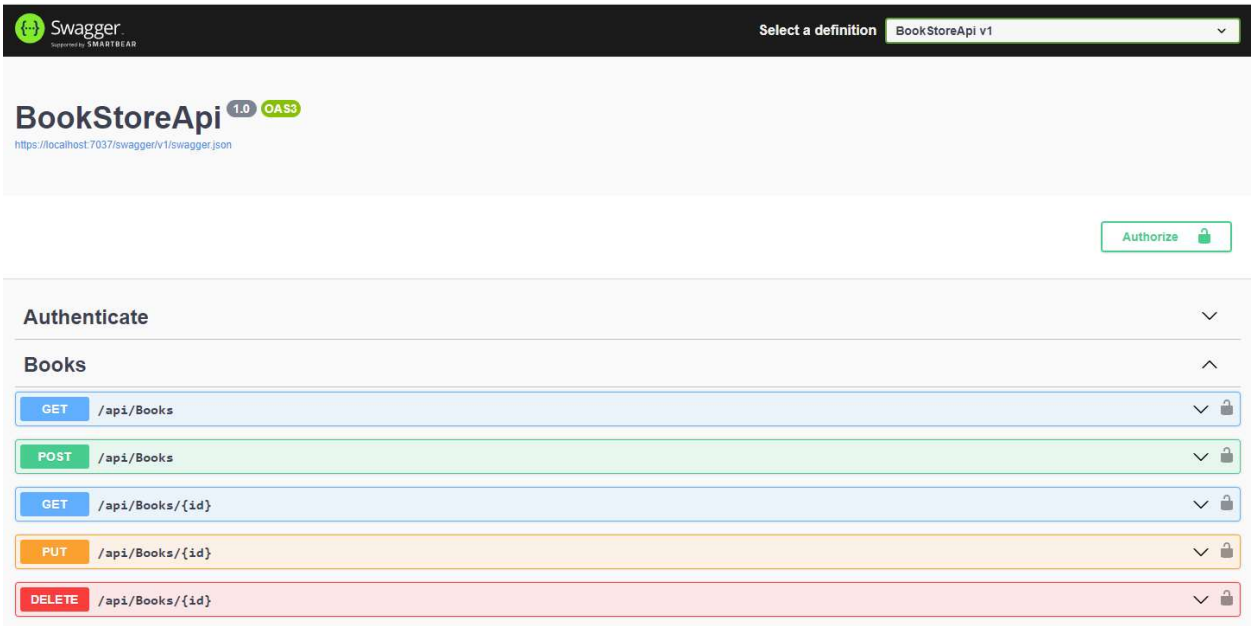
Building a secure ASP.NET web API for MongoDB with identity and JWT authentication

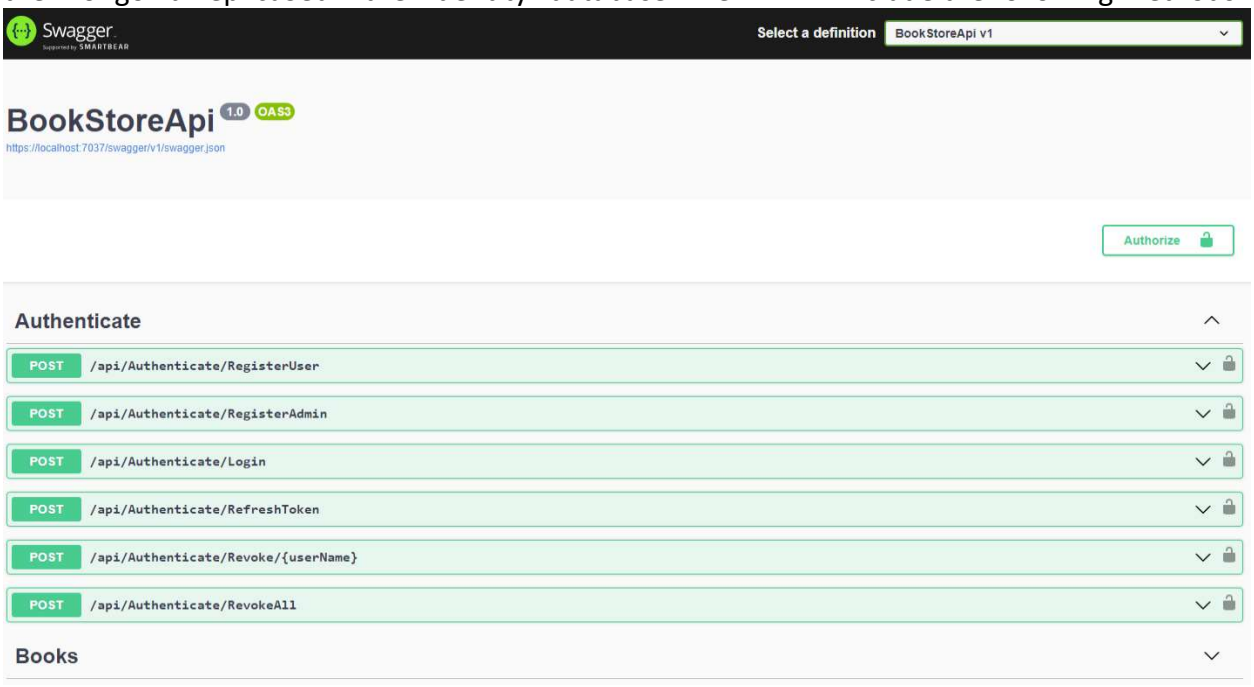
1. Introduction

In this article we are going to implement a web API ASP.Net Core that runs Create, Read, Update, and Delete (CRUD) operations on a MongoDB NoSQL database. Also, we provide Authentication and Authorization capabilities. We protect the Web API by implementing JWT authentication. We use authorization in ASP.NET Core to supply access to various functionalities of the application. We store user credentials in a MongoDb database.

We start our implementation developing a CRUD API with MongoDB ReplicaSet as database. In this figure we show in swagger the CRUD functions (get, post, get by id, put and delete).



After, we integrate the authorization an authentication features. We also store the user data in the MongoDb ReplicaSet in the “Identity” database. The API will include the following methods:

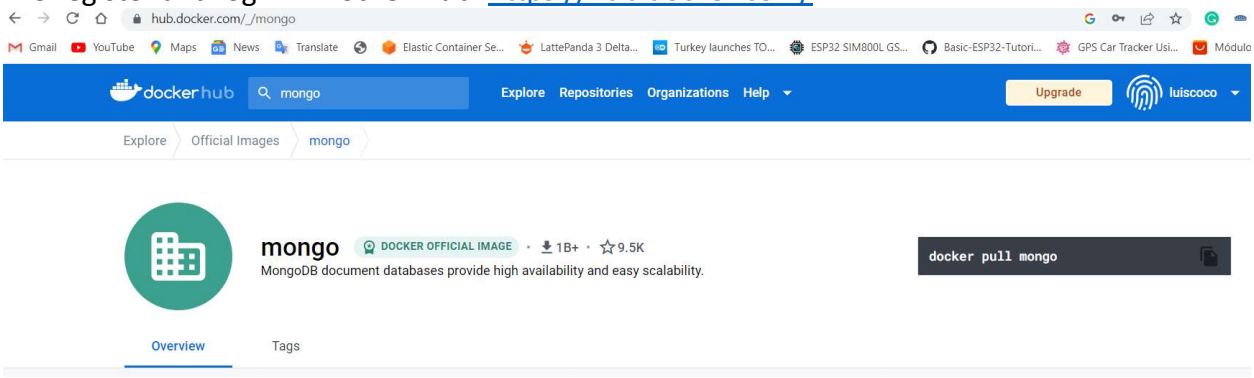


2. Run MongoDb ReplicaSet in a container

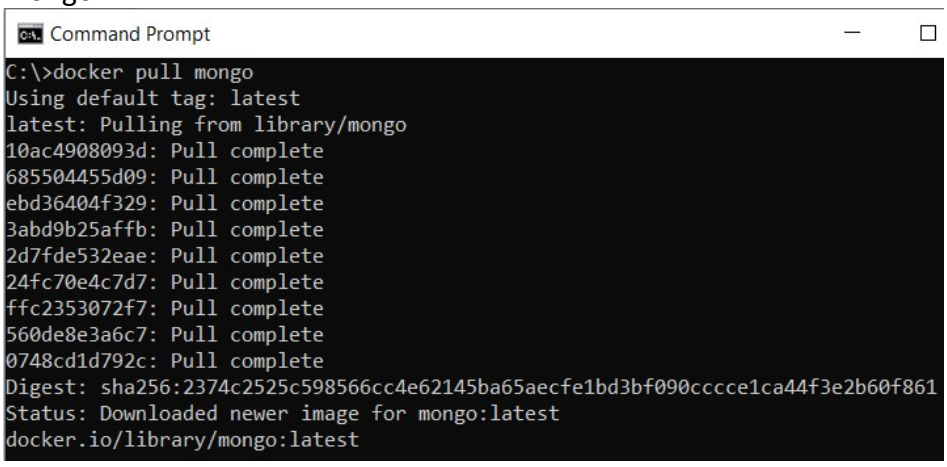
Before starting to develop the web API we have to run the MongoDb ReplicaSet in a Docker container. We have to follow these steps:

We install Docker Desktop: https://docs.docker.com/desktop/install/windows-install/

We register and login in Docker Hub: https://hub.docker.com/

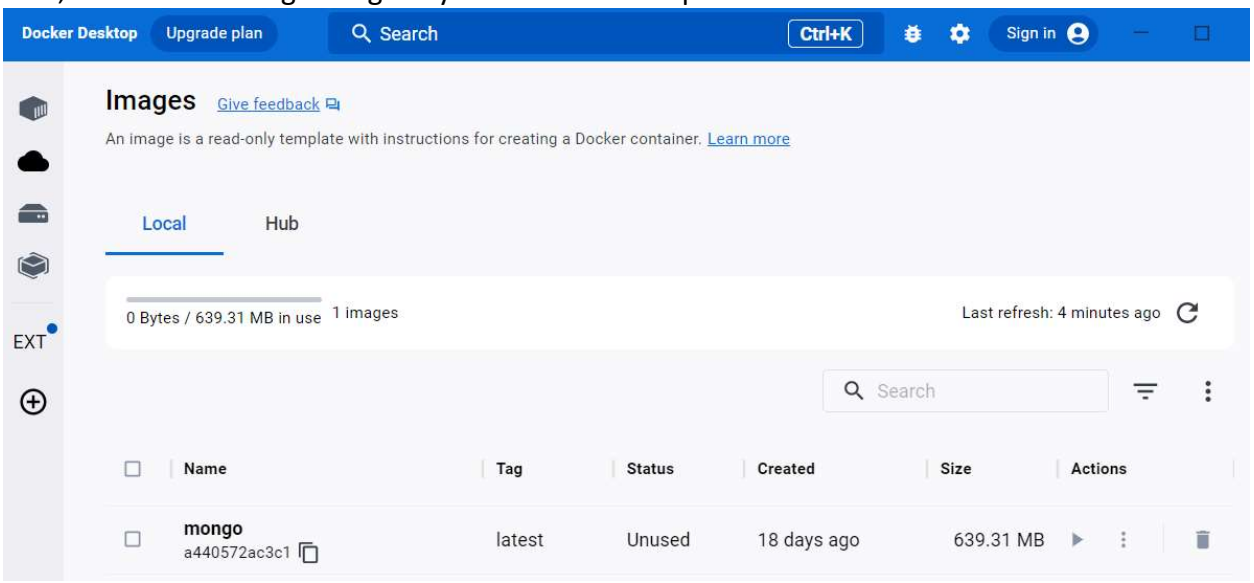


We run Docker Desktop application, and after that, we pull the MongoDb official image from Docker Hub to our local host. Open a command window and run the command “docker pull mongo”.



See the mongo image in your local host. Run the command “docker images”

Also, we see the mongo image in you Docker Desktop.



We create a new network. Run the command “docker network create mongoCluster”. Run MongoDb in three containers.

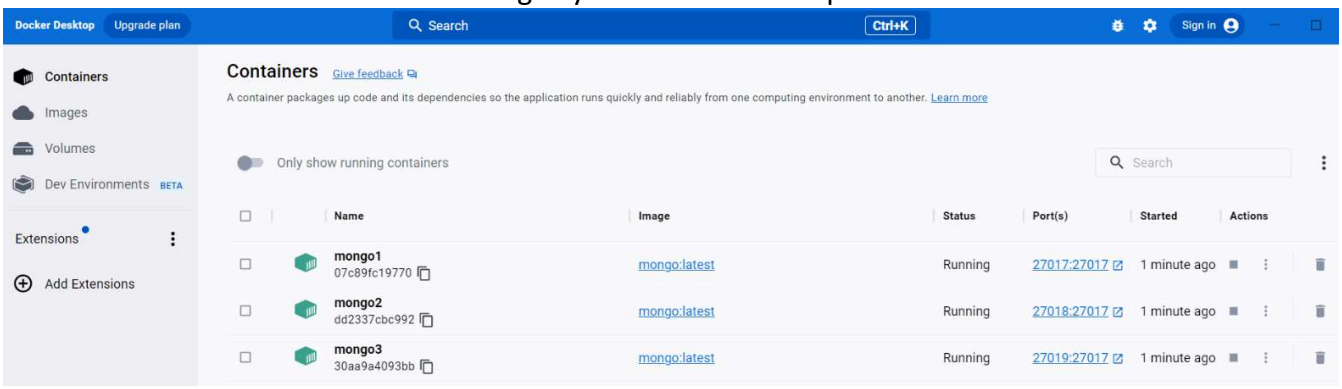
docker run -d --rm -p 27017:27017 --name mongo1 --network mongoCluster mongo:latest mongod --replSet myReplicaSet --bind_ip localhost,mongo1

docker run -d --rm -p 27018:27017 --name mongo2 --network mongoCluster mongo:latest mongod --replSet myReplicaSet --bind_ip localhost,mongo2

docker run -d --rm -p 27019:27017 --name mongo3 --network mongoCluster mongo:latest mongod --replSet myReplicaSet --bind_ip localhost,mongo3

```
Command Prompt

C:\>docker run -d --rm -p 27017:27017 --name mongo1 --network mongoCluster mongo:latest mongod --replSet myReplicaSet --bind_ip localhost,mongo1
07c89fc19770cfb960d3576ac00f0afe7c6549193b1603f66c0a2ab564d03dea

C:\>docker run -d --rm -p 27018:27017 --name mongo2 --network mongoCluster mongo:latest mongod --replSet myReplicaSet --bind_ip localhost,mongo2
dd2337cbc992a8a3d4bcc9233d7cdb240d375d06a9036ae88e980d70f12200f4

C:\>docker run -d --rm -p 27019:27017 --name mongo3 --network mongoCluster mongo:latest mongod --replSet myReplicaSet --bind_ip localhost,mongo3
30aa9a4093bbe6d9f9e0f3136853ee20a4f70814b56b26fc138ae768f0566c00
```

We can see the three containers running in your Docker Desktop.

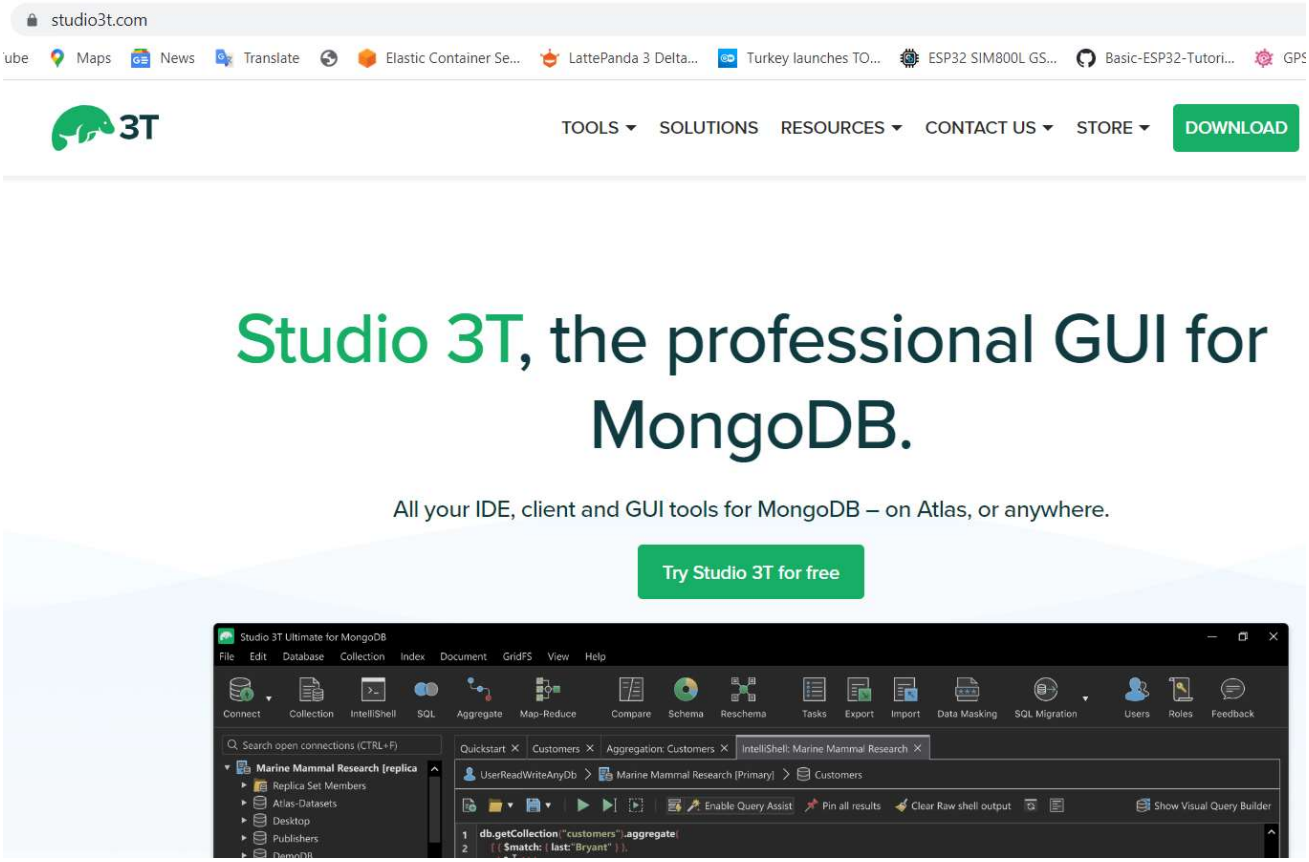


We initialize new MongoDb ReplicaSet.

