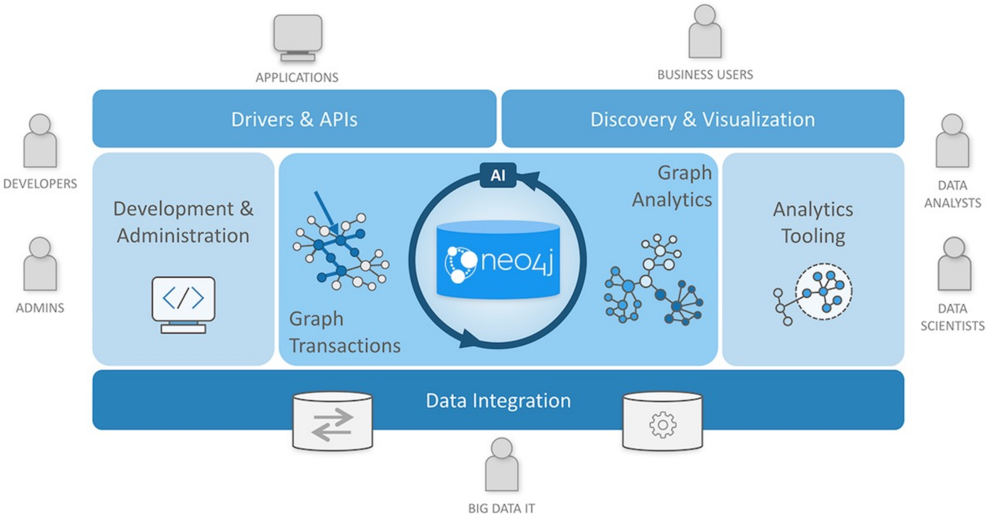
Intro To GraphQL & Neo4j

Contents

Lesson Overview

In this lesson we take a look at GraphQL, Neo4j, and the Neo4j GraphQL Library. We explore GraphQL including important concepts for querying with GraphQL and building GraphQL API applications. We introduce the Neo4j GraphQL Library, a Node.js library that helps developers build GraphQL APIs backed by Neo4j.

What is Neo4j?



Neo4j is a native graph database with many features and functionality making up the Neo4j Graph Platform. Specifically:

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- The Neo4j DBMS
- The property graph data model
- The Cypher query language
- Language drivers using the Bolt protocol for building applications
- Graph analytics with Graph Data Science
- Data visualization with Neo4j Bloom
- Neo4j Aura database-as-a-service
- A GraphQL integration for building GraphQL APIs backed by Neo4j

This course may be completed even if you don’t have much Neo4j experience, however we suggest reviewing the Neo4j Developer Guides ↗ for a better understanding of some of the features of the Neo4j graph database.

What is GraphQL?

Describe your data

```
type Project {
  name: String
  tagline: String
  contributors: [User]
}
```

Ask for what you want

```
{
  project(name: "GraphQL") {
    tagline
  }
}
```

Get predictable results

```
{
  "project": {
    "tagline": "A query language for APIs"
  }
}
```

GraphQL is an API query language and runtime for fulfilling those queries. GraphQL uses a type system to define the data available in the API, including what entities and attributes (**types** and **fields** in GraphQL parlance) exist and how types are connected (the data graph). GraphQL operations (queries, mutations, or subscriptions) specify an entry-point and a traversal of the data graph (the **selection set**) which defines what fields to be returned by the operation. See the official GraphQL site ↗ for a more in-depth overview of GraphQL.

Important GraphQL Concepts

GraphQL Type Definitions

GraphQL type definitions define the data available in the API. These type definitions are typically defined using the GraphQL Schema Definition Language (SDL), a language-agnostic way of expressing the types. However, type definitions can be also be defined programmatically.

