Lab: Create a web API with ASP.NET Core

In this lab

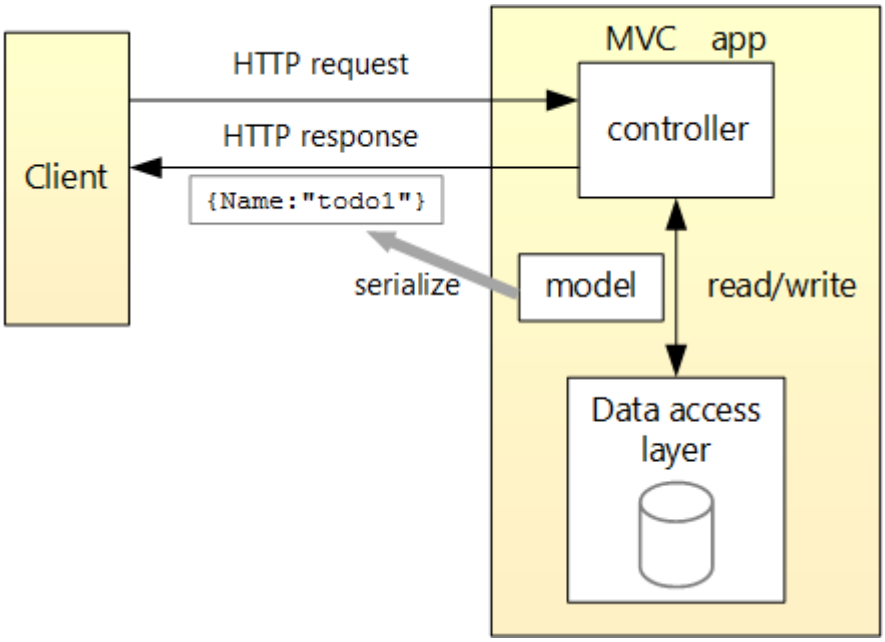
This lab teaches the basics of building a controller-based web API that uses a database. Another approach to creating APIs in ASP.NET Core is to create *minimal APIs* which was done in Lab 2.

Overview

This lab creates the following API:

API	Description	Request body	Response body
`GET /api/todoitems`	Get all to-do items	None	Array of to-do items
`GET /api/todoitems/{id}`	Get an item by ID	None	To-do item
`POST /api/todoitems`	Add a new item	To-do item	To-do item
`PUT /api/todoitems/{id}`	Update an existing item	To-do item	None
`DELETE /api/todoitems/{id}`	Delete an item	None	None

The following diagram shows the design of the app.



The client is represented by a box on the left. It submits a request and receives a response from the application, a box drawn on the right. Within the application box, three boxes represent the controller, the model, and the data access layer. The request comes into the application's controller, and read/write operations occur between the controller and the data access layer. The model is serialized and returned to the client in the response.

Create a web project

- Open the integrated terminal.
- Change directories (`cd`) to the folder that will contain the project folder.
- Run the following commands:

  ```
  dotnet new webapi -o TodoApi

  cd TodoApi

  dotnet add package Microsoft.EntityFrameworkCore.InMemory
  ```

  These commands:

  - Create a new web API project and open it in Visual Studio Code.
  - Add a NuGet package that is needed for the next section.

Test the project

Run the app:

- Run the following command to start the app on the `https` profile:

```
dotnet run
```

The output shows messages similar to the following, indicating that the app is running and awaiting requests:

```
...
info: Microsoft.Hosting.Lifetime[14]
      Now listening on: https://localhost:{port}
...
```

- Ctrl]+*click* the HTTPS URL in the output to test the web app in a browser.
- The default browser is launched to `https://PORT-YOUR_GITPOD_URL.gitpod.io/swagger/index.html`, where `<port>` is the randomly chosen port number displayed in the output. There is no endpoint at `https://PORT-YOUR_GITPOD_URL.gitpod.io`, so the browser returns HTTP 404 Not Found. Append `/swagger` to the URL, `https://PORT-YOUR_GITPOD_URL.gitpod.io/swagger`.

