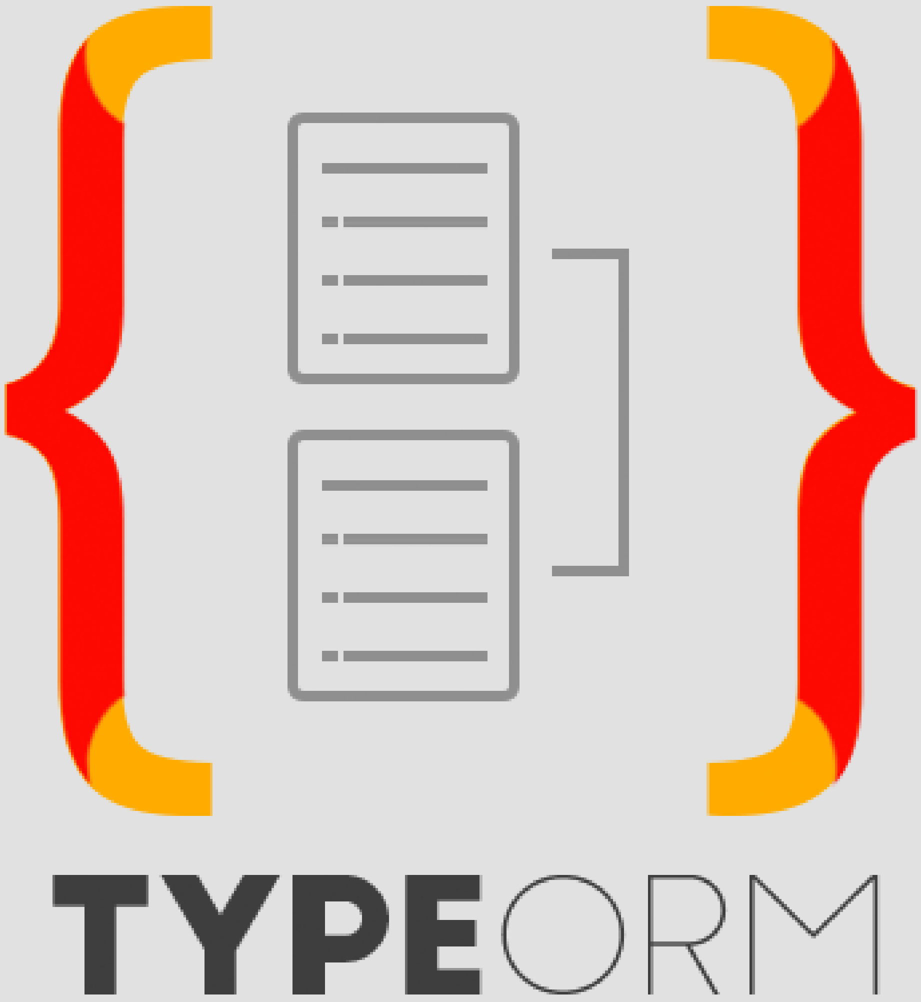

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About the Tutorial

TypeORM is an object-relational mapper library for TypeScript and JavaScript. TypeORM is a tool in the Micro-frameworks category of the tech stack. This tutorial walks through the basics of TypeORM framework, how to set up entity objects, how to configure relationship between objects, how to store/retrieve data from/to the database, how to customize the repository instance to manipulate the given database and finally conclude with different database operations.

Audience

This tutorial is prepared for professionals who are aspiring to make a career in the field of back-end database development using object relation mapping. This tutorial is intended to make you comfortable in getting started with the TypeORM concepts.

Prerequisites

Before proceeding with the various types of concepts given in this tutorial, we assume that the readers have the basic understanding of database and objects in programming languages. In addition to this, it will be very helpful, if the readers have a sound knowledge on TypeScript and JavaScript.

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Table of Contents

1. TypeORM — Introduction

TypeORM framework is an **Object Relational Mapping (ORM)** framework. In general, **Object** part refers to the domain / model in your application, **Relational** part refers to the relationship between tables in Relational Database Management System (e.g. Oracle, MySQL, MS-SQL, PostgreSQL, etc.) and finally the **Mapping** part refers to the act of bridging the model and our tables.

ORM is a type of tool that maps entities with database tables. ORM provides simplified development process by automating object-to-table and table-to-object conversion. Once you can write your data model in one place, it becomes easier to update, maintain, and reuse the code.

Since, the model is weakly bound to the rest of the application, you can change it without any hard dependency with other part of the application and can be easily use it anywhere inside the application. TypeORM is very flexible, abstracts the DB system away from the application and allows us to benefits from the use of OOPS concept.

Overview

TypeORM is an Object Relational Mapper library running in node.js and written in TypeScript. *TypeScript* is an improvement to JavaScript with optional typing. TypeScript is a compiled language. It is not interpreted at run-time. The TypeScript compiler takes TypeScript files (.ts) and compiles them in to JavaScript files (.js).

TypeORM supports multiple databases like MySQL, PostgreSQL, MariaDB, SQLite, MS SQL Server, Oracle, SAP Hana and WebSQL. TypeORM is an easy-to-use ORM to scaffold new apps that connect to databases. TypeORM functionality is RDBMS-specific concepts.

We can quickly create new projects and micro-services. It is inspired from similar tool like Hibernate, Doctrine, Entity framework, etc., from other programming languages.

Features of TypeORM

TypeORM comes with the following features:

- Automatically create database table schemes based on your models.
- Easily insert, update and delete object in the database.
- Create mapping (one-to-one, one-to-many and many-to-many) between tables.
- Provides simple CLI commands.

Benefits of TypeORM

TypeORM is easy to use ORM framework with simple coding. It has the following benefits:

- High quality and loosely-coupled applications.
- Scalable applications.
- Easily integrate with other modules.

- Perfectly fits any architecture from small to enterprise apps.

2. TypeORM — Installation

This chapter explains about how to install TypeORM on your machine. Before moving to installation, please make sure that **npm** is installed. To confirm that you have **npm**, you can run the following command in your terminal.

```
npm -v
```

It shows the version. If it is not installed, download the latest version and install on your machine.

Install TypeORM

Let us install TypeORM locally using npm module:

```
npm install typeorm --save
```

After executing the above command, you will get a response as given below:

```
+ typeorm@0.2.24
+
added 1 package and audited 1236 packages in 4.729s
```

Alternatively, to install TypeORM globally, use the below command:

```
npm install typeorm -g
```

After that, install optional package **reflect-metadata** using npm:

```
npm install reflect-metadata --save
```

You could see the following response:

```
+ reflect-metadata@0.1.13

added 1 package and audited 1236 packages in 2.426s
```

Now, install another optional package. node **typings** using the below command:

```
npm install @types/node --save
```

You could see the following response:

```
+ @types/node@12.12.31

added 1 package and audited 1236 packages in 2.167s
```

Install database driver

In this section, let us install the necessary node packages for our database.

To install **MySQL** or **MariaDB** package, use the below command:

```
npm install mysql --save
```

You could see the following response:

```
+ mysql@2.18.1

added 1 package and audited 1236 packages in 4.36s
```

To install **PostgreSQL** package, use the below command:

```
npm install pg --save
```

You could see the following response:

```
+ pg@7.18.2

added 1 package and audited 1236 packages in 2.863s
```

To install **SQLite** package, use the below command:

```
npm install sqlite3 --save
```

You could see the following response:

```
+ sqlite3@4.1.1
added 48 packages from 45 contributors and audited 1396 packages in 7.31s
```

To install **Microsoft SQL Server** package, use the below command:

```
npm install mssql --save
```

Your screen looks similar to this,

```
+ mssql@6.2.0

added 1 package and audited 1655 packages in 2.378s
```

To install **sql.js** package, use the below command:

```
npm install sql.js --save
```

You could see the following response:

```
+ sql.js@1.2.1

added 1 package and audited 1655 packages in 6.462s
```

To install **Oracle server** package, use the below command:

```
npm install oracledb --save
```

You could see the following response:

```
+ oracledb@4.2.0

added 1 package and audited 1655 packages in 2.265s
```

To install **mongodb** package, use the below command:

```
npm install mongodb --save
```

You could see the following response:

```
+ mongodb@3.5.5

added 1 package and audited 1655 packages in 3.716s
```

3. TypeORM — Creating a Simple Project

This chapter explains about how to create simple TypeORM application. Let us create a new directory named 'TypeORM' and move into the directory.

```
cd /path/to/TypeORM/
```

Syntax

Use below command to create new project:

```
typeorm init --name <project-name> --database <database-name>
```

Example

```
typeorm init --name FirstProject --database mysql
```

Here,

FirstProject is your project name and **sqlite3** is database name. After executing the above command, you could see the following response,

```
Project created inside /path/to/TypeORM/FirstProject directory
```

Now, move in to our project directory and install project dependencies using **npm** module,

```
$ cd FirstProject

$ npm install
```

Project structure

Let us understand project structure of our newly created project, **FirstProject.**

```
FirstProject

├──> src
│    ├──> entity
│    │    └──> User.ts
│    ├──> migration
│    └──> index.ts
├──> node_modules
├──> ormconfig.json
├──> package.json
├──> package-lock.json
└──> tsconfig.json
```

Here,

- **src** - contains source code of your application in **TypeScript** language. It has a file **index.ts** and two sub directories **entity** and **migration**.
- **index.ts** - Your entry point to the application.
- **entity** - Contains database models.
- **migration** - contains database migration code.
- **node_modules** - locally saved npm modules.
- **ormconfig.json** - Main configuration file of your application. It contains database configuration details and entities configuration.
- **package.json** - Contains node module dependencies.
- **package-lock.json** - Auto generated file and related to **package.json.**
- **tsconfig.json** - Contains TypeScript specific compiler options.

ormconfig.json file

Let us check the configuration option available for our application. Open **ormconfig.json** file and it looks similar to this:

```
{
   "type": "mysql",
   "host": "localhost",
   "port": 3306,
   "username": "test",
   "password": "test",
   "database": "test",
   "synchronize": true,
   "logging": false,
   "entities": [
      "src/entity/**/*.ts"
   ],
   "migrations": [
      "src/migration/**/*.ts"
   ],
   "subscribers": [
      "src/subscriber/**/*.ts"
   ],
   "cli": {
      "entitiesDir": "src/entity",
      "migrationsDir": "src/migration",
      "subscribersDir": "src/subscriber"
   }
}
```

Here,

type, **host**, **username**, **password**, **database** and **port** options are related to database setting. **mysql** can be configured using below configuration:

```
{
   "type": "mysql",
   "host": "localhost",
   "port": 3306,
   "username": "db_username",
   "password": "db_password",
   "database": "db_name"
}
```

- **entities** - refers the location of your entity classes.
- **migrations** - refers the location of your migration classes.
- **subscribers** - refers the location of your subscriber classes.
- **cli** - refers the option used by **TypeORM CLI** to auto generate the code

Start MySql server

Before starting the application, start your **MySQL** server or any database server used by you and make sure it is running properly.

Run application

Once everything is configured, we can execute the application using the below command:

```
npm start
```

You could see the following response:

```
> FirstProject@0.0.1 start /Users/../../TypeORM/FirstProject

> ts-node src/index.ts

Inserting a new user into the database...
Saved a new user with id: 1
Loading users from the database...
Loaded users:  [ User { id: 1, firstName: 'Timber', lastName: 'Saw', age: 25 }]

Here you can setup and run express/koa/any other framework.
```

The application inserted a new user into the database and then reverse load it from the database and finally show the loaded user in the console. We have successfully created a new **TypeORM** application, configured it and run the application.

We will discuss about how the data is executed elaborately in upcoming chapters.

4. TypeORM — Connection API

To interact with database, we need a connection object to the database. We need to create a connection object before doing the database operation and has to terminate it once thee database operations are done. Let us learn about **Connection API** provided by TypeORM in this section.