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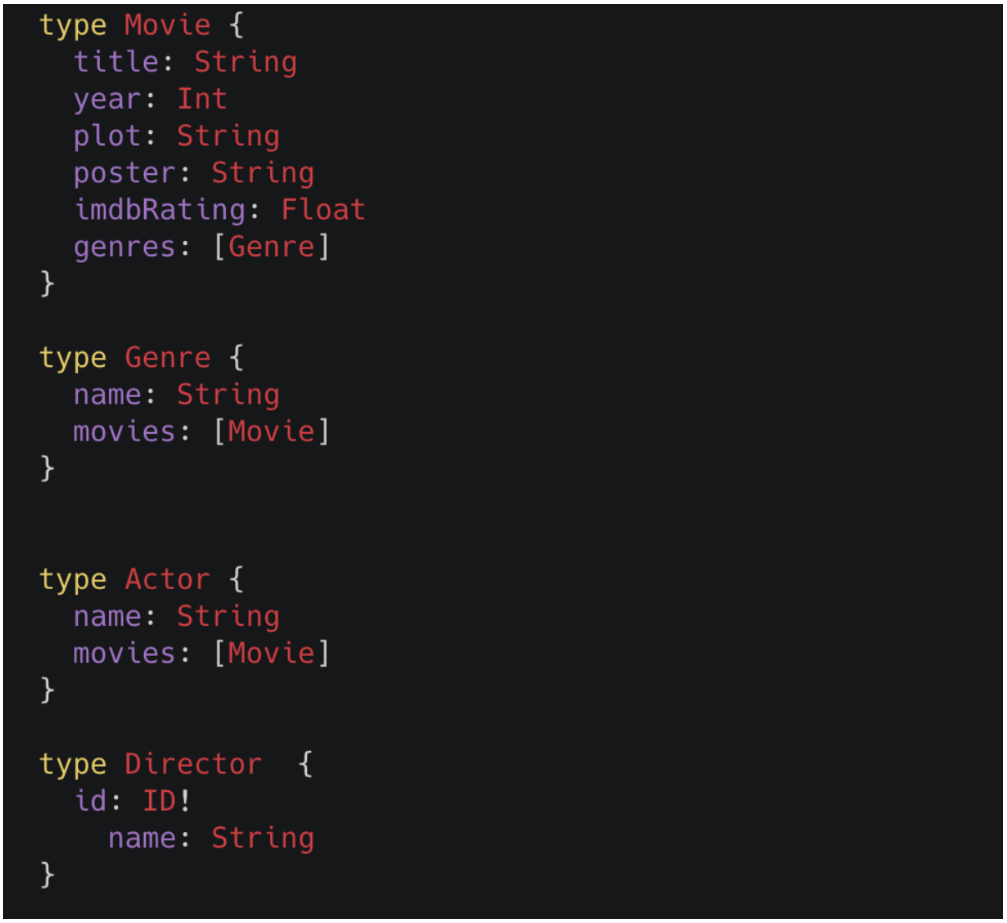
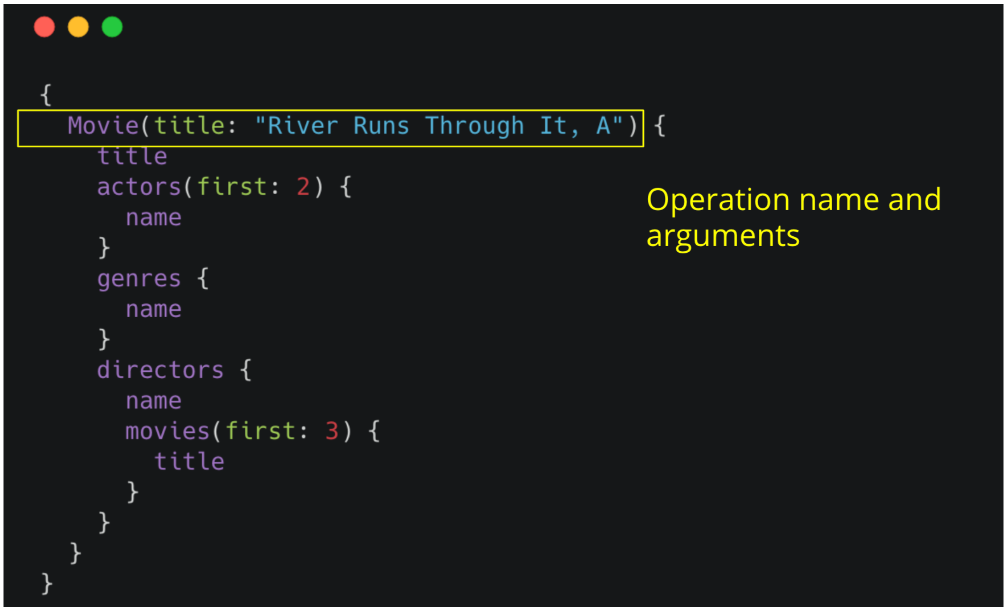


```
type Movie {
  title: String
  year: Int
  plot: String
  poster: String
  imdbRating: Float
  genres: [Genre]
}

type Genre {
  name: String
  movies: [Movie]
}


type Actor {
  name: String
  movies: [Movie]
}

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

GraphQL Operations

Each GraphQL operation is either a Query, Mutation, or Subscription. The fields of the Query, Mutation, and Subscription types define the entry points for an operation. Each operation starts at the field of one of these types.



