Security Lab

Perform these labs on your own computer using Visual Studio 2022 to ensure you understand the lessons presented in the corresponding videos and lectures.

Lab 1: Add Authentication

Open the **Program.cs** file and add the following line of code just before the call to the **builder.Services.ConfigureCors();** method.

```
// Add and Configure
builder.Services.AddAuthentication();
```

Just before the call to the app.UseAuthorization() method add the code shown in **bold** below.

```
// Enable Authentication & Authorization Middleware
app.UseAuthentication();
app.UseAuthorization();
```

Open the **WeatherForcastController.cs** file and add the [Authorize] attribute to the Get() method.

```
[HttpGet(Name = "GetWeatherForecast")]
[Authorize]
public IEnumerable<WeatherForecast> Get()
{
  // REST OF THE CODE HERE
}
```

Try it Out

Run the application and click on the **GET /WeatherForecast** button.

You should see a 500 Internal Server Error message.

Lab 2: Add JWT to Web API Project

Right mouse-click on the **AdvWorksAPI** project and select **Manage NuGet Packages…**

Click on the Browse tab.

Install the **System.IdentityModel.Tokens.Jwt** (select the latest package that targets .NET 6/7, should be around 6.27.0) package.

Install the **Microsoft.AspNetCore.Authentication.JwtBearer**

For .NET 6, select the version 6.0.14 package.

For .NET 7, select the version 7.03 package.

Add JWT Settings to AppSettings File

Open the **appsettings.Development.json** file and add the code shown in **bold** below:

```
{
  "AdvWorksAPI": {
    "InfoMessageDefault": "Problem Attempting to {Verb}
a Customer using the Customer API. Please Contact Your
System Administrator.",
    "DefaultTitle": "Ms.",
    "DefaultEmail": "FirstName.LastName@AdvWorks.com",
    "JwtSettings": {
      "key":
"This!Is&A*Long(Key)For#Creating(A)Symmetric*Key",
      "issuer": "http://localhost:5198",
      "audience": "AdvWorksAPI",
      "minutesToExpiration": "10"
    }
  },
}, /// REST OF THE JSON HERE
```

NOTE:	Change the PORT number in the settings to be the same as your port number on your Web API project.

Create a JWT Settings Class

Right mouse-click on the EntityLayer folder and add a new class named **JwtSettings**.

Replace the entire contents of this new file with the following code.

```
namespace AdvWorksAPI.EntityLayer;

public class JwtSettings
{
  public JwtSettings()
  {
    Key = "A_KEY";
    Issuer = "http://localhost:nnnn";
    Audience = "Audience";
    MinutesToExpiration = 30;
  }

  public string Key { get; set; }
  public string Issuer { get; set; }
  public string Audience { get; set; }
  public int MinutesToExpiration { get; set; }
}
```

Add JwtSettings Class to AdvWorksAPIDefaults Class

Open the **AdvWorksAPIDefaults.cs** file and add a new property.

```
public JwtSettings JWTSettings { get; set; }
```

Modify the constructor to initialize this new property.

```
public AdvWorksAPIDefaults()
{
  Created = DateTime.Now;
  InfoMessageDefault = string.Empty;
  CustomerCategoryID = 1;
  CustomerModelID = 2;
  JWTSettings = new();
}
```

Try it Out

Open the **CustomerController.cs** file and set a breakpoint on the closing brace of the constructor.

Run the application and click on the **GET /api/Customer** button.

Hover over the **_Settings** property and ensure all the settings are read in from the appsettings.Development.json file.

Lab 3: Register Authentication using JWT

Open the **ServiceExtension.cs** file and add a new method named ConfigureJwtAuthentcation().

```
public static AuthenticationBuilder
ConfigureJwtAuthentication(this IServiceCollection
services, AdvWorksAPIDefaults settings)
{
  // Add Authentication to Services
  return services.AddAuthentication(options =>
  {
    options.DefaultAuthenticateScheme =
JwtBearerDefaults.AuthenticationScheme;
    options.DefaultChallengeScheme =
JwtBearerDefaults.AuthenticationScheme;
    options.DefaultScheme =
JwtBearerDefaults.AuthenticationScheme;
  }).AddJwtBearer(jwtOptions =>
  {
    jwtOptions.TokenValidationParameters =
      new TokenValidationParameters
      {
        ValidIssuer = settings.JWTSettings.Issuer,
        ValidAudience = settings.JWTSettings.Audience,
        IssuerSigningKey = new
SymmetricSecurityKey(Encoding.UTF8.GetBytes(settings.JWT
Settings.Key)),
        ValidateIssuer = true,
        ValidateAudience = true,
        ValidateLifetime = true,
        ValidateIssuerSigningKey = true,
        ClockSkew =
TimeSpan.FromMinutes(settings.JWTSettings.MinutesToExpir
ation)
      };
  });
}
```

Add another method to configure the JWT Authorization. You will add more to this method later.

```
public static IServiceCollection
ConfigureJwtAuthorization(this IServiceCollection
services)
{
  return services.AddAuthorization();
}
```

Open the Program.cs file and locate the previous call you made to **builder.Services.AddAuthentication()** and delete that line of code.