After testing the web app in the following instruction, press [Ctrl]+[C] in the integrated terminal to shut it down.

The Swagger page `/swagger/index.html` is displayed. Select **GET** > **Try it out** > **Execute**. The page displays:

- The Curl command to test the WeatherForecast API.
- The URL to test the WeatherForecast API.
- The response code, body, and headers.
- A drop-down list box with media types and the example value and schema.

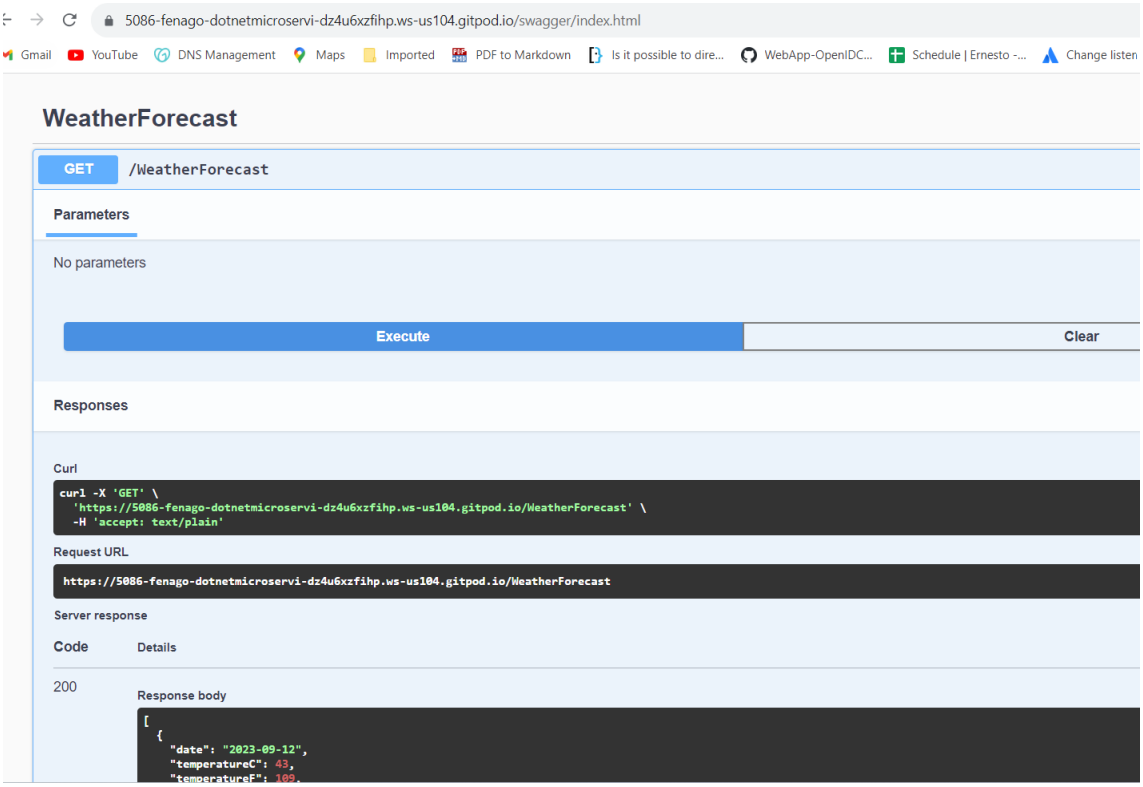
Swagger is used to generate useful documentation and help pages for web APIs. This lab uses Swagger to test the app. For more information on Swagger, see [ASP.NET Core web API documentation with Swagger / OpenAPI

Copy and paste the **Request URL** in the browser: `https://PORT-YOUR_GITPOD_URL.gitpod.io/weatherforecast`