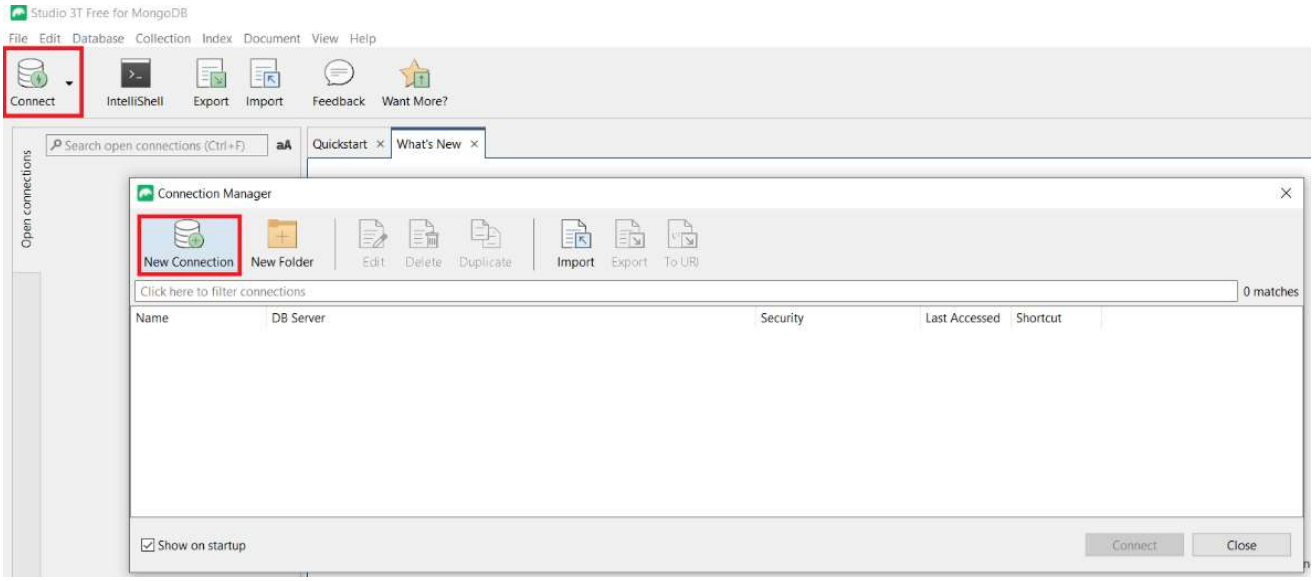
docker exec -it mongo1 mongosh --eval "rs.initiate({ _id: 'myReplicaSet', members: [{_id: 0, host: 'mongo1', priority: 3}, {_id: 1, host: 'mongo2', priority: 2}, {_id: 2, host: 'mongo3', priority: 1}]})"

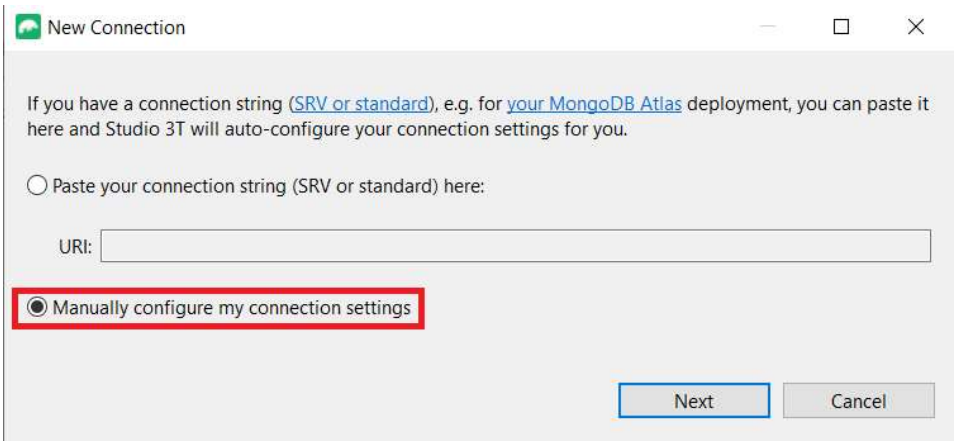
```
Command Prompt

C:\>docker exec -it mongo1 mongosh --eval "rs.initiate({ _id: 'myReplicaSet', members: [{_id: 0, host: 'mongo1', priority: 3}, {_id: 1, host: 'mongo2',
 priority: 2}, {_id: 2, host: 'mongo3', priority: 1}]})"
Current Mongosh Log ID: 63f377da516de05057f81059
Connecting to:          mongodb://127.0.0.1:27017/?directConnection=true&serverSelectionTimeoutMS=2000&appName=mongosh+1.6.2
Using MongoDB:          6.0.4
Using Mongosh:          1.6.2

For mongosh info see: https://docs.mongodb.com/mongodb-shell/


To help improve our products, anonymous usage data is collected and sent to MongoDB periodically (https://www.mongodb.com/legal/privacy-policy).
You can opt-out by running the disableTelemetry() command.

------
   The server generated these startup warnings when booting
   2023-02-20T13:33:51.981+00:00: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine. See http://dochub.mongodb.org/co
re/prodnotes-filesystem
   2023-02-20T13:33:53.386+00:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
   2023-02-20T13:33:53.386+00:00: /sys/kernel/mm/transparent_hugepage/enabled is 'always'. We suggest setting it to 'never'
   2023-02-20T13:33:53.386+00:00: vm.max_map_count is too low
------

------
   Enable MongoDB's free cloud-based monitoring service, which will then receive and display
   metrics about your deployment (disk utilization, CPU, operation statistics, etc).

   The monitoring data will be available on a MongoDB website with a unique URL accessible to you
   and anyone you share the URL with. MongoDB may use this information to make product
   improvements and to suggest MongoDB products and deployment options to you.

   To enable free monitoring, run the following command: db.enableFreeMonitoring()
   To permanently disable this reminder, run the following command: db.disableFreeMonitoring()
------

{ ok: 1 }
```

We install Studio 3T for MongoDb.

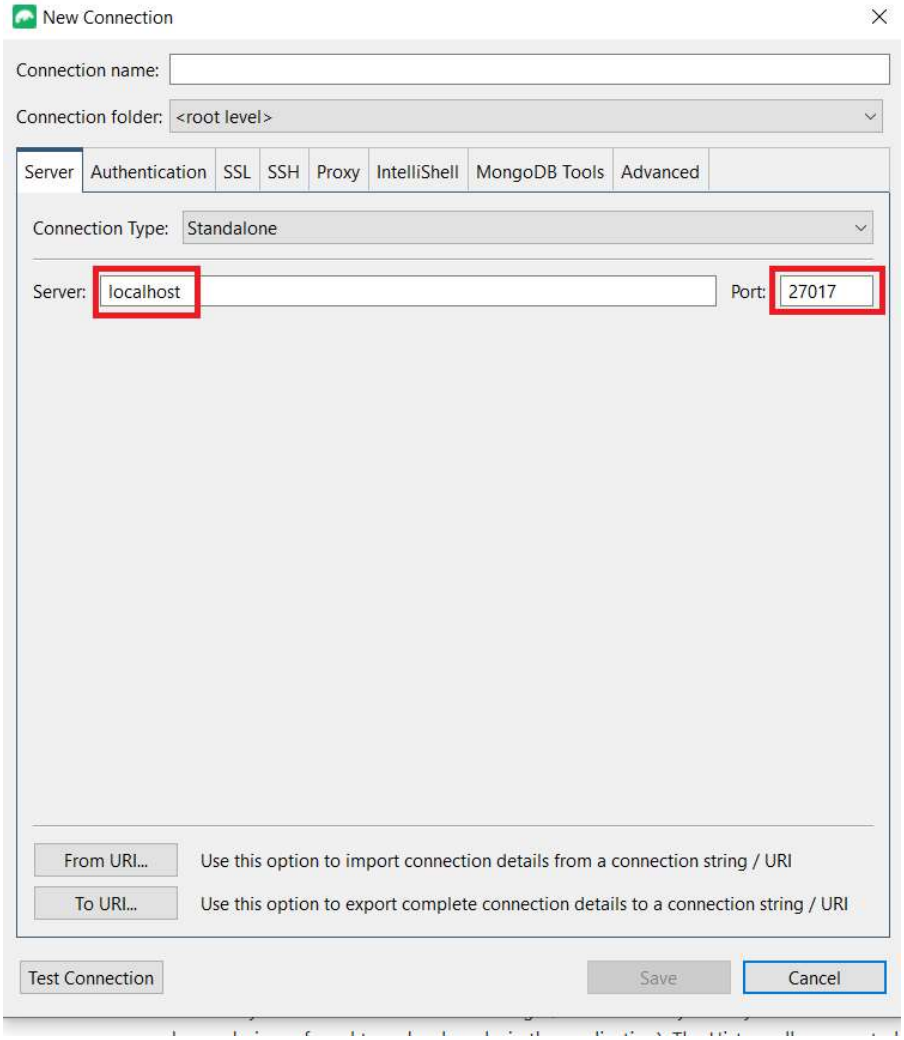


We connect to the MongoDb ReplicaSet from Studio 3T. Run Studio 3T and click on the “New Connection” button.

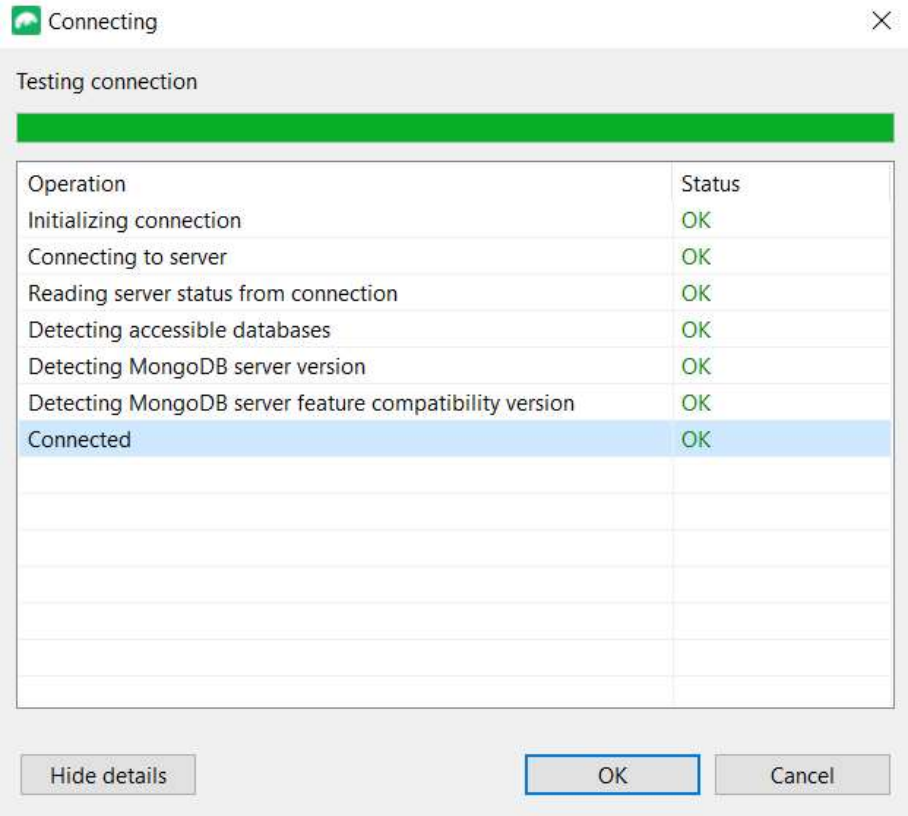




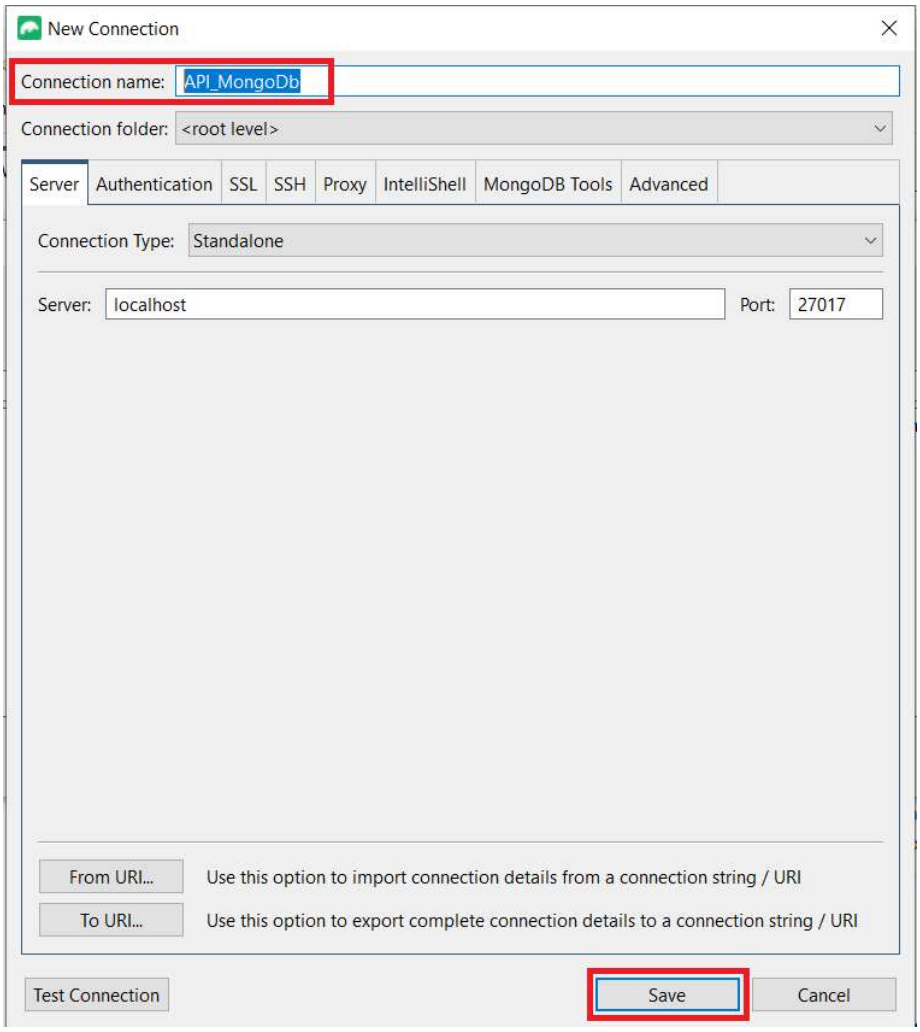
We set the hostname and the port number.



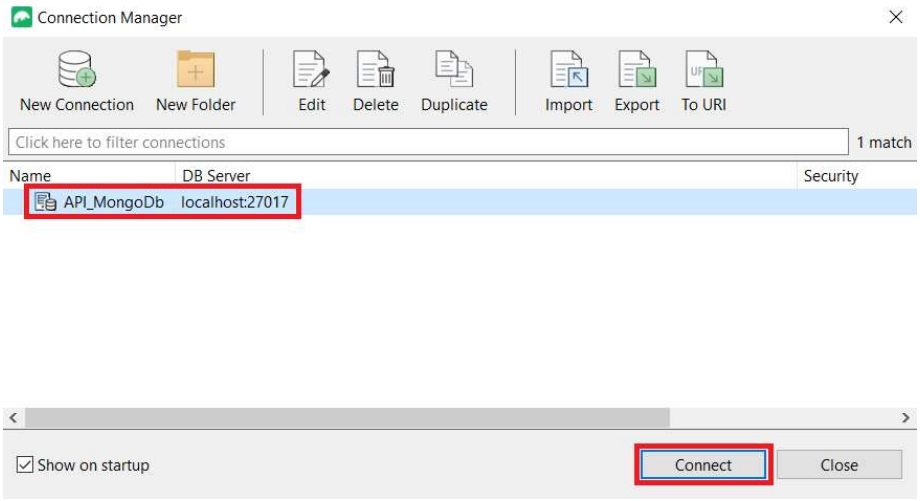
We press the “Test Connection” button.