```
{
  Movie(title: "River Runs Through It, A") {
    title
    actors(first: 2) {
      name
    }
    genres {
      name
    }
    directors {
      name
      movies(first: 3) {
        title
      }
    }
  }
}
```

Operation name and arguments

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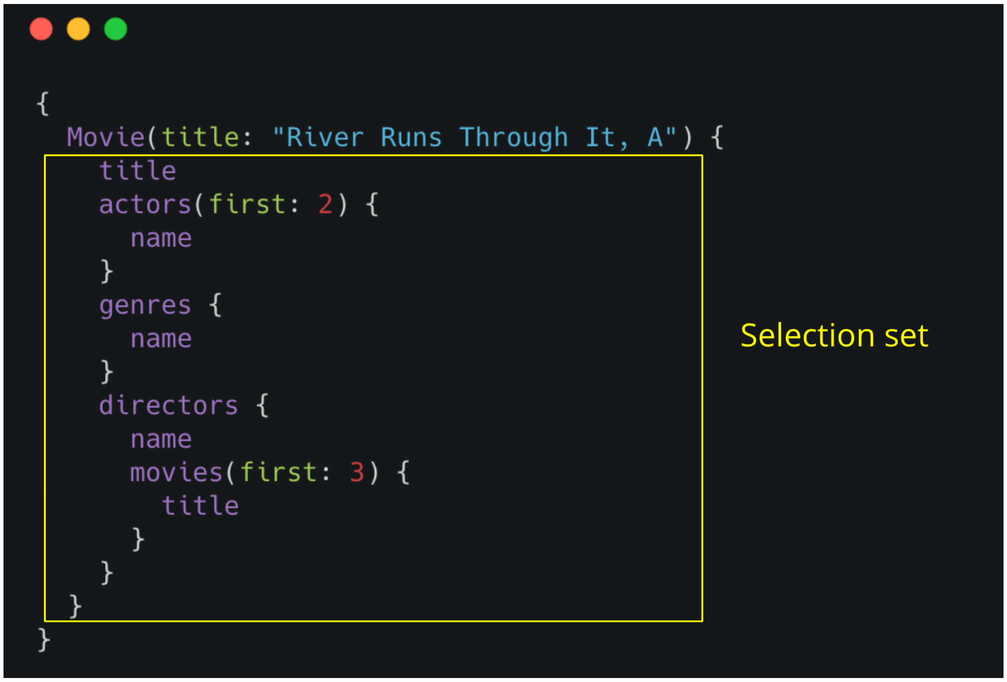
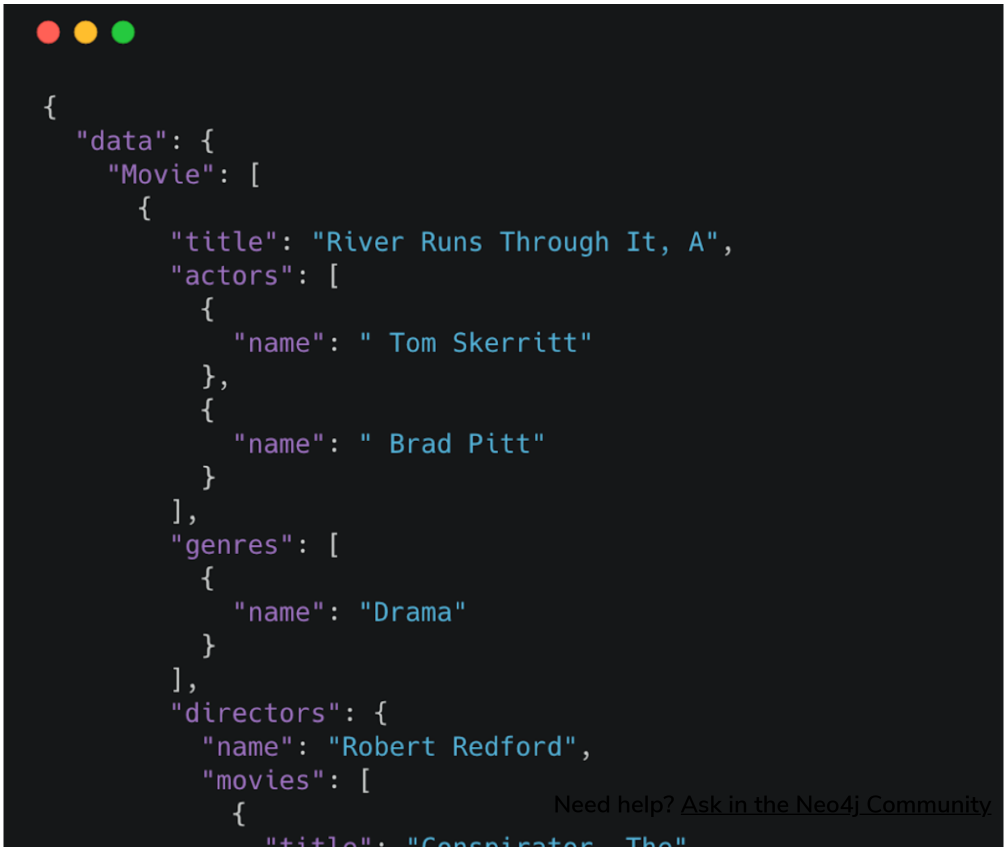
The Selection Set

The selection set specifies the fields to be returned by a GraphQL operation and can be thought of as a traversal through the data graph.



