----- Liste / Array  
}  
}
```

GRAPHQL SCHEMA

Schema Definition per SDL

```
type Rating {  
    id: ID!  
    comment: String!  
    stars: Int  
    author: User!  
}
```

```
type User {  
    id: ID!  
    name: String!  
}
```

```
type Beer {  
    name: String!  
    ratings: [Rating!]!  
    ratingsWithStars(stars: Int!): [Rating!]!  
}
```

Arguments

GRAPHQL SCHEMA

Root-Types: Einstiegspunkte in die API (Query, Mutation, Subscription)

Root-Type ("Query")	<pre>type Query { beers: [Beer!]! beer(beerId: ID!): Beer }</pre>	Root-Fields
Root-Type ("Mutation")	<pre>type Mutation { addRating(newRating: NewRating): Rating! }</pre>	
Root-Type ("Subscription")	<pre>type Subscription { onNewRating: Rating! }</pre>	

*"GraphQL is a query language for APIs and a **runtime for fulfilling those queries** with your existing data"*

- <https://graphql.org>

GraphQL für Java

TEIL 2: RUNTIME-UMGEBUNG (AKA: EURE ANWENDUNG)

graphql-java: <https://www.graphql-java.com/>

- Server-seitige Java Implementierung
- Application-Server unabhängig
- Eigenes Projekt für Spring Boot Integration

GRAPHQL FÜR JAVA-ANWENDUNGEN

Schritt 1: Schema definieren

- Per API oder per .graphqls-Datei

```
type User {  
    id: ID!  
    login: String!  
    name: String!  
}  
  
type Rating {  
    id: ID!  
    beer: Beer!  
    author: User!  
    comment: String!  
    stars: Int!  
}  
  
type Beer {  
    id: ID!  
    name: String!  
    price: String!  
    ratings: [Rating!]!  
    ratingsWithStars(stars: Int!): [Rating!]!  
}
```

```
type Query {  
    beer(beerId: ID!): Beer  
    beers: [Beer!]!  
}  
  
input AddRatingInput {  
    beerId: ID!  
    userId: ID!  
    comment: String!  
    stars: Int!  
}  
  
type Mutation {  
    addRating(ratingInput: AddRatingInput):  
        Rating!  
}
```

Schritt 2: DataFetcher

- (In anderen Implementierungen auch **Resolver** genannt)
- Ein **DataFetcher** liefert ein Wert für ein angefragtes Feld
 - Zwingend erforderlich für Root-Types (Query, Mutation)
 - Default: per Reflection (getter/setter, Maps, ...)
- DataFetcher ist funktionales Interface:

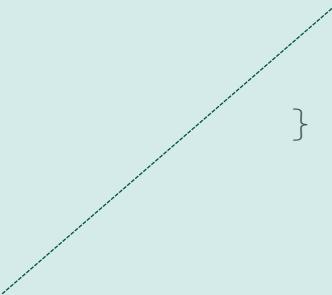
```
interface DataFetcher<T> {  
    T get(DataFetchingEnvironment environment);  
}
```

DATAFETCHER

DataFetcher implementieren

- Beispiel: beers-Feld

```
public class BeerAdvisorDataFetchers {  
  
    public DataFetcher<List<Beer>> beersFetcher() {  
        return environment -> beerRepository.findAll();  
    }  
  
}  
  
type Query {  
    beers: [Beer!]!  
}  
}
```



DATAFETCHER

DataFetcher implementieren

- environment gibt Informationen über den Query (z.B. Argumente)

```
public class BeerAdvisorDataFetchers {

    public DataFetcher<List<Beer>> beersFetcher() {
        return environment -> beerRepository.findAll();
    }

    public DataFetcher<Beer> beerFetcher() {
        return environment -> {
            String beerId = environment.getArgument("beerId");
            return beerRepository.getBeer(beerId);
        };
    }
}

type Query {
    beers: [Beer!]!
    beer(beerId: ID!): Beer
}
```

DATAFETCHER

DataFetcher für Mutations

- technisch analog zu Query
- dürfen Daten verändern

```
public DataFetcher<Rating> addRatingMutationFetcher() {  
    return environment -> {  
        final Map<String, Object> ri =  
            environment.getArgument("ratingInput");  
  
        type Mutation {  
            addRating  
            (ratingInput: AddRatingInput):  
                Rating!  
        }  
  
        Rating r = new Rating();  
        r.setBeerId((String)ratingInput.get("beerId"));  
        r.setComment((String)ratingInput.get("comment"));  
        r.setStars((Integer)ratingInput.get("stars"));  
        r.setUserId((String)ratingInput.get("userId"));  
  
        return ratingService.addRating(r);  
    };  
}
```

Schritt 3: Verbinden von Schema und DataFetcher

- Im RuntimeWiring werden wird Schema und DataFetcher verknüpft

Todo: drei folien, um code schritt-für-schritt einzublenden?