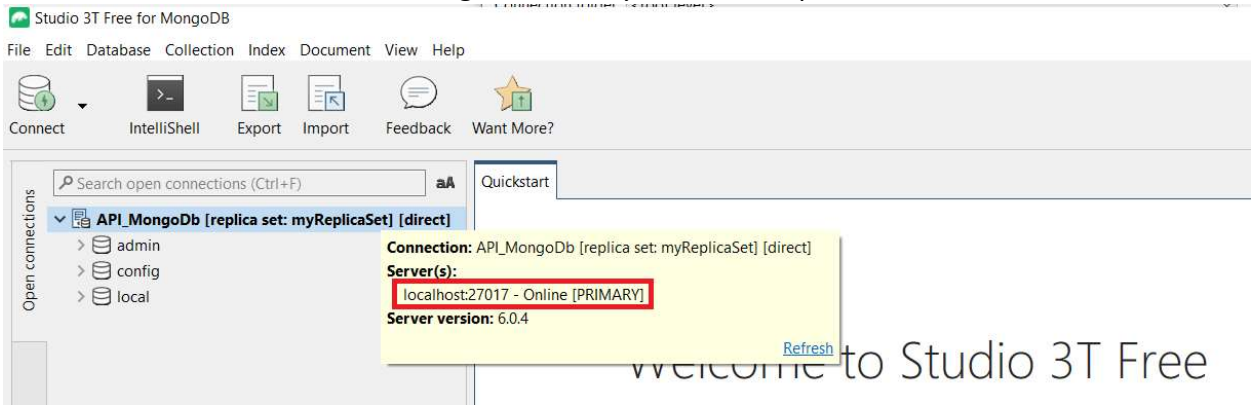
Finally, we set the connection name and press the “Save” button.



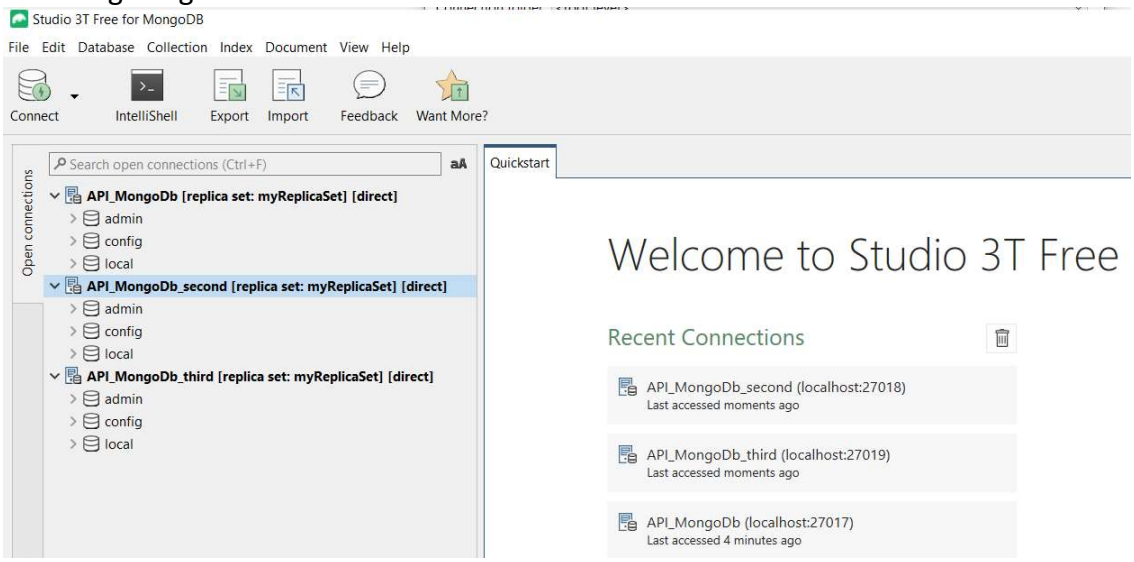
Now the new connection appears in the Connection Manager list. Select it and press the "Connect" button.



We are now connected to the MongoDb Primary localhost in port 27017.

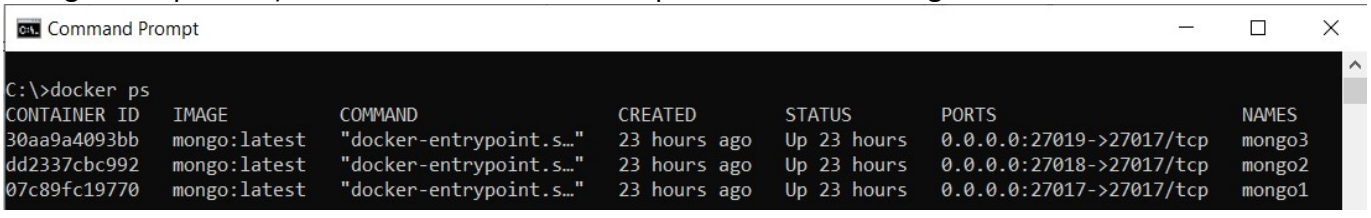


The same operation we could repeat for the other two nodes. The result is illustrated in the following image:

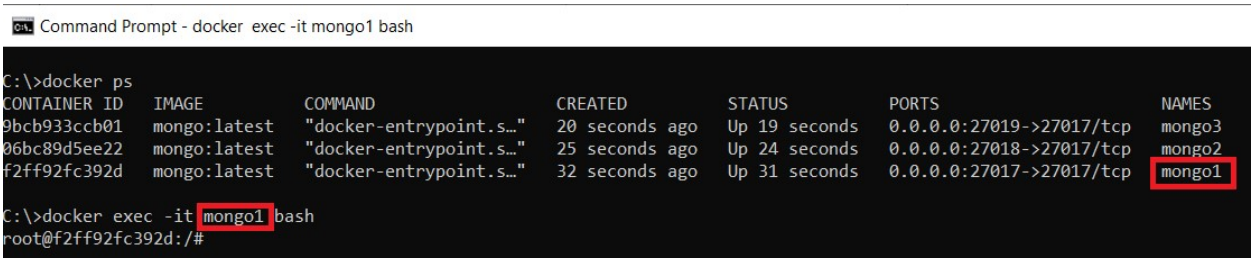


We can create the “BookStore” database and inside it, we create a new collection “Books”. We populate the collection with several documents.

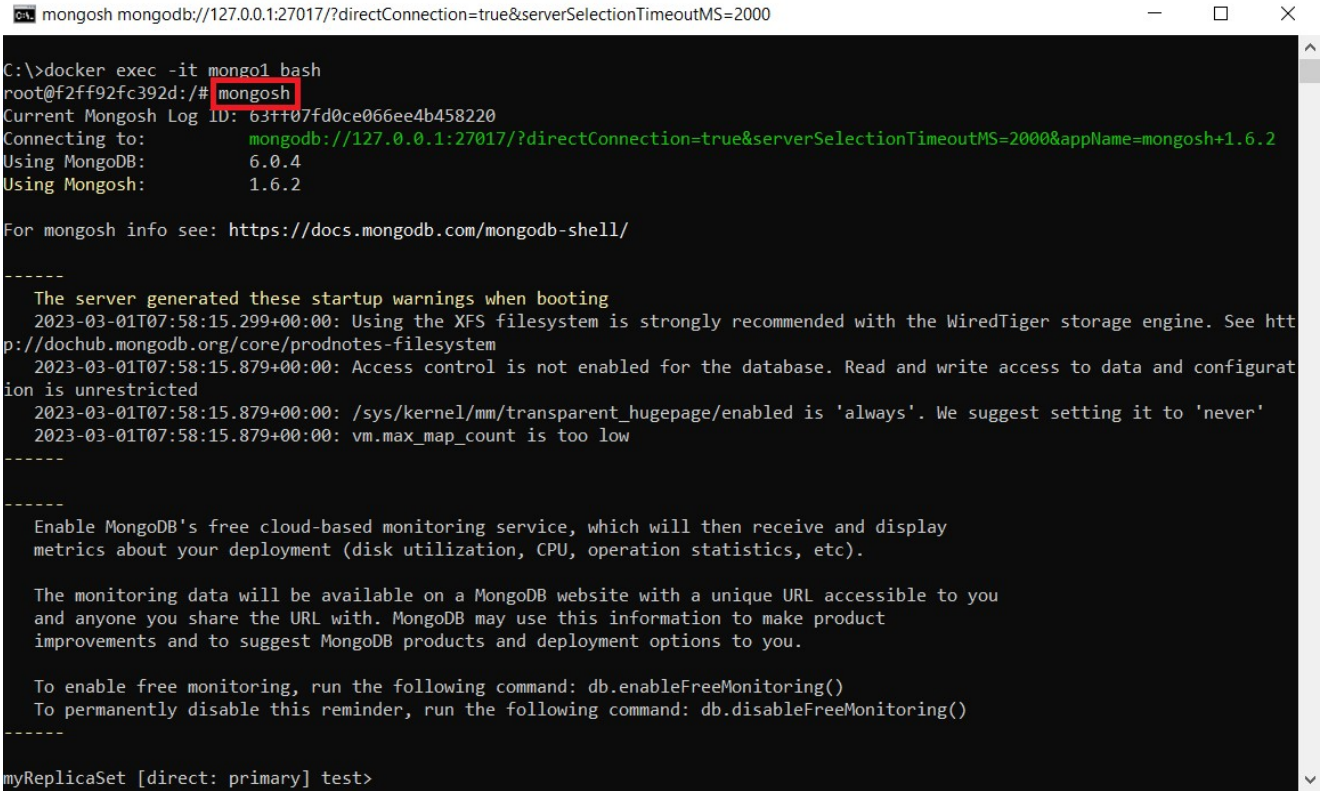
As we can see in the above screen, there are three mongo docker containers running (the MongoDb ReplicaSet). Run the command “docker ps” to see the running containers



We enter in a container bash running the command: docker exec -it mongo1 bash



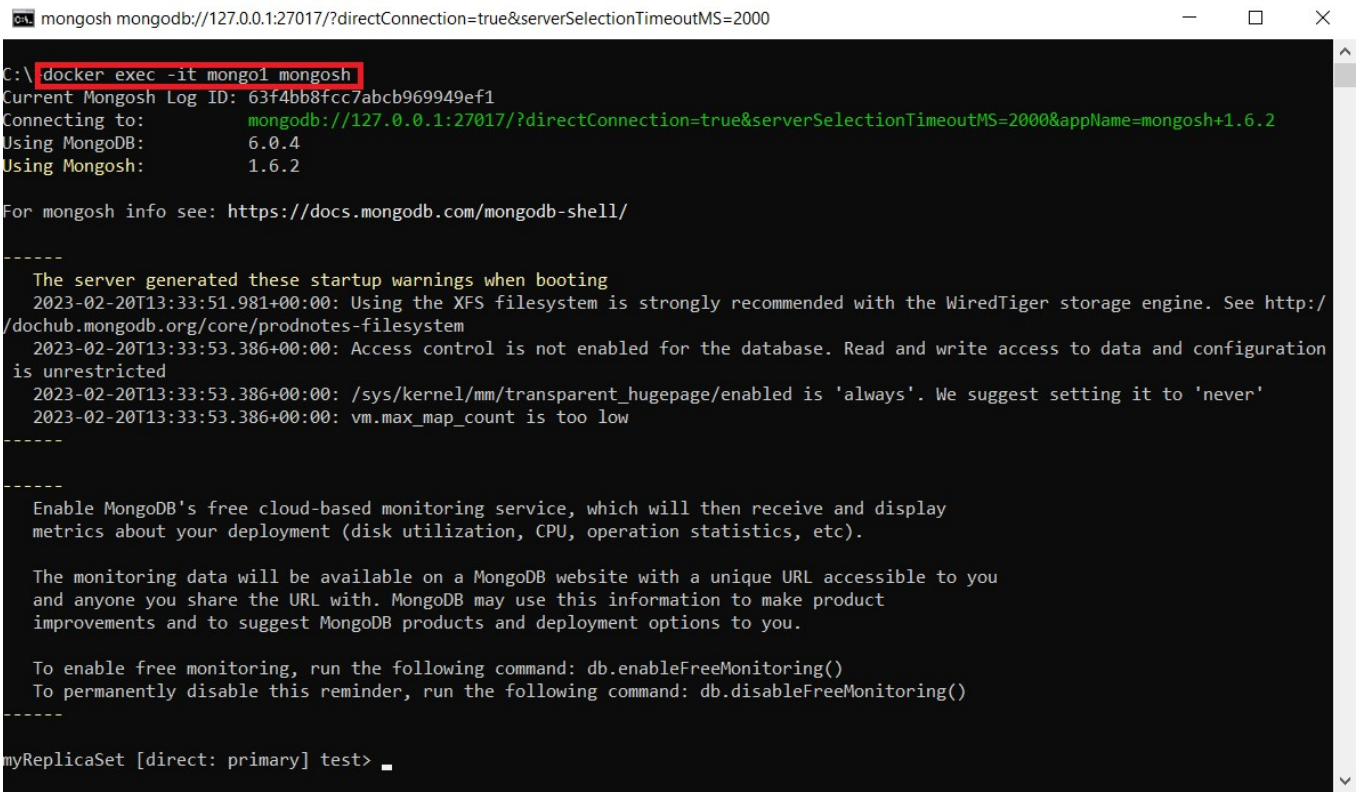
Now we enter in the MongoDb Shell (https://www.mongodb.com/docs/mongodb-shell/) executing this command: mongsh



The **-it** flag is short for **--interactive** + **--tty**. When you docker run with this command it takes you straight inside the container.

--interactive flag, allows you to send commands to the container via standard input ("STDIN"), which means you can "interactively" type commands to the pseudo-tty/terminal
--tty flag, tells Docker to allocate a virtual terminal session within the container

In this case is required the mongo1 docker container is previously running.



Now we are inside the MongoDb Shell, we can type the following mongo commands:

To list the databases run the command:
>show databases

```
myReplicaSet [direct: primary] test> show databases
admin    80.00 KiB
config  160.00 KiB
local   404.00 KiB
```

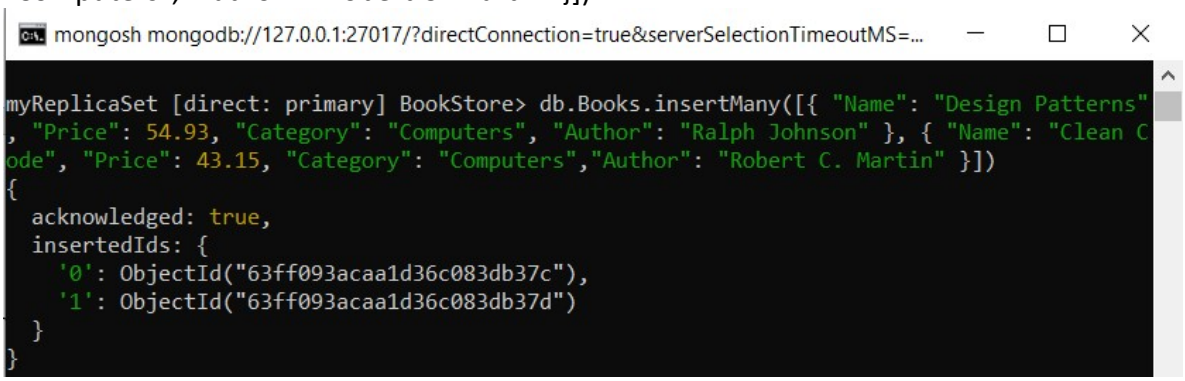
To switch or create the database “BookStore” run the command:
>use BookStore

To create a new collection “Books” run the command
>db.createCollection('Books')

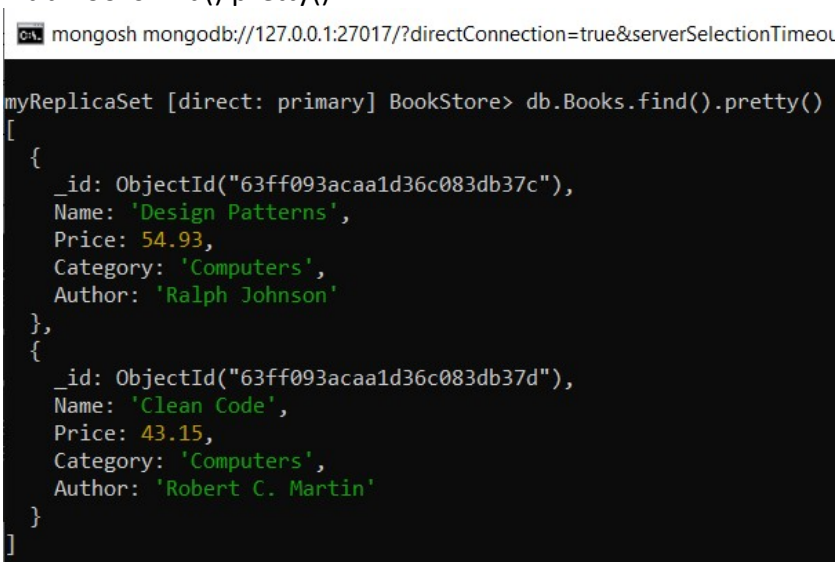
You can also show the collections inside the database running the command:
>show collections

```
myReplicaSet [direct: primary] BookStore> db.createCollection('Books')
{ ok: 1 }
myReplicaSet [direct: primary] BookStore> show collections
Books
```

