API Testing with C#

RestSharp

SoftUni Team

Technical Trainers

Software University

SoftUni

Software University

https://softuni.bg

Have a Question?

Software University

sli.do

#QA-BackEnd

Table of Contents

Integration and API Testing

Concepts

Brief Recap on Integration Testing

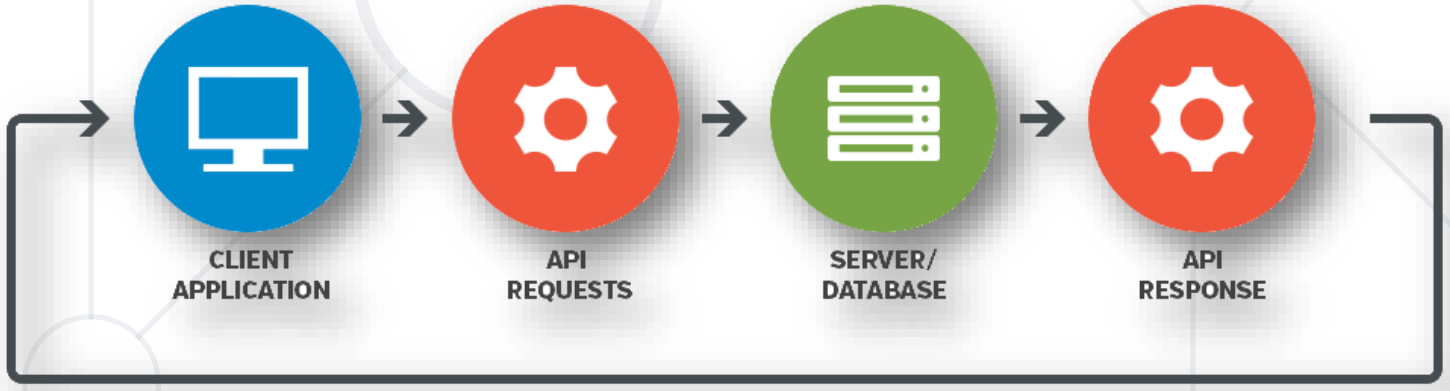
- Validates combined functionality of software modules
- Detects interface defects, verifies data flow and communication
- Follows unit testing; precedes system testing
- Applies to database integration, **APIs** (**REST, SOAP, GraphQL**), service interactions
- **Objective:** Ensure system integrity and seamless functionality

What is API Recap

- **API** == **A**pplication **P**rogramming **I**nterface
  - APIs serve as the intermediaries that allow two applications to talk to each other
  - Set of **functions** and **specifications** that software programs and components follow to talk to each other
- API **examples**:
  - **JDBC** – Java API for apps to talk with database servers
  - **Windows API** – Windows apps talk with Windows OS
  - **Web Audio API** – play audio in the Web browser with JS

Web Services and APIs

- **Web services** expose **back-end APIs** over the **network**
  - May use different **protocols** and **data formats**: HTTP, REST, GraphQL, gRPC, SOAP, JSON-RPC, JSON, BSON, XML, YML, …
- **Web services** are hosted on a Web server (HTTP server)
  - Provide a set of functions, invokable from the Web (Web API)
- **RESTful APIs** is the most popular Web service standard



SOAP APIs

- **SOAP** (**Simple Object Access Protocol**) APIs are protocol-based, ensuring high levels of security and standardized communication via XML
- Preferred for enterprise-level web services where security and transactional reliability are paramount
- **Testing Focus:** Requires thorough validation of the SOAP envelope, headers, and body, along with adherence to WS-* standards

SOAP API Example

- **National Weather Service** (NWS) SOAP-based API for weather data
- http://www.weather.gov/forecasts/xml/DWMLgen/wsdl/ndfdXML.wsdl
- Includes WSDL (Web Services Description Language) document for describing the services offered
  - **Operation**: Get weather forecast
  - **SOAP Action**: LatLonListCityNames
  - **Request**: XML formatted SOAP envelope specifying the desired operation and parameters(of city names or geographic coordinates)
  - **Response**: XML-formatted response (weather forecast data for the requested locations)

GraphQL APIs

- Defined by **GraphQL** (query language) that allows clients to request exactly what they need, making it highly efficient for data retrieval
- Enables clients to define the structure of the data required, reducing over-fetching and under-fetching issues common in REST APIs
- **Testing Considerations:** Emphasizes validating query responses, handling dynamic data retrieval, and ensuring efficient performance

GraphQL APIs Example

- GitHub offers a GraphQL API, enabling clients to request exactly the data they need
- GraphQL queries are tailored by the requester
- GraphQL API has a single endpoint:
  - https://api.github.com/graphql
- More on GitHun GraphQL API:
  - https://docs.github.com/en/graphql

GraphQL APIs Example

- Fetching a user's name and the last three issues from a repository

```
query {
  repository(owner:"octocat", name:"Hello-World") {
    issues(last:3) {
      edges {
        node {
          title
          url
        }
      }
    }
  }
}
```