Creating a new connection

Before creating a new connection, we need to configure database connection details in the **ormconfig.json** configuration file. A sample connection details is shown below:

ormconfig.json

```
{
    name: "firstconnection",
    type: "mysql",
    host: "localhost",
    port: 3306,
    username: "root",
    password: "root",
    database: "firstDB"
}
```

Here,

- **name** - Name of the database connection.
- **type** - Database type.
- **host** - Hostname of the database server.
- **port** - Database server port.
- **username** - Account name having access to the database.
- **password** - Password of the above mentioned account.
- **database** - Name of the database to connect.

createConnection

CreateConnection method is provided by TypeORM to create a new connection. It is defined as below,

```
import { createConnection, Connection } from "typeorm";

const connection = await createConnection({

});
```

Here, **createConnection** will use the configuration details specified in the **ormconfig.json** file.

Alternatively, you can define the connection URL as arguments to the **createConnection** method as specified follows:

```
const connection = createConnection({
    type: 'mysql',
    url: 'localhost:8888/firstDB'
})
```

Here,

createConnection returns an object, which can be used to open / close the connection to the database.

Multiple connections

TypeORM provides an option to create multiple database connection as well. First, the configuration file **ormconfig.json** can be used to specify the details of the multiple database connection. Let us configure multiple databases in **ormconfig.json** as specified follows,

ormconfig.json

```
{   name: "firstconnection",
    type: "mysql",
    host: "localhost",
    port: 3306,
    username: "root",
    password: "root",
    database: "firstDB"
},
{   name: "secondconnection",
    type: "mysql",
    host: "localhost",
    port: 3306,
    username: "root",
    password: "root",
    database: "secondDB"
},
{   name: "thirdconnection",
    type: "mysql",
    host: "localhost",
    port: 3306,
    username: "root",
    password: "root",
    database: "thirdDB"
}
```

Now, we can use the argument provided by the **createConnection** method to specify the name of the connection to create connection object as mentioned below:

```
const firstconnection: Connection = await createConnection("firstconnection");
```

Here,

createConnection will use the configuration details of the **firstconnection** specified in the **ormconfig.json** file to create the connection object.

TypeORM also provides yet another API, **createConnections** to create multiple connection as once and then, use it whenever necessary as specified below:

```
import { createConnections, Connection } from "typeorm";

const connections: Connection[] = await createConnections([

]);
```

Here,

connections hold all the connection objects as an array.

ConnectionManager

TypeORM also provides an another API, **connectionManager** to create connection. It is defined below:

```
import {getConnectionManager, ConnectionManager, Connection} from "typeorm";

const connectionManager = getConnectionManager();
const connection = connectionManager.create({

});
await connection.connect();
```

TypeORM prefers the usage of **createConnection** over **ConnectionManager** to create connection objects.

5. TypeORM — Entity

An entity is a collection of fields and associated database operations. It is used to map database table and its fields with the entities and its attributes. This chapter explains about the TypeORM entities in detail.

Introduction

Let us create a simple **Entity** class in our code. Move to your project root location and go inside *src* folder and move to **entity** folder. Now, create a TypeScript file, **Student.ts** and enter below code:

Student.ts

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";

@Entity()
export class Student {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    Name: string;

    @Column()
    age: number;

}
```

Here,

- **Entity()** decorator class is used to represent that the **Student** class is an entity.
- **PrimaryGeneratedColumn()** decorator class is used to represent that the *id* column is the primary key column of the **Student** entity.
- **Column()** decorator class is used to represent other columns such as **Name** and **Age** of the **Student** entity.

Now, Entity class **Student** is created. TypeORM will auto generate a table corresponding to the **Student** entity in our database and it will be named as **student**. Now, move to **src/index.ts** file and add the following code:

index.ts

```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Student} from "./entity/Student"; //import Student entity


createConnection().then(async connection => {

    console.log("Inserting a new record into the student database...");

    //create student object
    const stud = new Student();

    //Assign student name and age here
    stud.Name = "student1";
    stud.age = 12;

    //save student object in connection
    await connection.manager.save(stud);
    console.log("Saved a new user with id: " + stud.id);

    console.log("Loading users from the database...");

    //Display student saved records
    const students = await connection.manager.find(Student);
    console.log("Loaded users: ", students);

    console.log("Here you can setup and run express/koa/any other framework.");

}).catch(error => console.log(error));
```

Here,

- Line 1 - 3 imports the relevant classes, **createConnection** and **Student**
- Line 5 creates a new connection to the database using **createConnection** and if connection is established, it executes the code inside the **then** block.
- Line 10 create new **Student** object, **stud**.
- Line 13-14 set the attributes of our newly created **stud** object.
- Line 17 saves the entity to the database using **save** method available in **connection.manager** object.
- Line 23 fetches the student details from the database using **find** method available in **connection.manager** object.

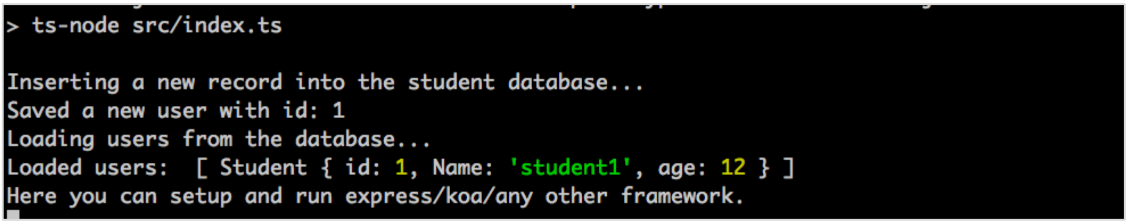
Start Mysql server and run your application

We have created Student entity and create connection in **index.ts.** Let us start both MySql server and your application.

```
npm start
```

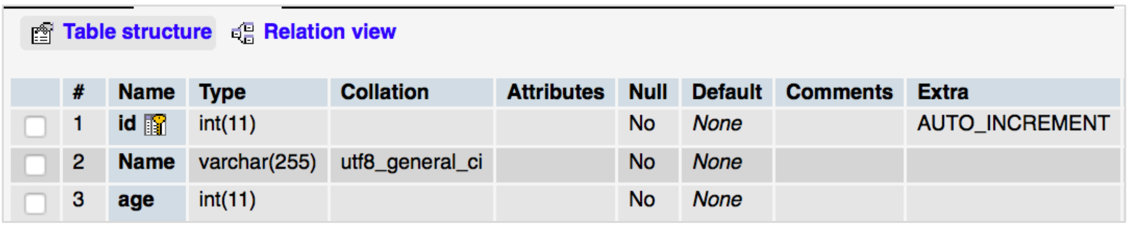
This will return the following output on your screen:

Result



```
> ts-node src/index.ts

Inserting a new record into the student database...
Saved a new user with id: 1
Loading users from the database...
Loaded users:  [ Student { id: 1, Name: 'student1', age: 12 } ]
Here you can setup and run express/koa/any other framework.
```

Open **mysql** server following **student** table is added inside your database.



	#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
☐	1	id	int(11)			No	*None*		AUTO_INCREMENT
☐	2	Name	varchar(255)	utf8_general_ci		No	*None*		
☐	3	age	int(11)			No	*None*		

Columns

As learned earlier, Entity is actually a collection of attributes. As entity object refers the database table. Its attributes / member variables refer the corresponding database table's fields / columns. TypeORM supports all type of database fields through *Column* class. Let us learn the different type of column supported by TypeORM in this chapter.

@Column() decorator class is used to represent the column and its type in the entity.

For example, *age* attribute of the student entity and the type of the *age* attribute can be defined as below:

```
@Column("int")
age: integer;

// OR
@Column({ type: "int" })
age: integer;
```

Here,

- **age** is the attribute of the entity. In other word, *age* is a field / column in the student table in the database.
- **int** represent the type of the *age* column in the database.

TypeORM supports nearly all the types available in the popular database engine. Actually, TypeORM enables different set of types for each database engine. We can use any database type supported by our database engine without any issue.

For example, the type supported by TypeORM for postgresql database engine is as follows:

```
int, int2, int4, int8, smallint, integer, bigint, decimal, numeric,
real, float, float4, float8, double precision, money, character varying,

varchar, character, char, text, citext, hstore, bytea, bit, varbit, bit


varying, timetz, timestamptz, timestamp, timestamp without time zone, timestamp
with time zone, date, time, time without time zone, time with time zone,
interval, bool, boolean, enum, point, line, lseg, box, path, polygon, circle,
cidr, inet, macaddr, tsvector, tsquery, uuid, xml, json, jsonb, int4range,
int8range, numrange, tsrange, tstzrange, daterange, geometry, geography, cube
```

Similarly, TypeORM supports a different set of datatype for MySQL.

Column Options

TypeORM provides an extensive set of options other than **type** to describe the column. For example, **length** option refers the length of the database field and it can be specified as below:

```
@Column("varchar", { length: 100 })
```

Some of the most common column options are as follows:

- **name** - Name of the database field / column.
- **length** - Length of the database field / column.
- **nullable** - Specify whether the database field / column allows null or not.
- **default** - Default value of the database field / column.
- **primary** - Specify whether the database field / column is primary key of the table.
- **unique** - Specify whether the database field / column is unique
- ***precision**** - Precision of the database field / column
- **scale** - Scale of the database field / column
- **comment** - Comment or description of the database field / column

@Generated decorator

TypeORM provides additional decorator, **@Generated** to auto generate the column values. For example, Universally Unique Identifier (UUID) is quite common to use in database to store unique value in a column. The sample code to generate UUID is as follows:

```
@Entity()
export class Student {

    @PrimaryColumn()
    id: number;

    @Column()
    @Generated("uuid")
    uuid: string;
}
```

Here,

uuid is generated automatically and stored inside the database.

Primary columns

At least one primary column field is mandatory for any entity in database. It is classified into different types of decorators. We will discuss it one by one.

@PrimaryColumn()

@PrimaryColumn() decorator is used to create primary column for any type of data. Simple example is shown below,

```
import {Entity, PrimaryColumn} from "typeorm";

@Entity()
export class Student {
    @PrimaryColumn()
    id: number;
}
```

Here,

id is an integer, which doesn't accept duplicate values, but we need to assign values.

We can assign primary column for one or more fields as well, if the situation demands.

Example:

```
import {Entity, PrimaryColumn} from "typeorm";

@Entity()
export class Student {

    @PrimaryColumn()
    id: number;

    @PrimaryColumn()
    email: string;

    @PrimaryColumn()
    phone: number;
}
```

@PrimaryGeneratedColumn()

@PrimaryGeneratedColumn() field is used to specify the primary column as well as to auto generate the column value in the database. It is shown below:

```
import {Entity, PrimaryGeneratedColumn} from "typeorm";

@Entity()
export class Student {


    @PrimaryGeneratedColumn()
    id: number;
}
```

Here,

You don’t have to assign *id* value; it will be generated automatically by the TypeORM in the database table.

@PrimaryGeneratedColumn(“uuid”)

@PrimaryGeneratedColumn also accepts an argument to specify the type of generator. One of the main use is to generate unique id based on UUID.