To insert may items/documents inside the “Books” collections then type the command:
>db.Books.insertMany([{ "Name": "Design Patterns", "Price": 54.93, "Category": "Computers", "Author": "Ralph Johnson" }, { "Name": "Clean Code", "Price": 43.15, "Category": "Computers","Author": "Robert C. Martin" }])

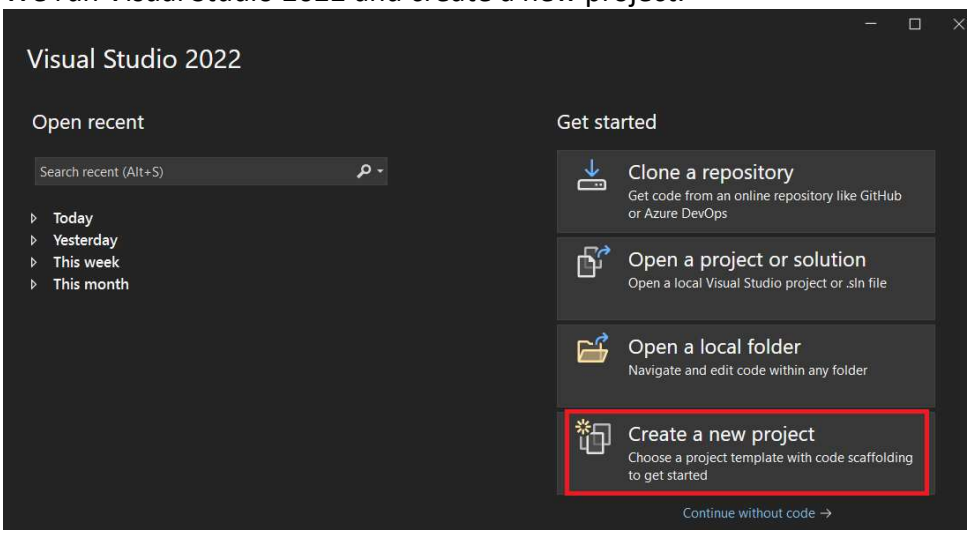


Finally, if you would like to show the items/documents inside the “Books” collection then type the command:
> db.Books.find().pretty()

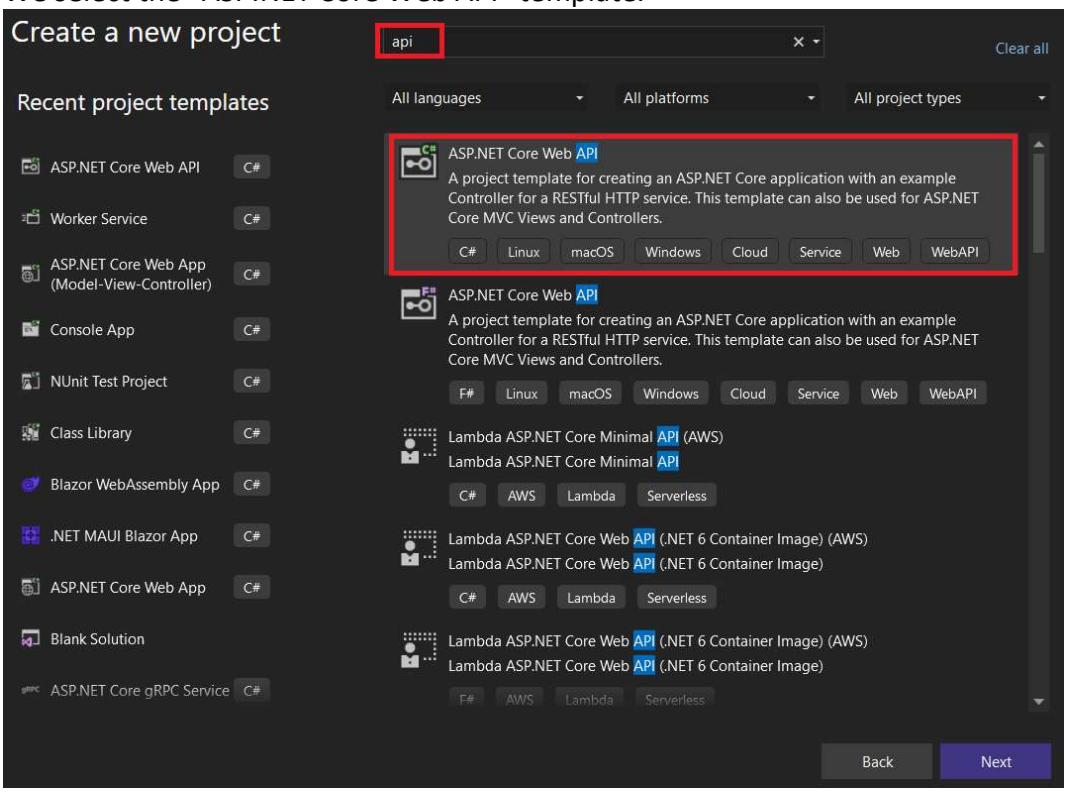


3. Develop a web API with ASP.NET Core and MongoDB

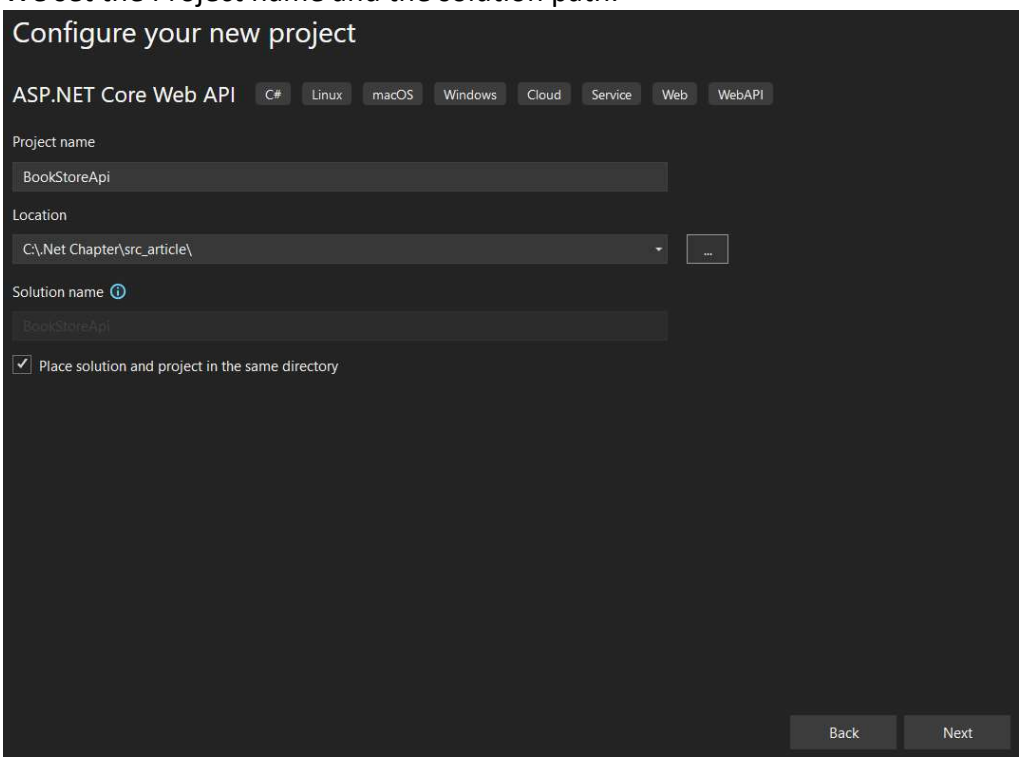
We run Visual Studio 2022 and create a new project.



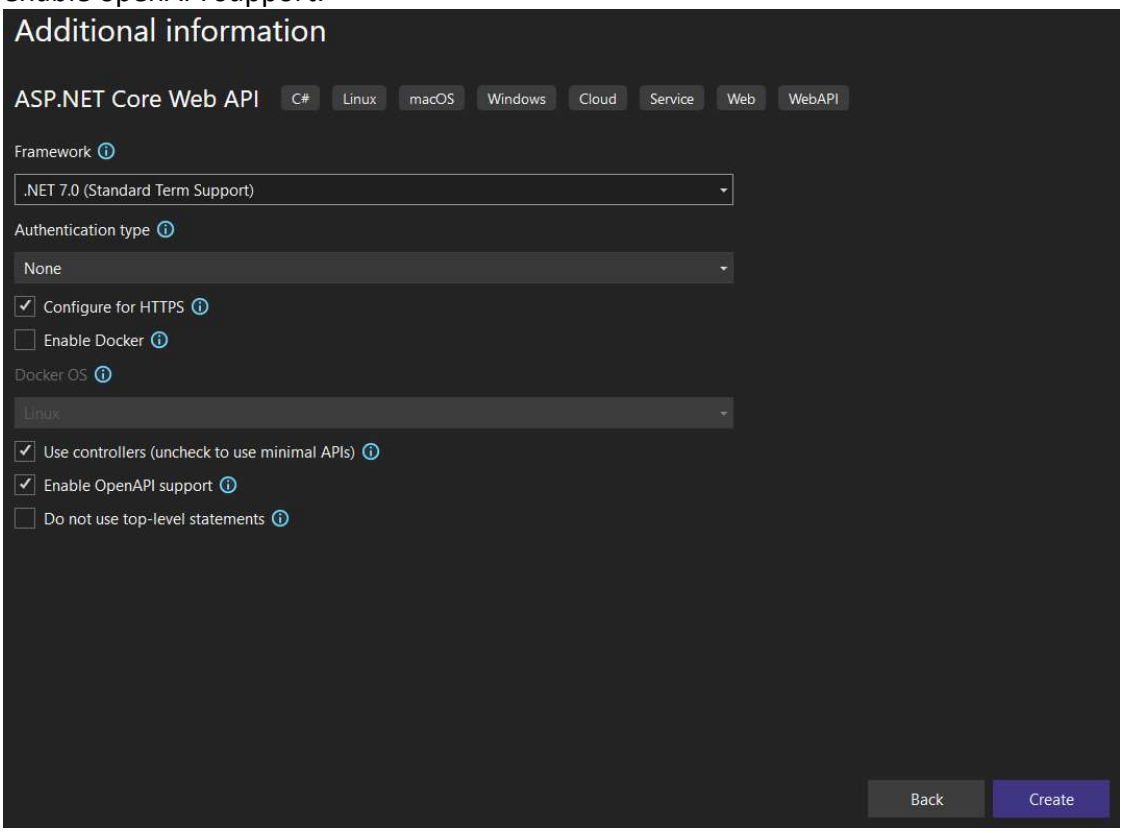
We select the “ASP.NET Core Web API” template.



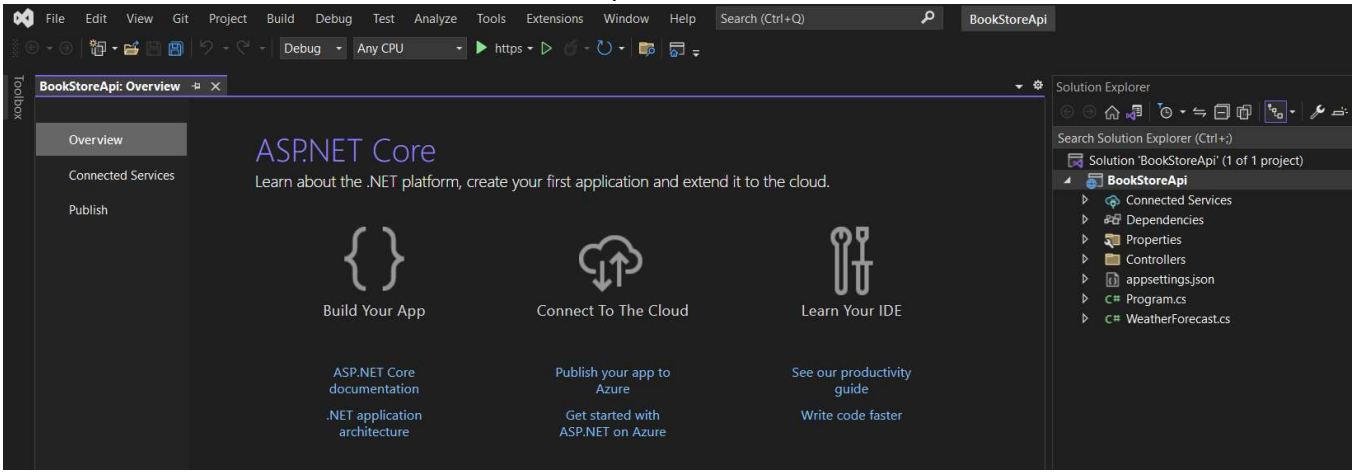
We set the Project name and the solution path.



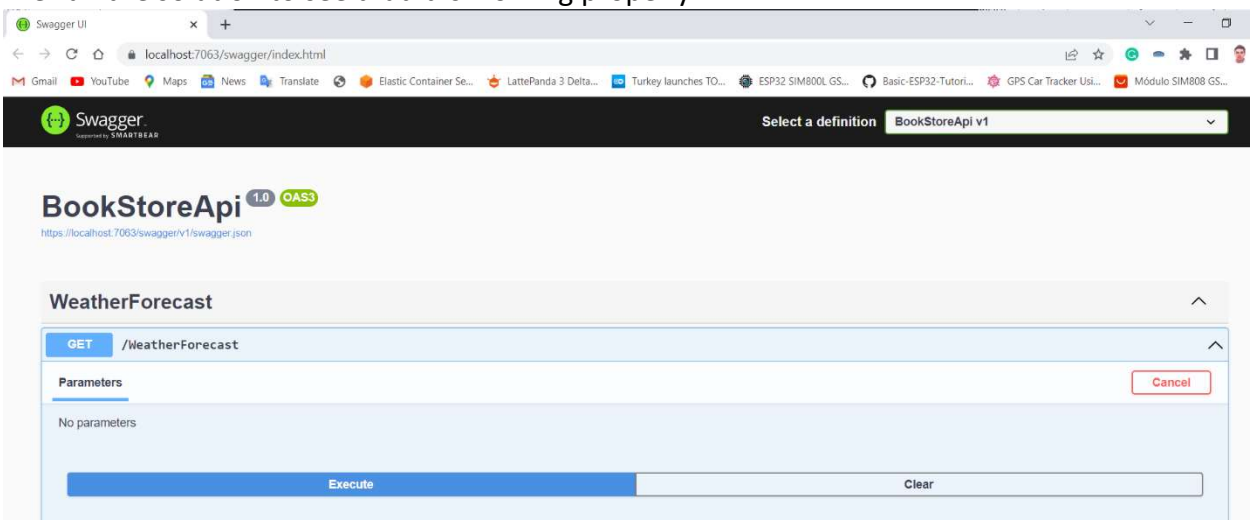
We select the Framework (.Net 7) and rest of the options: configure https and use controllers, enable openAPI support.

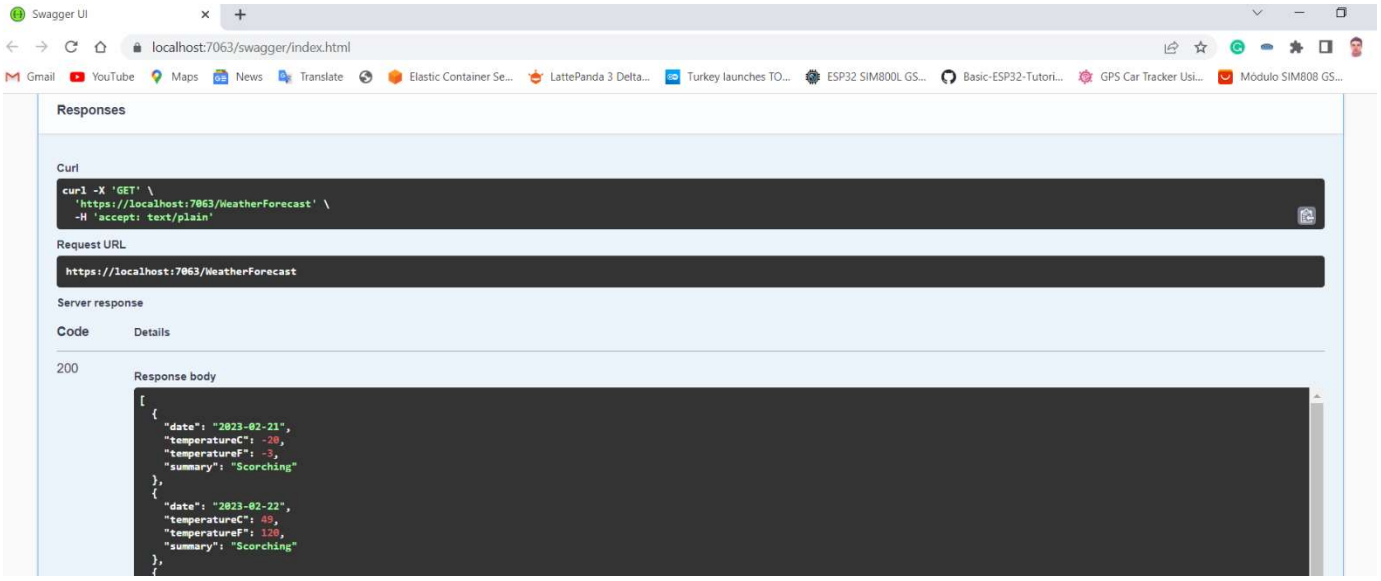


We can see the new solution in the Solution Explorer.