RESTful APIs

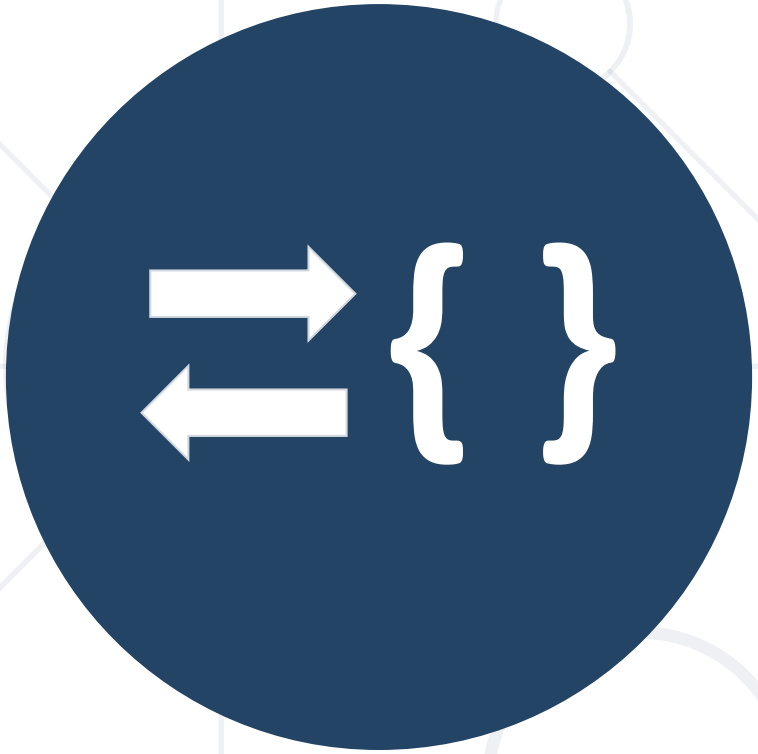
- Based on the Representational State Transfer architectural style, emphasizing simplicity, statelessness, and a uniform interface
- Utilizes standard **HTTP methods** (**GET, POST, PUT, DELETE**) for operations, making it widely adopted for web services
- Offers scalability, performance, and ease of use, with data typically exchanged in **JSON** or XML format

RESTful APIs Example

- The GitHub REST API - widely used for actions like creating repositories, fetching user data, or automating workflow processes
  - Base URL for GitHub API v3: https://api.github.com
  - Example Operation: Fetching a user's public repositories
  - Request Type: GET
  - Endpoint: /users/{username}/repos
  - Sample Request: GET https://api.github.com/users/octocat/repos
- Retrieves data in **JSON format**, listing **public repositories** for the specified GitHub username

RESTful API Testing

- The process includes sending various HTTP requests to the API endpoints and **assessing the responses against expected outcomes**
  - **Endpoints:** Each URL that allows access to the API's resources
  - **HTTP Methods:** GET, POST, PUT, DELETE, etc., which define the action on the resources
  - **Response Status:** HTTP response status codes like 200 OK, 404 Not Found, etc.
  - **Data Exchange:** Validating the request payload and response body



Serialization and Deserialization

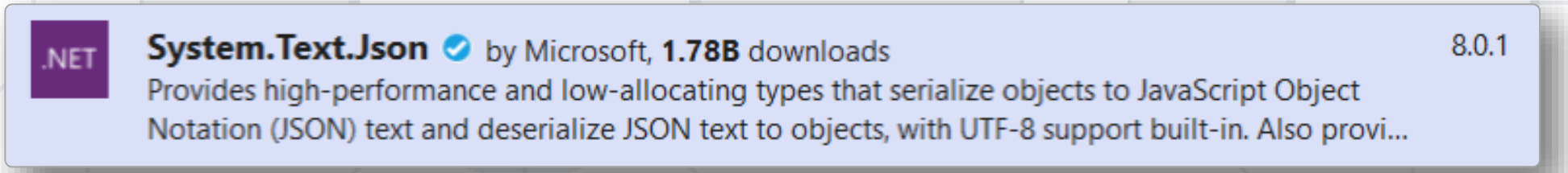
Data Handling in RESTful APIs

Data Exchange

- During RESTful API interactions, data is frequently exchanged between a client and a server
- The data must be in a format that both can understand
- **Serialization: Converts complex data** structures or object states into a **flat format** suitable for HTTP communication, storage, or file-based persistence
- **Deserialization: Reconstructs the flat data** back into **usable objects** or **data structures** after it's received

Built-in JSON Support

- .NET has built-in JSON support through the **System.Text.Json** NuGet Package



- It supports **serializing** objects and **deserializing** (parsing) strings

- Include **the following namespaces** into your project

```
using System.Text.Json;
using System.Text.Json.Serialization;
```

Serializing JSON

- The **System.Text.Json** serializer can read and write JSON

```
class WeatherForecast
{
    public DateTime Date { get; set; } = DateTime.Now;
    public int TemperatureC { get; set; } = 30;
    public string Summary { get; set; } = "Hot summer day";
}

static void Main()
{
    WeatherForecast forecast = new WeatherForecast();
    string weatherInfo = JsonSerializer.Serialize(forecast);
    Console.WriteLine(weatherInfo);
}
```

Deserializing JSON

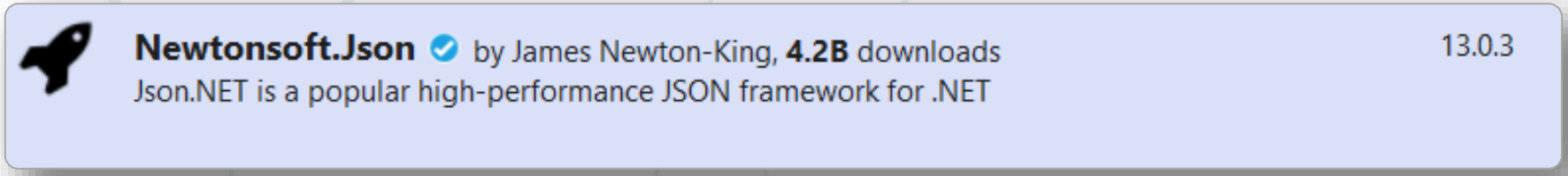
- To deserialize from a file, we read the file into a string and then use the **Deserialize** method

```
static void Main()
{
    string jsonString = File.ReadAllText(file);
    WeatherForecast forecast =
      JsonSerializer.Deserialize<WeatherForecast>(jsonString);
}
```

Name	Value	Type
forecast	{JsonDemo.Program.WeatherForecast}	JsonDemo.Program.WeatherForecast
Date	{5.2.2023 г. 20:16:32}	System.DateTime
Summary	"Hot summer day" View	string
TemperatureC	30	int

What is JSON.NET?