```
class BeerAdvisorGraphQLSetup {  
    public RuntimeWiring setupWiring() {  
        BeerAdvisorDataFetchers fetchers = ...; // z.B. Spring DI  
  
        return RuntimeWiring.newRuntimeWiring()  
            .type(newTypeWiring("Query")  
                .dataFetcher("beers", fetchers.beersFetcher())  
                .dataFetcher("beer", fetchers.beerFetcher()))  
            .build();  
    }  
}  
}
```

DATEN ERMITTLEMENT ZUR LAUFZEIT

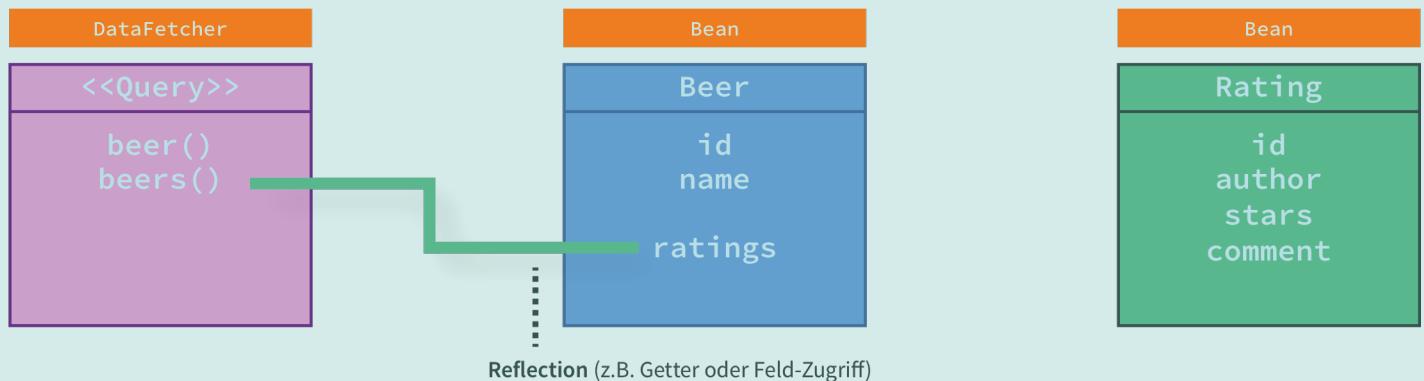
- Schritt 1: DataFetcher (wie eben implementiert)



DATEN ERMITTLEMENT ZUR LAUFZEIT

- Schritt 2: Zugriff auf Bean (PropertyDataFetcher)

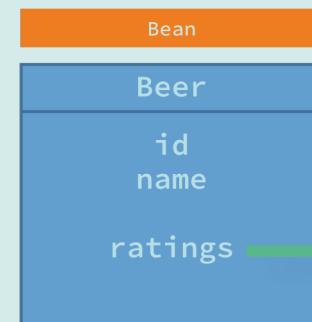
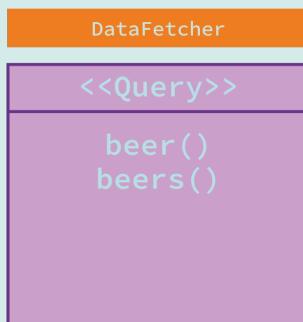
```
{  
  beers {  
    ratings {  
      comment  
    }  
  }  
}
```



DATEN ERMITTLEMENT ZUR LAUFZEIT

- Schritt 3: Zugriff auf Bean (PropertyDataFetcher)