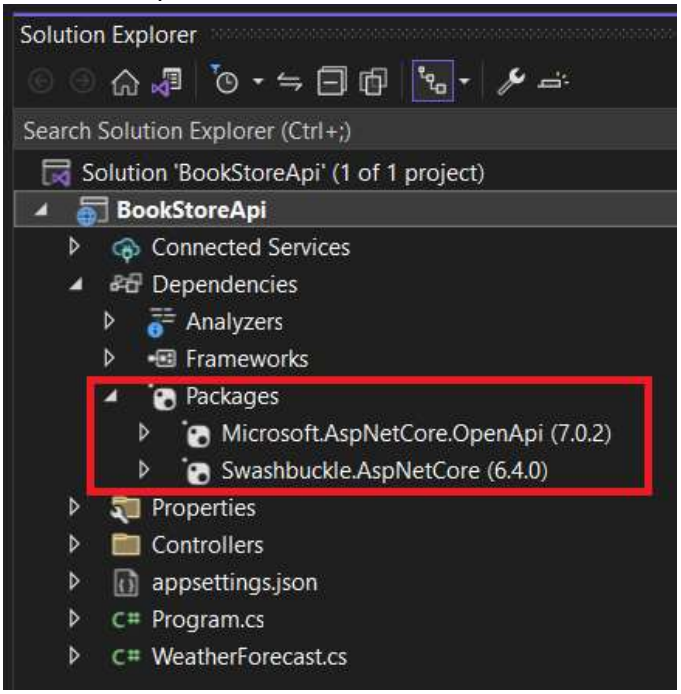


We run the solution to see that it is working properly.





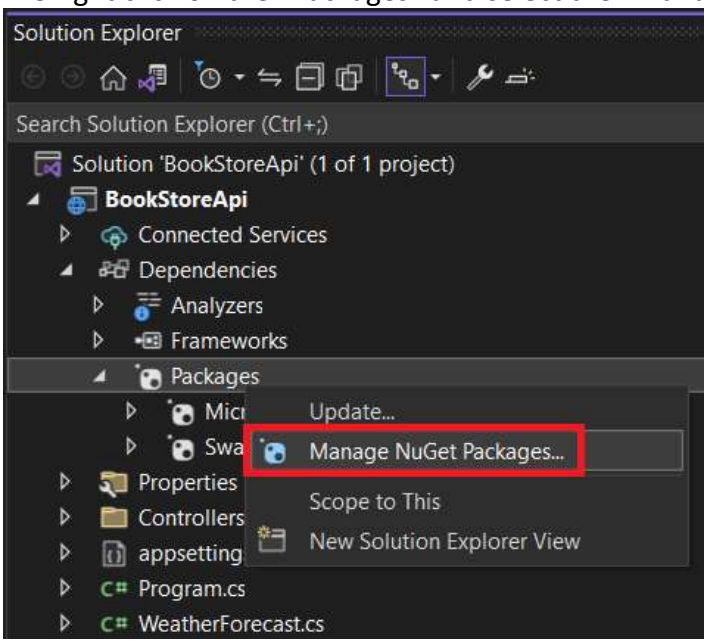
The first step is to load the NuGet libraries. Now we have only to dependencies.



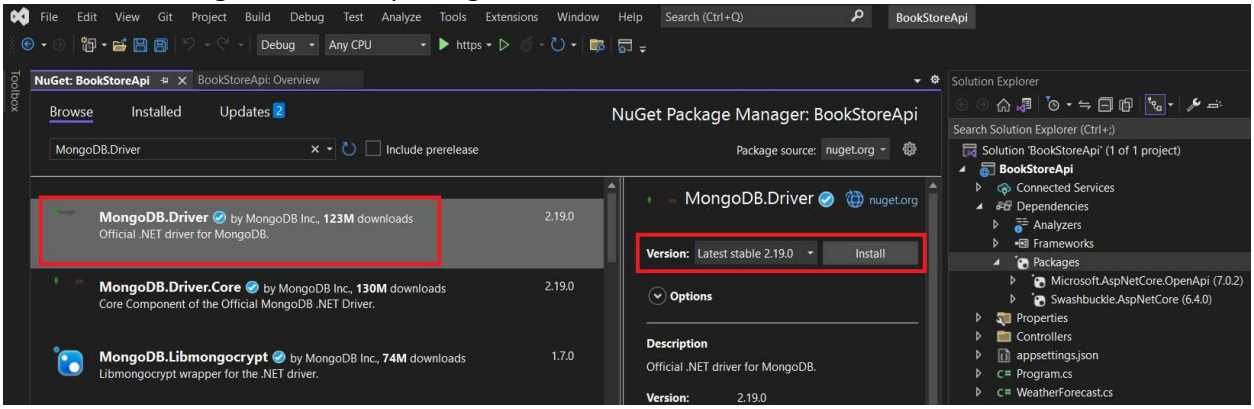
In order to access the MongoDb database from our API we have to install the following NuGet package:

MongoDB.Driver

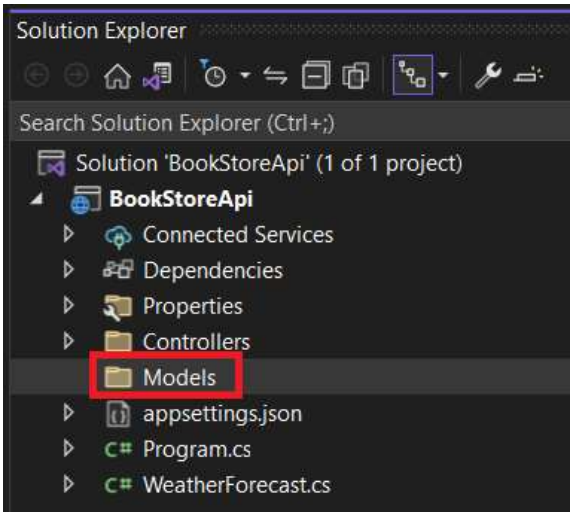
We right click on the “Packages” and select the “Manage NuGet Packages…” option.



Select the “MongoDB.Driver” package and install it.



We add the entity model. For this purpose, we add a “Models” folder/directory to the project root.



We add a “Book.cs” class to the “Entities” directory/folder with the following code:

```
using MongoDB.Bson;
using MongoDB.Bson.Serialization.Attributes;

namespace BookStoreApi.Entities;

public record Book
{
    [BsonId]//to mark as a PK for Mongo db
    [BsonRepresentation(BsonType.ObjectId)]//to allow passing as string instead of object
id...?
    public string? Id { get; init; }

    //[BsonElement("Name")]
    public string Name { get; init; } = null!;
    public decimal Price { get; init; }
    public string Category { get; init; } = null!;
    public string Author { get; init; } = null!;
}
```

In the “Book” class, we require the Id property for mapping the Common Language Runtime (CLR) object to the MongoDB collection. We use the [BsonId] annotation to make this property the document's primary key. We also use the [BsonRepresentation(BsonType.ObjectId)] annotation to allow passing the parameter as type string instead of an ObjectId structure.

Mongo handles the conversion from string to ObjectId. The BookName property is annotated with the [BsonElement] attribute. The attribute's value of Name represents the property name in the MongoDB collection. It is optional to use this attribute to rename the C# model property to a MongoDB column name.

We configure the MongoDb connection information in the appsettings.json file. We set the connection string, the database name and the books collection name:

…

```
  "BookStoreDbSettings": {
    "ConnectionString": "mongodb://localhost:27017",
    "DatabaseName": "BookStore",
    "BooksCollectionName": "Books"
  },
```

…

We add a “BookStoreDbSettings.cs” class to the “Configuration” directory/folder with the following code:

```
namespace BookStoreApi.Configuration;

public record BookStoreDbSettings
{
    public const string SectionName = "BookStoreDbSettings";
    public string ConnectionString { get; init; } = null!;
    public string DatabaseName { get; init; } = null!;
    public string  BooksCollectionName { get; init; } = null!;
}
```

We configure the “BookStoreSettings” in the middleware (Program.cs file):

```
builder.Services.Configure<BookStoreDbSettings>(builder.Configuration
    .GetSection(BookStoreDbSettings.SectionName));

builder.Services.AddSingleton<BookStoreDbSettings>(sp => sp
    .GetRequiredService<IOptions<BookStoreDbSettings>>().Value);
```

Now we add a CRUD operations to the project. We add a “Services” directory/folder to the project root. Inside this folder we implement the repository interface and class.

We create the “IBookRepository.cs” interface:

```
using BookStoreApi.Entities;

namespace BookStoreApi.Services;

public interface IBooksRepository
{
    Task<IReadOnlyCollection<Book>> GetAll();
    Task<Book?> GetById(string id);

    Task Create(Book newBook);
    Task Update(string id, Book updatedBook);
    Task Remove(string id);
}
```

We implement the interface with the “MongoDbBooksRepository.cs” class:

```
using BookStoreApi.Configuration;
using BookStoreApi.Entities;
using MongoDB.Driver;

namespace BookStoreApi.Services;

public class MongoDbBooksRepository : IBooksRepository
{
    private readonly IMongoCollection<Book> _booksCollection;

    public MongoDbBooksRepository(BookStoreDbSettings settings)
    {
        MongoClient client = new(settings.ConnectionString);
        var database = client.GetDatabase(settings.DatabaseName);
        _booksCollection = database.GetCollection<Book>(settings.BooksCollectionName);
    }

    public async Task<IReadOnlyCollection<Book>> GetAll() => await _booksCollection
        .Find(_ => true)
        .ToListAsync();

    public async Task<Book?> GetById(string id) => await _booksCollection
        .Find(book => book.Id == id)
        .FirstOrDefaultAsync();

    public async Task Create(Book newBook) =>
       await _booksCollection.InsertOneAsync(newBook);

    public async Task Update(string id, Book updatedBook)
    {
        var ub = updatedBook with { Id = id };
        await _booksCollection.ReplaceOneAsync(book => book.Id == id, ub);
    }

    public async Task Remove(string id) => await _booksCollection
        .DeleteOneAsync(book => book.Id == id);
}
```

We configure the repository in the middleware (program.cs file).

```
builder.Services.AddSingleton<IBooksRepository, MongoDbBooksRepository>();
```

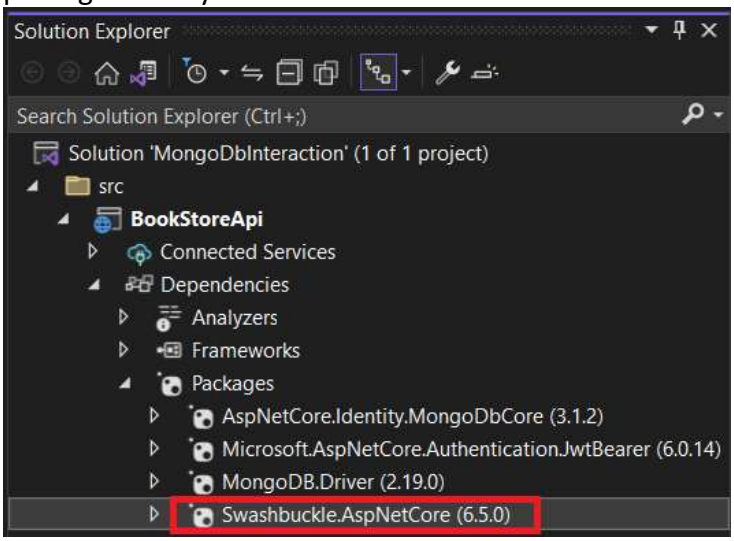
To finish this section 3, we add the controller. For this purpose, we create the "BooksController.cs" class inside the "Controllers" directory/folder. The controller includes the "IBooksRepository" dependency injection. By means of this service we access the functions (GetAsync, CreateAsync, UpdateAsync, RemoveAsync), now we can interchange information with the MongoDb database.

```
using BookStoreApi.Authorization;
using BookStoreApi.Entities;
using BookStoreApi.Services;
using Microsoft.AspNetCore.Authorization;
using Microsoft.AspNetCore.Mvc;

namespace BookStoreApi.Controllers;

[ApiController]
[Route("api/[controller]")]
public class BooksController : ControllerBase
{
    private const string IdUrlTemplate = "{id:length(24)}";
    private readonly IBooksRepository _booksRepository;

    public BooksController(IBooksRepository booksRepository)
    {
        _booksRepository = booksRepository;
    }


 [HttpGet]
 public async Task<IReadOnlyCollection<Book>> Get() => await _booksRepository.GetAll();


[HttpGet(IdUrlTemplate)]
public async Task<IActionResult> Get([FromRoute] string id)
{
  var book = await _booksRepository.GetById(id);
  return book is null ? NotFound() : Ok(book);
}


[HttpPost]
public async Task<IActionResult> Create([FromBody] Book book)
{
   await _booksRepository.Create(book);
   return CreatedAtAction(nameof(Get), new { Id = book.Id }, book);
}


[HttpPut(IdUrlTemplate)]
public async Task<IActionResult> Update([FromRoute] string id, [FromBody] Book book)
{
   var existing = await _booksRepository.GetById(id);
   if (existing is null) return NotFound($"There is no book with id '{id}'");

   await _booksRepository.Update(id, book);
   return NoContent();
}
```

```
[HttpDelete(IdUrlTemplate)]
public async Task<IActionResult> Remove([FromRoute] string id)
{
   var existing = await _booksRepository.GetById(id);
   if (existing is null) return NotFound($"There is no book with id '{id}'");

   await _booksRepository.Remove(id);
   return NoContent();
}

}//Controller
```

It is time to test the web API. For this purpose, we are going to use Swagger. Swagger UI offers a web-based UI that provides information about the service (API functions), using the generated OpenAPI specification. For more information see this link (ASP.NET Core web API documentation with Swagger/OpenAPI): https://learn.microsoft.com/en-us/aspnet/core/tutorials/web-api-help-pages-using-swagger?view=aspnetcore-7.0

Visual Studio 2022 when we create the API project, if we select the OpenAPI option, automatically integrates Swagger into our project. We can check it. In the "Soluciton Explorer" go to the "Dependencies" and inside "Packages" we can see the "Swashbuckle.AspNetCore(6.5.0)" package already referenced.

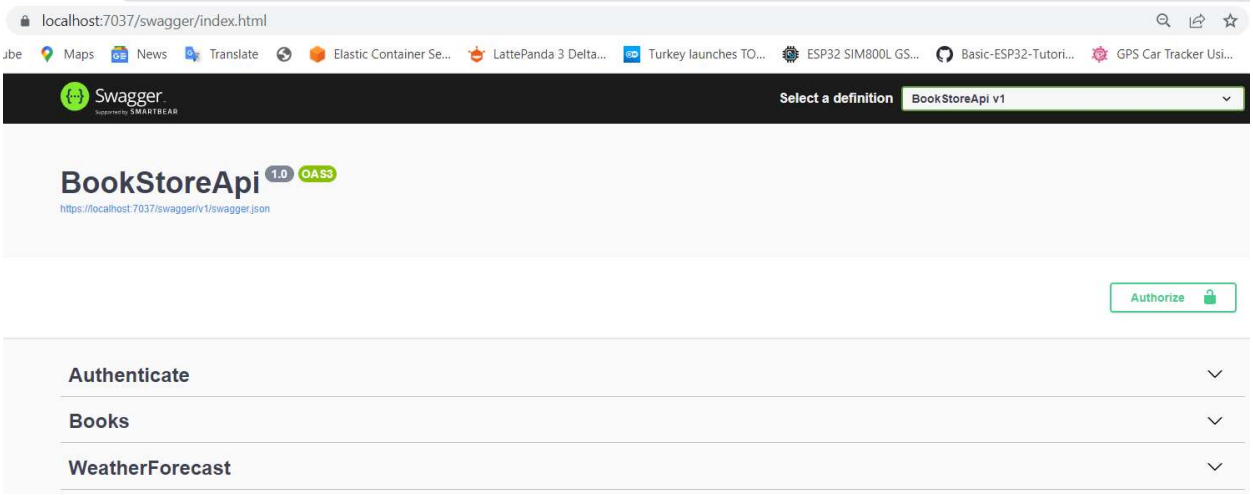


Also inside the middleware (Program.cs) we included the following code for implementing the Swagger service:

```
builder.Services.AddSwaggerGen(opt =>
{
…
});

…
```

```
if (app.Environment.IsDevelopment())
{
    app.UseSwagger();
    app.UseSwaggerUI(opt =>
    {
        opt.ConfigObject.TryItOutEnabled = true;
        opt.ConfigObject.DisplayRequestDuration = true;
    });
}
```

Now if we run the app, we can interact with BooksController via Swagger page: https://localhost:7075/swagger/index.html



4. We provide Authentication and Authorization to the web API

Authentication is the process of validating user credentials and authorization is the process of checking privileges for a user to access specific modules in an application. We protect an ASP.NET Core Web API application by implementing JWT authentication. We use authorization in ASP.NET Core to supply access to various functionalities of the application. We store user credentials in a MongoDb database.