JSON similar to the following example is returned:

```
[
    {
        "date": "2019-07-16T19:04:05.7257911-06:00",
        "temperatureC": 52,
        "temperatureF": 125,
        "summary": "Mild"
    },
    {
        "date": "2019-07-17T19:04:05.7258461-06:00",
        "temperatureC": 36,
        "temperatureF": 96,
        "summary": "Warm"
    },
    {
        "date": "2019-07-18T19:04:05.7258467-06:00",
        "temperatureC": 39,
        "temperatureF": 102,
        "summary": "Cool"
    },
    {
        "date": "2019-07-19T19:04:05.7258471-06:00",
        "temperatureC": 10,
```

```
        "temperatureF": 49,
        "summary": "Bracing"
    },
    {
        "date": "2019-07-20T19:04:05.7258474-06:00",
        "temperatureC": -1,
        "temperatureF": 31,
        "summary": "Chilly"
    }
]
```



Add a model class

A *model* is a set of classes that represent the data that the app manages. The model for this app is the `TodoItem` class.

- Add a folder named `Models`.
- Add a `TodoItem.cs` file to the `Models` folder with the following code:

```
namespace TodoApi.Models;

public class TodoItem
{
    public long Id { get; set; }
    public string? Name { get; set; }
    public bool IsComplete { get; set; }
}
```

The `Id` property functions as the unique key in a relational database.

Model classes can go anywhere in the project, but the `Models` folder is used by convention.

Add a database context

The *database context* is the main class that coordinates Entity Framework functionality for a data model. This class is created by deriving from the [Microsoft.EntityFrameworkCore.DbContext] class.

- Add a `TodoContext.cs` file to the `Models` folder.
- Enter the following code:

```
using Microsoft.EntityFrameworkCore;

namespace TodoApi.Models;

public class TodoContext : DbContext
{
    public TodoContext(DbContextOptions<TodoContext> options)
        : base(options)
    {
    }

    public DbSet<TodoItem> TodoItems { get; set; } = null!;
}
```

Register the database context

In ASP.NET Core, services such as the DB context must be registered with the [dependency injection (DI)] container. The container provides the service to controllers.

Update `Program.cs` with the following highlighted code:

```
using Microsoft.EntityFrameworkCore;
using TodoApi.Models;

var builder = WebApplication.CreateBuilder(args);

builder.Services.AddControllers();
builder.Services.AddDbContext<TodoContext>(opt =>
    opt.UseInMemoryDatabase("TodoList"));
builder.Services.AddEndpointsApiExplorer();
builder.Services.AddSwaggerGen();

var app = builder.Build();

if (app.Environment.IsDevelopment())
{
    app.UseSwagger();
    app.UseSwaggerUI();
}
```

```
app.UseHttpsRedirection();

app.UseAuthorization();

app.MapControllers();

app.Run();
```

The preceding code:

- Adds `using` directives.
- Adds the database context to the DI container.
- Specifies that the database context will use an in-memory database.

Scaffold a controller

Make sure that all of your changes so far are saved.

- Control-click the **TodoAPI** project and select **Open in Terminal**. The terminal opens at the `TodoAPI` project folder. Run the following commands:

```
dotnet add package Microsoft.VisualStudio.Web.CodeGeneration.Design -v 7.0.0
dotnet add package Microsoft.EntityFrameworkCore.Design -v 7.0.0
dotnet add package Microsoft.EntityFrameworkCore.SqlServer -v 7.0.0
dotnet tool uninstall -g dotnet-aspnet-codegenerator
dotnet tool install -g dotnet-aspnet-codegenerator
dotnet tool update -g dotnet-aspnet-codegenerator
```

Note: Run commands one by one and ignore not found errors while running uninstalling commands.

The preceding commands:

- Add NuGet packages required for scaffolding.
- Install the scaffolding engine (`dotnet-aspnet-codegenerator`) after uninstalling any possible previous version.

Build the project.

Run the following command:

```
dotnet aspnet-codegenerator controller -name TodoItemsController -async -api -m
TodoItem -dc TodoContext -outDir Controllers
```

The preceding command scaffolds the `TodoItemsController` .