- **JSON.NET** is a JSON **framework** for .NET
  - **More functionality** than built-in functionality
  - Supports **LINQ-to-JSON**
  - Out-of-the-box support for parsing between **JSON** and **XML**
  - Open-source project: **http://www.newtonsoft.com**
  - To install JSON.NET use the **NuGet Package Manager**



General Usage

- JSON.NET exposes a static service **JsonConvert**
- Used for parsing and configuration to
  - **Serialize** an object

```
var jsonProduct = JsonConvert.SerializeObject(product);
```

  - **Deserialize** an object

```
var objProduct =
    JsonConvert.DeserializeObject<Product>(jsonProduct);
```

Configuring JSON.NET

- By default, the result is a **single line of text**
- To indent the output string use **`Formatting.Indented`**

```
JsonConvert.SerializeObject(products, Formatting.Indented);
```

```
{
  "pump": {
    "Id": 0,
    "Name": "Oil Pump",
    "Description": null,
    "Cost": 25.0
  },
  "filter": {
    "Id": 0,
    "Name": "Oil Filter",
    "Description": null,
    "Cost": 15.0
  }
}
```

Configuring JSON.NET

- Deserializing to **anonymous** types

Incoming JSON

```
var json = @"{ 'firstName': 'Svetlin',
               'lastName': 'Nakov',
               'jobTitle': 'Technical Trainer' }";
var template = new
{
    FirstName = string.Empty,
    LastName = string.Empty,
    JobTitle = string.Empty
};
var person = JsonConvert.DeserializeAnonymousType(json,
template);
```

Template objects

JSON.NET Attributes

- By default JSON.NET takes each property / field from the class and parses it
  - This can be controlled using **attributes**

```
public class User
{
  [JsonProperty("user")]
  public string Username { get; set; }

  [JsonIgnore]
  public string Password { get; set; }
}
```

Parse Username to user

Skip the property

JSON.NET Parsing of Objects

- By default JSON.NET takes each property / field from the class and parses it
  - This can be controlled using **ContractResolver**

```
DefaultContractResolver contractResolver =
    new DefaultContractResolver()
    {
        NamingStrategy = new SnakeCaseNamingStrategy()
    };
var serialized = JsonConvert.SerializeObject(person,
    new JsonSerializerSettings()
    {
        ContractResolver = contractResolver,
        Formatting = Formatting.Indented
    });
```

LINQ-to-JSON

- LINQ-to-JSON works with **JObjects**
  - Create from JSON string

```
JObject obj = JObject.Parse(jsonProduct);
```

  - Reading from file

```
var people = JObject.Parse(File.ReadAllText(@"c:\people.json"))
```

  - Using **JObject**

```
foreach (JToken person in people)
{
  Console.WriteLine(person["FirstName"]); // Ivan
  Console.WriteLine(person["LastName"]); // Petrov
}
```

LINQ-to-JSON

- **JObjects** can be queried with LINQ

```
var json = JObject.Parse(@"{'products': [
  {'name': 'Fruits', 'products': ['apple', 'banana']},
  {'name': 'Vegetables', 'products': ['cucumber']}]}");

var products = json["products"].Select(t =>
  string.Format("{0} ({1})",
    t["name"],
    string.Join(", ", c["products"])
));

// Fruits (apple, banana)
// Vegetables (cucumber)
```

RestSharp

Simplifying REST API Calls in C#

RestSharp: REST API Client for C#

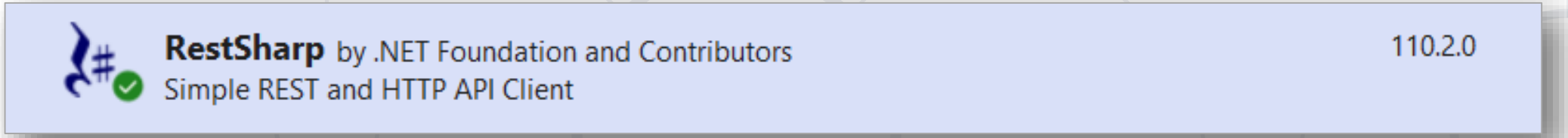
- **RestSharp** is popular REST API client library for .NET
  - Very simple, quite powerful
  - Official site: https://restsharp.dev
  - Execute HTTP **requests** (sync & async)
  - Submit HTTP **parameters**, forms, query string, URL segment, etc.
  - Send / receive / serialize / parse **JSON** and **XML** payloads
  - Multiple **authentication** schemes: Basic, JWT, OAuth
  - **Community** of millions developers

RestSharp

Probably, the most popular REST API client library for .NET

Using RestSharp

- **Installing** RestSharp through NuGet:



- Executing simple **HTTP GET** request:

```
using RestSharp;
```

```
var client = new RestClient("https://api.github.com");
```

```
var request = new RestRequest("/users/softuni/repos", Method.Get);
```

```
var response = client.Execute(request);
```

```
Console.WriteLine(response.Content);
```

Using URL Segment Parameters

```
var client = new RestClient("https://api.github.com");
```

```
var request = new RestRequest(
  "/repos/{user}/{repo}/issues/{id}", Method.Get);
```

```
request.AddUrlSegment("user", "testnakov");
request.AddUrlSegment("repo", "test-nakov-repo");
request.AddUrlSegment("id", 1);
```

```
var response = client.Execute(request);
```

```
Console.WriteLine(response.StatusCode);
Console.WriteLine(response.Content);
```