Replace that line of code with the following lines of code.

```
// Add & Configure JWT Authentication
builder.Services.ConfigureJwtAuthentication(

builder.Configuration.GetRequiredSection("AdvWorksAPI").
Get<AdvWorksAPIDefaults>());

// Add & Configure JWT Authorization
builder.Services.ConfigureJwtAuthorization();
```

Try it Out

Run the application and click on the **GET /WeatherForecast** button.

You should still get a 500 status code, but now it just shows the path you were trying to get to.

Lab 4: Handle 401 Call

Open the **ErrorController.cs** file, locate the StatusCodeHandler() method and add a new case statement in the switch().

```
case 401:
  msg = $"You are not authorized for this route:
'{msg}'";
  ret = StatusCode(StatusCodes.Status401Unauthorized,
msg);
break;
```

Try it Out

Run the application again and click on the **GET /WeatherForecast** button.

You should now get a 401 status code.

Lab 5: Create Security Classes

Right mouse-click on the Web API project and add a new folder named **SecurityLayer**.

Add User Class

Right mouse-click on the SecurityLayer folder and add a new class named **AppUser**.

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

namespace AdvWorksAPI.SecurityLayer;

public partial class AppUser
{
  public AppUser()
  {
    UserId = Guid.NewGuid();
    UserName = string.Empty;
    Password = string.Empty;
    IsAuthenticated = false;
  }

  public Guid UserId { get; set; }
  public string UserName { get; set; }
  [JsonIgnore]
  public string Password { get; set; }
  public bool IsAuthenticated { get; set; }
}
```

Add User Claim Class

Right mouse-click on the SecurityLayer folder and add a new class named **AppUserClaim**.

```
namespace AdvWorksAPI.SecurityLayer;

public partial class AppUserClaim
{
  public AppUserClaim()
  {
    ClaimId = Guid.NewGuid();
    UserId = Guid.NewGuid();
    ClaimType = string.Empty;
    ClaimValue = string.Empty;
  }

  public Guid ClaimId { get; set; }
  public Guid UserId { get; set; }
  public string ClaimType { get; set; }
  public string ClaimValue { get; set; }
}
```

Add Security Token Class

Right mouse-click on the SecurityLayer folder and add a new class named **AppSecurityToken**.

```
namespace AdvWorksAPI.SecurityLayer;

public class AppSecurityToken
{
  public AppSecurityToken()
  {
    User = new() { UserName = "Not Authenticated" };
    BearerToken = string.Empty;
    Claims = new();
  }

  public AppUser User { get; set; }
  public string BearerToken { get; set; }
  public List<AppUserClaim> Claims { get; set; }
}
```

Lab 6: Create a Security Manager Class

Right mouse-click on the SecurityLayer folder and add a new class named **SecurityManager**.

```
using System.IdentityModel.Tokens.Jwt;
using System.Security.Claims;
using System.Text;
using AdvWorksAPI.EntityLayer;
using Microsoft.IdentityModel.Tokens;

namespace AdvWorksAPI.SecurityLayer;

public class SecurityManager
{
  #region AuthenticateUser Method
  public AppSecurityToken AuthenticateUser(string name,
string password, JwtSettings settings)
  {
    AppSecurityToken asToken;

    // Validate the user passed in
    // Create the AppSecurityToken object
    asToken = ValidateUser(name, password);

    if (asToken.User.IsAuthenticated) {
      // Load User Claims into Security Token
      LoadUserClaims(asToken);

      // Build Application Security Token
      SetJwtToken(settings, asToken);
    }

    return asToken;
  }
  #endregion

  #region ValidateUser Method
  protected AppSecurityToken ValidateUser(string name,
string password)
  {
    AppSecurityToken asToken = new();

    // Validate User - HARD CODED FOR NOW
    // TODO: Authenticate against a data store
    switch (name.ToLower()) {
      case "pauls":
        if (password == "password") {
          asToken.User.UserName = name;
          asToken.User.UserId = new Guid("4df9b2b3-e497-
407f-8b84-d0e638bdcdcc");
          asToken.User.IsAuthenticated = true;
```