```
{
  Movie(title: "River Runs Through It, A") {
    title
    actors(first: 2) {
      name
    }
    genres {
      name
    }
    directors {
      name
      movies(first: 3) {
        title
      }
    }
  }
}
```

The response to a GraphQL operation matches the shape of the selection set, returning on the data requested.



```
{
  "data": {
    "Movie": [
      {
        "title": "River Runs Through It, A",
        "actors": [
          {
            "name": " Tom Skerritt"
          },
          {
            "name": " Brad Pitt"
          }
        ],
        "genres": [
          {
            "name": "Drama"
          }
        ],
        "directors": {
          "name": "Robert Redford",
          "movies": [
            {
              "title": "Conspirator, The"
```

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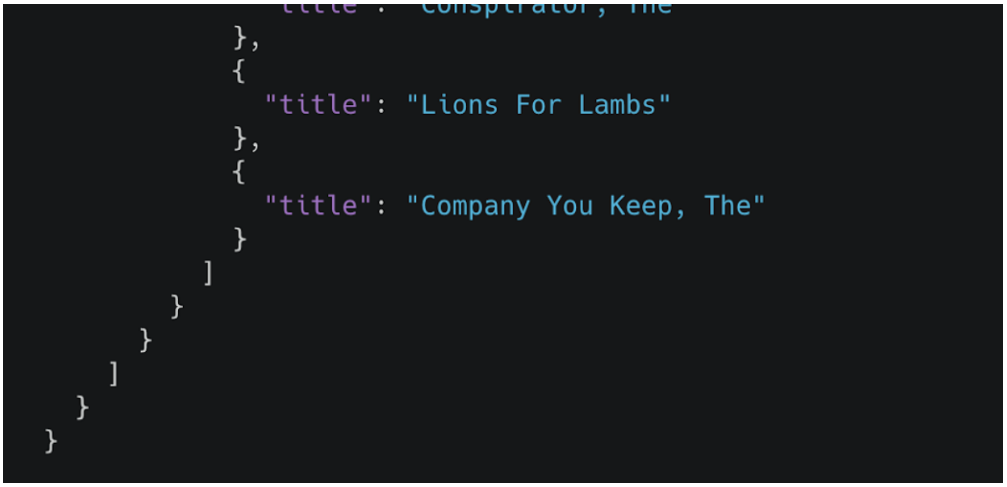
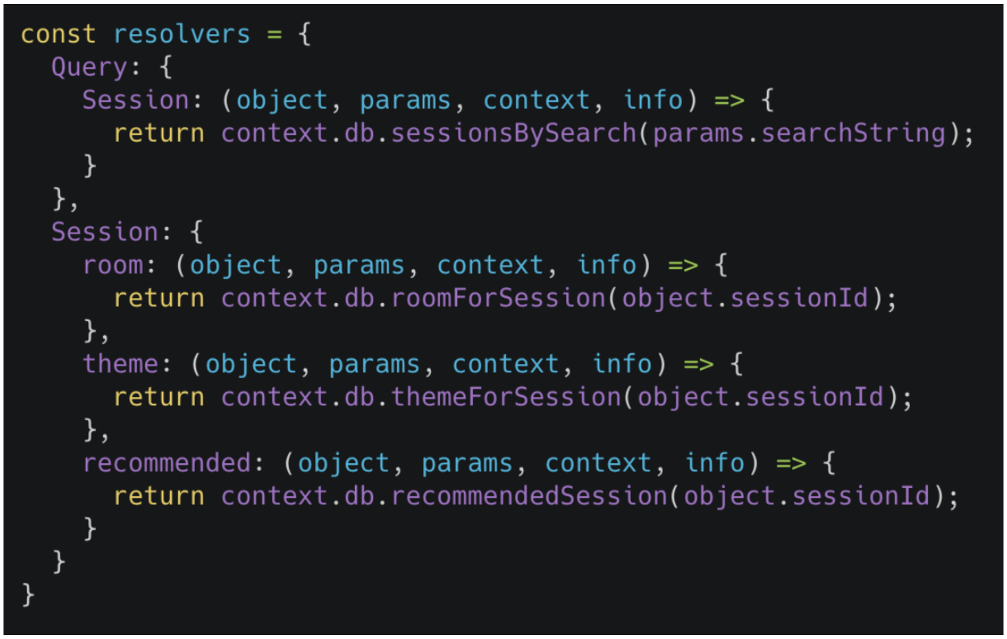