Deserializing JSON Responses

```
var client = new RestClient("https://api.github.com");
```

```
var request = new RestRequest(
  "/users/softuni/repos", Method.Get);
```

```
var resp = client.Execute(request);
```

```
public class Repo {
  public int id { get; set; }
  public string full_name { get; set; }
  public string html_url { get; set; }
}
```

- Reference the GitHub REST API documentation, which outlines the properties of a repository object

```
var repos = JsonSerializer.Deserialize<List<Repo>>(resp.Content);
```

GitHub Authentication

- **Reading** from a public GitHub project is open to everyone
- **Modifying** data in a GitHub project requires **authentication**
  - Get an **API access token** from your GitHub profile: https://github.com/settings/tokens/new
  - Use **HTTP basic authentication**: username + token

New personal access token (classic)

Personal access tokens (classic) function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to authenticate to the API over Basic Authentication.

  - Under "Select Scopes" Choose Repo

☑ repo

RestSharp: HTTP POST Request

- Executing **HTTP POST** request with RestSharp:

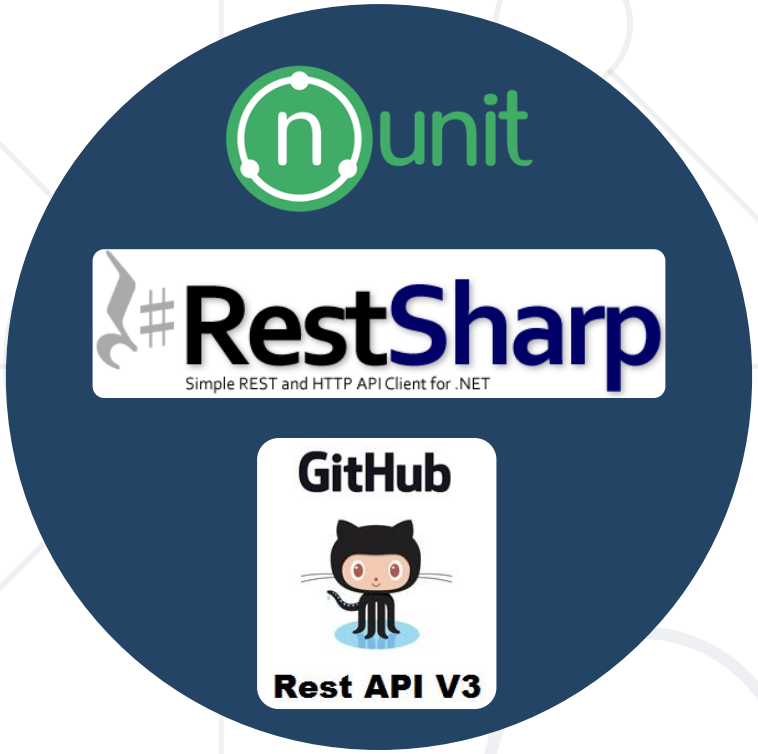
```
var client = new RestClient(new RestClientOptions("https://api.github.com")
{
    Authenticator = new HttpBasicAuthenticator("username", "api-token")
});
```

```
var request = new RestRequest
      ("/repos/testnakov/test-nakov-repo/issues", Method.Post);
```

```
request.AddHeader("Content-Type", "application/json");
request.AddJsonBody(new { title = "Title", body = "Body" });
```

```
var response = client.Execute(request);
```

```
Console.WriteLine(response.StatusCode);
```



API Testing for GitHub Issues

Testing RESTful Services

API Testing with NUnit + RestSharp

- Creating **API tests** in C# with **NUnit** + **RestSharp**:
  1. Create **new NUnit Test Project** in Visual Studio
  2. Install the **RestSharp** package from NuGet
  3. Write the test methods

```
[Test]
0 references
public void Test_GitHubAPIRequest()
{
    var client = new RestClient("https://api.github.com");
    var request = new RestRequest("/repos/testnakov/test-nakov-repo/issues", Method.Get);
    var response = client.Get(request);
    Assert.That(response.StatusCode, Is.EqualTo(HttpStatusCode.OK));
}
```

Creating API Tests

- Use MaxTimeout on the RestClient to establish a maximum timeout that applies to all requests made by that client instance

```
public class GitHubAPITests
{
    private RestClient client;

    [SetUp]
    0 references
    public void Setup()
    {
        var options = new RestClientOptions("https://api.github.com")
        {

            MaxTimeout = 3000
        };

        client = new RestClient(options);
    }
```

Creating API Tests

- Use Timeout on the RestRequest when you want to set a timeout for individual requests

