CREATING A JSON API WITH MINIMAL APIS

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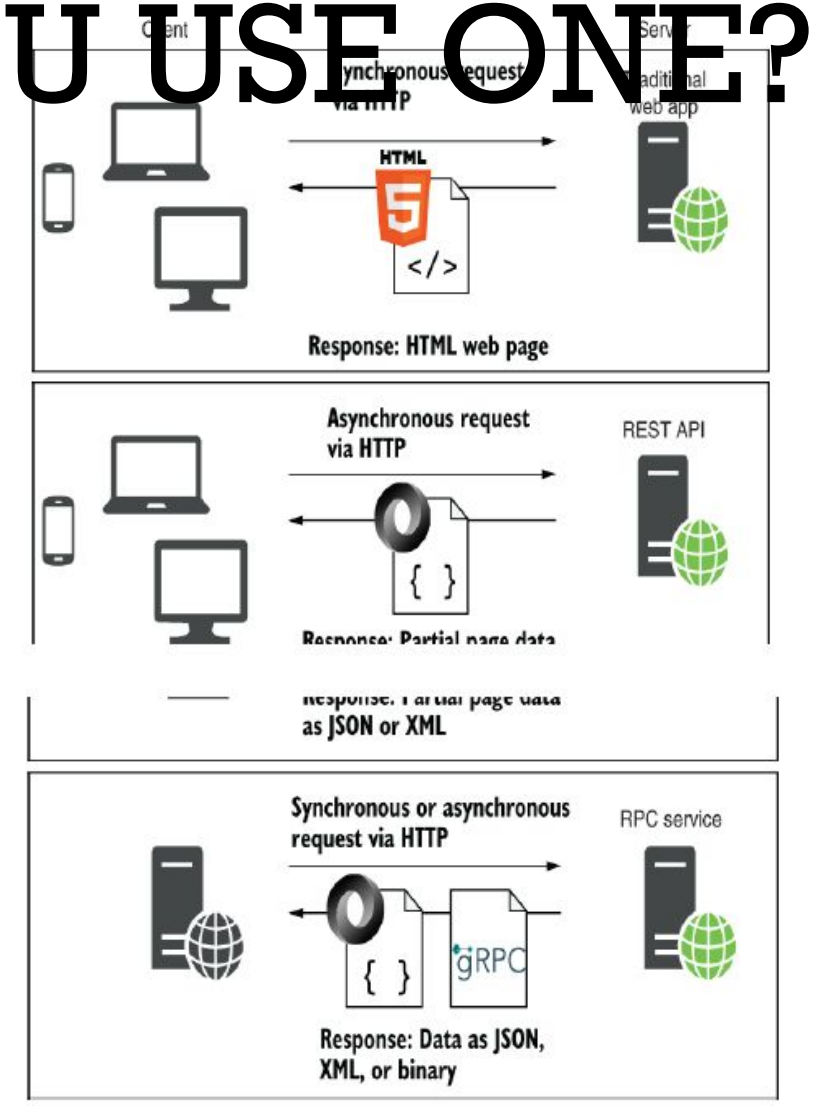
WHAT IS AN HTTP API, AND WHEN SHOULD YOU USE ONE?

- Traditional web applications use HTML to handle requests, and the generated HTML is displayed in a web browser.
- **Razor Pages** are commonly used to build such applications, allowing the generation of HTML with Razor templates..
- While this approach is common and well-understood, modern application developers have other options to explore.

WHAT IS AN HTTP API, AND WHEN SHOULD YOU USE ONE?

Traditional web applications

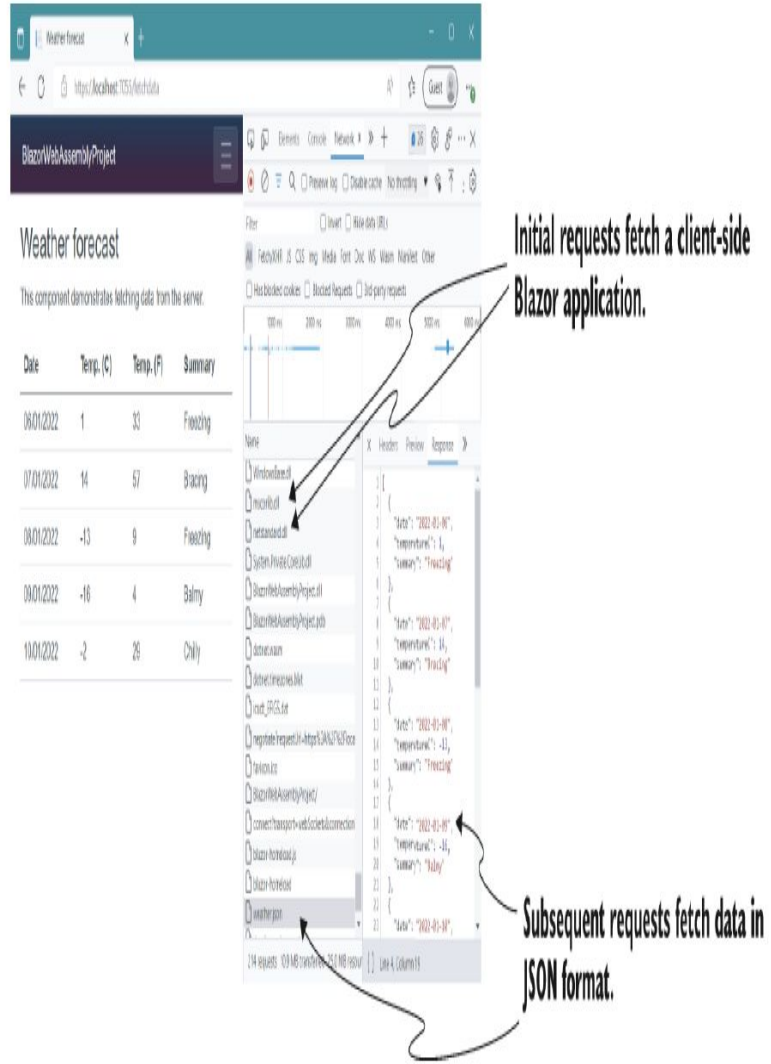


SPA

- Client-side single-page applications (SPAs) have gained popularity, thanks to frameworks like **Angular**, **React**, and **Vue**.
  - These frameworks leverage **JavaScript** in a web browser to dynamically generate HTML for user interaction.
- In the SPA model, the server sends initial JavaScript to the browser when the user accesses the application.
- The user's browser loads and runs this JavaScript, initializing the SPA before fetching **application data** from the server.
- This approach contrasts **more dynamic and interactive** with traditional server-side rendering, emphasizing a user

SPA

- SPAs load in the browser and continue communication with the server over **HTTP**.
- Instead of sending HTML directly to the browser, the **server-side application sends data**, typically in **JSON** format, to the client-side application.
- The **SPA parses this data and generates HTML** dynamically to display to the user.
- The server-side application endpoint that the client communicates with is referred to as an **HTTP API, JSON API, or REST API** based on its design specifics.