```
        }
        break;

      case "johnk":
        if (password == "password") {
          asToken.User.UserName = name;
          asToken.User.UserId = new Guid("1a8418ff-550f-
4341-b6f8-1003085ce01b");
          asToken.User.IsAuthenticated = true;
        }
        break;
    }

    return asToken;
  }
  #endregion

  #region LoadUserClaims
  protected void LoadUserClaims(AppSecurityToken
asToken)
  {
    // Get Claims for a user - HARD CODED FOR NOW
    // TODO: Get Claims from a Data Store
    switch (asToken.User.UserName.ToLower()) {
      case "pauls":
        // Add GetCustomers
        asToken.Claims.Add(new AppUserClaim()
        {
          UserId = asToken.User.UserId,
          ClaimType = "GetCustomers",
          ClaimValue = "true"
        });
        // Add GetACustomer
        asToken.Claims.Add(new AppUserClaim()
        {
          UserId = asToken.User.UserId,
          ClaimType = "GetACustomer",
          ClaimValue = "true"
        });
        // Add Search
        asToken.Claims.Add(new AppUserClaim()
        {
          UserId = asToken.User.UserId,
          ClaimType = "Search",
          ClaimValue = "true"
        });
        break;
```

```
      case "johnk":
        // Add GetACustomer
        asToken.Claims.Add(new AppUserClaim()
        {
          UserId = asToken.User.UserId,
          ClaimType = "GetACustomer",
          ClaimValue = "true"
        });
        // Add AddCustomer
        asToken.Claims.Add(new AppUserClaim()
        {
          UserId = asToken.User.UserId,
          ClaimType = "AddCustomer",
          ClaimValue = "true"
        });
        // Add UpdateCustomer
        asToken.Claims.Add(new AppUserClaim()
        {
          UserId = asToken.User.UserId,
          ClaimType = "UpdateCustomer",
          ClaimValue = "true"
        });
        break;
    }
  }
  #endregion

  #region SetJwtToken
  protected void SetJwtToken(JwtSettings settings,
AppSecurityToken asToken)
  {
    // Build JWT claims
    List<Claim> claims = BuildJWTClaims(asToken);

  SecurityTokenDescriptor tokenDescriptor = new()
    {
      Expires =
DateTime.UtcNow.AddMinutes(settings.MinutesToExpiration)
,
      Issuer = settings.Issuer,
      Audience = settings.Audience,
      SigningCredentials = new SigningCredentials
        (new
SymmetricSecurityKey(Encoding.ASCII.GetBytes(settings.Ke
y)),
        SecurityAlgorithms.HmacSha512Signature),
```

```
      // Add Claims
      Subject = new ClaimsIdentity(claims)
    };

    var tokenHandler = new JwtSecurityTokenHandler();
    var bearerToken =
tokenHandler.WriteToken(tokenHandler.CreateToken(tokenDe
scriptor));

    // Create a string representation of the Jwt token
    // Stored into BearerToken property
    asToken.BearerToken = bearerToken;
  }
  #endregion

  #region BuildJWTClaims Method
  protected List<Claim> BuildJWTClaims(AppSecurityToken
asToken)
  {
    // Create standard JWT claims
    List<Claim> ret = new()
    {
      // Add Unique User Name
      new Claim(JwtRegisteredClaimNames.Sub,
asToken.User.UserName),
      // Add Unique JWT Token Identifier
      new Claim(JwtRegisteredClaimNames.Jti,
Guid.NewGuid().ToString()),
      // Add IsAuthenticated Claim
      new Claim("IsAuthenticated",
asToken.User.IsAuthenticated.ToString())
    };

    // Add Custom Claims for your Application
    foreach (var item in asToken.Claims) {
      ret.Add(new Claim(item.ClaimType,
item.ClaimValue));
    }

    return ret;
  }
  #endregion
}
```

Lab 7: Add Security Controller to Generate JWT Token

Right mouse-click on the Controllers folder and add a new class named **SecurityTestController**.

Replace the entire contents of this new file with the following code.

```
using AdvWorksAPI.BaseClasses;
using AdvWorksAPI.EntityLayer;
using AdvWorksAPI.SecurityLayer;
using Microsoft.AspNetCore.Mvc;
using Microsoft.Extensions.Options;

namespace AdvWorksAPI.Controllers;

[Route("api/[controller]")]
[ApiController]
public class SecurityTestController : ControllerBaseAPI
{
  private readonly AdvWorksAPIDefaults _Settings;

  public
SecurityTestController(IOptionsMonitor<AdvWorksAPIDefaul
ts> defaults, ILogger<SecurityTestController> logger) :
base(logger)
  {
    _Settings = defaults.CurrentValue;
  }

  [HttpGet()]
  [Route("AuthenticateUser/{name}/password/{password}")]
  [ProducesResponseType(StatusCodes.Status200OK)]