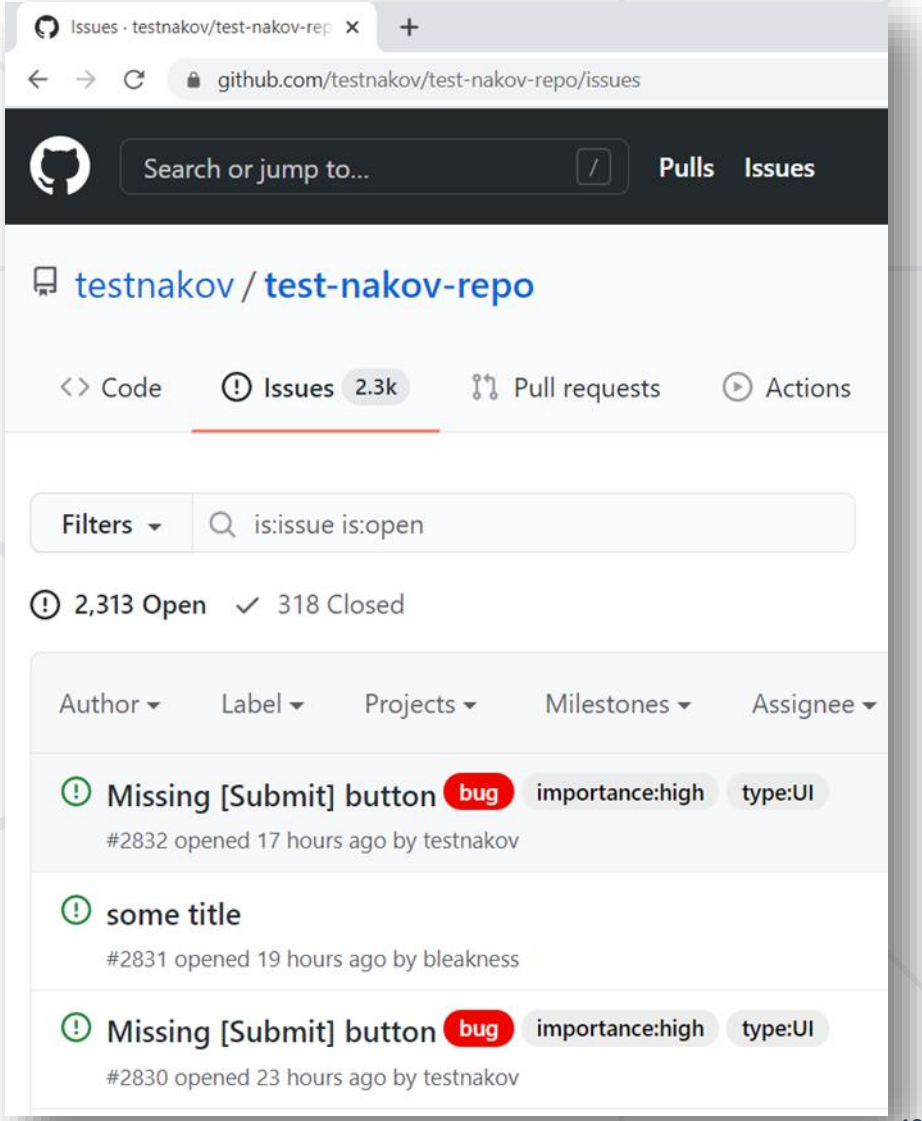
```
[Test]
0 references
public void Test_GitHubAPIRequest()
{
    var client = new RestClient("https://api.github.com");
    var request = new RestRequest("/repos/testnakov/test-nakov-repo/issues", Method.Get);
    //request.Timeout = 1000;
    var response = client.Get(request);
    Assert.That(response.StatusCode, Is.EqualTo(HttpStatusCode.OK));
}
```

Test

- RestSharpDemoTests (1)
  - RestSharpDemoTests (1)
    - GitHubAPITests (1)
      - Test_GitHubAPIRequest

Problem: Testing the GitHub API

- Using the **GitHub official REST API** cerate the following requests and **test them**:
  - **List all issues** from the repo "**`testnakov/test-nakov-repo`**"
  - Create a **new issue** in the same repo
  - Edit created issue
- You can check the results in the [project's issue tracker]



Solution: Setup the Test Class

- Setup the **test class**, create the **REST client** and configure HTTP **Basic Authentication**

```
0 references
public class GitHubAPITests
{
    private RestClient client;

    [SetUp]
    0 references
    public void Setup()
    {
        var options = new RestClientOptions("https://api.github.com")
        {
            Authenticator = new HttpBasicAuthenticator("username", "token")
        };

        this.client = new RestClient(options);
    }
```

Solution: Get All Issues (HTTP GET)

```
[Test]
0 references
public void Test_GetAllIssuesFromARepo()
{
    var request = new RestRequest("repos/testnakov/test-nakov-repo/issues");
    var response = client.Execute(request);
    var issues = JsonSerializer.Deserialize<List<Issue>>(response.Content);

    Assert.That(issues.Count > 1);
```

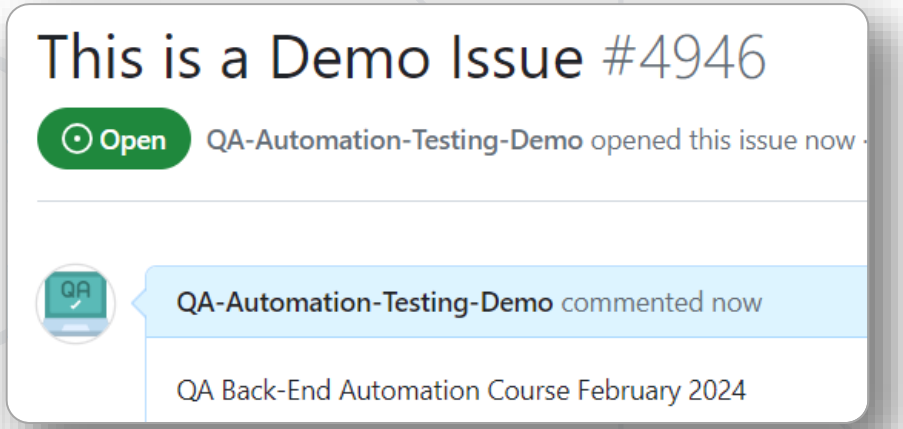
```
    foreach (var issue in issues)
    {
        Assert.That(issue.id, Is.GreaterThan(0));
        Assert.That(issue.number, Is.GreaterThan(0));
        Assert.That(issue.title, Is.Not.Empty);

    }
}
```

```
public class Issue
{
    2 references | 2/2 passing
    public int id { get; set; }
    2 references | 2/2 passing
    public int number { get; set; }
    2 references | 2/2 passing
    public string title { get; set; }
    0 references
    public string body { get; set; }
}
```