```
import {Entity, PrimaryGeneratedColumn} from "typeorm";

@Entity()
export class Student {
    @PrimaryGeneratedColumn("uuid")
    id: string;
}
```

simple-array column type

Advanced relational database supports array datatype. To support the array datatype, TypeORM provides a special column type, *simple-array" to store primitive array values. A sample code to use it is as follows:

```
@Entity()
export class Student {

    @PrimaryGeneratedColumn()
    id: number;

    @Column("simple-array")
    names: string[];
}
```

simple-json column type

Lot of modern database engine supports JSON database. To use JSON datatype, TypeORM provides a special type, **single-json**. The sample code to use it is as follows:

```
@Entity()
export class Student {

    @PrimaryGeneratedColumn()
    id: number;

    @Column("simple-json")
    info: { firstName: string, middleName: string, lastName: string };
}
```

This value can be defined in **index.ts** as,

index.ts

```
const stud = new Student();
stud.info = { firstName: "John", middleName: "peter", lastName: "Michael" };
```

Special columns

TypeORM supports the following special columns

- **@CreateDateColumn** - It is a special column to set entity's insertion date automatically.
- **@UpdateDateColumn** - It is used to set the entity's update time automatically.
- **@VersionColumn** - Set version number for entity automatically.

Entity Inheritance

Entity inheritance is use to reduce duplication of entities. Consider the below entities:

Result.ts

```
@Entity()
export class Result {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    title: string;

    @Column()
    description: string;

    @Column()
    eligible: string
}
```

Grade.ts

The code for grade.ts is as follows:

```
@Entity()
export class Grade {
    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;

    @Column()
    title: string;

    @Column()
    description: string;



    @Column()
    grading : string;
}
```

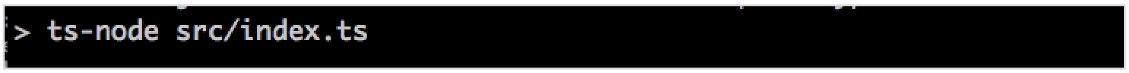
Here,

The above two entities have **columns id, title** and **description**. Using entity inheritance, we create one base class **Details** and combine the above two entities as specified below.

Details.ts

```
export abstract class Details {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    title: string;

    @Column()
    description: string;
}

@Entity()
export class Result extends Details {
    @Column()
    eligible: string
}

@Entity()
export class Grade extends Details {
    @Column()
    name : string;

    @Column()
    grading : string;
}
```

Now start your server, you could see the below response,



```
> ts-node src/index.ts
```

Now open your **mysql** server and move to your database, you could see the following tables,

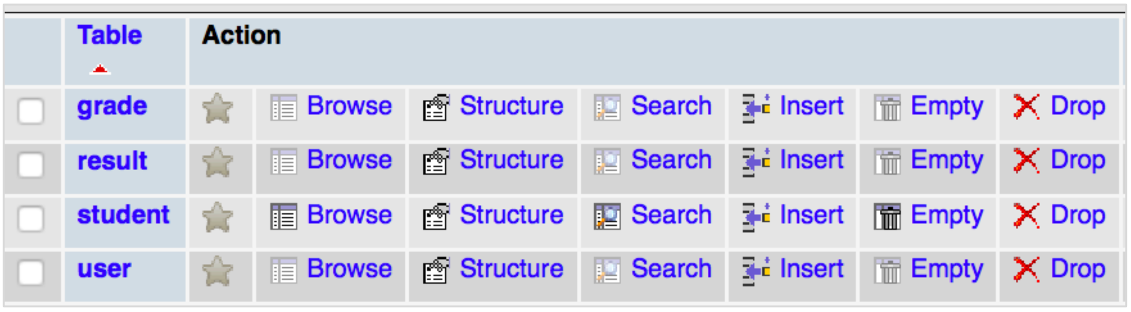
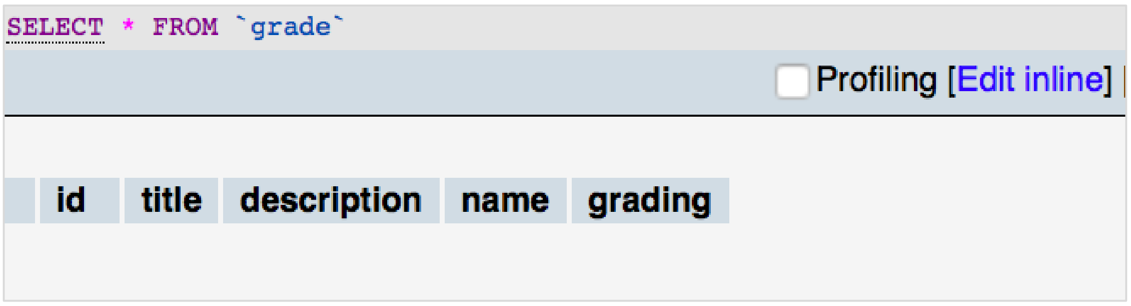


	Table	Action						
☐	grade	☆	Browse	Structure	Search	Insert	Empty	Drop
☐	result	☆	Browse	Structure	Search	Insert	Empty	Drop
☐	student	☆	Browse	Structure	Search	Insert	Empty	Drop
☐	user	☆	Browse	Structure	Search	Insert	Empty	Drop

Grade table

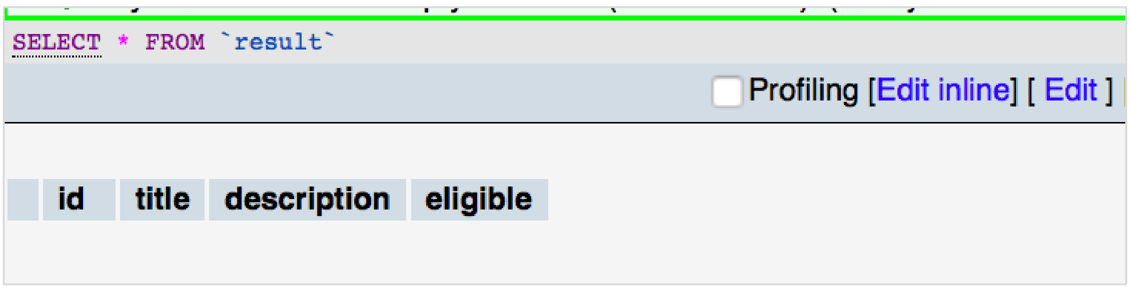


```
SELECT * FROM `grade`
```

☐ Profiling [Edit inline] |

id	title	description	name	grading

Result table



```
SELECT * FROM `result`
```

☐ Profiling [Edit inline] [Edit] |

id	title	description	eligible

6. TypeORM — Relations

Relations are used to refer the relationship between table in database. In general, a relationship exists between two tables when one of them has a foreign key that references the primary key of the other table. This feature makes relational database more powerful and efficiently store information.

TypeORM allows the entities to be related to each other and subsequently database tables. In general, relationship can be classified into four broader categories. They are as follows,

one-to-one: One object of the given entity relates to only one object of the target entity and vice versa. For example, a country will have only one capital city and similarly a city will be capital of only one country.

many-to-one: Multiple object of the given entity relates to one object of the target entity. For example, city comes under only one country but country can have multiple cities.

one-to-many: Same as many-to-one except the relationship is reversed.

many-to-many: Multiple object of the given entity relates to multiple object of the target entity. For example, an article may be tagged under multiple topic like programming language, finance, etc., and at the same time a particular tag may have multiple articles as well.

TypeORM also provides options to enhance the relationship of the entities. They are as follows:

- **eager** - Source entity object loads the target entity objects as well.
- **cascade** - Target entity object gets inserted or updated while the source entity object is inserted or updated.
- **onDelete** - Target entity objects get deleted as well while the source entity object is deleted.
- **primary** - Used to specify that the relation column is primary key or not.
- **nullable** - Used to specify that the relation column is nullable or not.

Let us go through different types of relation mapping in detail.

One-to-One

As we learned earlier, it is referred by the instance of one table field contains the instance of another table field and vice versa. Let us create a **Details** table:

Details.ts

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";


```

```
@Entity()
export class Details {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    gender: string;

    @Column()
    country: string;
}
```

Let's create an another entity **Customer** as follows:

Customer.ts

```
import {Entity, PrimaryGeneratedColumn, Column, OneToOne, JoinColumn} from
"typeorm";

import {Details} from "./Details";

@Entity()

export class Customer {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;

    @OneToOne(type => Details)
    @JoinColumn()
    details: Details;

}
```

Here,

We have added mapping **OneToOne** to **Details** table. **@JoinColumn()** contain a "relation id" and foreign key to **Customer** table. We can save the relation in **index.ts** as follows:

```
const details = new Details();
details.gender = "female";
details.country = "india"
await connection.manager.save(details);

const customer = new Customer();
customer.name = 'customer1';
customer.details = Details;
await connection.manager.save(Customer);
```

One-to-Many and Many-to-One

As we learned earlier, it is referred by the instance of first table field contains the multiple instances of second table field called **One-to-Many** mapping and multiple instances of first table contains only one instance of second table called **Many-to-One** mapping.

Consider an example of **Student** and **project** entities whereas, student can work on more than one project but each project is handled by only one student.

Let's create a **Project** entity as follows:

Project

```
import {Entity, PrimaryGeneratedColumn, Column, ManyToOne} from "typeorm";
import {Student} from "./Student";

@Entity()
export class Project {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    projects: string;

    @ManyToOne(type => Student, student => student.projects)
    student: Student;
}
```

Now, we create **Student** entity as below:

```
import {Entity, PrimaryGeneratedColumn, Column, OneToMany} from "typeorm";
import {Project} from "./Project";

@Entity()
export class User {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;

    @OneToMany(type => Project, project => project.student)
    projects: Project[];
}
```

Here,

@OneToMany property mapped **Project** and **@ManyToOne** property mapped to **Student**. However, **@OneToMany** cannot exist without **@ManyToOne** and **@ManyToOne** property contain "relation id" and foreign key.

We can save the connection in **index.ts** as follows:

```
const proj1 = new Project();
proj1.projects = "database management";
await connection.manager.save(proj1);

const proj2 = new Project();
proj2.projects = "web application";
await connection.manager.save(proj2);

const stud = new Student();
stud.name = "Student1";
stud.projects = [proj1, proj2];
await connection.manager.save(stud);
```

Many-to-Many

As we learned earlier, it is referred by multiple records in one table are related to multiple records in another table. Consider an example, University student can be enrolled in multiple classes at a time which means student may have four or five classes per semester and a class can have many students.

We can simply conclude, a student has many classes, and a class has many students. Let's create an entity for **Classes** as follows:

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";

@Entity()
export class Classes {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;

}
```

Now, we create **Student** entity as below:

```
import {Entity, PrimaryGeneratedColumn, Column, ManyToMany, JoinTable} from
"typeorm";
import {Classes} from "./Classes";

@Entity()
export class Student {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;
    @Column()
    subjects: string;

    @ManyToMany(type => Classes)
    @JoinTable()
    classes: Classes[];
}
```

7. TypeORM — Working with Repository

Repository is specific to an entity. In other words, each entity will have its own, build-in repository and it can be accessed using **getRepository()** method of *connection* object as specified below:

```
const studRepository = manager.getRepository(Student);
```

Once the student repository object is created, it can be used to do all database operation of student object.

Repository types

Repository is classified into four categories. They are as follows:

Repository

Default repository of an entity and it can be accessed using **getRepository()** method as specified below:

```
const studRepository = manager.getRepository(Student);
```

Now, **studRepository** can be used to query **student** table

TreeRepository

Used for tree like structure entities and it can be accessed using **getTreeRepository()** method as specified below:

```
const studcaRepository = manager.getTreeRepository(Student);
```

MongoRepository

Used inside mongoDB operation entities and it can be accessed using **getMongoRepository()** method as specified below:

```
const detailsRepository = manager.getMongoRepository(Details);
```

CustomRepository

Used to customize the repository and it can be accessed using **getCustomRepository()** method as specified below,

```
const myUserRepository = manager.getCustomRepository(UserRepository);
```

Repository API

Let us learn most important method of the EntityManager in this chapter.

manager

We can access **EntityManager** using manager method as specified below:

```
const manager = repository.manager;
```

queryRunner

queryRunner method returns custom query runner object and it is used for database operations by repository. The sample code is as follows:

```
const queryRunner = repository.queryRunner;
```

metadata

metadata returns repository's metadata. The sample code is as follows:

```
const metadata = repository.metadata;
```

query

query method executes SQL queries. Simple select query as shown below:

```
const qur = await repository.query(`select * from students`);
```

insert

insert method is used to insert a new entity or array of entities to the database. The sample code is as follows:

```
await repository.insert({
     Name: "Student3",
     Age: 14
});
```

The above query is equivalent to,

```
insert into student(Name,age) values("Student3",14)
```

update

update is used to update the existing records in the database.