HTTP API

- HTTP API exposes multiple URLs via HTTP for accessing or modifying data on a server.
  - **It commonly returns data in the JSON format**.
- HTTP APIs are also known as web APIs, although in ASP.NET Core, "web API" refers to a specific technology.
- **Mobile applications** typically interact with server applications via an HTTP API, receiving data in JSON format, similar to SPAs.
- Another use case for an HTTP API is when an application is intended for consumption by other backend services.
  - a web application designed for sending emails can provide an HTTP API.

DEFINING MINIMAL API ENDPOINTS

```
app.MapGet("/", () => "Hello World!");
app.MapGet("/person", () => new Person("Andrew", "Lock");
```

it always returns the same Person object.

If you create an API using the route template /person/{name}, for example, and send a request to the path /person/Andrew, the name parameter will have the value "Andrew".

DEFINING MINIMAL API ENDPOINTS

```
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();

var people = new List<Person>                                    ❶
{                                                                ❶
    new("Tom", "Hanks"),                                         ❶
    new("Denzel", "Washington"),                                 ❶
    new("Leondardo", "DiCaprio"),                                ❶
    new("Al", "Pacino"),                                         ❶
    new("Morgan", "Freeman"),                                    ❶
};                                                               ❶

app.MapGet("/person/{name}", (string name) =>                    ❷
    people.Where(p => p.FirstName.StartsWith(name)));            ❸

app.Run();
```

If you send a request to /person/Al for the app defined, the name parameter will have the value "Al", and the API will return the following JSON:

[{"firstName":"Al","lastName":"Pacino"}]

MAPPING VERBS TO ENDPOINTS

- Use **GET** only to retrieve data from the server.
- **Avoid** using GET to send or modify data on the server.
- Instead, utilize HTTP verbs such as POST or DELETE for data modification.

MAPPING VERBS TO ENDPOINTS

- While each HTTP verb has a defined purpose, many apps only use POST and GET in practice.
  - acceptable for **server-rendered apps like Razor Pages**, as it simplifies the process.
- However, when creating APIs, it's **recommended to use HTTP verbs** with appropriate semantics.
  - Minimal APIs can define endpoints for other verbs using **Map*** functions, like MapPost().

MAPPING VERBS TO ENDPOINTS

Method	HTTP verb	Expected operation
`MapGet(path, handler)`	`GET`	Fetch data only; no modification of state. May be safe to cache.
`MapPost(path, handler)`	`POST`	Create a new resource.
`MapPut(path, handler)`	`PUT`	Create or replace an existing resource.
`MapDelete(path, handler)`	`DELETE`	Delete the given resource.
`MapPatch(path, handler)`	`PATCH`	Modify the given resource.
`MapMethods(path, methods, handler)`	Multiple verbs	Multiple operations.
`Map(path, handler)`	All verbs	Multiple operations.
`MapFallback(handler)`	All verbs	Useful for SPA fallback routes.

NOTE

- Using the **wrong HTTP verb** for an API endpoint triggers specific behavior.
  - For example, if a GET endpoint is called with a POST request, the **handler won't execute**.
- Instead, a response with status code **405** *Method Not Allowed* is returned.
  - a mismatch between the expected and actual HTTP verb.
- Ensure the correct HTTP verb and URL path are used to avoid encountering a 405 response.