```
{  
  beers {  
    ratings {  
      comment  
    }  
  }  
}
```

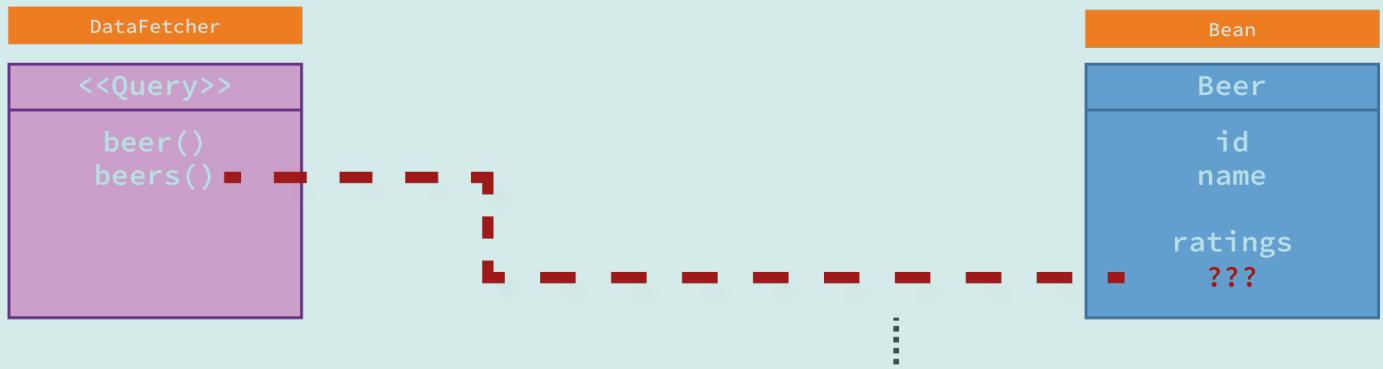


Reflection (z.B. Getter oder Feld-Zugriff)

DATEN ERMITTLEMENT ZUR LAUFZEIT

Problem: Mismatch zwischen Java-Klassen und Schema

```
{  
  beers {  
    ratingsWithStars  
    (stars: 3) {  
      comment  
    }  
  }  
}
```



Feld/Methode 'ratingWithStars' nicht in Beer-Klasse vorhanden

DATEN ERMITTLEMENT ZUR LAUFZEIT

DataFetcher für beliebige Felder

- PropertyDataFetcher ist nur default, Fetcher können pro Feld festgelegt werden
- Z.B. auch für Felder, deren Signatur zwischen API und Java-Klasse abweicht
 - (Rückgabe-Wert oder Parameter)

```
{  
    beers {  
        ratingsWithStars  
        (stars: 3) {  
            comment  
        }  
    }  
}
```



DATA FETCHER FÜR NICHT-ROOT-FELDER

DataFetcher implementieren

- getSource() liefert das Parent-Objekt zurück, auf dem das Feld abgefragt wird

```
type Beer {
  ratingsWithStars(stars: Int!): [Rating]!
}

public class BeerDataFetchers {

  public DataFetcher<List<Rating>> ratingsWithStarsFetcher() {
    return environment -> {
      Beer beer = environment.getSource();
      int starsInput = environment.getArgument("stars");

      return beer.getRatings().stream()
        .filter(r -> r.getStars() == starsInput)
        .collect(Collectors.toList());
    }
  }
}
```

RUNTIME WIRING

DataFetcher dem Feld im Schema zu weisen

- Analog zum Query-Type im RuntimeWiring

```
type Beer {
  ratingsWithStars(stars: Int!): [Rating!]!
}

class BeerAdvisorGraphQLSetup {
  public RuntimeWiring setupWiring() {
    BeerDataFetchers f = ...; // z.B. Spring DI

    return RuntimeWiring.newRuntimeWiring()
      .type(newTypeWiring("Query") . . .
            .type(newTypeWiring("Beer") .
                  .dataFetcher("ratingsWithStars", f.beersFetcher())))
      .build();
  }
}
```

ALTERNATIVE: GRAPHQL-JAVA-TOOLS

Resolver mit graphql-java-tools

- <https://github.com/graphql-java-kickstart/graphql-java-tools>
- Abstraktion, basierend auf graphql-java, arbeitet mit POJOs

ALTERNATIVE: GRAPHQL-JAVA-TOOLS

Resolver mit graphql-java-tools

- <https://github.com/graphql-java-kickstart/graphql-java-tools>
- Abstraktion, basierend auf graphql-java, arbeitet mit POJOs