```
await repository.update(1, { Name: "Adam" });
```

This query works similar to the one mentioned below:

```
update student SET Name = "Adam" where id = 1
```

delete

delete method will delete the specified record from the table,

```
await repository.delete(Student, 1);
```

This will delete student with id **1** from the **student** table. It is equivalent to,

```
delete from student where id=1;
```

If you want to delete by name then use the below query,

```
await repository.delete({ Name: "Student1" });
```

This query will delete all the student having name, **Student1**

** softDelete and restore **

It is used to soft delete the data and you can restore the record based on the id of the student. The sample code is as follows:

```
await repository.softDelete(1);
```

You can restore the student record using below command:

```
await repository.restore(1);
```

An alternative option to delete and restore is to use **softRemove** and **recover** methods. The sample code is as follows:

```
//find the entities
const enty = await repository.find();

//soft removed entity
const entySoftRemove = await repository.softRemove(enty);
```

And, you can recover them using **recover** method as specified below,

```
await repository.recover(entySoftRemove);
```

save

save is used to save the given entity into the database. Simple Student entity can be save as shown below:

```
import {Student} from "./entity/Student";

createConnection().then(async connection => {
    console.log("Inserting a new record into the student database...");
    const stud = new Student();
    stud.Name = "student1";
    stud.age = 12;
    await repository.save(stud);
```

This will add new student record into the database.

remove

remove is used to delete the given entity from the database. Simple Student entity can be deleted as shown below:

```
await repository.remove(stud);
```

count

count method will return the number of records available in the table and you can use it pagination purposes. The sample code is as follows:

```
const cnt = await repository.count(Student, { age: 12 });
```

find

find method is used for searching purposes. It fetches all the record from database as shown below:

```
const result = await repository.find({ id: 1 });
```

findOne

Similar to **find** method, but returns the first matched record. The sample code is as follows:

```
const result = await repository.findOne({ id: 1 });
```

clear

clear method clears all the data from the table. The sample code is as follows:

```
await repository.clear();
```

8. TypeORM — Working with Entity Manager

EntityManager is similar to **Repository** and used to manage database operations such as insert, update, delete and load data. While **Repository** handles single entity, **EntityManager** is common to all entities and able to do operations on all entities.

Entity Manager API

We can access **EntityManager** using **getManager()** method as specified below:

```
import { getManager } from "typeorm";
const entityManager = getManager();
```

Let us learn most important method of the EntityManager in this chapter.

connection

connection method returns database ORM connection to specific databases. The sample code is as follows:

```
const connection = manager.connection;
```

QueryRunner

queryRunner method returns custom query runner object and it is used for database operations by entity manager. The sample code is as follows:

```
const queryRunner = manager.queryRunner;
```

transaction

If multiple database requests are called, **transaction** will execute in a single database transaction. The sample code to get the transaction is as follows:

```
await manager.transaction(async manager => {
});
```

query

query method executes sql queries. Simple insert query as shown below:

```
const qur = await manager.query(`insert into student(name,age)
values('stud2',13)`);
```

insert

insert method is used to insert a new entity or array of entities to the database. The sample code is as follows:

```
await manager.insert(Student, {
     Name: "Student3",
     Age: 14
});
```

update

update is used to update the existing records in the database.

```
await manager.update(User, 1, { Name: "Adam" });
```

This query works similar to the below SQL query,

```
UPDATE student SET Name = "Adam" WHERE id = 1
```

delete

delete method will delete the specified record from the table,

```
await manager.delete(Student, 1);
```

This will delete with id 1 of student record.

save

save is used to save the given entity into the database. Simple **Student** entity can be save as shown below:

```
import {Student} from "./entity/Student";

createConnection().then(async connection => {
    console.log("Inserting a new record into the student database...");
    const stud = new Student();
    stud.Name = "student1";
    stud.age = 12;
    await connection.manager.save(stud);
}
```

This will add new student record into the database. **save** method will insert the student, if the given student does not exist in the database. Otherwise, **save** will update existing student record in the database.

remove

remove is used to delete the given entity from the database. Simple **Student** entity can be deleted as shown below:

```
await manager.remove(stud);
```

count

count method will return the number of records available in the table and you can use it pagination purposes. The sample code is as follows:

```
const cnt = await manager.count(Student, { age: 12 });
```

find

find method is used for searching purposes. It fetches all the record from database as shown below:

```
console.log("Loading users from the database...");
const students = await connection.manager.find(Student);
console.log("Loaded users: ", students);
```

findOne

Similar to **find** method, but returns the first matched record. The sample code is as follows:

```
const stud = await manager.findOne(Student, 1);
```

clear

clear method clears all the data from the table. The sample code is as follows:

```
await manager.clear(Student);
```

9. TypeORM — Query Builder

Query builder is used build complex SQL queries in an easy way. It is initialized from Connection method and QueryRunner objects.

We can create QueryBuilder in three ways.

Connection

Consider a simple example of how to use **QueryBuilder** using connection method.

```
import {getConnection} from "typeorm";

const user = await getConnection()
    .createQueryBuilder()
    .select("user")
    .from(User, "user")
    .where("user.id = :id", { id: 1 })
    .getOne();
```

Entity manager

Let's create a query builder using entity manager as follows:

```
import {getManager} from "typeorm";

const user = await getManager()
    .createQueryBuilder(User, "user")
    .where("user.id = :id", { id: 1 })
    .getOne();
```

Repository

We can use repository to create query builder. It is described below,

```
import {getRepository} from "typeorm";

const user = await getRepository(User)
    .createQueryBuilder("user")
    .where("user.id = :id", { id: 1 })
    .getOne();
```

Aliases

Aliases are same as SQL alias. We create alias for Student table using QueryBuilder as described below:

```
import {getConnection} from "typeorm";

const user = await getConnection()
    .createQueryBuilder()
    .select("stud")
    .from(Student, "stud")
```

This query is equivalent to,

```
select * from students as stud
```

Parameters

Parameters are used as placeholders for the dynamic values in the query. In many cases, the query to find different entity object will be same except values. For example, the query to find different student is same except the **Student ID** data. In this case, we can use parameter for **Student ID** and then change the parameter to get the different student objects.

Another important use of parameter is to prevent ***SQL* injection**. It is one of the important security breach in the modern web application. By using parameter in the query, we can survive the **SQL injection** attacks.

For example,

```
"student.id = :id", { id: 1 }
```

Here,

:id - parameter name.

{ id: 1 } - value of the parameter

Adding expression

This section explains about how to use expressions.

where

where is used to filter the records if the condition is matched.

```
createQueryBuilder("student")
    .where("student.id = :id", { id: 1 })
```

This query is equivalent to,

```
select * from students student where student.id=1;
```

We can also use **AND, OR, NOT, IN** conditions inside.

having

Simple **having** expression is defined below:

```
createQueryBuilder("student")
    .having("student.id = :id", { id: 1 })
```

This query is equivalent to,

```
select * from students student having student.id=1;
```

orderBy

orderby is used to sort the records based on the field.

```
createQueryBuilder("student")
    .orderBy("student.name")
```

This query is equivalent to,

```
select * from students student order by student.name;
```

groupBy

It is used to group the records based on the specified column.

```
createQueryBuilder("student")
    .groupBy("student.id")
```

This query is equivalent to,

```
select * from students student group by student.id;
```

limit

It is used to limit the selection of rows. Below, example shows how to use **limit** in query builder,

```
createQueryBuilder("student")
    .limit(5)
```

This query is equivalent to,

```
select * from students student limit 5;
```

offset

Offset is used to specify, how many rows to skip the result. It is defined below:

```
createQueryBuilder("student")
    .offset(5)
```

This query is equivalent to,

```
select * from students student offset 5;
```

joins

join clause is used to combine rows from two or more tables, based on a related column. Consider the two entities:

Student.ts

```
import {Entity, PrimaryGeneratedColumn, Column, OneToMany} from "typeorm";
import {Project} from "./Project";

@Entity()
export class User {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;

    @OneToMany(type => Project, project => project.student)
    projects: project[];
}
```

Project.ts

```
import {Entity, PrimaryGeneratedColumn, Column, ManyToOne} from "typeorm";
import {Student} from "./Student";

@Entity()
export class Project {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    title: string;

    @ManyToOne(type => Student, student => student.projects)
    student: Student;
}
```

Let us perform simple left join using the below query:

```
const student = await createQueryBuilder("student")
    .leftJoinAndSelect("student.projects", "project")
    .where("student.name = :name", { name: "Student1" })
    .getOne();
```

This query is equivalent to,

```
SELECT student.*, project.* FROM students student
    LEFT JOIN projects project ON project.student = student.id
    WHERE student.name = 'Student1'
```

Similarly, we can try **inner join** as well.

Join without selection

We can join data without using *select*. Let us try this example using *Inner join* as follows:

```
const student = await createQueryBuilder("student")
    .innerJoin("student.projects", "project")
    .where("student.name = :name", { name: "student1" })
    .getOne();
```

The above query is equivalent to:

```
SELECT student.* FROM students student
    INNER JOIN projects project ON project.student = student.id
    WHERE student.name = 'Student1';
```

Pagination

If you have more data in your application, you need pagination, page slider or scrolling functionalities.

For example, if you want to show first five students projects in your application,

```
const students = await getRepository(Student)
    .createQueryBuilder("student")
    .leftJoinAndSelect("student.projects", "project")
    .take(5)
    .getMany();
```

If you want to skip five students' projects in your application,

```
const students = await getRepository(Student)
    .createQueryBuilder("student")
    .leftJoinAndSelect("student.projects", "project")
    .skip(5)
    .getMany();
```

subqueries

It is called query within another query or nested query. We use subqueries in **FROM, WHERE** and **JOIN** expressions.

Simple example is shown below:

```
const projects = await connection
    .createQueryBuilder()
    .select("project.id", "id")
    .addSelect(subQuery => {
        return subQuery
            .select("student.name", "name")
            .from(Student, "student")
            .limit(1);
    }, "name")
    .from(Project, "project")
    .getMany();
```

Hidden field

If any of your column field is marked as *{select: false}* then that column is considered as hidden column. Consider the below entity:

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";

@Entity()
export class Student {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;

    @Column({select: false})
    address: string;
}
```

Here,

address field is marked as **hidden**. We can use **addSelect** method to retrieve the information from the column. It is defined below,

```
const student = await connection.getRepository(Student)
    .createQueryBuilder()
    .select("student.id", "student")
    .addSelect("student.address")
    .getMany();
```

getSql()

This method is used to get the generated SQL query by query builder. It is defined below:

```
const sql = createQueryBuilder("student")
    .where("student.name = :name", { name: "Student1" })
    .orWhere("student.age = :age", { age: 14 })
    .getSql();
```

10. TypeORM — Query Operations

Data manipulation is used to manage and view data. This section explains about how to access database queries like insert, update, select and delete queries using QueryBuilder. Let’s go through one by one in detail.