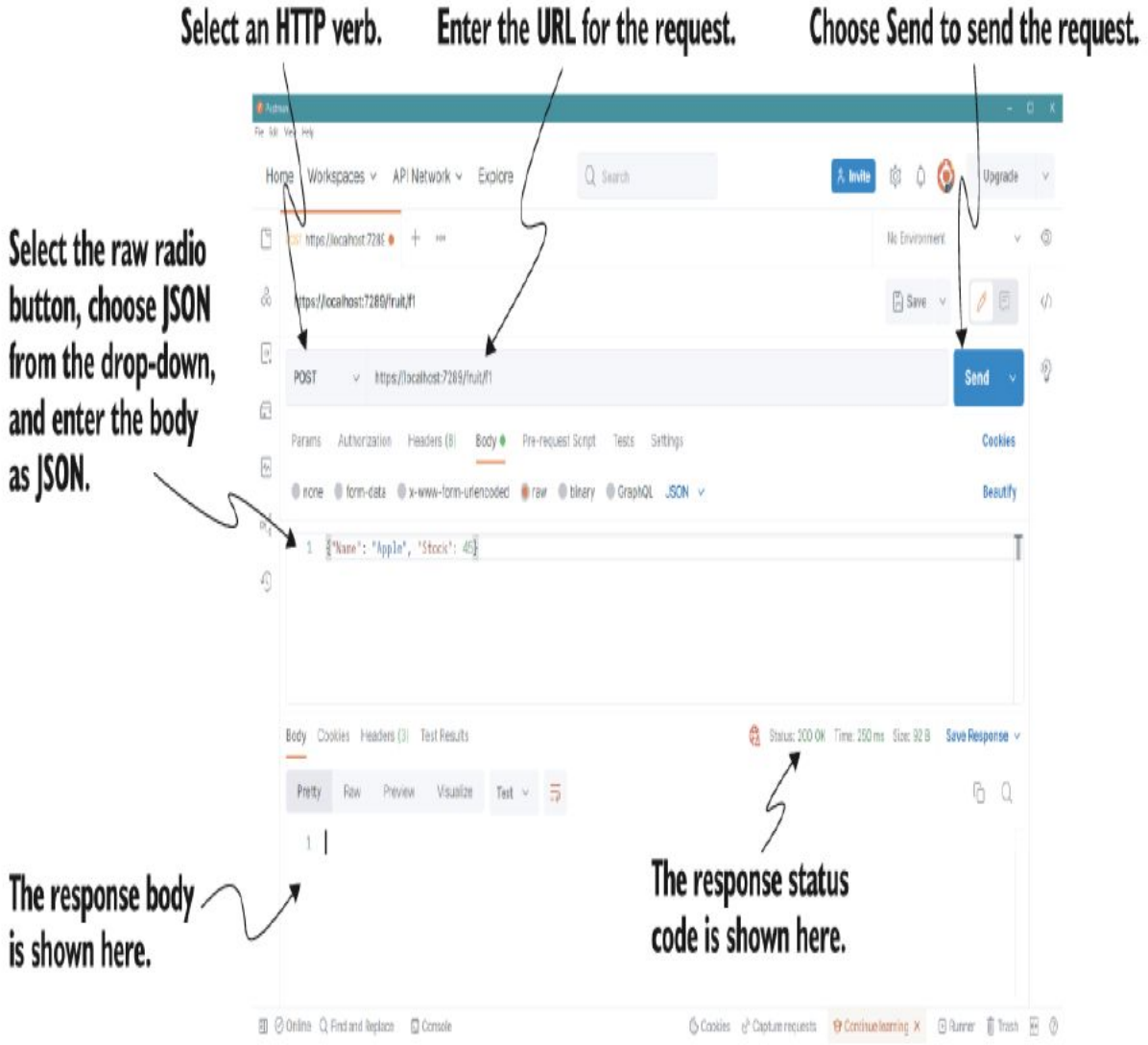
DEFINING ROUTE HANDLERS WITH FUNCTIONS

```
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();

app.MapGet("/fruit", () => Fruit.All);                    ❶

var getFruit = (string id) => Fruit.All[id];              ❷
app.MapGet("/fruit/{id}", getFruit);                      ❷

app.MapPost("/fruit/{id}", Handlers.AddFruit);            ❸

Handlers handlers = new();                                ❹
app.MapPut("/fruit/{id}", handlers.ReplaceFruit);         ❹

app.MapDelete("/fruit/{id}", DeleteFruit);                ❺

app.Run();

void DeleteFruit(string id)                               ❺
{
    Fruit.All.Remove(id);
}
```

```
record Fruit(string Name, int Stock)
{
    public static readonly Dictionary<string, Fruit> All = new();
};

class Handlers
{
    public void ReplaceFruit(string id, Fruit fruit)          ❻
    {
        Fruit.All[id] = fruit;
    }

    public static void AddFruit(string id, Fruit fruit)       ❼
    {
        Fruit.All.Add(id, fruit);
    }
}
```

NOTE

By contrast with APIs built using ASP.NET and ASP.NET Core web API controllers , **minimal APIs can bind only to JSON bodies** and always use the System.Text.Json library for JSON deserialization.



GENERATING RESPONSES WITH IRESULT

The endpoint middleware handles each return type as follows:

- **void** or **Task**—The endpoint returns a 200 response with no body.
- **string** or **Task<string>**—The endpoint returns a 200 response with the string serialized to the body as text/plain.
- **IResult** or **Task<IResult>**—The endpoint executes the IResult.ExecuteAsync method.
  - Depending on the implementation, this type **can customize the response**, **returning any status code**.
- **T** or **Task<T>**—All other types (such as POCO objects) are serialized to JSON and returned in the body of a 200 response as application/json.

RETURNING STATUS CODES WITH RESULTS AND TYPEDRESULTS

- ASP.NET Core exposes the simple **static** helper types **Results** and **TypedResults** in the namespace Microsoft.AspNetCore.Http.
  - Useful to **create a response** with common **status codes**, optionally including a JSON body.
- The only difference is that the Results methods return an IResult, whereas TypedResults return a concrete generic type, such as Ok<T>.

```
using System.Collections.Concurrent;

WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();

var _fruit = new ConcurrentDictionary<string, Fruit>();                ❶

app.MapGet("/fruit", () => _fruit);

app.MapGet("/fruit/{id}", (string id) =>
    _fruit.TryGetValue(id, out var fruit)                              ❷
        ? TypedResults.Ok(fruit)                                       ❸
        : Results.NotFound());                                         ❹


app.MapPost("/fruit/{id}", (string id, Fruit fruit) =>
    _fruit.TryAdd(id, fruit)                                           ❺
        ? TypedResults.Created($"/fruit/{id}", fruit)                  ❻
        : Results.BadRequest(new                                       ❼
            { id = "A fruit with this id already exists" }));          ❼

app.MapPut("/fruit/{id}", (string id, Fruit fruit) =>
{
    _fruit[id] = fruit;
    return Results.NoContent();                                        ❽
});

app.MapDelete("/fruit/{id}", (string id) =>
{
    _fruit.TryRemove(id, out _);                                       ❾
    return Results.NoContent();                                        ❾
});

app.Run();
record Fruit(string Name, int stock);
```

❶ Uses a concurrent dictionary to make the API thread-safe

❷ Tries to get the fruit from the dictionary. If the ID exists in the dictionary, this returns true . . .

❸ . . . and we return a 200 OK response, serializing the fruit in the body as JSON.

❹ If the ID doesn't exist, returns a 404 Not Found response

❺ Tries to add the fruit to the dictionary. If the ID hasn't been added yet. this returns true . . .

❻ . . . and we return a 201 response with a JSON body and set the Location header to the given path.

❼ If the ID already exists, returns a 400 Bad Request response with an error message

❽ After adding or replacing the fruit, returns a 204 No Content response

❾ After deleting the fruit, always returns a 204 No Content response

STATUS CODES

- **200 OK**—The standard successful response. It **often** includes content in the body of the response but doesn't have to.
- **201 Created**—Often returned when you successfully created an entity on the server.
- **204 No Content**—Similar to a 200 response but without any content in the response body.
- **400 Bad Request**—Indicates that the request was invalid in some way; often used to indicate data validation failures.
- **404 Not Found**—Indicates that the requested entity could not be found.