```
              "title": "Conspirator, The"
            },
            {
              "title": "Lions For Lambs"
            },
            {
              "title": "Company You Keep, The"
            }
          ]
        }
      }
    ]
  }
}
```

Resolver Functions

GraphQL resolvers are the functions responsible for actually fulfilling the GraphQL operation. In the context of a query, this means fetching data from a data layer.



```
const resolvers = {
  Query: {
    Session: (object, params, context, info) => {
      return context.db.sessionsBySearch(params.searchString);
    }
  },
  Session: {
    room: (object, params, context, info) => {
      return context.db.roomForSession(object.sessionId);
    },
    theme: (object, params, context, info) => {
      return context.db.themeForSession(object.sessionId);
    },
    recommended: (object, params, context, info) => {
      return context.db.recommendedSession(object.sessionId);
    }
  }
}
```

Benefits of GraphQL

Some of the benefits of GraphQL include:

- **Overfetching** - sending less data over the wire
- **Underfetching** - everything the client needs in a single request
- The **GraphQL specification** defines exactly what GraphQL is
- **Simplify data fetching** with component-based data interactions

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- **"Graphs all the way down" -** GraphQL can help unify disparate systems and focus API interactions on relationships instead of resources.
- **Developer productivity -** By reasoning about application data as a graph with a strict type system, developers can focus on building applications.

GraphQL Challenges

Of course GraphQL is not a silver bullet. It’s important to be aware of some of the challenges that come from introducing GraphQL in a system.

- Some well understood practices from REST don’t apply
- HTTP status codes
- Error handling
- Caching
- Exposing arbitrary complexity to the client and performance considerations
- The n+1 query problem - the nested nature of GraphQL operations can lead to multiple requests to the data layer(s) to resolve a request
- Query costing and rate limiting

Best practices and tooling have emerged to address all of the above, however it’s important to be aware of these challenges.

What is the Neo4j GraphQL Library?

The fundamental goal of the Neo4j GraphQL Library is to make it easier to build GraphQL APIs backed by Neo4j.

> *It’s important to point out that GraphQL is an API query language and NOT a database query language. The goal of the Neo4j GraphQL Library is to help build the API layer that sits between the client and database, not to execute GraphQL queries directly against the database.*

At a high level, the goals of the Neo4j GraphQL Library are focused on:

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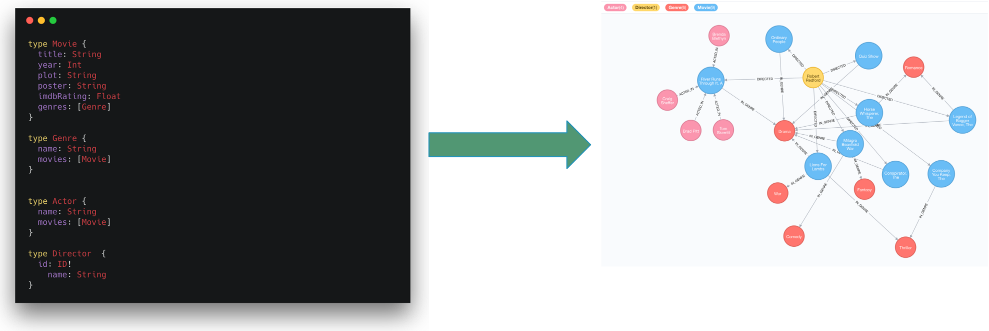
- Reducing boilerplate
- Developer productivity
- Extensibility
- Performance

Goals of the Neo4j GraphQL Library

GraphQL First Development

GraphQL type definitions can drive the database data model, which means we don't need to maintain two separate schemas for our API and database.

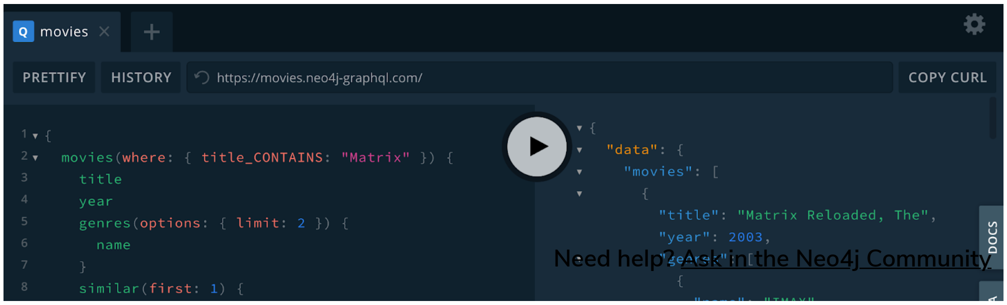