Solution: Create New Issue (HTTP POST)

```
private Issue CreateIssue(string title, string body)
{
    var request = new RestRequest("repos/testnakov/test-nakov-repo/issues");
    request.AddBody(new { body, title });
    var response = client.Execute(request, Method.Post);
    var issue = JsonSerializer.Deserialize<Issue>(response.Content);
    return issue;
}
```

```
[Test]
| 0 references
public void Test_CreateGitHubIssue()
{
    string title = "This is a Demo Issue";
    string body = "QA Back-End Automation Course February 2024";
    var issue = CreateIssue(title, body);
    Assert.That(issue.id, Is.GreaterThan(0));
    Assert.That(issue.number, Is.GreaterThan(0));
    Assert.That(issue.title, Is.Not.Empty);
}
```

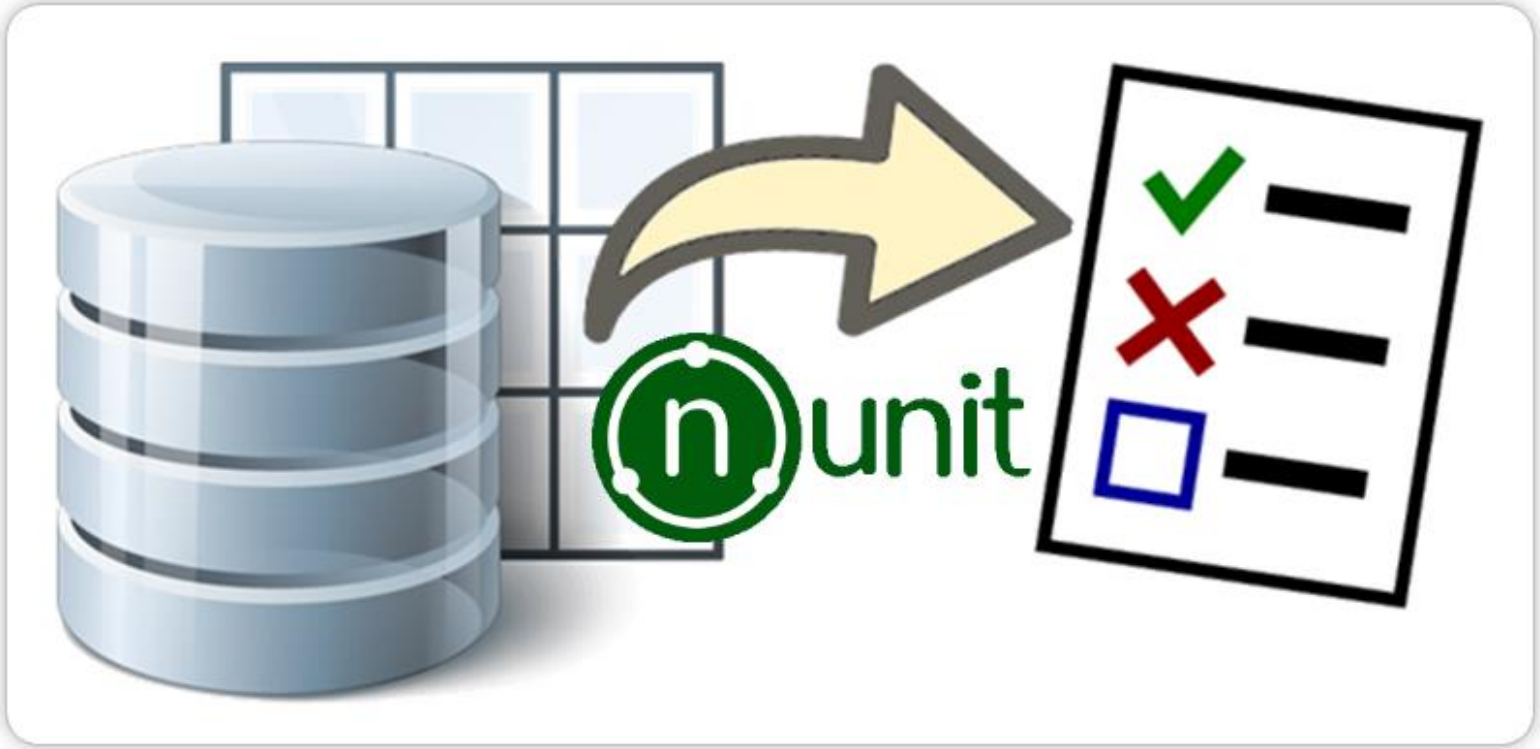


Solution: Edit Created Issue (HTTP PATCH)

```
[Test]
0 references
public void Test_EditIssue()
{
    var request = new RestRequest("repos/testnakov/test-nakov-repo/issues/4946");
    request.AddJsonBody(new
    {
        title = "Changing the name of the issue that I created"
    }
    );

    var response = client.Execute(request, Method.Patch);
    var issue = JsonSerializer.Deserialize<Issue>(response.Content);

    Assert.That(response.StatusCode, Is.EqualTo(HttpStatusCode.OK));
    Assert.That(issue.id, Is.GreaterThan(0), "Issue ID should be greater than 0.");
    Assert.That(response.Content, Is.Not.Empty, "The response content should not be empty.");
    Assert.That(issue.number, Is.GreaterThan(0), "Issue number should be greater than 0.");
    Assert.That(issue.title, Is.EqualTo("Changing the name of the issue that I created"));
}
```