WRITING THE RESPONSE MANUALLY USING HTTPRESPONSE

```
using System.Net.Mime
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();

app.MapGet("/teapot", (HttpResponse response) =>          ❶
{
    response.StatusCode = 418;                            ❷
    response.ContentType = MediaTypeNames.Text.Plain;     ❸
    return response.WriteAsync("I'm a teapot!");          ❹
});

app.Run();
```

❶ Accesses the HttpResponse by including it as a parameter in your endpoint handler

❷ You can set the status code directly on the response.

❸ Defines the content type that will be sent in the response

❹ You can write data to the response stream manually.

RETURNING USEFUL ERRORS WITH PROBLEM DETAILS

- **Problem Details** is a web **specification** for providing **machine-readable errors** for HTTP APIs.
  - It defines the required and optional fields that should be in the **JSON body for errors**.
- Two helper methods for generating Problem Details responses **from minimal APIs**:
  - Results.Problem()
  - Results.ValidationProblem() (plus their TypedResults complements).
- The only difference is that **Problem() defaults to a 500 status code**, whereas **ValidationProblem() defaults to a 400 status** and requires you to pass in a Dictionary of validation errors

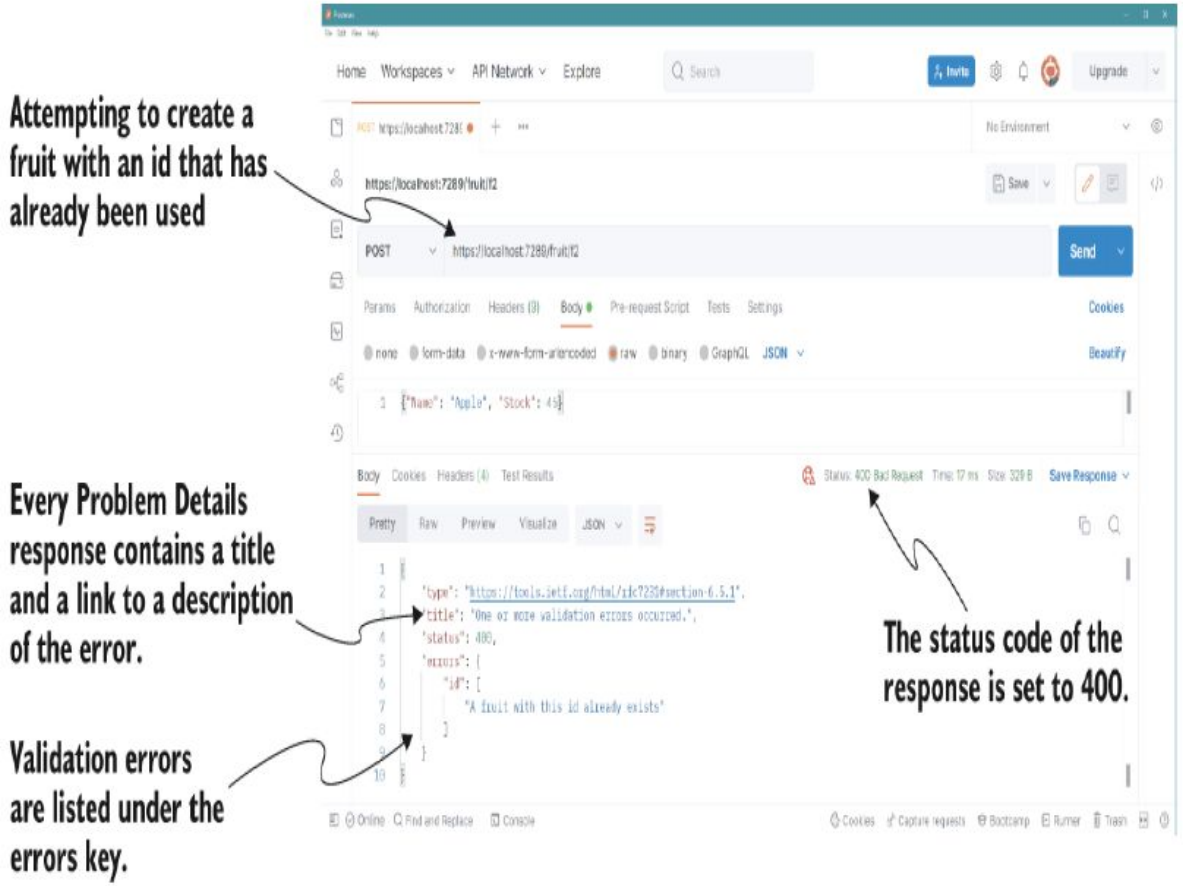
RETURNING USEFUL ERRORS WITH PROBLEM DETAILS

```
using System.Collections.Concurrent;

WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();

var _fruit = new ConcurrentDictionary<string, Fruit>();

app.MapGet("/fruit", () => _fruit);

app.MapGet("/fruit/{id}", (string id) =>
    _fruit.TryGetValue(id, out var fruit)
        ? TypedResults.Ok(fruit)
        : Results.Problem(statusCode: 404));                    ❶


app.MapPost("/fruit/{id}", (string id, Fruit fruit) =>
    _fruit.TryAdd(id, fruit)
        ? TypedResults.Created($"/fruit/{id}", fruit)
        : Results.ValidationProblem(new Dictionary<string, string[]>   ❷
          {                                                             ❷
              {"id", new[] {"A fruit with this id already exists"}}     ❷
          }));                                                          ❷
```

❶ Returns a Problem Details object with a 404 status code

❷ Returns a Problem Details object with a 400 status code and includes the validation errors