Build insert query

Let us create a *Customer* entity as follows:

Customer.ts

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";

@Entity()
export class Customer {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    name: string;

    @Column()
    age: number;
}
```

Let’s add the following changes in **index.ts** as follows:

index.ts

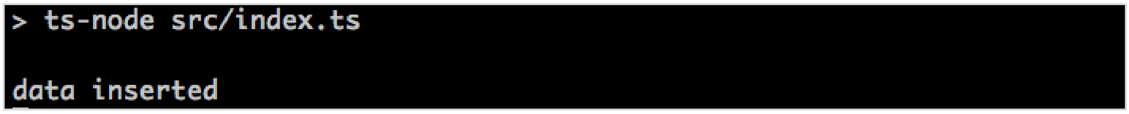
```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Customer} from "./entity/Customer";
import {getConnection} from "typeorm";

createConnection().then(async connection => {
    await getConnection().createQueryBuilder()
    .insert()
    .into(Customer)
    .values([
        { name: "Adam",age:11},
        { name: "David",age:12}

     ])
    .execute();

}).catch(error => console.log(error));
```

Now, start your application using the below command:

```
npm start
```

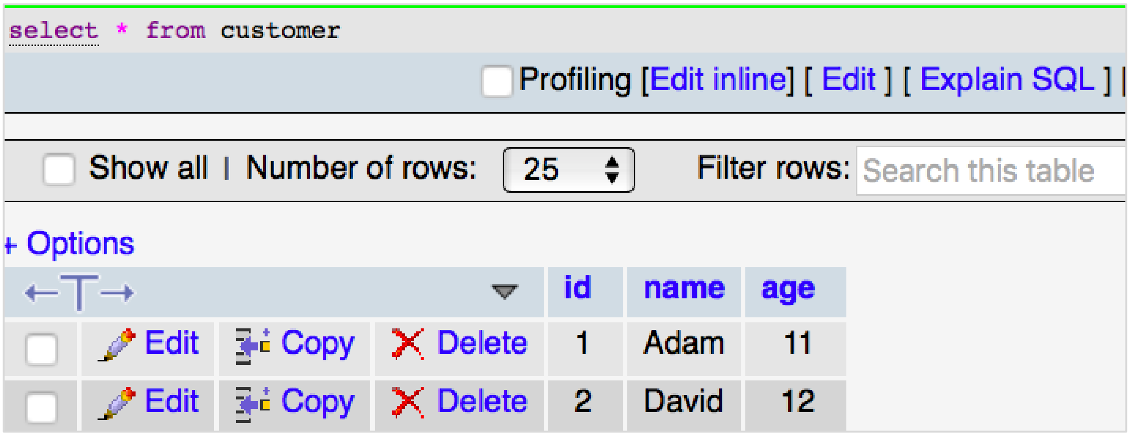
Result

You could see the following output on your screen:



```
> ts-node src/index.ts

data inserted
```

Now open your mysql server, table inserted with two fields as shown below:



```
select * from customer
```

Profiling [Edit inline] [Edit] [Explain SQL]
Show all | Number of rows: 25
Filter rows: Search this table
+ Options

				id	name	age
	Edit	Copy	Delete	1	Adam	11
	Edit	Copy	Delete	2	David	12

Build update query

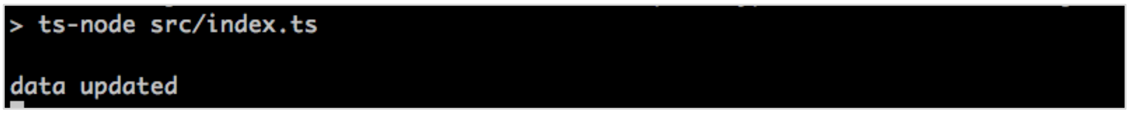
Last section, we have inserted two rows of data. Let's check how update query works. Add the following changes in **index.ts** as follows:

```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Customer} from "./entity/Customer";
import {getConnection} from "typeorm";

createConnection().then(async connection => {

await getConnection()
    .createQueryBuilder()
    .update(Customer)
    .set({ name: "Michael" })
    .where("id = :id", { id: 1 })
    .execute();

    console.log("data updated");

}).catch(error => console.log(error));
```

Now, start your application using the below command:

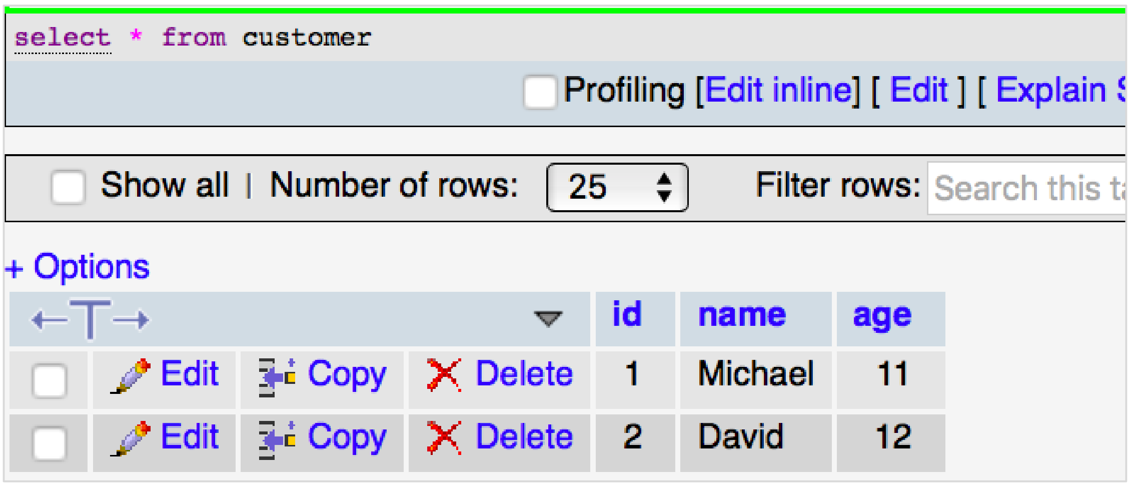
```
npm start
```

You could see the following output on your screen:



```
> ts-node src/index.ts

data updated
```

Mysql table is modified as shown below:



```
select * from customer
```

Profiling [Edit inline] [Edit] [Explain S

Show all | Number of rows: 25 Filter rows: Search this t

+ Options

				id	name	age
☐	Edit	Copy	Delete	1	Michael	11
☐	Edit	Copy	Delete	2	David	12

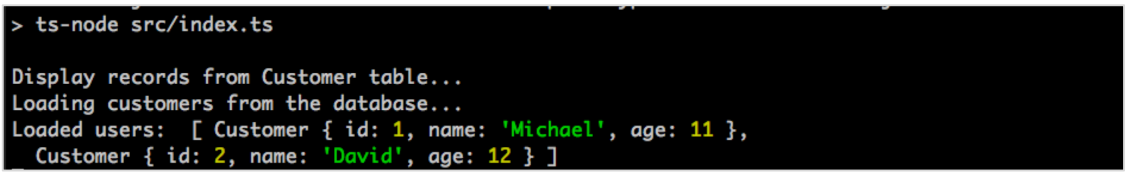
Build select query

select query is used to display the records from the table. Let's add the following code in **index.ts** as follows:

index.ts

```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Customer} from "./entity/Customer";

createConnection().then(async connection => {

    console.log("Display records from Customer table...");
    const cus = new Customer();

    console.log("Loading customers from the database...");
    const customers = await connection.manager.find(Customer);
    console.log("Loaded users: ", customers);

}).catch(error => console.log(error));
```

You could see the following output on your screen:



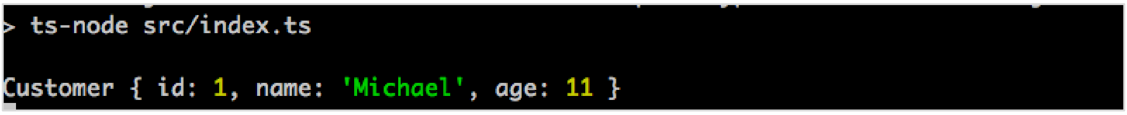
```
> ts-node src/index.ts

Display records from Customer table...
Loading customers from the database...
Loaded users:  [ Customer { id: 1, name: 'Michael', age: 11 },
  Customer { id: 2, name: 'David', age: 12 } ]
```

where expression

Let us add *where* expression in the query to filter the customers. The sample code is as follows:

```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Customer} from "./entity/Customer";
import {getConnection} from "typeorm";

createConnection().then(async connection => {
    const customer = await getConnection()
    .createQueryBuilder()
    .select("cus")
    .from(Customer, "cus")
    .where("cus.id = :id", { id: 1 })
    .getOne();

    console.log(customer);
}).catch(error => console.log(error));
```

The above program will return first id records. You could see the following output on your screen,



```
> ts-node src/index.ts

Customer { id: 1, name: 'Michael', age: 11 }
```

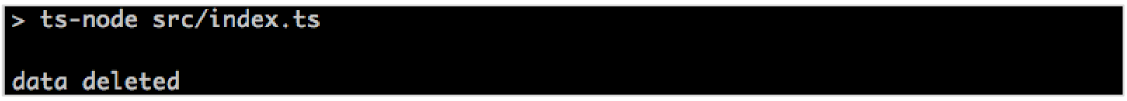
Similarly, you can try other expressions as well.

Build delete query

Last section, we have inserted, updated and select data. Let's check how delete query works. Add the following changes in **index.ts** as follows:

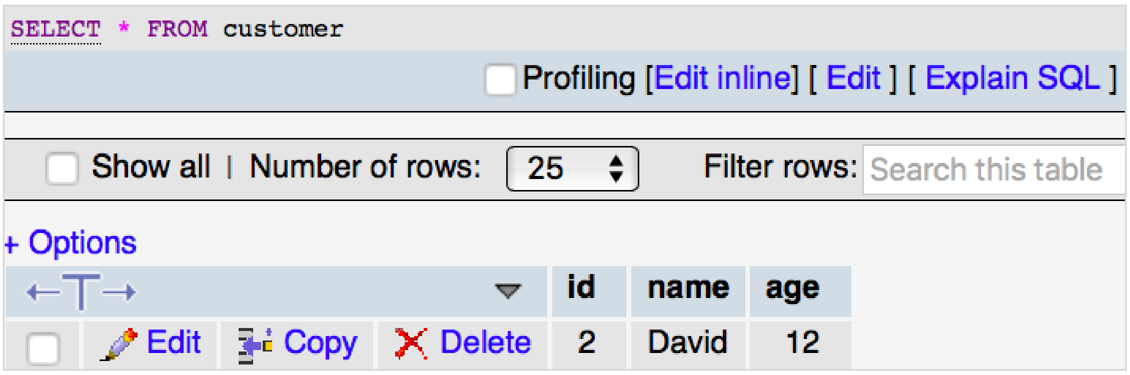
```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Customer} from "./entity/Customer";
import {getConnection} from "typeorm";

createConnection().then(async connection => {
    await getConnection()
    .createQueryBuilder()
    .delete()
    .from(Customer)
    .where("id = :id", { id: 1 })
    .execute();
    console.log("data deleted");
}).catch(error => console.log(error));
```

You could see the following output on your screen:



```
> ts-node src/index.ts

data deleted
```

And your mysql table is modified as follows:



```
SELECT * FROM customer
```

Profiling [Edit inline] [Edit] [Explain SQL]
Show all | Number of rows: 25
Filter rows: Search this table
+ Options

				id	name	age
	Edit	Copy	Delete	2	David	12

11. TypeORM — Transactions

Generally, transaction is a logic unit responsible for execution of data retrieval and updates. This section explains about *Transactions* in detail.

Creating transactions

We can create a transaction using either **connection** or **EntityManage**. Below example is used to specify create connection and save data inside it.