```
type Movie {
  title: String
  year: Int
  plot: String
  poster: String
  imdbRating: Float
  genres: [Genre]
}

type Genre {
  name: String
  movies: [Movie]
}


type Actor {
  name: String
  movies: [Movie]
}

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

Auto-generate GraphQL API Operations

With the Neo4j GraphQL Library, GraphQL type definitions provide the starting point for a generated API that includes:

- Query & Mutation types (an API entrypoint for each type defined in the schema)
- Ordering
- Pagination
- Complex filtering
- DateTime & Spatial types and filtering



```
{
  movies(where: { title_CONTAINS: "Matrix" }) {
    title
    year
    genres(options: { limit: 2 }) {
      name
    }
    similar(first: 1) {
```

```
{
  "data": {
    "movies": [
      {
        "title": "Matrix Reloaded, The",
        "year": 2003,
        "genres": [
          {
            "name": "IMAX"
```

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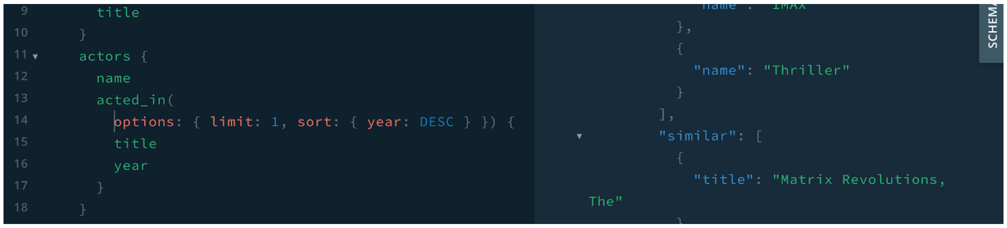
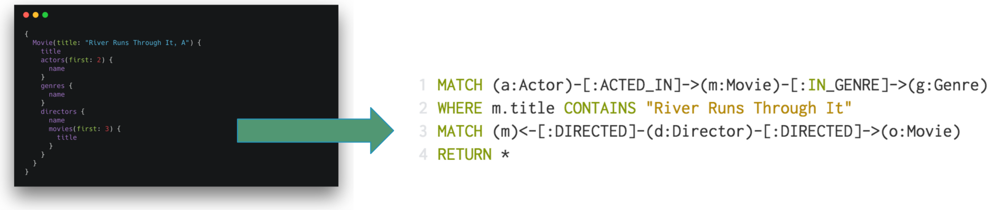


```
      title
    }
    actors {
      name
      acted_in(
        options: { limit: 1, sort: { year: DESC } }) {
        title
        year
      }
    }
```

```
                "name": "IMAX"
              },
              {
                "name": "Thriller"
              }
            ],
            "similar": [
              {
                "title": "Matrix Revolutions,
 The"
```

Generate Cypher From GraphQL Operations

To reduce boilerplate and optimize for performance the Neo4j GraphQL Library automatically generates a single database query for any arbitrary GraphQL request. This means the developer does not need to implement resolvers and each GraphQL operation results in a single roundtrip to the database.