RETURNING USEFUL ERRORS WITH PROBLEM DETAILS



CONVERTING ALL YOUR RESPONSES TO PROBLEM DETAILS

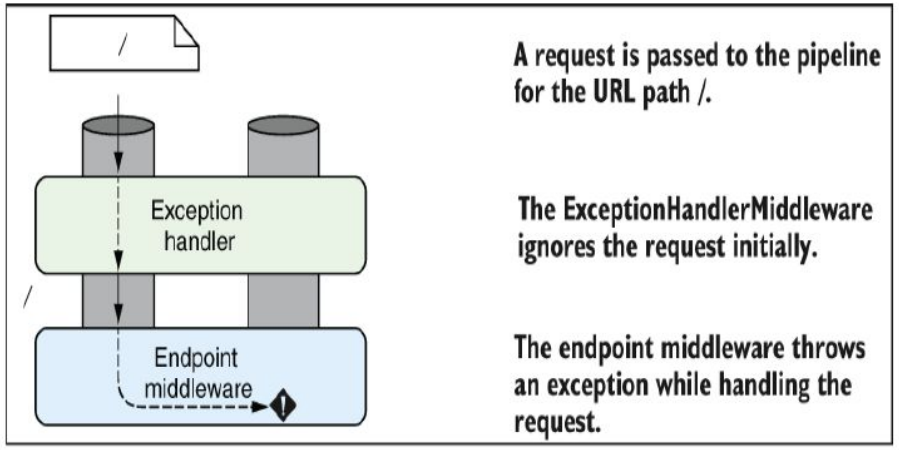
A minimal API application could generate **an error response** in several **ways**:

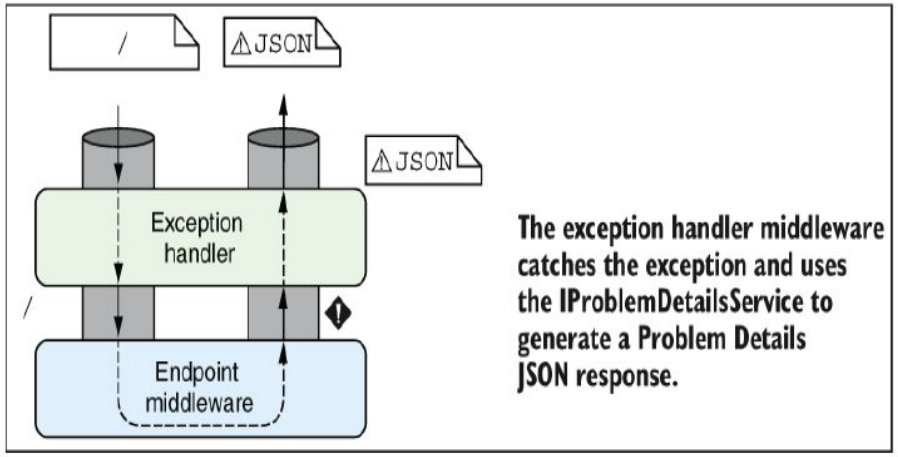
- Returning an **error status code** from an endpoint handler
- **Throwing an exception** in an endpoint handler, which is **caught** by the ExceptionHandlerMiddleware or the DeveloperExceptionPageMiddleware and converted to an error response
- The middleware pipeline returning a 404 response because **a request isn't handled by an endpoint**
- A **middleware component** in the pipeline throwing an exception
- A middleware component returning **an error response** because a request requires authentication, and no credentials were provided

CONVERTING EXCEPTIONS TO PROBLEM DETAILS

- **IProblemDetailsService**:
  - A new service introduced.
  - Can be added to the application by calling AddProblemDetails() on WebApplicationBuilder.Services.
- **ExceptionHandlerMiddleware** Configuration:
  - If the ExceptionHandlerMiddleware is configured **without specifying an error-handling path**, it automatically utilizes the IProblemDetailsService to generate the response.

CONVERTING EXCEPTIONS TO PROBLEM DETAILS





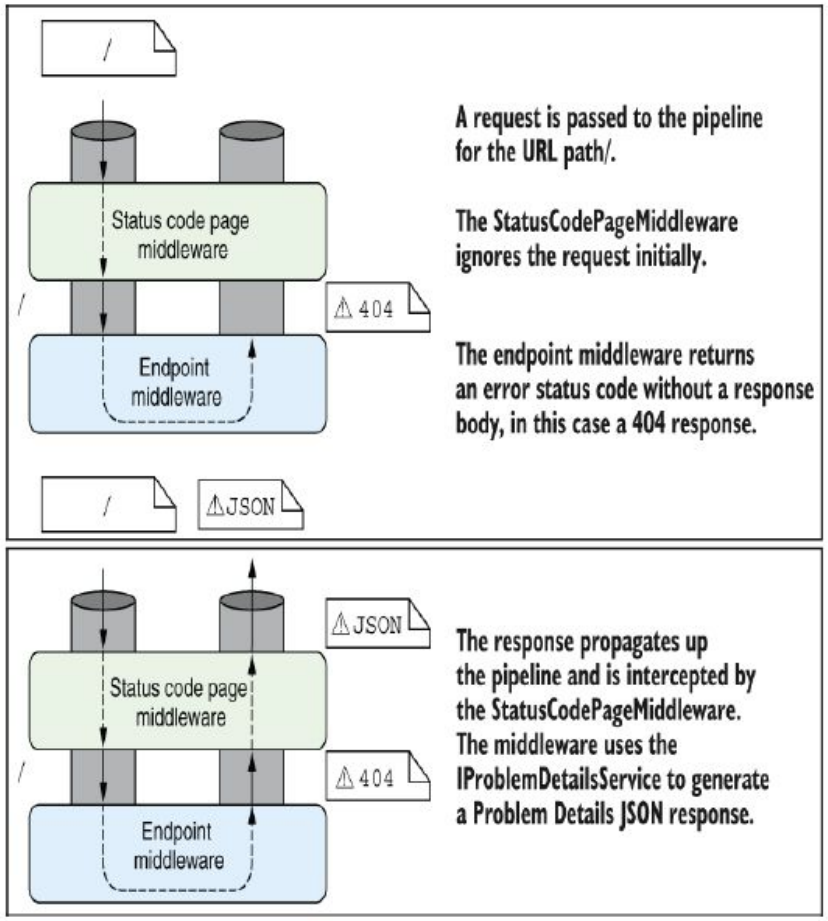

```
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
builder.Services.AddProblemDetails();                    ❶

WebApplication app = builder.Build();

if (!app.Environment.IsDevelopment())
{
    app.UseExceptionHandler();                           ❷
}

app.MapGet("/", void () => throw new Exception());       ❸

app.Run();
```

❶ Adds the IProblemDetailsService implementation

❷ Configures the ExceptionHandlerMiddleware without a path so that it uses the IProblemDetailsService

❸ Throws an exception to demonstrate the behavior

CONVERTING ERROR STATUS CODES TO PROBLEM DETAILS




```
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
builder.Services.AddProblemDetails();          ❶

WebApplication app = builder.Build();

if (!app.Environment.IsDevelopment())
{
    app.UseExceptionHandler();
}

app.UseStatusCodePages();                      ❷

app.MapGet("/", () => Results.NotFound());     ❸

app.Run();
```

❶ Adds the IProblemDetailsService implementation

❷ Adds the StatusCodePagesMiddleware

❸ The StatusCodePagesMiddleware automatically adds a Problem Details body to the 404 response.