```
import {getConnection} from "typeorm";

await getConnection().transaction(async transactionalEntityManager => {

await connection.manager.save(students);

});
```

EntityManager is shown below:

```
import {getManager} from "typeorm";

await getManager().transaction(async transactionalEntityManager => {
  await transactionalEntityManager.save(students);
});
```

Decorators

We have three types of transaction related **decorators** in TypeORM.

- **@Transaction** - Wraps all the execution in single database transcation.
- **@TransactionManager** - Used to execute queries inside transaction. It is defined below,

```
@Transaction({ isolation: "SERIALIZABLE" })

save(@TransactionManager() manager: EntityManager, student: Student) {
    return manager.save(student);
}
```

Here,

We used **SERIALIZABLE** isolation level for transaction.

- **@TransactionRepository** - Used to inject transaction in repository. It is defined below,

```
@Transaction()
save(student: Student, @TransactionRepository(Student) studentRepository:
Repository<Student>) {
    return studentRepository.save(student);
}
```

Transaction in *QueryRunner*

QueryRunner is used to execute all database queries. It has single database connection. Database transaction can be organized using *QueryRunner*. Let's perform single transaction using *QueryRunner*.

```
import {getConnection} from "typeorm";

// get a connection and create a new query runner
const connection = getConnection();
const queryRunner = connection.createQueryRunner();

// establish real database connection using our new query runner
await queryRunner.connect();

// now we can execute any queries on a query runner, for example:
await queryRunner.query("SELECT * FROM students");
```

Now, start transaction using the below statement:

```
await queryRunner.startTransaction();
```

Then, commit and rollback the transaction using the below statement,

```
try {
    await queryRunner.commitTransaction();
}
```

If there is any error, it is handled by catch(),

```
catch (err) {

    // since we have errors lets rollback changes we made
    await queryRunner.rollbackTransaction();

}
```

Now, release the **queryRunner** as below:

```
finally {

    // you need to release query runner which is manually created:
    await queryRunner.release();
}
```

12. TypeORM — Indices

In general, **Indexing** is a process to optimize the performance of a database by optimizing the data storage. It is used to quickly locate and access the data in a database. This section explains about how to use index in TypeORM. Indices are classified into different types. Let's go through one by one in detail.

Column indices

We can create index for particular column using **@Index**. Consider an example of *Customer* entity as shown below and index defined for **firstName** column,

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";

@Entity()
export class Student {

    @PrimaryGeneratedColumn()
    id: number;

    @Index()
    @Column()
    firstName: string;

    @Column()
    lastName: string;

    @Column()
    age: number;

    @Column()
    address: string;
}
```

@Index allow to specify name for an index as well:

```
@Index("Name-idx")
@Column()
firstName: string;
```

Unique indices

To specify *Unique* constraints in your column, use the below property:

```
{ unique: true }
```

For example, below is the code to specify **unique** index for **Name** column:

```
@Index({ unique: true })
@Column()
firstName: string;
```

To apply indices for more than one columns, we can directly specify it after **@Entity().** The sample code is as follows:

```
@Entity()
@Index(["firstName", "lastName"])
@Index(["firstName", "lastName"], { unique: true })
```

Spatial indices

Spatial index allows to access spatial objects. MySQL and PostgreSQL supports spacial indices. To enable spatial indices in your column, add the following property:

```
{ spatial: true }
```

Spatial type has multiple sub types such as, geometry, point, line string, polygon etc., For example, if you want to add *point* spatial type in your column, use below code:

```
@Column("point")
@Index({ spatial: true })
point: string;
```

Disable synchronization

To disable synchronization, use the below option on **@Index** decorator:

```
{ synchronize: false }
```

13. TypeORM — Entity Listener and Logging

Entity listener is used in entities which supports custom method and listen specific events. We can define any entity custom method using decorators. Let's understand decorators in brief.

- **@AfterLoad**: When the entity is loaded using QueryBuilder or repository/manager, this method will be called.
- **@BeforeInsert:** This method will call before the entity is inserted using repository/manager.
- **@AfterInsert:** This method will call after the entity is inserted using repository/manager.
- **@BeforeUpdate:** This method will call it before an existing entity is updated using repository/manager.
- **@AfterUpdate:** It will call after an entity is updated.
- **@BeforeRemove:** It will call before an entity is removed.
- **@AfterRemove:** It will call after an entity is removed.

Subscriber

Subscriber is used to listen specific entity events. It is implemented from **EntitySubscriberInterface**. Let's understand a simple example for how to use entity listener in subscriber. Consider the Student entity is shown below:

Student.ts

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";

@Entity()
export class Student {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    Name: string;

    @Column()
    age: number;

}
```

Create student subscriber

Subscriber is created using the below command:

```
typeorm subscriber:create -n StudentSubscriber
```

The above command creates a *subscriber* directory inside your project **src.** Then, **StudentSubscriber.ts** file is created inside your *subscriber*. You could see the following response,

```
Subscriber
/Users/workspace/TypeORM/FirstProject/src/subscriber/StudentSubscriber.ts has
been created successfully.
```

Now move to file, you could see the below coding:

StudentSubscriber.ts

```
import {EventSubscriber, EntitySubscriberInterface} from "typeorm";

@EventSubscriber()
export class StudentSubscriber implements EntitySubscriberInterface<any> {
}
```

Now, add the following changes in the file,

```
import {EventSubscriber, EntitySubscriberInterface,InsertEvent} from "typeorm";
import {Student} from "../entity/Student";

@EventSubscriber()
export class StudentSubscriber implements EntitySubscriberInterface<any> {
    listenTo()
    {
        return Student;
    }

    afterInsert(event: InsertEvent<Student>) {
        console.log(event);
    }
}
```

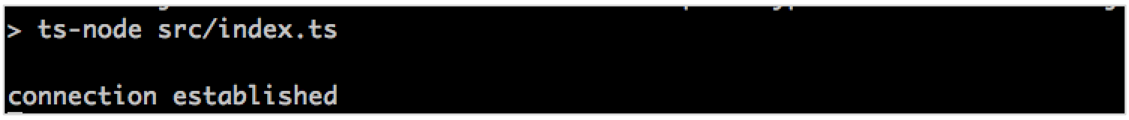
Here,

We have used **afterInsert()** method to call the entity event. Similarly, you can use other events as well. We have already configured **ormconfig.json** file. Now, add the below changes in **index.ts** file as follows:

index.ts

```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Student} from "./entity/Student";

createConnection().then(async connection => {
        console.log('connection established');


}).catch(error => console.log(error));
```

After executing the application, you could see the below output on your screen,



```
> ts-node src/index.ts

connection established
```

Logging

Database logging is an important part of your highly available database solution design because database logs make it possible to recover from a failure, and they make it possible to synchronize primary and secondary databases.

All databases have logs associated with them. These logs keep records of database changes. If a database needs to be restored to a point beyond the last full, off-line backup, logs are required to roll the data forward to the point of failure.

Logging options

Logging is enabled by adding *{logging: true}* in database connection. Logging options are classified into different types. They are as follows:

query - return all log queries. It is defined as given below:

```
{
    host: "localhost",
    ...
    logging: ["query"]
}
```

error - return logs for all failed queries and errors. It is defined below:

```
{
    host: "localhost",
    ...
    logging: ["error"]
}
```

schema - return logs for the schema.

warn - return internal ORM warnings.

info - return logs internal ORM informative messages.

log - return internal ORM log messages.

Custom logger

Custom logging is simple and highly customizable logging option. We can create our own logger class using the below code:

```
import {Logger} from "typeorm";

export class MyCustomLogger implements Logger {

    // implement all methods from logger class

}
```

Connection option is specified in **ormconfig.json** as follows:

```
name: "mysql",
type: "mysql",
host: "localhost",
port: 3306,
username: "root",
password: "root",
database: "test",
logger: new MyCustomLogger()
```

14. TypeORM with JavaScript

The default language supported by **TypeORM** is **TypeScript.** Since, **TypeScript** supports static typing, classes and decorators, it is easy to define the entity and its attributes. At the same time, **JavaScript** is necessary as well in certain project where the preferred language is JavaScript. **TypeORM** provides full support for JavaScript language as well. TypeORM support both es5 and es6 flavors of JavaScript.

In this chapter, let us learn how to write TypeORM application in JavaScript ES5 (ECMAScript 5).

Open a command prompt and go to your workspace.

```
cd /path/to/workspace/
```

Run below command to create a TypeORM project.

```
typeorm  init --name typeorm-javascript-student-app --database mysql
```

Open **package.json** file to remove the typescipt references.

original

```
{
   "name": "typeorm-javascript-student-app",
   "version": "0.0.1",
   "description": "Awesome project developed with TypeORM.",
   "devDependencies": {
      "ts-node": "3.3.0",
      "@types/node": "^8.0.29",
      "typescript": "3.3.3333"
   },
   "dependencies": {
      "typeorm": "0.2.24",
      "reflect-metadata": "^0.1.10",
      "mysql": "^2.14.1"
   },
   "scripts": {
      "start": "ts-node src/index.ts"
   }
}
```

updated

```
{
   "name": "typeorm-javascript-student-app",
   "version": "0.0.1",
   "description": "Awesome project developed with TypeORM.",
   "dependencies": {
      "typeorm": "0.2.24",
      "mysql": "^2.14.1"
   },
   "scripts": {
      "start": "node src/index.js"
   }
}
```

Here,

- Removed the **devDependencies** section and typescript related package in **dependences** section.
- Changed the start script to point javascript code instead of typescript code.

Run below command to install necessary packages.

```
npm install
```

Remove **tsconfig.json** and index.ts file.

Remove User.ts file inside entity folder and then create student entity in json format, **student.json** as specified below:

```
{
    "name": "Student",
    "columns": {
        "id": {
            "primary": true,
            "type": "int",
            "generated": true
        },
        "name": {
            "type": "varchar"
        },
        "age": {
            "type": "integer"
        }
    }
}
```

Create a new file, *src/index.js* and put the below code:

```
var typeorm = require("typeorm");
var EntitySchema = typeorm.EntitySchema;

typeorm.createConnection({
    "type": "mysql",
   "host": "localhost",
   "port": 3306,
   "username": "root",
   "password": "123456",
   "database": "typeorm_test_db",
    "synchronize": true,
    "logging": false,
     entities: [
     new EntitySchema(require("./entity/student.json"))
     ]
})
.then(function(connection) {
    return connection.getRepository("Student");
})
.then(function(studentRepository) {
    var student = {
    name: "Student1",
    age: 18
    };
    return studentRepository.save(student)
    .then(function(savedStudent) {
        console.log("Student has been successfully saved: ", savedStudent);
        return studentRepository.find();
    })
    .then(function(students) {
        console.log("All students: ", students);
        return;
    })
    .catch(function(error) {
        console.log("Error: ", error);
        return;
    })
})
.catch(function(error) {
    console.log("Error: ", error)
    return;
});
```

Here,

We have used the same typeORM methods except the below mentioned changes,

- Used **EntitySchema** to configure the student entity.
- Used JavaScript Promise concept (then / catch / finally) blocks.

Now, run the application using below command:

```
npm start
```

The application inserts the student information into the database and then fetch all student in the database and show it in the console as shown below:

```
> typeorm-javascript-student-app@0.0.1 start /path/to/workspace/typeorm-
javascript-student-app
```

```
> node src/index.js

Student has been successfully saved:  { name: 'Student1', age: 18, id: 1 }
All students:  [ { id: 1, name: 'Student1', age: 18 } ]
```

15. TypeORM — Working with MongoDB

This chapter explains the extensive **MongoDB** database support provided by TypeORM. Hopefully, we have installed mongodb using npm. If it is not installed, use the below command to install **MongoDB** driver,

```
npm install mongodb --save
```

Creating a project

Let's create a new project using MongoDB as follows:

```
typeorm init --name MyProject --database mongodb
```

Configure ormconfig.json

Let's configure MongoDB host, port and database options in **ormconfig.json** file as specified below:

ormconfig.json