JSON Web Token (JWT) is an open standard (RFC 7519) that defines a compact and self-contained way for securely transmitting information between parties as a JSON object. This information can be verified and trusted because it is digitally signed. JWTs can be signed using a secret (with the HMAC algorithm) or a public/private key pair using RSA or ECDSA.

In its compact form, JSON Web Tokens consist of three parts separated by dots (.), which are:

Header
Payload
Signature

Therefore, a JWT typically looks like the following.

xxxx.yyyy.zzzz

You can find more details about JSON Web Tokens here.

We install the Nugget packages:

- "AspNetCore.Identity.MongoDbCore"
  This is a MongoDb UserStore and RoleStore adapter for Microsoft.Extension.Identity.Core 3.1.
- "Microsoft.AspNetCore. Authentication.JwtBearer"
  This package enables the application to receive an OpenID Connect bearer token.

After loading the Nugget packages, we start our implementation creating a new directory/folder called "Authorization" where to store all the models to manage the authentication and authorization process.

We first define our Identity "User" and "Role" classes. The Identity User class inherits from "MongoIdentityUser" class and is mapped to "Users" collections.

```
using AspNetCore.Identity.MongoDbCore.Models;
using MongoDbGenericRepository.Attributes;

namespace BookStoreApi.Authorization;

[CollectionName("Users")]
public class ApplicationUser : MongoIdentityUser<Guid>
{
    public string? RefreshToken { get; set; }
    public DateTime RefreshTokenExpiryTime { get; set; }
}
```

The Identity Role class inherits from "MongoIdentityRole" class and is mapped to "Roles" collections. The code is given below.

```
[CollectionName("Roles")]
public class ApplicationRole : MongoIdentityRole<Guid>
{
}
```

Also, we create a static class "UserRoles to add two constant values "Admin" and "User" as roles. You can add as many roles as you wish.

```
public class UserRoles
{
    public const string Admin = "Admin";
    public const string User = "User";
}
```

We create a “User.cs” class for new user registration. In this class we store the personal information for each user (Name, Email and Password).

```
using System.ComponentModel.DataAnnotations;

namespace BookStoreApi.Authorization;

public record User
{
    [Required] public string Name { get; init; } = null!;

    [Required]
    [EmailAddress(ErrorMessage = "Invalid Email")]
    public string Email { get; init; } = null!;

    [Required]
    public string Password { get; init; } = null!;
}
```

We store the login user credentials (name and password) inside the “LoginModel.cs” class. See the code below.

```
using System.ComponentModel.DataAnnotations;

namespace BookStoreApi.Authorization;
public record LoginModel
{
    [Required(ErrorMessage = "User name is needed")]
    public string UserName { get; init; } = null!;

    [Required(ErrorMessage = "Password is needed")]
    public string Password { get; init; } = null!;
}
```

To store the information required by the JWT authorization we create the “TokenModel.cs” class. In this class we store the AccessToken and the RefreshToken. The access token is valid for the time period we stablish in the appsettings.json file. After that period of time, we have to create a new token with the refreshtoken. We will explain later in more detail.

```
public record TokenModel
{
    public string? AccessToken { get; set; }
    public string? RefreshToken { get; set; }
}
```

To manage the http requests responses, we create the “Response.cs” class. In this class we define the response message and the response status code.

```
namespace BookStoreApi.Authorization;

public record Response
{
    public string? Status { get; init; }
    public string? Message { get; init; }

    public static Response Success { get; } = new Response() { Status = "Success" };
    public static Response Error { get; } = new Response() { Status = "Error" };
}
```

After creating all the authentication and authorization models classes inside the “Authorization” directory/folder, we proceed with the appsettings.json file modifications. We have to include a new section “JWT”. Inside this new section in the appsettings.json file we define five new variable (ValidAudience, ValidIssuer, Secret, TokenValidityInMinutes and RefreshTokenValidityInDays).

…

```
  "JwtSettings": {
    "ValidAudience": "http://localhost:4200",
    "ValidIssuer": "http://localhost:5094",
    "Secret": "JwtRefreshTokenSecuredString019~!#Password",
    "TokenValidity": "00:10:00",
    "RefreshTokenValidity":  "7.00:00:00"
```

…

ValidAudience: What is the target of this token. In other words which services should accept this token an access token for the service. They may be many valid tokens in the world, but not all of those tokens have been granted by the user to allow access to the resources saved in the product services. A token valid for Google drive should not be accepted for GMail, even if both of them have the same issuer, they’ll have different audiences.

ValidIssuer: Who created the token. In this case is our localhost web API. When we launch the API, the URL is set in the launchSettings.json.

…

```
"profiles": {
  "http": {
    "commandName": "Project",
    "dotnetRunMessages": true,
    "launchBrowser": true,
    "launchUrl": "swagger",
    "applicationUrl": "http://localhost:5000",
    "environmentVariables": {
      "ASPNETCORE_ENVIRONMENT": "Development"
    }
  },
```

…

Secret: The secret will be used for setting the JWT “IssuerSigningKey”. It is the public key used for validating incoming JWT tokens. By specifying a key here, the token can be validated without any need for the issuing server. What is needed, instead, is the location of the public key. The certLocation parameter, for example a string pointing to a .cer certificate file containing the

public key corresponding to the private key used by the issuing authentication server. Of course, this certificate could just as easily (and more likely) come from a certificate store instead of a file.

TokenValidityInMinutes: the access token is valid for the period of time established in this variable. After that time the token expires and the user should request a new token with the aid of the refresh token. In this case to have enough time to test the application we set the expiration time to 10 minutes. But in a production environment the most common practice is to set 1 minute for the expiration time to increase the system security.

RefreshTokenValidityInDays: as an additionally functionality we can set the refresh token expiration time. We create this variable in the appsettings.json file to track in the Authenticate Controller, but in this article is not implemented.

After setting the JWT configuration variables we have to modify the middleware (Program.cs) for including the authentication and authorization scenario. Let's explain which the main modifications are required.

We define the MongoDb, the "Identity" database, as the database for storing the users' credential (usernames, roles, etc). The MongoDb is running in three Docker containers our localhost in port 27017, 27018 and 27019.

```
builder.Services
    .AddIdentity<ApplicationUser, ApplicationRole>()
    .AddMongoDbStores<ApplicationUser, ApplicationRole, Guid>
    (
        bookStoreSettings.ConnectionString, "Identity"
    )
    .AddDefaultTokenProviders();
```

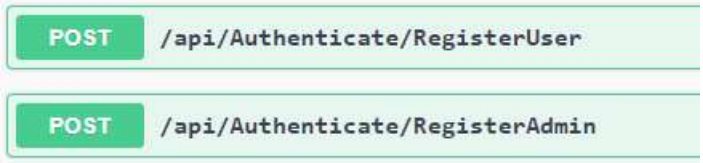
We also confiture the JWT Authentication system with the following code. For more information and a detail explanation take a look here and here.

```
builder.Services
    .AddAuthentication(opt =>
    {
        opt.DefaultAuthenticateScheme = JwtBearerDefaults.AuthenticationScheme;
        opt.DefaultChallengeScheme = JwtBearerDefaults.AuthenticationScheme;
        opt.DefaultScheme = JwtBearerDefaults.AuthenticationScheme;
    })
    .AddJwtBearer(opt =>
    {
        opt.SaveToken = true;
        opt.RequireHttpsMetadata = false;
        opt.TokenValidationParameters = new TokenValidationParameters()
        {
            ValidateIssuer = true,
            ValidateAudience = true,
            ValidAudience = jwtSettings.ValidAudience,
            ValidIssuer = jwtSettings.ValidIssuer,
            IssuerSigningKey = jwtSettings.GetKey()
        };
    });
```

After introducing the required modification in the middleware, we are going to create an API controller “AuthenticateController.cs” inside the “Controllers” folder and add below code.

```
using System.IdentityModel.Tokens.Jwt;
using System.Security;
using System.Security.Claims;
using BookStoreApi.Authorization;
using BookStoreApi.Configuration;
using Microsoft.AspNetCore.Authentication;
using Microsoft.AspNetCore.Authorization;
using Microsoft.AspNetCore.Identity;
using Microsoft.AspNetCore.Mvc;
using Microsoft.IdentityModel.Tokens;

namespace BookStoreApi.Controllers;

[ApiController]
[Route("api/[controller]")]
public class AuthenticateController : ControllerBase
{
    private readonly UserManager<ApplicationUser> _userManager;
    private readonly RoleManager<ApplicationRole> _roleManager;
    private readonly SignInManager<ApplicationUser> _signInManager;
    private readonly JwtSettings _jwtSettings;
    private readonly ISystemClock _systemClock;

    public AuthenticateController(
        UserManager<ApplicationUser> userManager
        , RoleManager<ApplicationRole> roleManager
        , SignInManager<ApplicationUser> signInManager
        , JwtSettings jwtSettings
        , ISystemClock systemClock)
    {
        _userManager = userManager;
        _roleManager = roleManager;
        _signInManager = signInManager;
        _jwtSettings = jwtSettings;
        _systemClock = systemClock;
    }
```

RegisterUser, RegisterAdmin: this function receives as a parameter the new user info (username, password and email). The action first looks for that user info in the MongoDb database, if the user already exists, send a message “User already exists!”, otherwise create the new user in the “Identity” database and assign the new user with the “User” or “Admin” role.



```
    [HttpPost("[action]")]
    public async Task<IActionResult> RegisterUser([FromBody] User user) =>
        await RegisterWithRole(user, UserRoles.User);

    [HttpPost("[action]")]
    public async Task<IActionResult> RegisterAdmin([FromBody] User user) =>
        await RegisterWithRole(user, UserRoles.Admin);
```

Login: after registering a new user, we have stored the user personal information in the Mongo database. The login action receives as a parameter the user's name and password and look for that user in the Mongo collection. If the user is found the CreateToken function is called to create an access token for that user.


```
[HttpPost("[action]")]
    public async Task<IActionResult> Login([FromBody] LoginModel loginModel)
    {
        var user = await _userManager.FindByNameAsync(loginModel.UserName);
        if (user == null
        || !await _userManager.CheckPasswordAsync(user, loginModel.Password))
            return Unauthorized();

        var roles = await _userManager.GetRolesAsync(user);
        var claims = new Claim[]
            {
                new(ClaimTypes.Name, user.UserName),
                new(JwtRegisteredClaimNames.Jti, Guid.NewGuid().ToString()),
            }
            .Concat(roles.Select(role => new Claim(ClaimTypes.Role, role)))
            .ToArray();

        var token = CreateToken(claims);

        var refreshToken = GenerateRefreshToken();
        user.RefreshToken = refreshToken;

        user.RefreshTokenExpiryTime = _systemClock.UtcNow.LocalDateTime
            .Add(_jwtSettings.RefreshTokenValidity);

        var signInResult = await _signInManager.PasswordSignInAsync
        (
            user, loginModel.Password, isPersistent: false, lockoutOnFailure: false
        );
        if (!signInResult.Succeeded)
            return Unauthorized();

        await _userManager.UpdateAsync(user);
        return Ok(new
        {
            Token = new JwtSecurityTokenHandler().WriteToken(token),
            RefreshToken = refreshToken,
            Expiration = _systemClock.UtcNow.ToLocalTime()
                            .Add(_jwtSettings.TokenValidity)
        });
    }
```

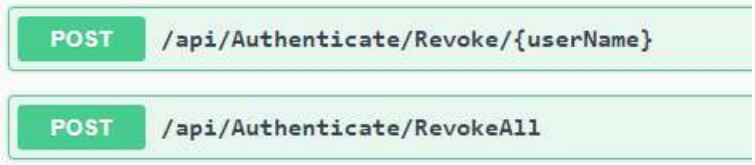
We create a token with the function “JwtSecurityToken”, and we attach the following properties: issuer, audience, claims, expires and signingCredentials:

```
private SecurityToken CreateToken(IEnumerable<Claim> claims) => new JwtSecurityToken
(
        issuer: _jwtSettings.ValidIssuer,
        audience: _jwtSettings.ValidAudience,
        claims: claims,
        expires: _systemClock.UtcNow.LocalDateTime.Add(_jwtSettings.TokenValidity),
        signingCredentials: new SigningCredentials
        (
            key: _jwtSettings.GetKey(),
            algorithm: SecurityAlgorithms.HmacSha256
        )
);
```

After the token expires, we need to create a new token. For this purpose we have to call the “RefreshToken” function. Remember in the appSettings.json we set the token expiration time.


```
[HttpPost("[action]")]
    public async Task<IActionResult> RefreshToken([FromBody] TokenModel tokenModel)
    {
        var principal = GetPrincipalFromExpiredToken(tokenModel.AccessToken);
        if (principal is null)
            return BadRequest();

        var user = await _userManager.FindByNameAsync(principal.Identity.Name);
        if (user is null
            || user.RefreshToken != tokenModel.RefreshToken
            || user.RefreshTokenExpiryTime <= _systemClock.UtcNow.LocalDateTime)
            return BadRequest();

        user.RefreshToken = GenerateRefreshToken();
        await _userManager.UpdateAsync(user);

        return Ok(new
        {
            AccessToken = new JwtSecurityTokenHandler()
              .WriteToken(CreateToken(principal.Claims)),
            RefreshToken = user.RefreshToken,
        });
    }

private static string GenerateRefreshToken()
{
    var randomNumber = new byte[64];
    Random.Shared.NextBytes(randomNumber);
    return Convert.ToBase64String(randomNumber);
}
```

In case we would like to revoke the permissions granted to a user, we can call the “Revoke” an user or “RevokeAll” users. These functions set to “null” the RefreshToken, then the user cannot create a new token after the expiration time:




```
[Authorize]
    [HttpPost("[action]/{userName}")]
    public async Task<IActionResult> Revoke([FromRoute] string userName)
    {
        var user = await _userManager.FindByNameAsync(userName);
        if (user is null)
            return BadRequest($"There is no user with name '{userName}'.");

        user.RefreshToken = null;
        await _userManager.UpdateAsync(user);

        return NoContent();
    }

    [Authorize]
    [HttpPost("[action]")]
    public async Task<IActionResult> RevokeAll()
    {
        var users = _userManager.Users.ToList();
        foreach (var user in users)
        {
            user.RefreshToken = null;
            await _userManager.UpdateAsync(user);
        }

        return NoContent();
    }
```

After the Authentication process (register user, login, create token, etc) defined in the “AuthenticateController.cs”, we have to authorize users to access the actions in the “BooksController.cs” and “WeatherForecastController.cs”. For this purpose, we include the [Authorize] attribute in all the actions where we require a granted permission to be accessed.

In our API we granted permission to the users with “Admin” role to access the actions inside the “BooksController.cs”.