RETURNING OTHER DATA TYPES

Results and TypedResults are convenient to return:

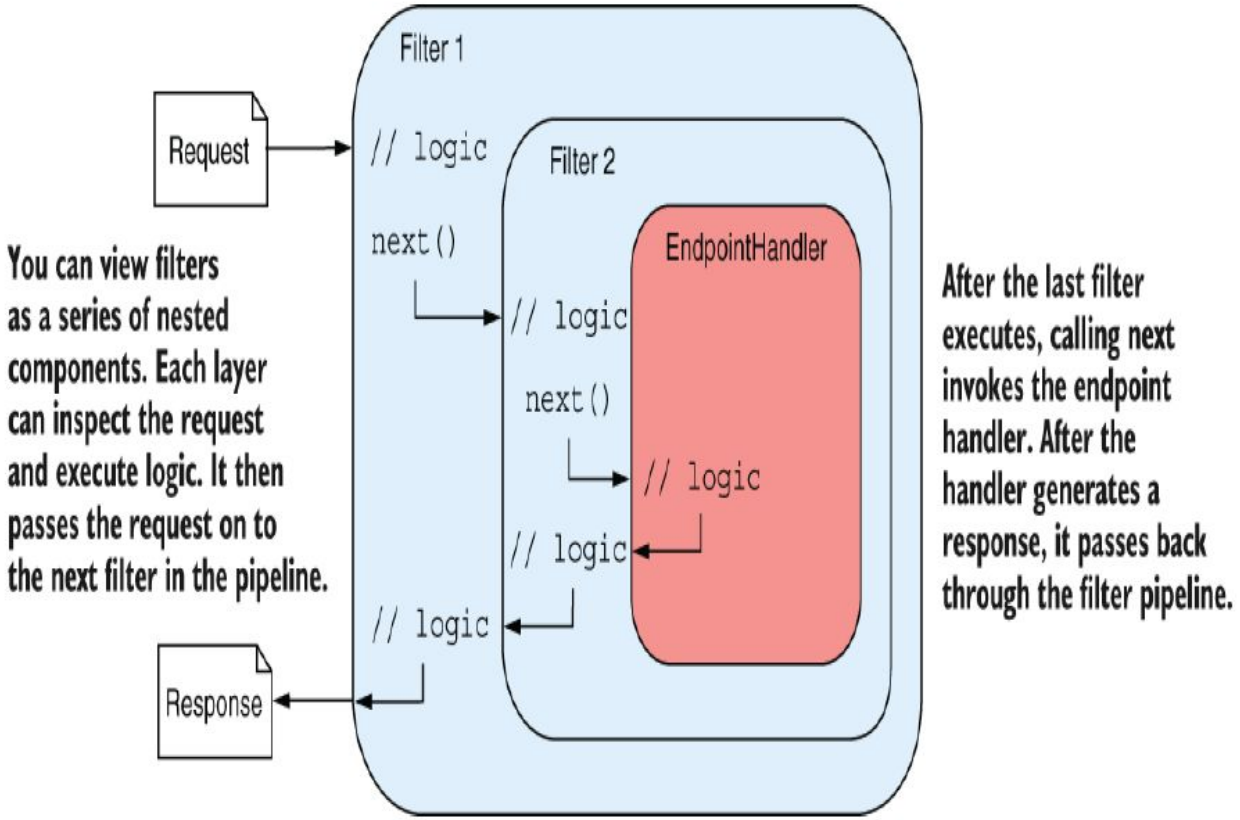
- **Results.File()**—Pass in the path of the file to return, and ASP.NET Core takes care of streaming it to the client.
- **Results.Byte()**—For returning binary data, you can pass this method a byte[] to return.
- **Results.Stream()**—You can send data to the client asynchronously by using a Stream.

RUNNING COMMON CODE WITH ENDPOINT FILTERS

```
using System.Collections.Concurrent;
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();

var _fruit = new ConcurrentDictionary<string, Fruit>();

app.MapGet("/fruit/{id}", (string id) =>
{
    if (string.IsNullOrEmpty(id) || !id.StartsWith('f'))     ❶
    {
        return Results.ValidationProblem(new Dictionary<string, string[]>
        {
            {"id", new[] {"Invalid format. Id must start with 'f'"}}
        });
    }

    return _fruit.TryGetValue(id, out var fruit)
            ? TypedResults.Ok(fruit)
            : Results.Problem(statusCode: 404);
});

app.Run()
```

❶ Adds extra validation that the provided id has the required format

RUNNING COMMON CODE WITH ENDPOINT FILTERS



RUNNING COMMON CODE WITH ENDPOINT FILTERS

```
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();
var _fruit = new ConcurrentDictionary<string, Fruit>();

app.MapGet("/fruit/{id}", (string id) =>
    _fruit.TryGetValue(id, out var fruit)
        ? TypedResults.Ok(fruit)
        : Results.Problem(statusCode: 404))
    .AddEndpointFilter(ValidationHelper.ValidateId);          ❶

app.Run();

class ValidationHelper
{
    internal static async ValueTask<object?> ValidateId(     ❷
        EndpointFilterInvocationContext context,              ❸
        EndpointFilterDelegate next)                          ❹
    {
        var id = context.GetArgument<string>(0);              ❺
        if (string.IsNullOrEmpty(id) || !id.StartsWith('f'))
        {
            return Results.ValidationProblem(
                new Dictionary<string, string[]>
                {
                    {"id", new[]{"Invalid format. Id must start with 'f'"}}
                });
        }

        return await next(context);                           ❻
    }
}
```

❶ Adds the filter to the endpoint using AddEndpointFilter

❷ The method must return a ValueTask.

❸ context exposes the endpoint method arguments and the HttpContext.

❹ next represents the filter method (or endpoint) that will be called next.

❺ You can retrieve the method arguments from the context.

❻ Calling next executes the remaining filters in the pipeline.