```
{
    "type": "mongodb",
    "host": "localhost",
    "port": 27017,
    "database": "test",
    "synchronize": true,
    "logging": false,
    "entities": [
        "src/entity/**/*.ts"
    ],
    "migrations": [
        "src/migration/**/*.ts"
    ],
    "subscribers": [
        "src/subscriber/**/*.ts"
    ],
    "cli": {
        "entitiesDir": "src/entity",
        "migrationsDir": "src/migration",
        "subscribersDir": "src/subscriber"
    }
}
```

Define entities and columns

Let us create a new entity named **Student** inside your **src** directory. Entities and columns are same. To generate primary key column, we use **@PrimaryColumn** or

@PrimaryGeneratedColumn. This can be defined as **@ObjectIdColumn**. Simple example is shown below:

Student.ts

```
import {Entity, ObjectID, ObjectIdColumn, Column} from "typeorm";

@Entity()
export class Student {

    @ObjectIdColumn()
    id: ObjectID;

    @Column()
    Name: string;

    @Column()
    Country: string;

}
```

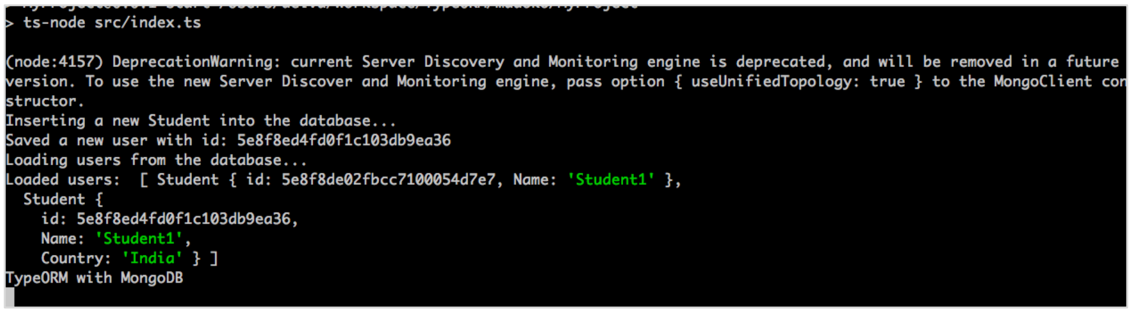
To save this entity, open **index.ts** file and add the following changes:

index.ts

```
import "reflect-metadata";
import {createConnection} from "typeorm";
import {Student} from "./entity/Student";

createConnection().then(async connection => {

    console.log("Inserting a new Student into the database...");
    const std = new Student();
    std.Name = "Student1";
    std.Country = "India";
    await connection.manager.save(std);
    console.log("Saved a new user with id: " + std.id);

    console.log("Loading users from the database...");
    const stds = await connection.manager.find(Student);
    console.log("Loaded users: ", stds);

    console.log("TypeORM with MongoDB");

}).catch(error => console.log(error));
```

Now, start your server and you will get the following response:

```
npm start
```



```
> ts-node src/index.ts

(node:4157) DeprecationWarning: current Server Discovery and Monitoring engine is deprecated, and will be removed in a future
version. To use the new Server Discover and Monitoring engine, pass option { useUnifiedTopology: true } to the MongoClient con
structor.
Inserting a new Student into the database...
Saved a new user with id: 5e8f8ed4fd0f1c103db9ea36
Loading users from the database...
Loaded users:  [ Student { id: 5e8f8de02fbcc7100054d7e7, Name: 'Student1' },
  Student {
    id: 5e8f8ed4fd0f1c103db9ea36,
    Name: 'Student1',
    Country: 'India' } ]
TypeORM with MongoDB
```

MongoDB EntityManager

We can also use *EntityManager* to fetch data. Simple example is shown below:

```
import {getManager} from "typeorm";

const manager = getManager();
const result = await manager.findOne(Student, { id:1 });
```

Similarly, we can also use repository to access data.

```
import {getMongoRepository} from "typeorm";

const studentRepository = getMongoRepository(Student);
const result = await studentRepository.findOne({ id:1 });
```

If you want to filter the data using **equal** option as follows:

```
import {getMongoRepository} from "typeorm";

const studentRepository = getMongoRepository(Student);
const result = await studentRepository.find({
  where: {
    Name: {$eq: "Student1"},
  }
});
```

As we seen in this chapter, TypeORM makes it easy to work with *MongoDB* database engine.

16. TypeORM with Express

Express is one of the popular JavaScript framework to create web application. Let us learn how to use **TypeORM** along with express framework in this chapter.

Creating a simple application

TypeORM CLI provides an easy option to create a complete working express web application (Restful API application) integrated with **TypeORM**. The CLI command to create the application is as follows:

```
cd /path/to/workspace
typeorm init --express --name typeorm-express-sample --database mysql
```

Above command will create a new web application under **typeorm-express-sample** folder. The structure of the application is as follows:

```
│    .gitignore
│    ormconfig.json
│    package.json
│    README.md
│    tsconfig.json
│
└───src
    │    index.ts
    │    routes.ts
    │
    ├───controller
    │        UserController.ts
    │
    ├───entity
    │        User.ts
    │
    └───migration
```

Here,

As we know, **ormconfig.json** is the **TypeORM** configuration file. The code is as follows,

```
{
   "type": "mysql",
   "host": "localhost",
   "port": 3306,
   "username": "test",
   "password": "test",
   "database": "test",
   "synchronize": true,
   "logging": false,
   "entities": [
      "src/entity/**/*.ts"
   ],
   "migrations": [
      "src/migration/**/*.ts"
   ],
   "subscribers": [
      "src/subscriber/**/*.ts"
   ],
   "cli": {
      "entitiesDir": "src/entity",
      "migrationsDir": "src/migration",
      "subscribersDir": "src/subscriber"
   }
}
```

Here, change the database setting to match your local database setting.

package.json file is the main configuration of the application.

tsconfig.json file contains the configuration related to TypeScript.

entity folder contains the **TypeORM** models. A default *User* model will be created by CLI and it is as follows:

```
import {Entity, PrimaryGeneratedColumn, Column} from "typeorm";

@Entity()
export class User {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    firstName: string;

    @Column()
    lastName: string;

    @Column()
    age: number;

}
```

controller folder contains the express controllers. CLI create a default user API controller with add / list / delete user details. The code is as follows:

```
import {getRepository} from "typeorm";
import {NextFunction, Request, Response} from "express";
import {User} from "../entity/User";

export class UserController {
    private userRepository = getRepository(User);

    async all(request: Request, response: Response, next: NextFunction) {
    return this.userRepository.find();
    }

    async one(request: Request, response: Response, next: NextFunction) {
    return this.userRepository.findOne(request.params.id);
    }

    async save(request: Request, response: Response, next: NextFunction) {
    return this.userRepository.save(request.body);
    }

    async remove(request: Request, response: Response, next: NextFunction) {
    let userToRemove = await this.userRepository.findOne(request.params.id);
    await this.userRepository.remove(userToRemove);
    }

}
```

Here,

all method is used to fetch all users from the database.

one method is used to fetch a single user from the database using **user id**

save method is used to save the user information into the database.

delete method is used to delete the user from the database using **user id**

routes.ts file maps the user controller methods to proper URL and the code is as follows:

```
import {UserController} from "./controller/UserController";

export const Routes = [{
    method: "get",
    route: "/users",
    controller: UserController,
    action: "all"
}, {
    method: "get",
    route: "/users/:id",
    controller: UserController,
    action: "one"
}, {
    method: "post",
    route: "/users",
    controller: UserController,
    action: "save"
}, {
    method: "delete",
    route: "/users/:id",
    controller: UserController,
    action: "remove"
}];
```

Here,

/users url is mapped to user controller. Each verb post, get and delete are mapped to different methods.

Finally, **index.ts** is our main web application entry point. The source code is as follows:

```
import "reflect-metadata";
import {createConnection} from "typeorm";
import * as express from "express";
import * as bodyParser from "body-parser";
import {Request, Response} from "express";
import {Routes} from "./routes";
import {User} from "./entity/User";

createConnection().then(async connection => {

    // create express app
    const app = express();
    app.use(bodyParser.json());

    // register express routes from defined application routes
    Routes.forEach(route => {
    (app as any)[route.method](route.route, (req: Request, res: Response, next: 
Function) => {
        const result = (new (route.controller as any))[route.action](req, res, 
next);
        if (result instanceof Promise) {
        result.then(result => result !== null && result !== undefined ? 
res.send(result) : undefined);

        } else if (result !== null && result !== undefined) {
        res.json(result);
        }
    });
    });

    // setup express app here
    // ...

    // start express server
    app.listen(3000);

    // insert new users for test
    await connection.manager.save(connection.manager.create(User, {
    firstName: "Timber",
    lastName: "Saw",
    age: 27
    }));
    await connection.manager.save(connection.manager.create(User, {
    firstName: "Phantom",
    lastName: "Assassin",
    age: 24
    }));

    console.log("Express server has started on port 3000. Open
http://localhost:3000/users to see results");

}).catch(error => console.log(error));
```

Here, the application configures the routes, insert two users and then start the web application at port *3000*. We can access the application at **http://localhost:3000**

To run the application, follow below steps:

Let us install the necessary packages using below command:

```
npm install
```

Output

```
npm notice created a lockfile as package-lock.json. You should commit this
file.
npm WARN typeorm-express-sample@0.0.1 No repository field.
npm WARN typeorm-express-sample@0.0.1 No license field.

added 176 packages from 472 contributors and audited 351 packages in 11.965s

3 packages are looking for funding
  run `npm fund` for details

found 0 vulnerabilities
```

Run the below command to start the application.

```
npm start
```

Output

```
> typeorm-express-sample@0.0.1 start /path/to/workspace/typeorm-express-sample
> ts-node src/index.ts

Express server has started on port 3000. Open http://localhost:3000/users to
see results
```

Let us access our web application API using *curl* command as below:

```
curl http://localhost:3000/users
```

Here,

curl is a command line application to access web application from command prompt. It supports all the HTTP verbs such as get, post, delete, etc.,

Output

```
[{"id":1,"firstName":"Timber","lastName":"Saw","age":27},{"id":2,"firstName":"P
hantom","lastName":"Assassin","age":24}]
```

To fetch the first record, we can use below command:

```
curl http://localhost:3000/users/1
```

Output

```
{"id":1,"firstName":"Timber","lastName":"Saw","age":27}
```

To delete a user record, we can use below command:

```
curl -X DELETE http://localhost:3000/users/1
```

As we seen in this chapter, **TypeORM** can be easily integrated into express application.

17. TypeORM — Migrations

Migrations are like version control for your database. It is used to modify and share application's database schema. This section explains about how migrations works in TypeORM.

Creating new migration

To create a new migration, first we need to setup connection in **ormconfig.json**. It is defined below:

ormconfig.json

```
"type": "mysql",
"host": "localhost",
"port": 8889,
"username": "root",
"password": "root",
"database": "Library",
"entities": ["entity/*.js"],
"migrationsTableName": "student_migration_table",
"migrations": ["migration/*.js"],
"cli": {
        "migrationsDir": "migration"
    }
```

Here,

- **migrationsTableName** - it refers the migration table name.
- **migrations** - TypeORM loads migrations from given directory.
- **cli** - indicates migration will create inside the specific directory.

Create *Book* entity

Let's create an entity named **Book** entity inside **src/entity/Book.ts** as follows:

```
import { Entity, Column, PrimaryGeneratedColumn } from 'typeorm';

@Entity()
export class Book {

    @PrimaryGeneratedColumn()
    id: number;

    @Column()
    title: string;

    @Column()
    text: string;
}
```

Execute CLI to create new migration

Now, we can execute new migration using CLI as follows:

Syntax

```
typeorm migration:create -n <migration-name>
```

Example

```
typeorm migration:create -n myMigration
```

After executing the above command, you could see the below response:

```
Migration /path/to/project/src/migration/1587101104904-myMigration.ts has been
generated successfully.
```

Now, move inside **src/migration/1587101104904-myMigration.ts** file looks similar to this.