The generated code:

- Marks the class with the [`[ApiController]`] attribute. This attribute indicates that the controller responds to web API requests. For information about specific behaviors that the attribute enables, see [Create web APIs with ASP.NET Core].
- Uses DI to inject the database context (`TodoContext`) into the controller. The database context is used in each of the CRUD methods in the controller.

The ASP.NET Core templates for:

- Controllers with views include `[action]` in the route template.
- API controllers don't include `[action]` in the route template.

When the `[action]` token isn't in the route template, the [action] name (method name) isn't included in the endpoint. That is, the action's associated method name isn't used in the matching route.

Update the PostTodoItem create method

Update the return statement in the `PostTodoItem` to use the [nameof] operator:

```
[HttpPost]
public async Task<ActionResult<TodoItem>> PostTodoItem(TodoItem todoItem)
{
    _context.TodoItems.Add(todoItem);
    await _context.SaveChangesAsync();

    //    return CreatedAtAction("GetTodoItem", new { id = todoItem.Id }, todoItem);
    return CreatedAtAction(nameof(GetTodoItem), new { id = todoItem.Id }, todoItem);
}
```

The preceding code is an `HTTP POST` method, as indicated by the [`[HttpPost]`] attribute. The method gets the value of the `TodoItem` from the body of the HTTP request.

For more information, see [Attribute routing with Http[Verb] attributes].

The [CreatedAtAction] method:

- Returns an HTTP 201 status code if successful. `HTTP 201` is the standard response for an `HTTP POST` method that creates a new resource on the server.
- Adds a Location header to the response. The `Location` header specifies the URI of the newly created to-do item.
- References the `GetTodoItem` action to create the `Location` header's URI. The C# `nameof` keyword is used to avoid hard-coding the action name in the `CreatedAtAction` call.

Test PostTodoItem

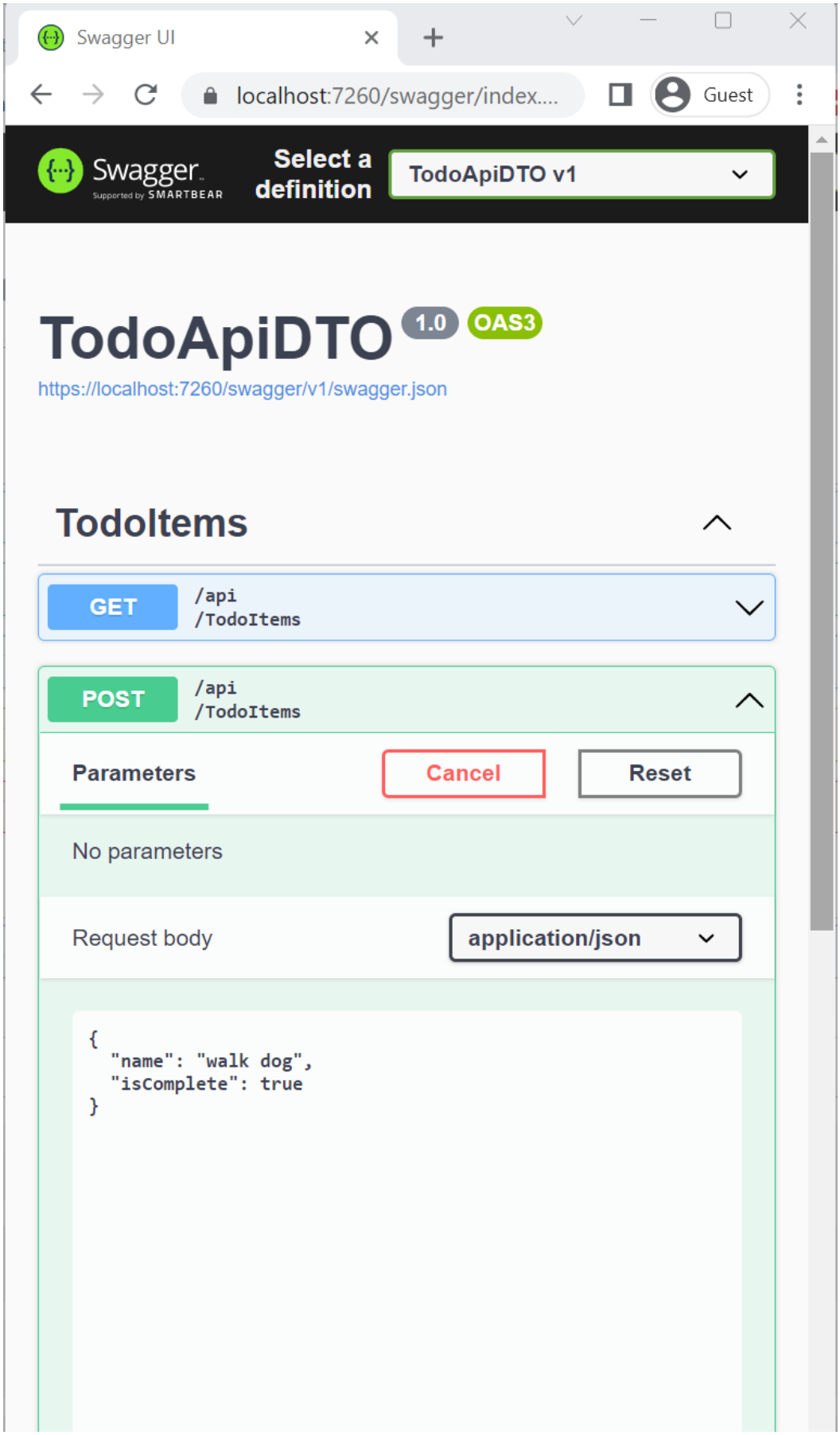
- Run following command in terminal to run the app:

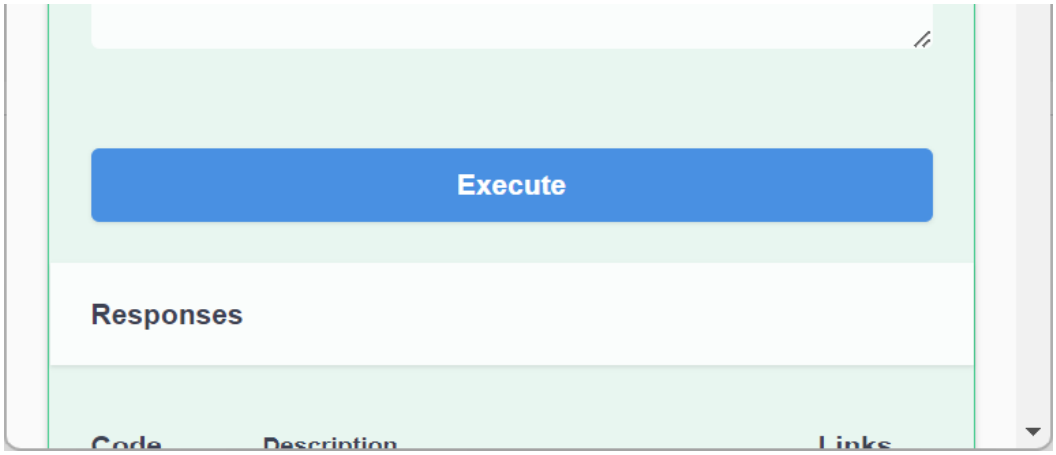
  ```
  dotnet run
  ```

- In the Swagger browser window, select **POST /api/TodoItems**, and then select **Try it out**.
- In the **Request body** input window, update the JSON. For example,

  ```
  {
    "name": "walk dog",
    "isComplete": true
  }
  ```