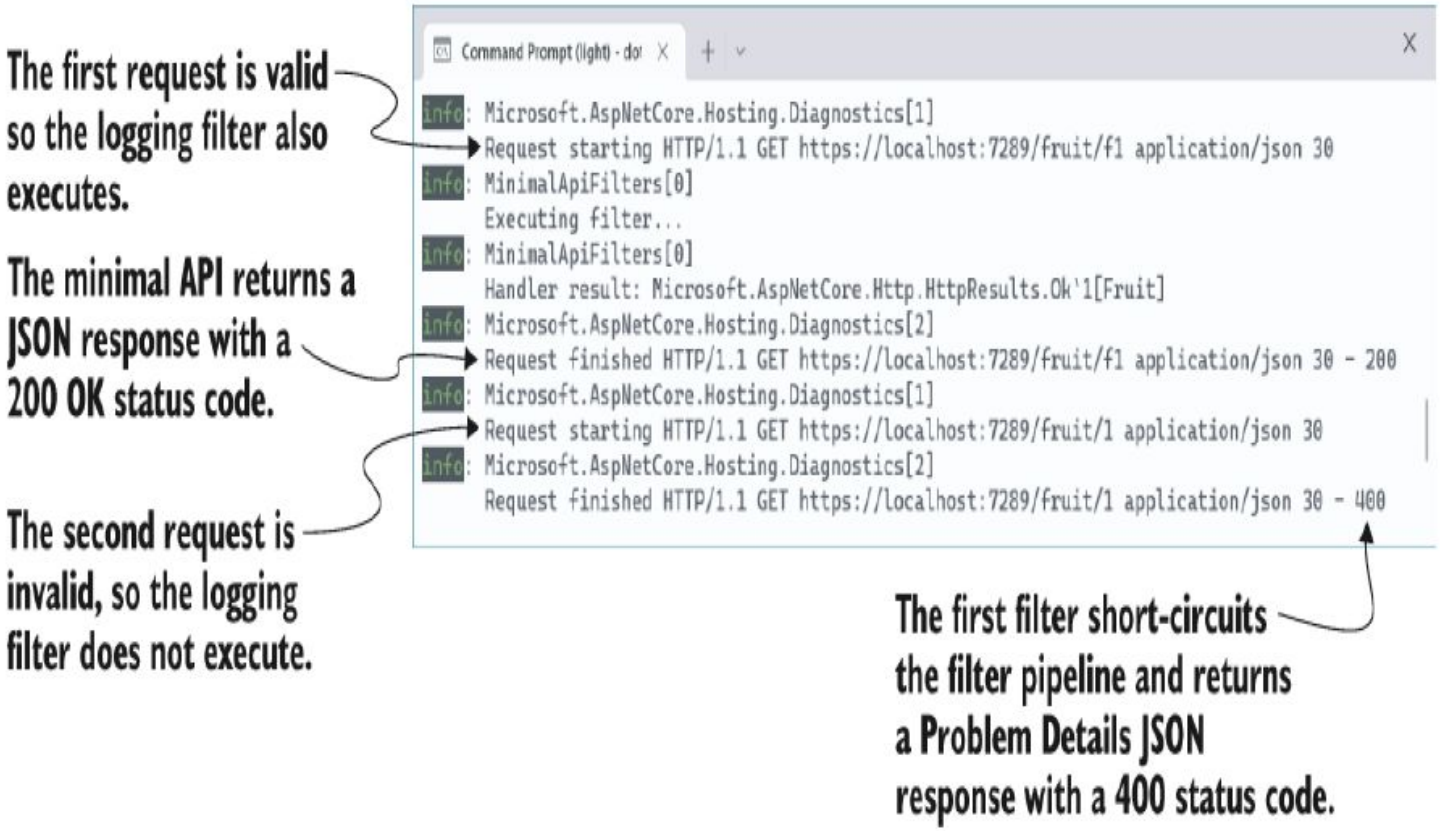
ADDING MULTIPLE FILTERS TO AN ENDPOINT

```
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();
var _fruit = new ConcurrentDictionary<string, Fruit>();

app.MapGet("/fruit/{id}", (string id) =>
    _fruit.TryGetValue(id, out var fruit)
        ? TypedResults.Ok(fruit)
        : Results.Problem(statusCode: 404))
```

```
    .AddEndpointFilter(ValidationHelper.ValidateId)                    ❶
    .AddEndpointFilter(async (context, next) =>                        ❷
    {
        app.Logger.LogInformation("Executing filter...");              ❸
        object? result = await next(context);                          ❹
        app.Logger.LogInformation($"Handler result: {result}");        ❺
        return result;                                                 ❻
    });

app.Run();
```

❶ Adds the validation filter as before
❷ Adds a new filter using a lambda function
❸ Logs a message before executing the rest of the pipeline
❹ Executes the remainder of the pipeline and the endpoint handler
❺ Logs the result returned by the rest of the pipeline
❻ Returns the result unmodified

ADDING MULTIPLE FILTERS TO AN ENDPOINT



FILTERS OR MIDDLEWARE: WHICH SHOULD YOU CHOOSE?

EBOOK

GENERALIZING YOUR ENDPOINT FILTERS

EBOOK

IMPLEMENTING THE IENDPOINTFILTER INTERFACE

```
WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();
var _fruit = new ConcurrentDictionary<string, Fruit>();

app.MapGet("/fruit/{id}", (string id) =>
    _fruit.TryGetValue(id, out var fruit)
        ? TypedResults.Ok(fruit)
        : Results.Problem(statusCode: 404))
    .AddEndpointFilter<IdValidationFilter>();          ❶

app.Run();

class IdValidationFilter : IEndpointFilter             ❷
{
    public async ValueTask<object?> InvokeAsync(       ❸
        EndpointFilterInvocationContext context,       ❸
        EndpointFilterDelegate next)                   ❸
    {
        var id = context.GetArgument<string>(0);
        if (string.IsNullOrEmpty(id) || !id.StartsWith('f'))
        {
            return Results.ValidationProblem(
                new Dictionary<string, string[]>
                {
                    {"id", new[]{"Invalid format. Id must start with 'f'"}}
                });
        }

        return await next(context);
    }
}
```