```
import {MigrationInterface, QueryRunner} from "typeorm";

export class myMigration1587101104904 implements MigrationInterface {

    public async up(queryRunner: QueryRunner): Promise<any> {
    }

    public async down(queryRunner: QueryRunner): Promise<any> {
    }
}
```

Here,

We have two methods **up** and **down**. **up** method is used to add changes to the migration and **down** method is used to revert changes in your migration.

Let us add **up** method inside **myMigration.ts** file as specified below:

```
import {MigrationInterface, QueryRunner} from "typeorm";

export class Book1587131893261 implements MigrationInterface {

    public async up(queryRunner: QueryRunner): Promise<any> {
        await queryRunner.query(`ALTER TABLE book ADD COLUMN price int`);
    }
    public async down(queryRunner: QueryRunner): Promise<any> {
    }
}
```

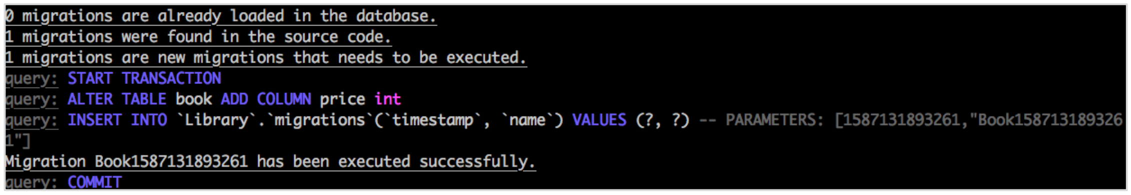
Here,

We have added a new column **price** inside **book** table. Now, execute the CLI to add the above changes.

```
ts-node ./node_modules/typeorm/cli.js migration:run
```

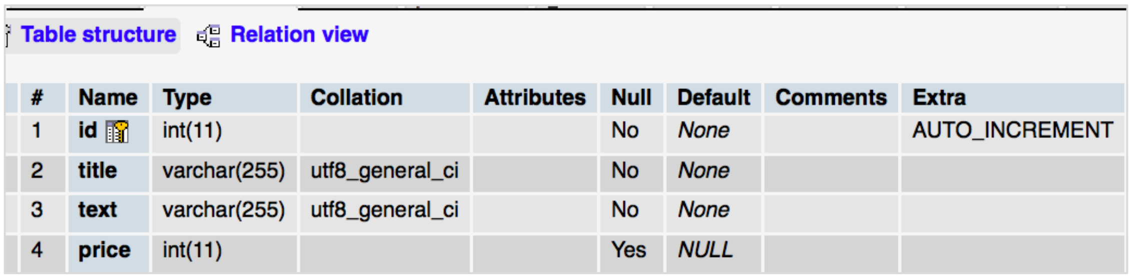
The above command executes migrations and run them in a sequence. Now, you could see the below changes in your screen:

Output



```
0 migrations are already loaded in the database.
1 migrations were found in the source code.
1 migrations are new migrations that needs to be executed.
query: START TRANSACTION
query: ALTER TABLE book ADD COLUMN price int
query: INSERT INTO `Library`.`migrations`(`timestamp`, `name`) VALUES (?, ?) -- PARAMETERS: [1587131893261,"Book158713189326
1"]
Migration Book1587131893261 has been executed successfully.
query: COMMIT
```

Now open your *mysql* server, new column is added. It is shown below:



#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
1	**id**	int(11)			No	*None*		AUTO_INCREMENT
2	**title**	varchar(255)	utf8_general_ci		No	*None*		
3	**text**	varchar(255)	utf8_general_ci		No	*None*		
4	**price**	int(11)			Yes	*NULL*		

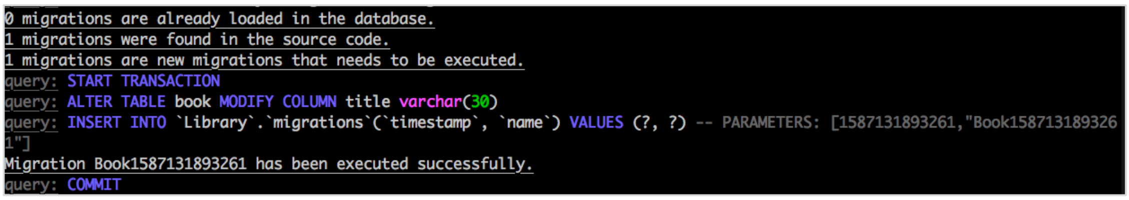
Similarly, We can **modify** column **title** datatype to **varchar(30)** as follows,

```
import {MigrationInterface, QueryRunner} from "typeorm";

export class Book1587131893261 implements MigrationInterface {

    public async up(queryRunner: QueryRunner): Promise<any> {
        await queryRunner.query(`ALTER TABLE book MODIFY COLUMN title
varchar(30)`);
    }

    public async down(queryRunner: QueryRunner): Promise<any> {
    }
}
```

Now, execute the same command and you could the below changes:

```
ts-node ./node_modules/typeorm/cli.js migration:run
```

Output



```
0 migrations are already loaded in the database.
1 migrations were found in the source code.
1 migrations are new migrations that needs to be executed.
query: START TRANSACTION
query: ALTER TABLE book MODIFY COLUMN title varchar(30)
query: INSERT INTO `Library`.`migrations`(`timestamp`, `name`) VALUES (?, ?) -- PARAMETERS: [1587131893261,"Book158713189326
1"]
Migration Book1587131893261 has been executed successfully.
query: COMMIT
```

Book table is modified as,

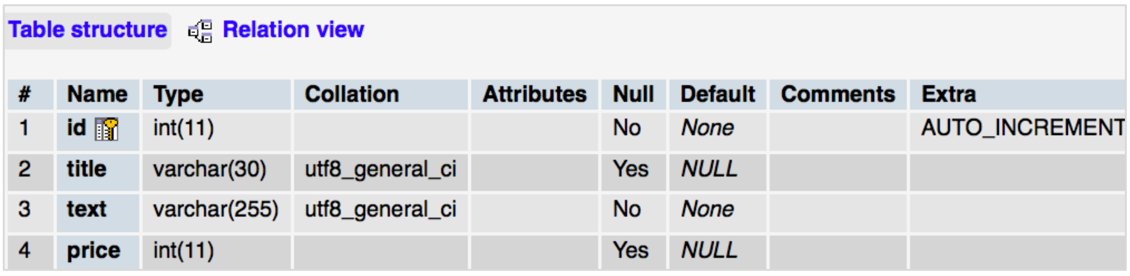


Table structure Relation view

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
1	id	int(11)			No	*None*		AUTO_INCREMENT
2	title	varchar(30)	utf8_general_ci		Yes	*NULL*		
3	text	varchar(255)	utf8_general_ci		No	*None*		
4	price	int(11)			Yes	*NULL*		

Revert migration

Let’s add the below code inside **down** method to revert migration:

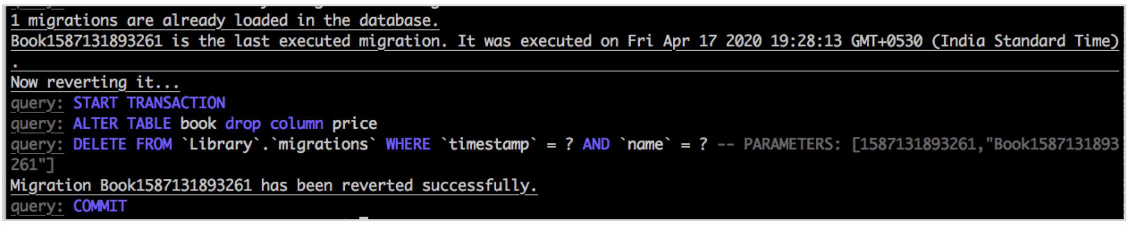
```
import {MigrationInterface, QueryRunner} from "typeorm";

export class Book1587131893261 implements MigrationInterface {

    public async up(queryRunner: QueryRunner): Promise<any> {

    }

    public async down(queryRunner: QueryRunner): Promise<any> {

        await queryRunner.query(`ALTER TABLE book drop column price`); //
reverts things made in "up" method

    }
}
```

Now, execute the below command to revert all the changes:

```
ts-node ./node_modules/typeorm/cli.js migration:revert
```

You could see the following response:

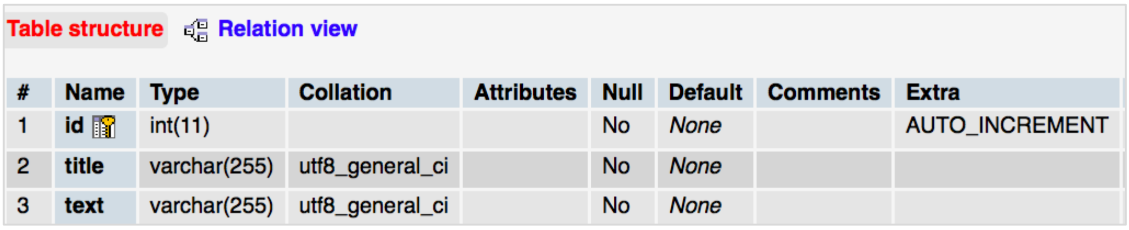
Output



```
1 migrations are already loaded in the database.
Book1587131893261 is the last executed migration. It was executed on Fri Apr 17 2020 19:28:13 GMT+0530 (India Standard Time)
.
Now reverting it...
query: START TRANSACTION
query: ALTER TABLE book drop column price
query: DELETE FROM `Library`.`migrations` WHERE `timestamp` = ? AND `name` = ? -- PARAMETERS: [1587131893261,"Book1587131893
261"]
Migration Book1587131893261 has been reverted successfully.
query: COMMIT
```

Book table is modified as,

Output



#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
1	**id**	int(11)			No	*None*		AUTO_INCREMENT
2	**title**	varchar(255)	utf8_general_ci		No	*None*		
3	**text**	varchar(255)	utf8_general_ci		No	*None*		

As we seen in this chapter, **TypeORM** makes it easy to write database migration script.

18. TypeORM — Working with CLI

This section explains about TypeORM CLI commands in detail.

Create TypeORM project

typeorm init is the easiest and fastest way to setup a TypeORM project. You can create a new project as,

```
typeorm init --name Demoproject --database mysql
```

After executing the command, you will get the following output on your screen:

```
Project created inside /Users/workspace/TypeORM/Demoproject directory.
```

Create an entity

To create a new entity using CLI as,

```
typeorm entity:create -n Person
```

Now, Person entity is created inside your project src directory.

```
Entity /Users/workspace/TypeORM/Demoproject/src/entity/Person.ts has been
created successfully.
```

If you have a multi-module project structure with multiple entities in different directories, you can use the below command,

```
typeorm entity:create -n Person -d src/Person/entity
```

Create a new subscriber

To create a new subscriber using CLI as follows:

```
typeorm subscriber:create -n PersonSubscriber
```

You could see the following response:

```
Subscriber /path/to/TypeORM/Demoproject/src/subscriber/PersonSubscriber.ts has
been created successfully.
```

Create migrations

You can create a new migration using CLI as mentioned below:

```
typeorm migration:create -n PersonMigration
```

The above command created a **migration** directory inside your project **src**. Migration files are stored inside it.

```
Migration /path/to/TypeORM/Demoproject/src/migration/1587395030750-
PersonMigration.ts has been generated successfully.
```

Database schema

To synchronize a database schema, use the below command:

```
typeorm schema:sync
```

To completely drop a database schema, use the below command:

```
typeorm schema:drop
```

Sql queries

If you want to execute any sql queries, we can execute directly from here. For example, to display all the records of customers, use the below query:

```
typeorm query "select * from customers"
```

If you want to clear everything stored in the cache. You can do it using the following command:

```
typeorm cache:clear
```

Conclusion

TypeORM is an excellent open source ORM framework to create high quality and scalable applications from small scale applications to large scale enterprise applications with multiple databases.