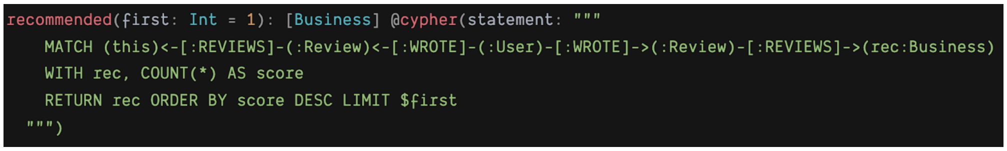


```
{
  Movie(title: "River Runs Through It, A") {
    title
    actors(first: 2) {
      name
    }
    genres {
      name
    }
    directors {
      name
      movies(first: 3) {
        title
      }
    }
  }
}
```

```
MATCH (a:Actor)-[:ACTED_IN]->(m:Movie)-[:IN_GENRE]->(g:Genre)
WHERE m.title CONTAINS "River Runs Through It"
MATCH (m)<-[:DIRECTED]-(d:Director)-[:DIRECTED]->(o:Movie)
RETURN *
```

Extend GraphQL With Cypher

To add custom logic beyond CRUD operations, you can use the `@cypher` GraphQL schema directive ↗ to add computed fields bound to a Cypher query to the GraphQL schema.



```
recommended(first: Int = 1): [Business] @cypher(statement: """
    MATCH (this)<-[:REVIEWS]-(:Review)<-[:WROTE]-(:User)-[:WROTE]->(:Review)-[:REVIEWS]->(rec:Business)
    WITH rec, COUNT(*) AS score
    RETURN rec ORDER BY score DESC LIMIT $first
  """)
```

Neo4j GraphQL Library Quickstart

The focus of this course is using the Neo4j GraphQL Library to build GraphQL APIs backed by the Neo4j graph database. Each lesson will be a hands-on mix of introducing concepts, examples, exercises, and quizzes.

> As mentioned previously you won't be installing or running the Neo4j GraphQL Library locally, instead you will use Codesandbox to run the code. In this course you will be using a Codesandbox environment and won't need to worry about performing these quickstart steps.

However, it's important to understand how to install and get started with the Neo4j GraphQL Library after you have completed this course.

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The Neo4j GraphQL Library can be installed using `npm` as shown here:

Bash

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```bash
$ npm install @neo4j/graphql graphql neo4j-driver apollo-server
```

The Neo4j GraphQL Library is a **Node.js** JavaScript library that can be used with JavaScript GraphQL implementations.

JavaScript

```javascript
// index.js

const { Neo4jGraphQL } = require("@neo4j/graphql");
const neo4j = require("neo4j-driver");
const { ApolloServer } = require("apollo-server");

const typeDefs = `
    type Movie {
        title: String
        year: Int
        imdbRating: Float
        genres: [Genre] @relationship(type: "IN_GENRE", direction: OUT)
    }

    type Genre {
        name: String
        movies: [Movie] @relationship(type: "IN_GENRE", direction: IN)
    }
`;

const driver = neo4j.driver(
    "bolt://localhost:7687",
    neo4j.auth.basic("neo4j", "letmein")
);

const neoSchema = new Neo4jGraphQL({ typeDefs, driver });

const server = new ApolloServer({
    schema: neoSchema.schema,
    context: ({ req }) => ({ req }),
});

server.listen(4000).then(() => console.log("Online"));
```

Then to start a **local** GraphQL API:

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Bash Copy to Clipboard

```
node index.js
```

This will start a **local** GraphQL API and will also serve the GraphQL Playground IDE for querying the API or exploring documentation using GraphQL's introspection feature.

Exercise: Exploring The Movies GraphQL API

1. To familiarize yourself with GraphQL and writing GraphQL queries, open the public movies GraphQL API at movies.neo4j-graphql.com .
2. Explore GraphQL Playground by executing the following queries, and opening the Docs and Schema tab to see the type definitions.
3. Modify the queries by adding additional fields in the selection set and see how the results change.

GraphQL Copy to Clipboard

```
{
  movies(options: { limit: 10 }) {
    title
    actors {
      name
    }
  }
}
```

GraphQL Copy to Clipboard