- Select **Execute**


Swagger UI
localhost:7260/swagger/index....
Guest
Swagger
Supported by SMARTBEAR
Select a definition
TodoApiDTO v1
TodoApiDTO
1.0
OAS3
https://localhost:7260/swagger/v1/swagger.json
TodoItems
GET
/api
/TodoItems
POST
/api
/TodoItems
Parameters
Cancel
Reset
No parameters
Request body
application/json
{
"name": "walk dog",
"isComplete": true
}

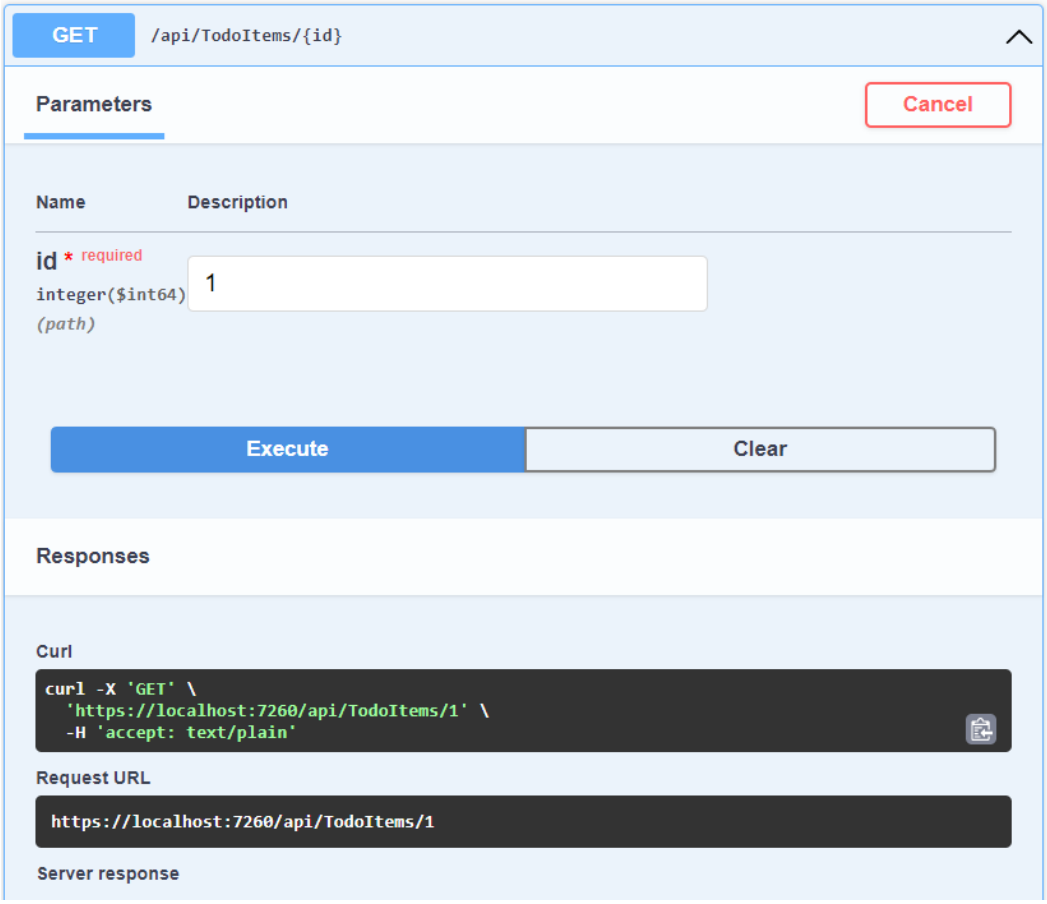


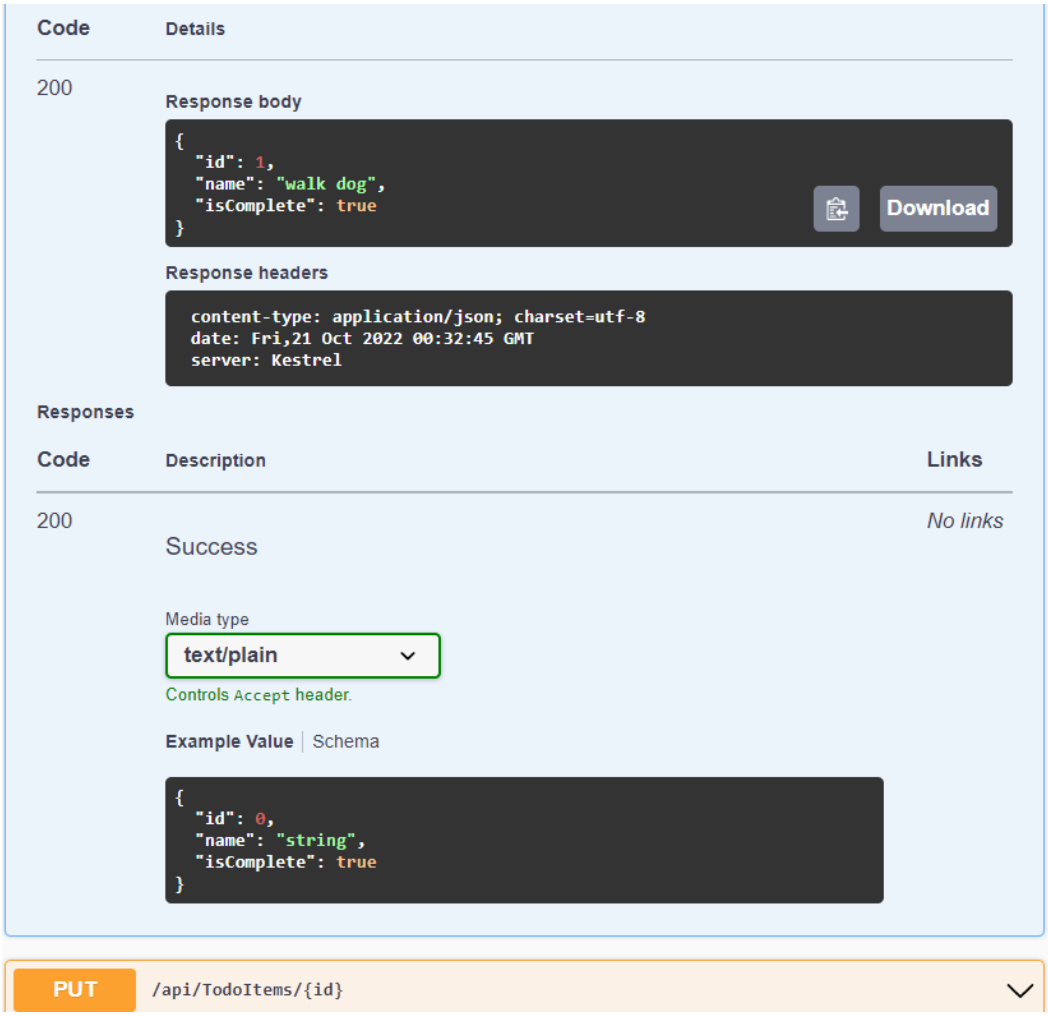
Test the location header URI

In the preceding POST, the Swagger UI shows the location header under **Response headers**. For example, `location: http://PORT-YOUR_GITPOD_URL.gitpod.io/api/TodoItems/1`. The location header shows the URI to the created resource.

To test the location header:

- In the Swagger browser window, select **GET /api/TodoItems/{id}**, and then select **Try it out**.
- Enter `1` in the `id` input box, and then select **Execute**.





Examine the GET methods

Two GET endpoints are implemented:

- `GET /api/todoitems`
- `GET /api/todoitems/{id}`

The previous section showed an example of the `/api/todoitems/{id}` route.

Follow the [POST instructions to add another todo item, and then test the `/api/todoitems` route using Swagger.

This app uses an in-memory database. If the app is stopped and started, the preceding GET request will not return any data. If no data is returned, POST data to the app.