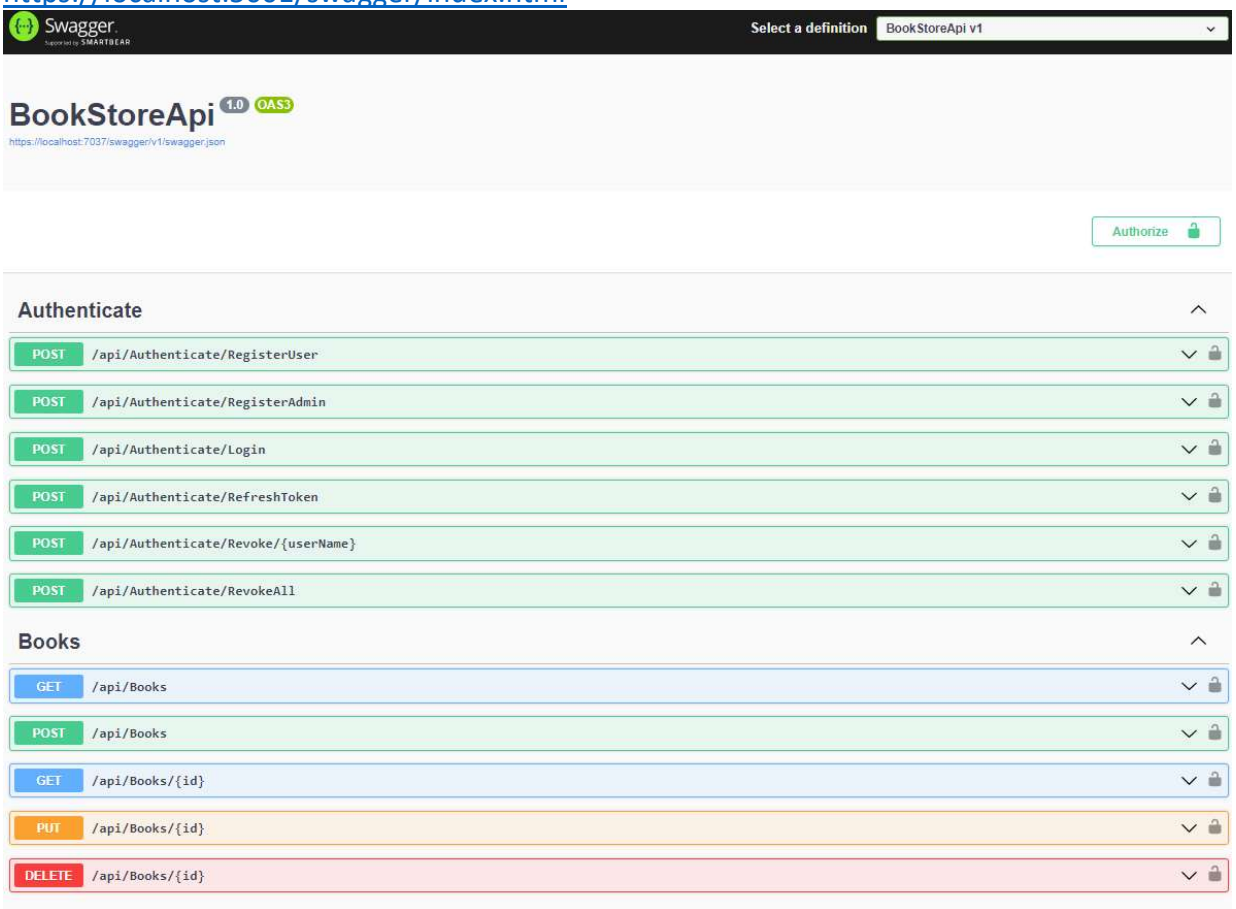
```
using BookStoreApi.Authorization;
using BookStoreApi.Entities;
using BookStoreApi.Services;
using Microsoft.AspNetCore.Authorization;
using Microsoft.AspNetCore.Mvc;

namespace BookStoreApi.Controllers;

[Authorize(Roles = UserRoles.Admin)]
[ApiController]
[Route("api/[controller]")]
public class BooksController : ControllerBase
{
    private const string IdUrlTemplate = "{id:length(24)}";
    private readonly IBooksRepository _booksRepository;

    public BooksController(IBooksRepository booksRepository)
    {
        _booksRepository = booksRepository;
    }

[AllowAnonymous]
[HttpGet]
public async Task<IReadOnlyCollection<Book>> Get() => await _booksRepository.GetAll();


[AllowAnonymous]
[HttpGet(IdUrlTemplate)]
public async Task<IActionResult> Get([FromRoute] string id)
{
   var book = await _booksRepository.GetById(id);
   return book is null ? NotFound() : Ok(book);
}


[HttpPost]
public async Task<IActionResult> Create([FromBody] Book book)
{
    await _booksRepository.Create(book);
    return CreatedAtAction(nameof(Get), new { Id = book.Id }, book);
}


[HttpPut(IdUrlTemplate)]
public async Task<IActionResult> Update([FromRoute] string id, [FromBody] Book book)
{
   var existing = await _booksRepository.GetById(id);
   if (existing is null) return NotFound($"There is no book with id '{id}'");

   await _booksRepository.Update(id, book);
   return NoContent();
}
```

```
[HttpDelete(IdUrlTemplate)]
public async Task<IActionResult> Remove([FromRoute] string id)
{
    var existing = await _booksRepository.GetById(id);
    if (existing is null) return NotFound($"There is no book with id '{id}'");

    await _booksRepository.Remove(id);
    return NoContent();
}
}//Controller
```

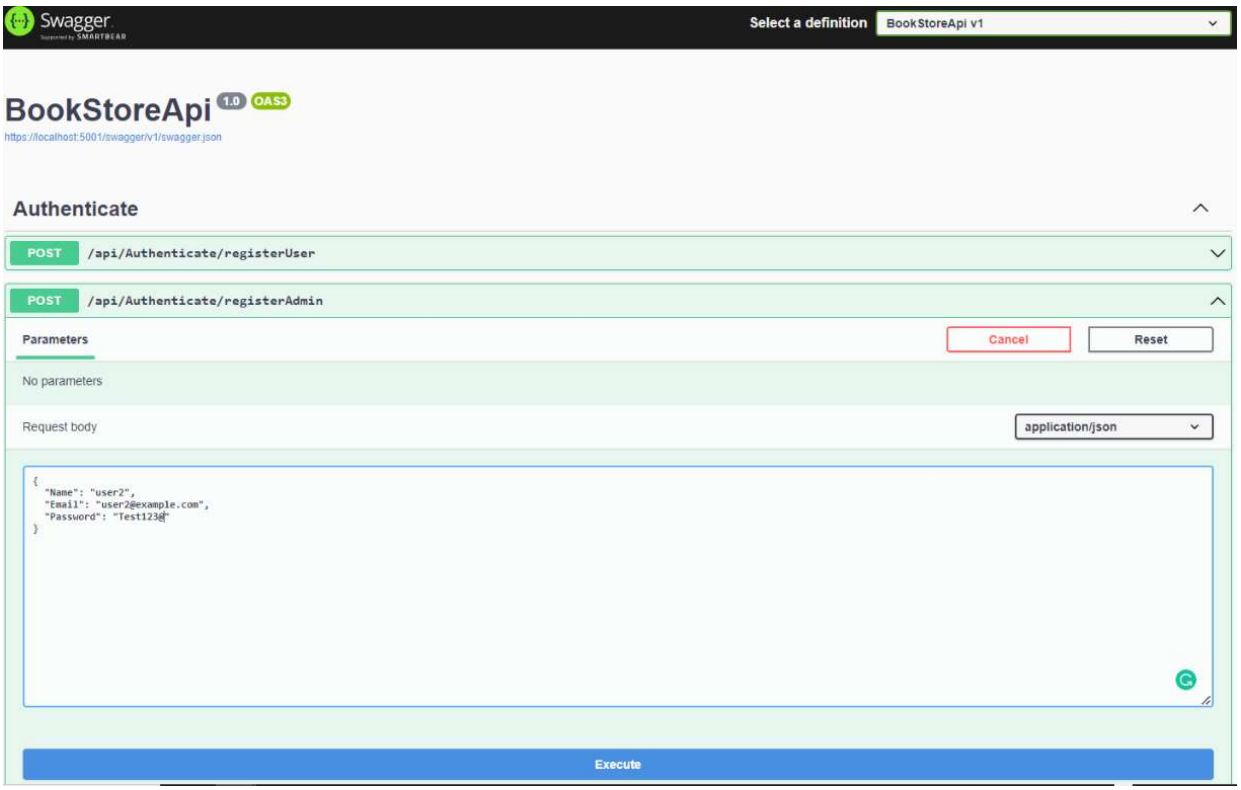
5. Testing the API

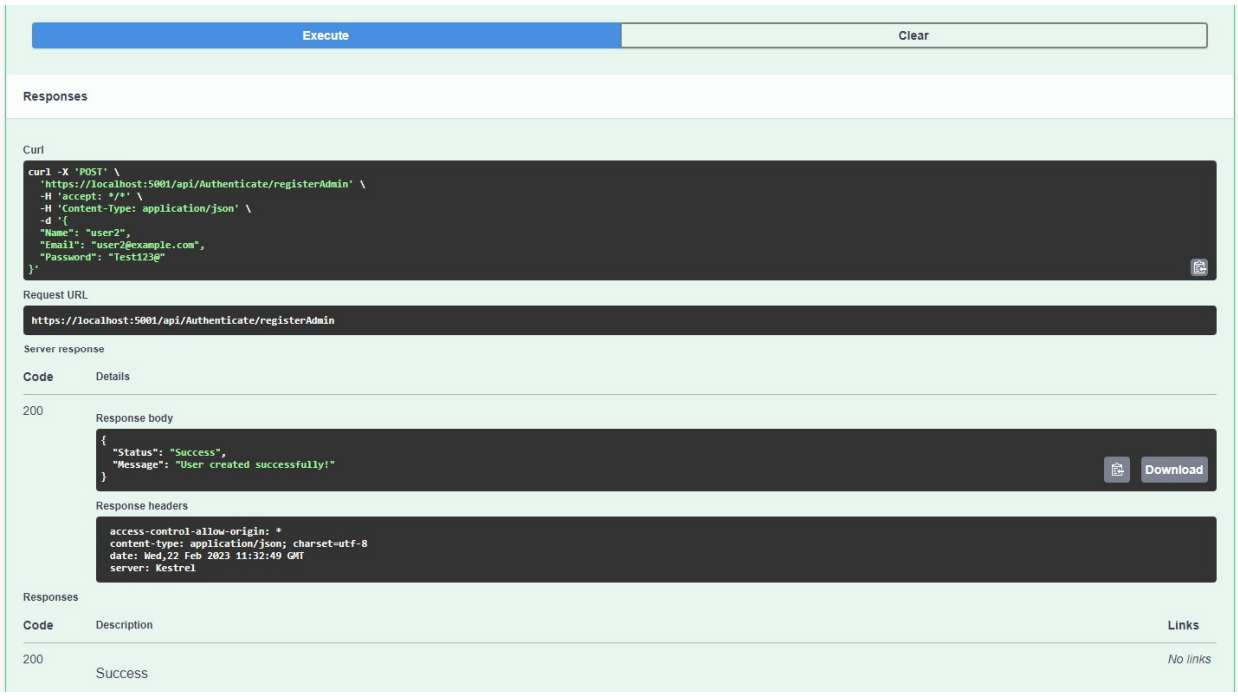
We run the application in Visual Studio 2022.

https://localhost:5001/swagger/index.html

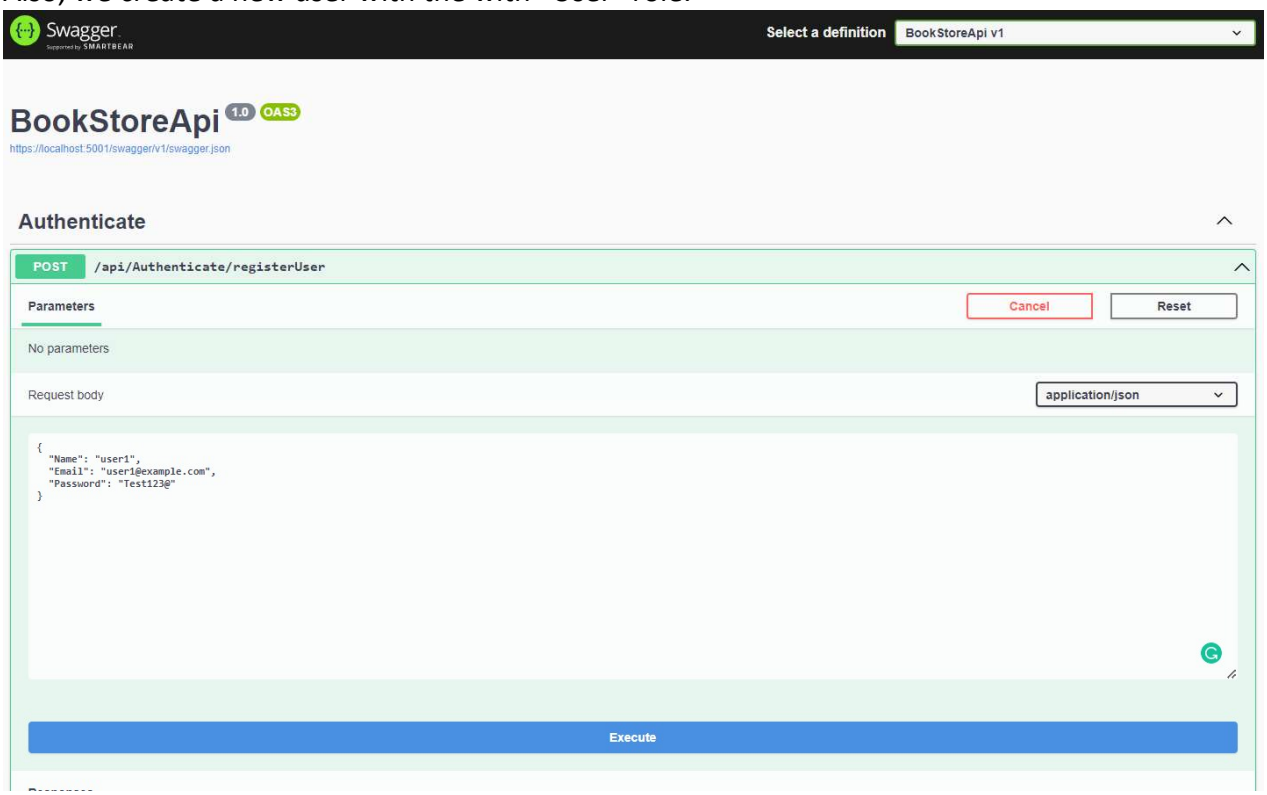


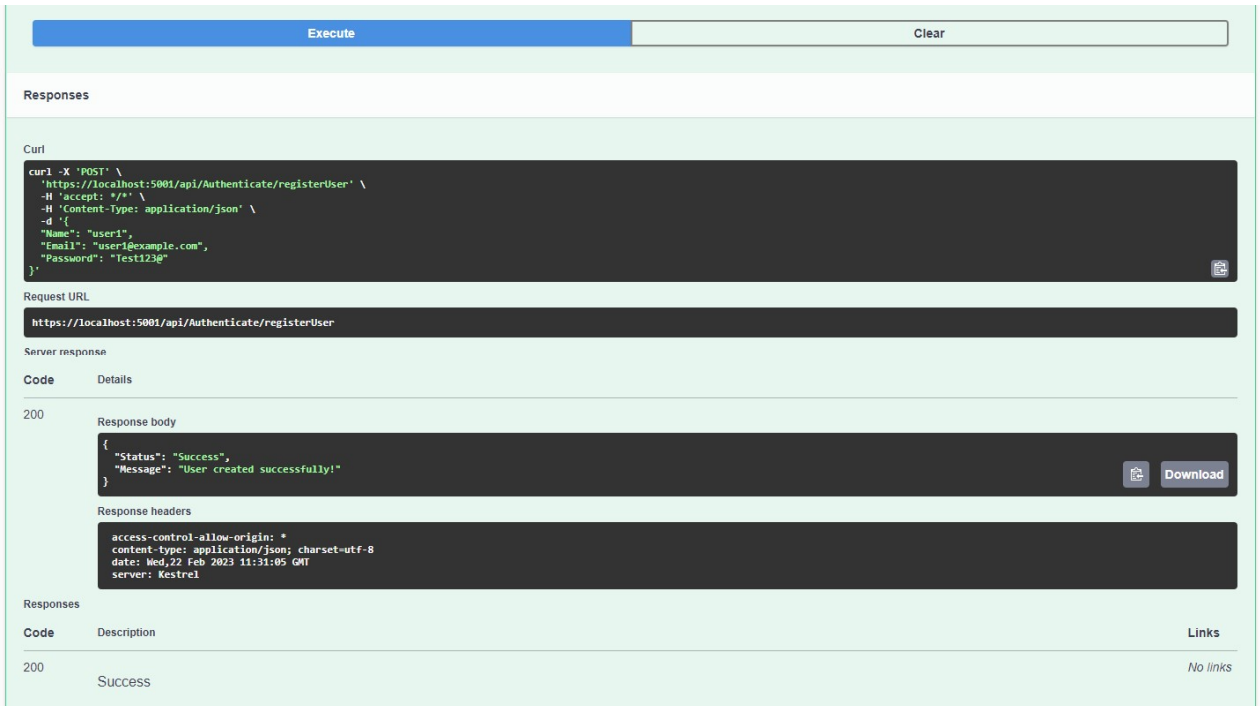
We create a new user with “Admin” role.