```
{
  directors(where: {name:"Robert Redford"}) {
    name
    directed {
      title
      plot
    }
  }
}
```

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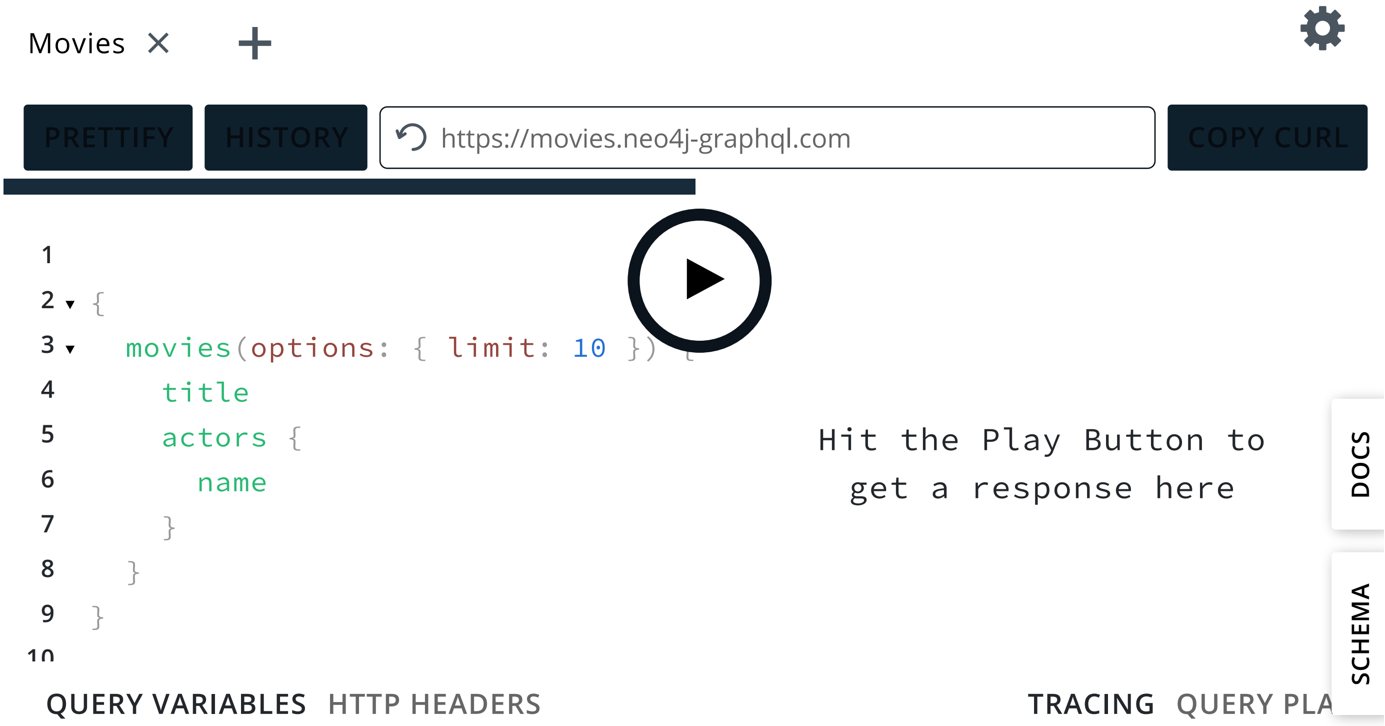

```

{
  movies(options: { limit: 10 }) {
    title
    actors {
      name
    }
  }
}
```

Hit the Play Button to get a response here

> *The GraphQL Playground embed above is interactive and can be used directly in this page or if you'd like some more screen real estate can be opened in a new tab at movies.neo4j-graphql.com* ↗

Check Your Understanding

Question 1

The n+1 query problem is a common problem developers face when building GraphQL APIs and can lead to poor performance if not properly addressed.

Is this statement true or false?

☑ True

□ False

Question 2

What is the name of the browser-based GraphQL IDE for executing GraphQL operations and exploring GraphQL API documentation?

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Select the correct answer.

☑ GraphQL Playground

□ Neo4j Browser

□ GraphQL Sunshine Beam

Question 3

What is the term for the list of fields that define the information to be returned by a GraphQL operation?

Select the correct answer.

□ GraphQL type definitions

□ GraphQL SDL

□ query field

□ field arguments

☑ selection set

Summary

In this lesson, we introduced GraphQL and the features of the Neo4j GraphQL Library. In the next lesson we get started using the Neo4j GraphQL Library to build a GraphQL API backed by Neo4j.

Prev
‹ Course Overview(../00-graphq

Next
The Neo4j GraphQL Library ›

Contents

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l-apis-about-this-course/)

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