Changing the name of the issue that I created #4946

Open QA-Automation-Testing-Demo opened this issue 7 minutes ago · 0 comments



Data-Driven API Tests

Using **[TestCase]** to Assign Data to Tests

Data-Driven Testing Recap

- **Data-driven testing** == running the same test case with multiple data (e. g. datasets in the C# code / Excel spreadsheet)
  - Each `[TestCase(… data …)]` creates a separate unit test

Data Set

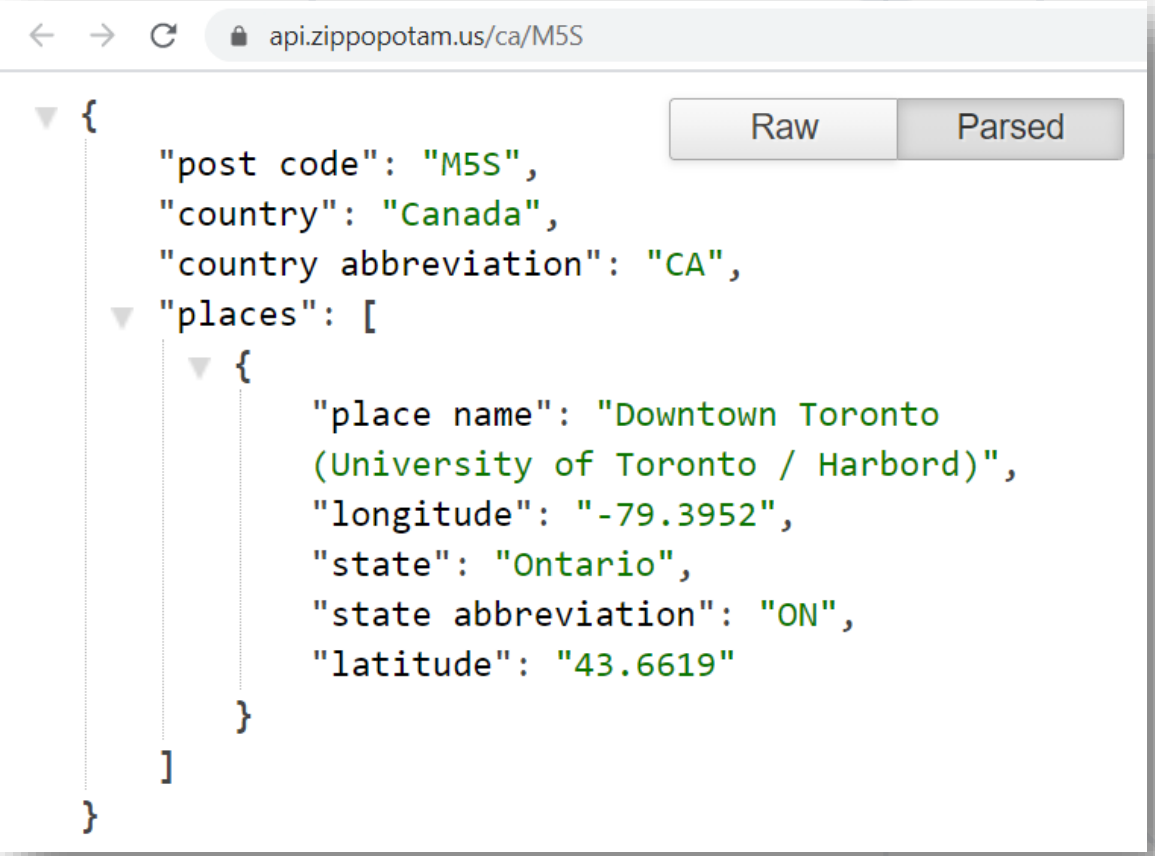
```
[TestCase("BG", "1000", "Sofija")]
[TestCase("BG", "5000", "Veliko Turnovo")]
[TestCase("CA", "M5S", "Toronto")]
[TestCase("GB", "B1", "Birmingham")]
[TestCase("DE", "01067", "Dresden")]
public void TestZippopotamus(
    string countryCode, string zipCode,
    string expectedPlace)
```

Testing Script

```
public void TestZippopotamus(
    string countryCode, string zipCode,
    string expectedPlace)
    // Arrange
    var restClient = new RestClient("https://api.zippopotam.us");
    var httpRequest = new RestRequest(countryCode + "/" + zipCode);

    // Act
    var httpResponse = restClient.Execute(httpRequest);
    var location = new JsonDeserializer().Deserialize<Location>(httpResponse);

    // Assert
    StringAssert.Contains(expectedPlace, location.Places[0].PlaceName);
}
```

Zippopotam.us API

- **Zippopotam.us** is free API
  - Provides location data by **country code + zip code**
- Example HTTP GET request: https://api.zippopotam.us/ca/M5S
- Use the "**JSON Formatter**" plugin for Chrome to view the JSON response



Data-Driven NUnit Tests with [Main TestCase]

```
[TestCase("BG", "1000", "Sofija")]
[TestCase("BG", "5000", "Veliko Turnovo")]
[TestCase("CA", "M5S", "Toronto")]
[TestCase("GB", "B1", "Birmingham")]
[TestCase("DE", "01067", "Dresden")]
public void TestZippopotamus(
    string countryCode, string zipCode, string expectedPlace)
{
    // Arrange
    var restClient = new RestClient("https://api.zippopotam.us");
    var httpRequest = new RestRequest(countryCode + "/" + zipCode);

    // Act
    var httpResponse = restClient.Execute(httpRequest);
    var location = new JsonDeserializer().Deserialize<Location>(httpResponse);

    // Assert
    StringAssert.Contains(expectedPlace, location.Places[0].PlaceName);
}
```