```
type Query {  
  beers: [Beer!]!  
  beer(beerId: ID!): Beer  
}  
  
public class BeerAdvisorQueryResolver implements  
  GraphQLQueryResolver {  
  
  public List<Beer> beers() {  
    return beerRepository.findAll();  
  }  
  
  public Beer beer(String beerId) {  
    return beerRepository.getBeer(beerId);  
  }  
}
```

ALTERNATIVE: GRAPHQL-JAVA-TOOLS

Mutations mit Resolver

```
public class BeerAdvisorMutationResolver implements  
    GraphQLMutationResolver {  
  
type Mutation {  
    addRating  
    (ratingInput: AddRatingInput):  
        Rating!  
}  
  
    public Rating addRating(AddRatingInput ratingInput) {  
        Rating rating = Rating.from(ratingInput);  
        ratingRepository.save(rating);  
        return rating;  
    }  
}
```

GRAPHQL FÜR JAVA-ANWENDUNGEN

Schritt 3: Ausführbares Schema erzeugen

- Statisches Schema und DataFetcher (Wirings) werden verknüpft
- Einstiegspunkt zum Ausführen von Queries

```
class BeerAdvisorGraphQLSetup {  
  
    public GraphQLSchema setupGraphQLSchema() {  
  
        // Schritt 1: Schema-Beschreibung  
        File schemaFile = new File("beeradvisor.graphqls");  
  
        // Schritt 2: RuntimeWiring (wie zuvor gesehen)  
        RuntimeWiring runtimeWiring = setupWiring();  
  
        SchemaGenerator schemaGenerator = new SchemaGenerator();  
  
        return schemaGenerator.makeExecutableSchema(  
            new SchemaParser().parse(schemaFile),  
            runtimeWiring  
        );  
    }  
}
```

GRAPHQL FÜR JAVA-ANWENDUNGEN

Schritt 4: Queries ausführen (per API)

- Ergebnis wird in verschachtelter Map zurückgeliefert

```
GraphQLSchema schema = new BeerAdvisorGraphQLSetup().setupGraphQLSchema();  
  
GraphQL graphQL = GraphQL.newGraphQL(schema).build();  
  
ExecutionInput executionInput =  
    ExecutionInput  
        .newExecutionInput("query { beers { name ratings { stars } } }").build();  
  
Map<String, Object> result = graphQL.execute(executionInput).toSpecification();
```

Schritt 4: Queries ausführen (per HTTP)

- Voraussetzung: GraphQL Schema ist erzeugt
- Variante 1: <https://github.com/graphql-java/graphql-java-spring>
 - REST Controller für Spring (Boot)
 - Stammt aus graphql-java Projektfamilie
 - Kein Support für Subscriptions zurzeit
- Variante 2: <https://github.com/graphql-java-kickstart/graphql-java-servlet>
 - HTTP Servlet (für Spring bzw Servlet Container)
 - Auch als Starter für Spring Boot verfügbar

GRAPHQL FÜR JAVA-ANWENDUNGEN

Schritt 4: Queries ausführen (per HTTP)

- Schema des HTTP Requests und Antwort sind standardisiert
- Endpunkt kann Sprach- und Framework-unabhängig genutzt werden

```
$ curl -X POST -H "Content-Type: application/json" \
-d '{"query":"{ beers { name } }}}' \
http://localhost:9000/graphql
```

```
{"data":  
  {"beers": [  
    {"name": "Barfüßer"},  
    {"name": "Frydenlund"},  
    {"name": "Grieskirchner"},  
    {"name": "Tuborg"},  
    {"name": "Baltic Triple"},  
    {"name": "Viktoria Bier"}  
  ]}  
}
```

Spring Boot Starter

- <https://github.com/graphql-java-kickstart/graphql-spring-boot>
- Basiert auf Resolvern (aus graphql-java-tools)
- Mergt alle Schema-Dateien im Klassenpfad zusammen (*.graphqls)
- Resolver werden als Beans annotiert (zB. @Component) und automatisch dem Schema hinzugefügt
- Servlet-Konfiguration erfolgt per application.properties
- GraphiQL (API Explorer) kann ebenfalls per Konfiguration aktiviert werden



Vielen Dank!

Beispiel-Code: <http://bit.ly/javaland-graphql-example>

Slides: <https://bit.ly/javaland-graphql>