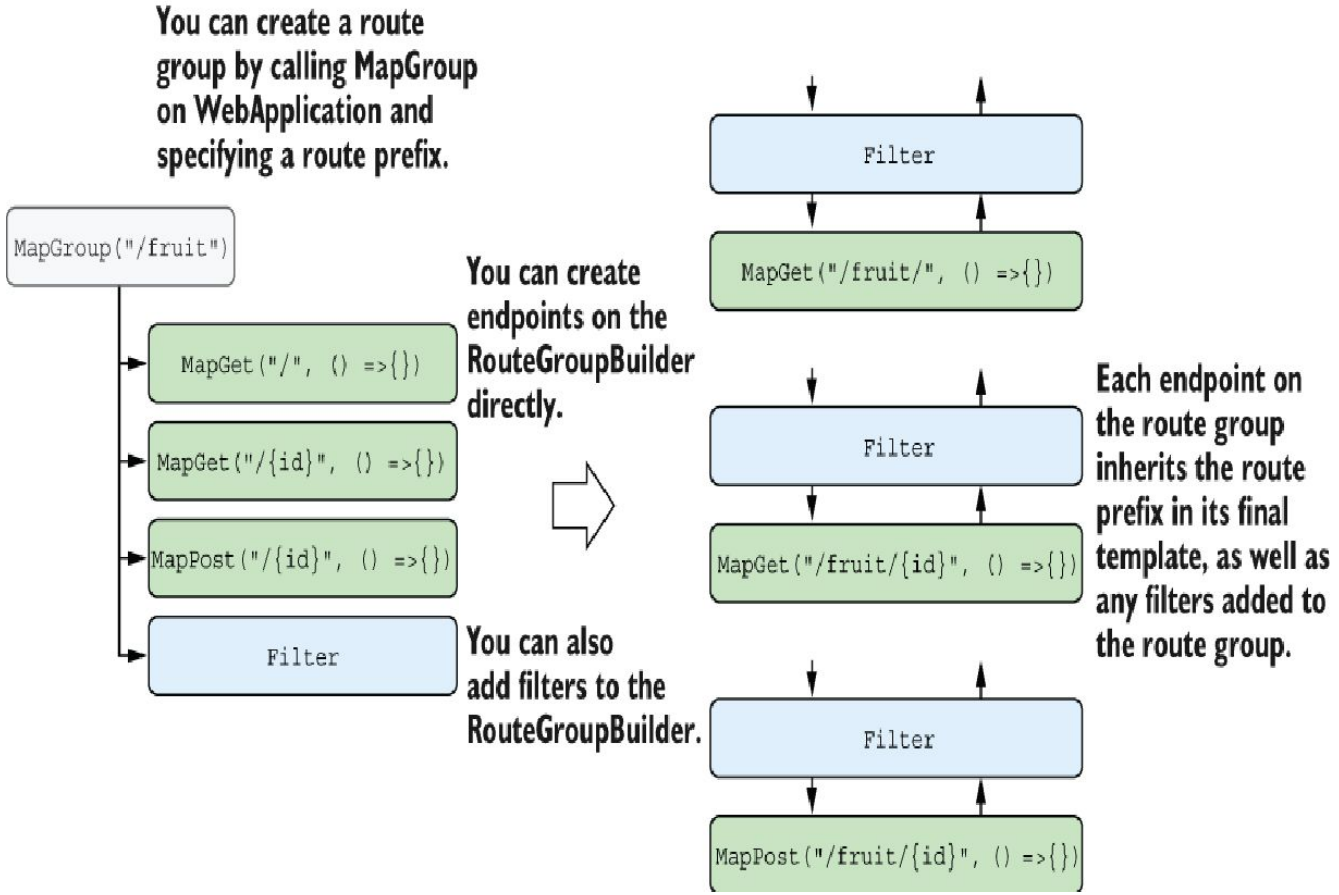
❶ Adds the filter using the generic AddEndpointFilter method

❷ The filter must implement IEndpointFilter . . .

❸ . . . which requires implementing a single method.

ORGANIZING YOUR APIS WITH ROUTE GROUPS

- `MapGet("/fruit", () => {/* */})`
- `MapGet("/fruit/{id}", (string id) => {/* */})`
- `MapPost("/fruit/{id}", (Fruit fruit, string id) => {/* */})`
- `MapPut("/fruit/{id}", (Fruit fruit, string id) => {/* */})`
- `MapDelete("/fruit/{id}", (string id) => {/* */})`



ORGANIZING YOUR APIS WITH ROUTE GROUPS

```
using System.Collections.Concurrent;

WebApplicationBuilder builder = WebApplication.CreateBuilder(args);
WebApplication app = builder.Build();

var _fruit = new ConcurrentDictionary<string, Fruit>();

RouteGroupBuilder fruitApi = app.MapGroup("/fruit");                    ❶

fruitApi.MapGet("/", () => _fruit);                                     ❷

RouteGroupBuilder fruitApiWithValidation = fruitApi.MapGroup("/")       ❸
    .AddEndpointFilter(ValidationHelper.ValidateIdFactory);             ❹

fruitApiWithValidation.MapGet("/{id}", (string id) =>                   ❺
    _fruit.TryGetValue(id, out var fruit)
        ? TypedResults.Ok(fruit)
        : Results.Problem(statusCode: 404));

fruitApiWithValidation.MapPost("/{id}", (Fruit fruit, string id) =>     ❺
    _fruit.TryAdd(id, fruit)
        ? TypedResults.Created($"/fruit/{id}", fruit)
        : Results.ValidationProblem(new Dictionary<string, string[]>
          {
              { "id", new[] { "A fruit with this id already exists" } }
          }));

fruitApiWithValidation.MapPut("/{id}", (string id, Fruit fruit) =>      ❺
{
    _fruit[id] = fruit;
    return Results.NoContent();
});

fruitApiWithValidation.MapDelete("/fruit/{id}", (string id) =>          ❺
{
    _fruit.TryRemove(id, out _);
    return Results.NoContent();
});

app.Run();
```

❶ Creates a route group by calling MapGroup and providing a prefix

❷ Endpoints defined on the route group will have the group prefix prepended to the route.

❸ You can create nested route groups with multiple prefixes.

❹ You can add filters to the route group . . .

❺ . . . and the filter will be applied to all the endpoints defined on the route group.