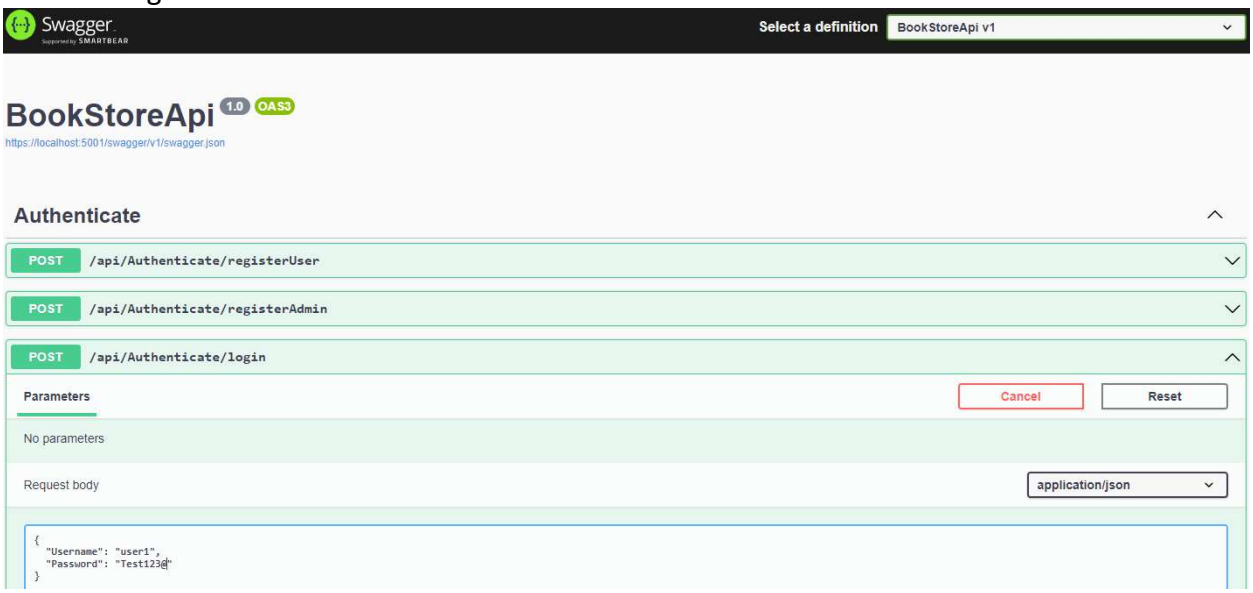


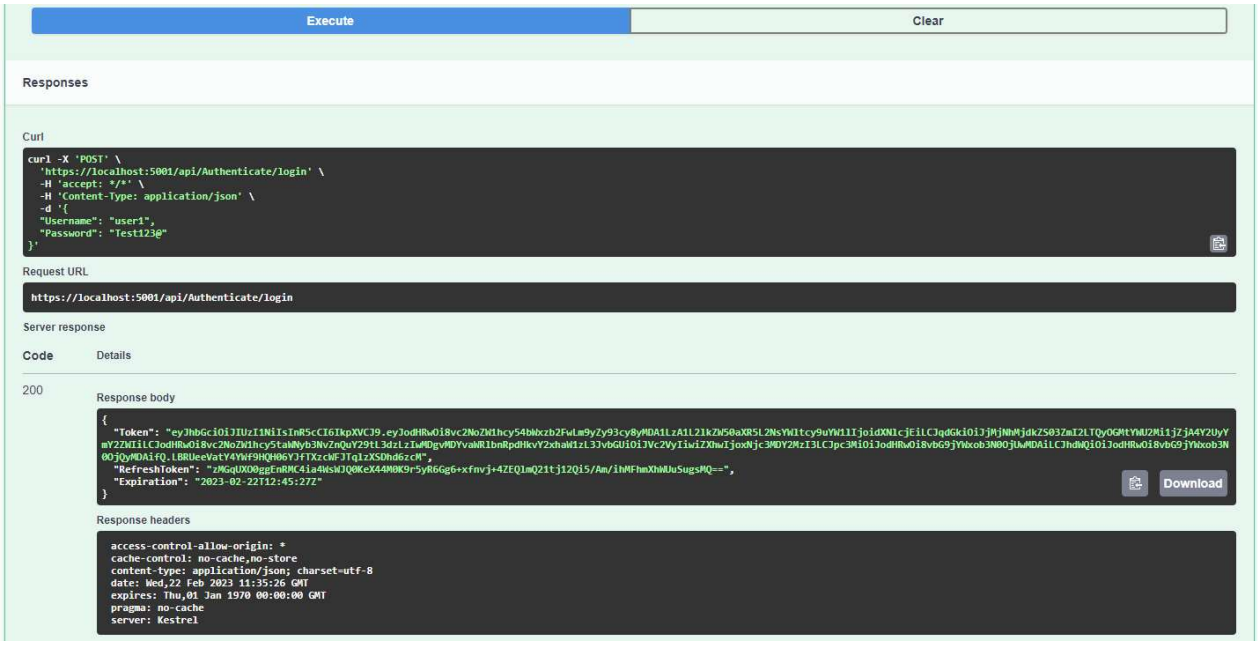
Also, we create a new user with the with “User” role.



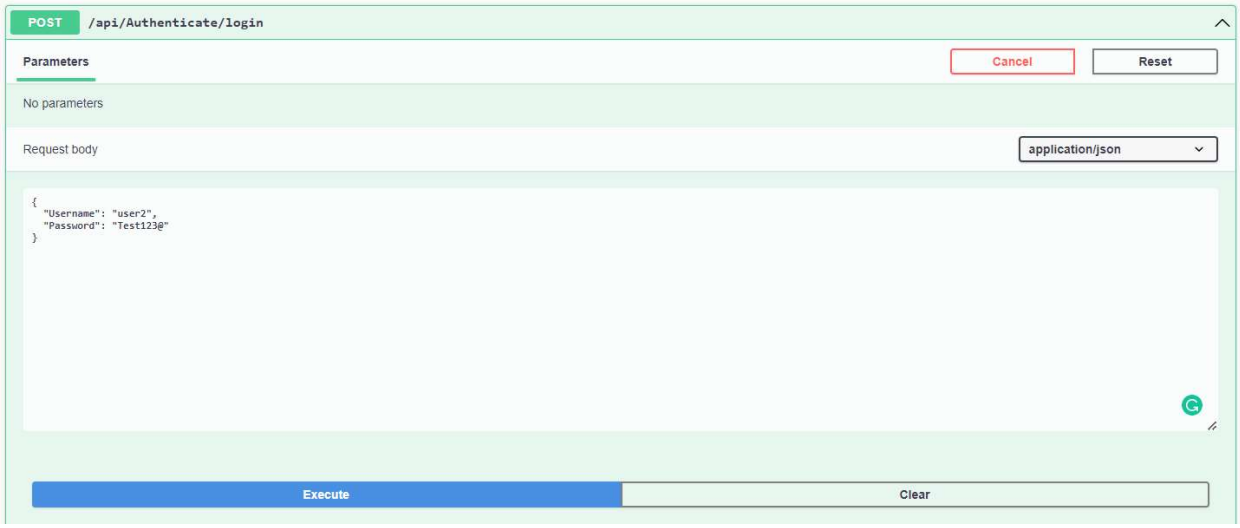


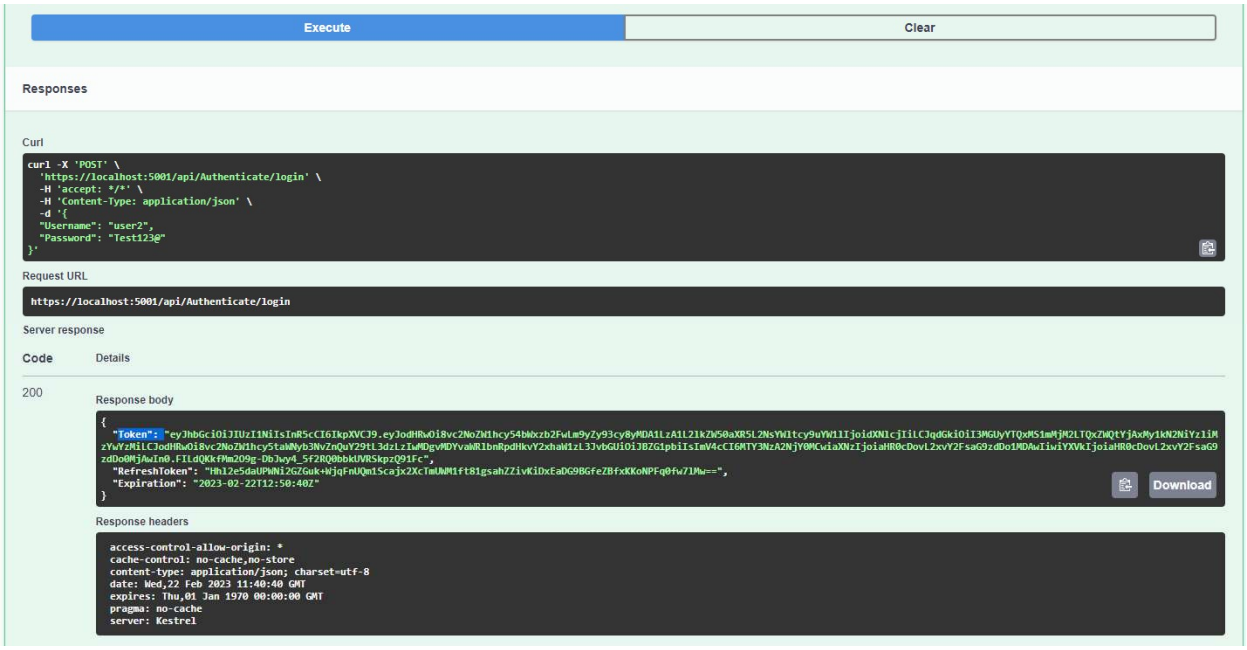
After we login and obtain the access token for each user: “user1” and “user2”.





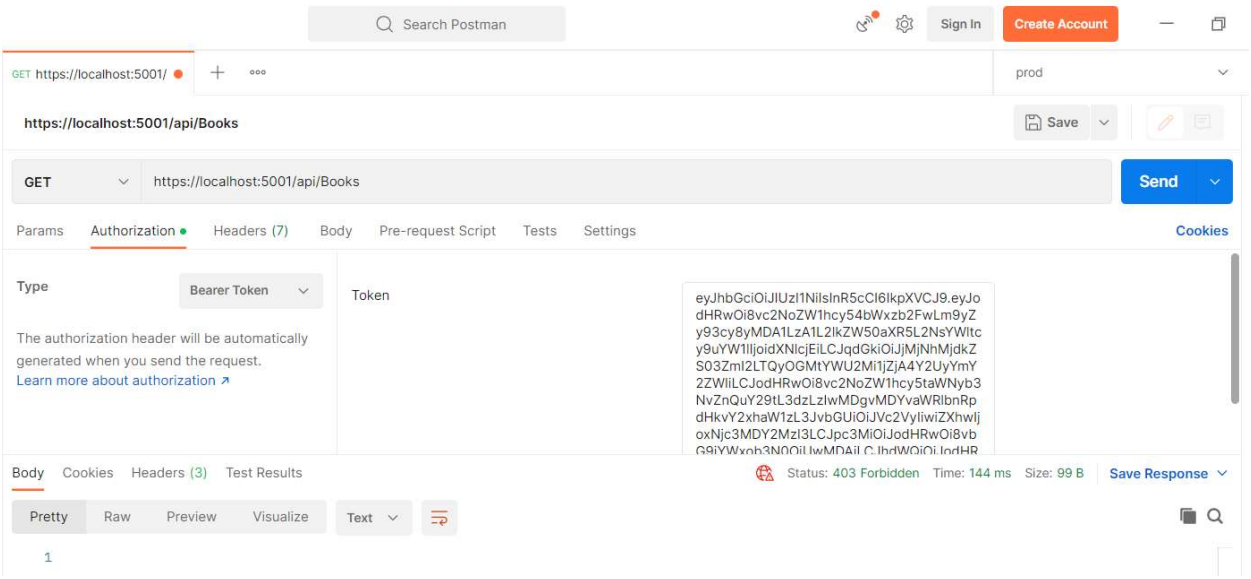
We proceed in the same way for the “user2”



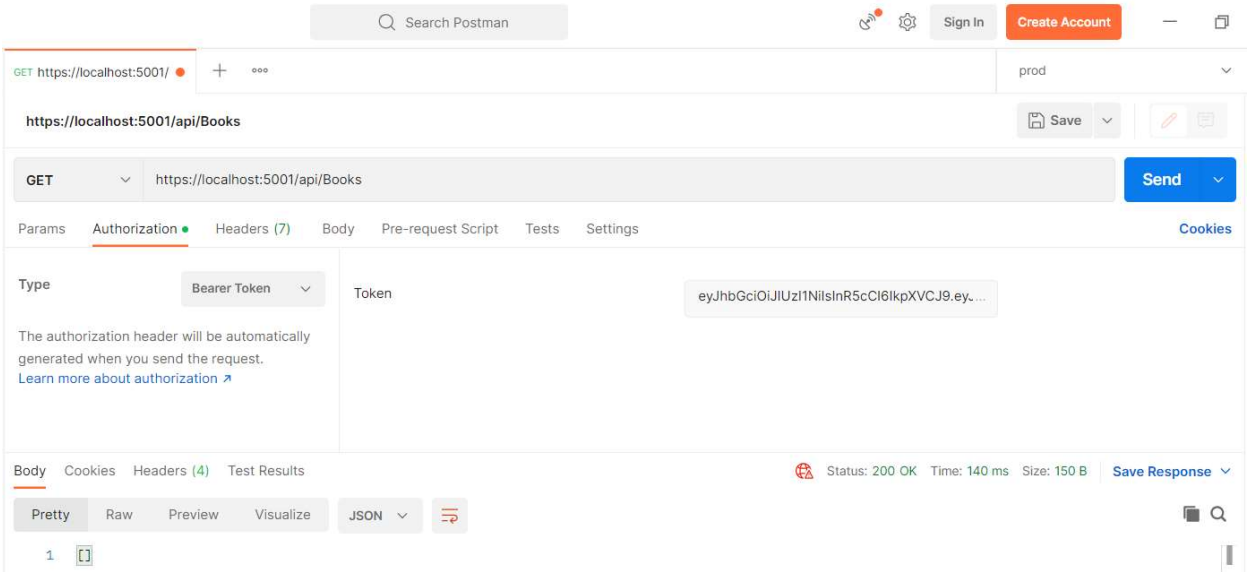


We run Postman and we send a GET requests. As we populated, in previous section in this article, the “BookStore” database and “Books” collection with documents we receive as response the requested data.

For the “user1” with the “User” role we receive a “403 Forbidden” response status code, because as we mentioned in this article, we only authorized the “Admin” role user to access the actions inside the “BooksController”, as we explained in section 4.



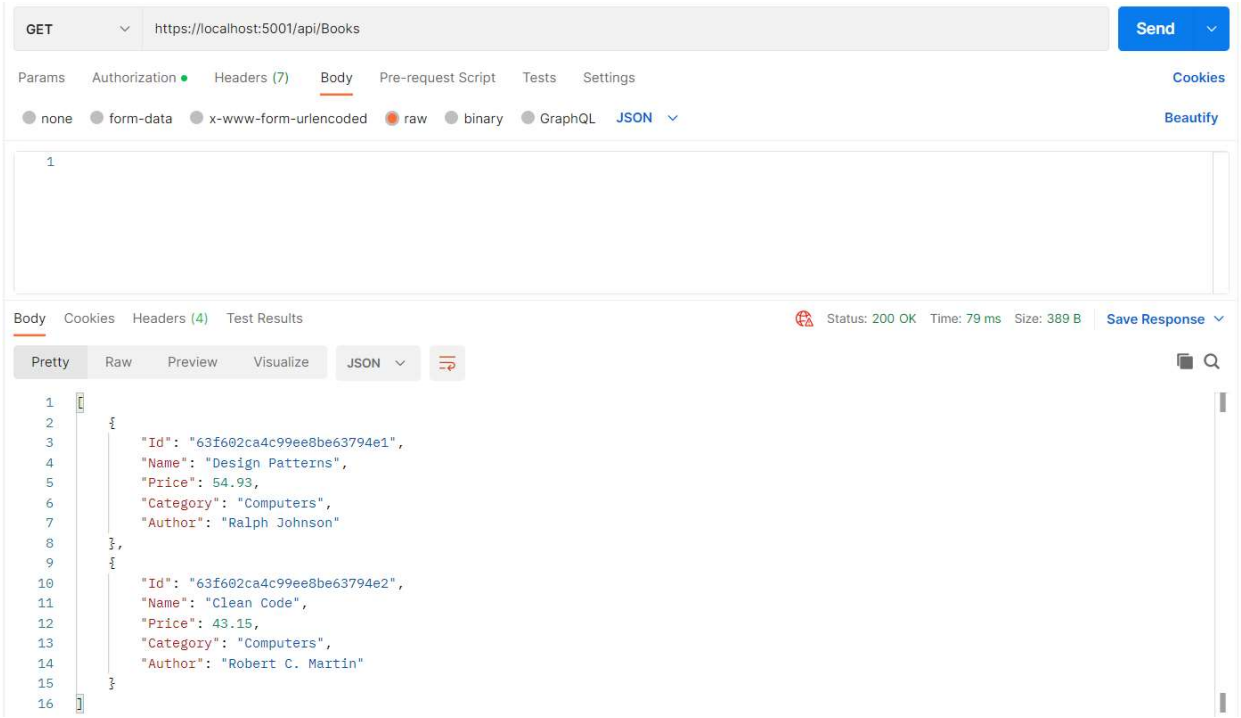
However, for the “user2” we receive a response status code “200 OK” because the “user2” has the “Admin” role, and hence he is authorized to access all the actions inside the “BooksController”, as defined in section 4.



In this first test I did not populated the MongoDb database containers, due to this issue I receive a blank array as response.
But if we populate the Mongo database with the following commands, we receive the JSON response with two books items retrieve from the “Books” collections inside the “BookStore” database.

C:/>docker exec -it mongo1 mongosh
>use BookStore
>db.createCollection('Books')

>db.Books.insertMany([{ "Name": "Design Patterns", "Price": 54.93, "Category": "Computers", "Author": "Ralph Johnson" }, { "Name": "Clean Code", "Price": 43.15, "Category": "Computers","Author": "Robert C. Martin" }])



6. Conclusion

In this article we define a methodology/procedure to create a .Net 7 web API with Mongo database, and we also provided authentication and authorization to access the API functions by means of JWT.

7. Future work

We propose the reader to achieve the integration test creating a Client Web API to send and receive data from the API developed in this article.

Also we recomend to deploy the API and the MongoDb Replicaset on an Elastic Container Instance (Azure ACI, AWS ECS, etc) or on Kubernetes hosted in the Cloud (Azure AKS, AWS EKS, Google GKE, etc).

Also it would be a good practice to redo this article instead with MongoDb with an Azure CosmosDb, a AWS DynamoDb , a Google Cloud DataStore or an Oracle NoSQL Database Cloud Service. These are NoSQL databases hosted in the Cloud. In these cases we can study to simplify the authentication and authorizations process and use the identity services available in the Clouds Providers.

8. References

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