Routing and URL paths

The [`[HttpGet]`] attribute denotes a method that responds to an `HTTP GET` request. The URL path for each method is constructed as follows:

- Start with the template string in the controller's `Route` attribute:

```
[Route("api/[controller]")]
[ApiController]
public class TodoItemsController : ControllerBase
```

- Replace `[controller]` with the name of the controller, which by convention is the controller class name minus the "Controller" suffix. For this sample, the controller class name is **TodoItems**Controller, so the controller name is "TodoItems". ASP.NET Core [routing] is case insensitive.
- If the `[HttpGet]` attribute has a route template (for example, `[HttpGet("products")]`), append that to the path. This sample doesn't use a template. For more information, see [Attribute routing with Http[Verb] attributes].

In the following `GetTodoItem` method, `"{id}"` is a placeholder variable for the unique identifier of the to-do item. When `GetTodoItem` is invoked, the value of `"{id}"` in the URL is provided to the method in its `id` parameter.

```
[HttpGet("{id}")]
public async Task<ActionResult<TodoItem>> GetTodoItem(long id)
{
    var todoItem = await _context.TodoItems.FindAsync(id);

    if (todoItem == null)
    {
        return NotFound();
    }

    return todoItem;
}
```

Return values

The return type of the `GetTodoItems` and `GetTodoItem` methods is [ActionResult<T> type]. ASP.NET Core automatically serializes the object to `JSON` and writes the JSON into the body of the response message. The response code for this return type is `200 OK`, assuming there are no unhandled exceptions. Unhandled exceptions are translated into 5xx errors.

`ActionResult` return types can represent a wide range of HTTP status codes. For example, `GetTodoItem` can return two different status values:

- If no item matches the requested ID, the method returns a 404 status [NotFound] error code.
- Otherwise, the method returns 200 with a JSON response body. Returning `item` results in an `HTTP 200` response.

The PutTodoItem method

Examine the `PutTodoItem` method:

```
[HttpPut("{id}")]
public async Task<IActionResult> PutTodoItem(long id, TodoItem todoItem)
{
    if (id != todoItem.Id)
    {
```

```
        return BadRequest();
    }

    _context.Entry(todoItem).State = EntityState.Modified;

    try
    {
        await _context.SaveChangesAsync();
    }
    catch (DbUpdateConcurrencyException)
    {
        if (!TodoItemExists(id))
        {
            return NotFound();
        }
        else
        {
            throw;
        }
    }

    return NoContent();
}
```

`PutTodoItem` is similar to `PostTodoItem`, except it uses `HTTP PUT`. The response is [204 (No Content)](). According to the HTTP specification, a `PUT` request requires the client to send the entire updated entity, not just the changes. To support partial updates, use **HTTP PATCH**.

Test the PutTodoItem method

This sample uses an in-memory database that must be initialized each time the app is started. There must be an item in the database before you make a PUT call. Call GET to ensure there's an item in the database before making a PUT call.

Using the Swagger UI, use the PUT button to update the `TodoItem` that has Id = 1 and set its name to `"feed fish"`. Note the response is `HTTP 204 No Content`.

The DeleteTodoItem method

Examine the `DeleteTodoItem` method:

```
[HttpDelete("{id}")]
public async Task<IActionResult> DeleteTodoItem(long id)
{
    var todoItem = await _context.TodoItems.FindAsync(id);
    if (todoItem == null)
    {
        return NotFound();
    }

    _context.TodoItems.Remove(todoItem);
    await _context.SaveChangesAsync();
```

```
    return NoContent();
}
```

Test the DeleteTodoItem method

Use the Swagger UI to delete the `TodoItem` that has Id = 1. Note the response is `HTTP 204 No Content`.

Test with Postman

Note: You can test the APIs by installing Postman on your workstation and access dotnet app using gitpod URL.

- Install Postman.
- Start the web app.
- Start Postman.
- Disable SSL certificate verification if you get SSL certificate error.

IMPORTANT: We will calling these APIs using Javascript in the next lab. You can create copy of this labssolution for the next lab.