GitHubTests.ZipopotamusApiTests.TestZipopotamus	1,8 sec
TestZipopotamus("BG","1000","Sofija")	597 ms
TestZipopotamus("BG","8600","Jambol")	322 ms
TestZipopotamus("CA","M5S","Toronto")	305 ms
TestZipopotamus("DE","01067","Dresden")	309 ms
TestZipopotamus("GB","B1","Birmingham")	308 ms

Data-Driven NUnit Tests with Classes

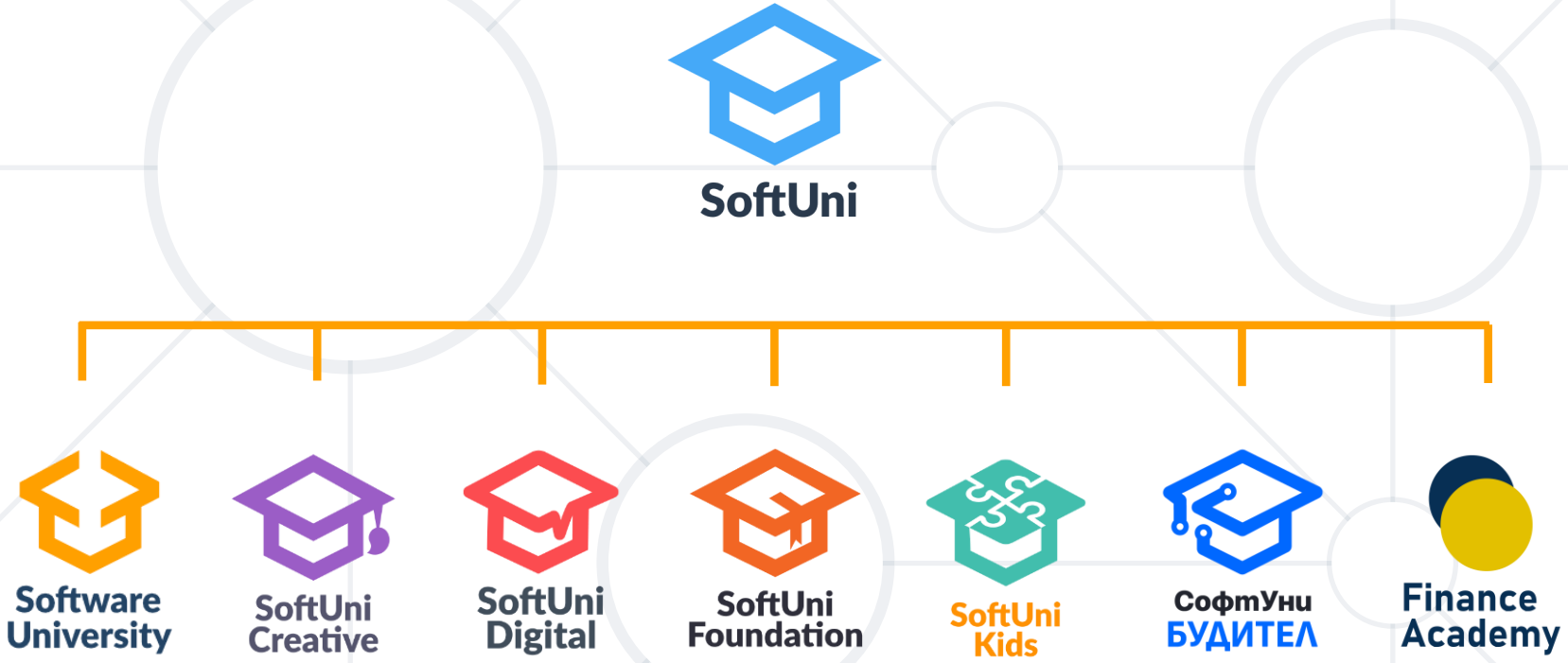
```
public class Location
{
    [JsonPropertyName("post code")]
    0 references
    public string postCode { get; set; }

    [JsonPropertyName("country")]
    0 references
    public string Country { get; set; }

    [JsonPropertyName("country abbreviation")]
    0 references
    public string CountryAbbreviation { get; set; }

    [JsonPropertyName("places")]
    1 reference | 5/5 passing
    public List<Place> Places { get; set; }
}
```

```
public class Place
{
    [JsonPropertyName("place name")]
    1 reference | 5/5 passing
    public string PlaceName { get; set; }
    0 references
    public string State { get; set; }
    0 references
    public string StateAbbreviation { get; set; }
    0 references
    public string Latitude { get; set; }
    0 references
    public string Longitude { get; set; }
}
```

Summary

- Understanding APIs: Interface for services
- Serialization and Deserialization: Data to format conversion
- JSON: Data interchange and object mapping
- How to use NUnit to structure the tests and run them, and RestSharp to make the HTTP requests to the API and verify the responses
- Data-Driven API Tests

Questions?



SoftUni Diamond Partners

Software University

SmartIT

Coca-Cola HBC Bulgaria

SUPER HOSTING .BG

createX

Postbank

Решения за твоето утре

DRAFT KINGS

THE CROWN IS YOURS

VIVACOM

AMBITIONED

INDEAVR

Serving the high achievers

PHAR VISION

Trainings @ Software University (SoftUni)

- Software University – High-Quality Education, Profession and Job for Software Developers
  - softuni.bg, about.softuni.bg
- Software University Foundation
  - softuni.foundation
- Software University @ Facebook
  - facebook.com/SoftwareUniversity

License

- This course (slides, examples, demos, exercises, homework, documents, videos and other assets) is **copyrighted content**
- Unauthorized copy, reproduction or use is illegal
- © SoftUni – https://about.softuni.bg/
- © Software University – https://softuni.bg