[ProducesResponseType(StatusCodes.Status401Unauthorized)
]
  public ActionResult<AppSecurityToken>
AuthenticateUser(string name, string password)
  {
    ActionResult<AppSecurityToken> ret;
    AppSecurityToken asToken;

    asToken = new
SecurityManager().AuthenticateUser(name, password,
_Settings.JWTSettings);

    if (asToken.User.IsAuthenticated) {
      ret = StatusCode(StatusCodes.Status200OK,
asToken);
    }
    else {
      ret =
StatusCode(StatusCodes.Status401Unauthorized, "Invalid
User Name/Password.");
    }
```

```
        return ret;
    }
}
```

Try it Out

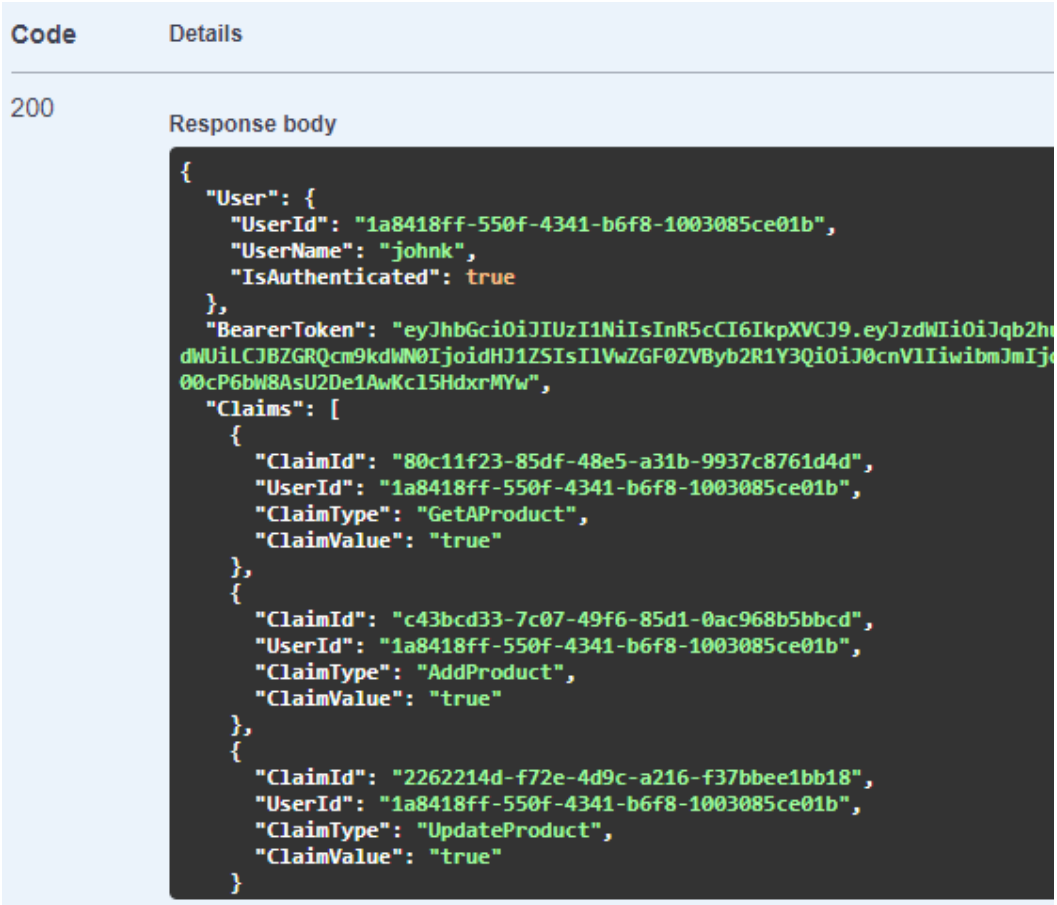
Run the application and click on the **GET /api/SecurityTest/AuthenticateUser/{name}/password/{password}** button.

Enter **johnk** into the **name** field.

Enter **password** into the **password** field.

Click on the **Execute** button.

You should see something that looks like the following:



Now try entering a bad name such as "asdf" with a bad password.

You should see a **401 – Not Authorized** status code.

Lab 8: Add JWT Token in Swagger

You need to add some options to the Swagger generation to be able to enter a bearer token.

Open the **ServiceExtension.cs** file and add a new method.

```
public static IServiceCollection ConfigureOpenAPI(this
IServiceCollection services)
{
  // Configure Open API (Swagger)
  // More Info: https://aka.ms/aspnetcore/swashbuckle
  services.AddEndpointsApiExplorer();
  return services.AddSwaggerGen(options =>
  {
    options.AddSecurityDefinition("Bearer", new
OpenApiSecurityScheme
    {
      Scheme = "Bearer",
      BearerFormat = "JWT",
      In = ParameterLocation.Header,
      Name = "Authorization",
      Description = "Bearer Authentication with JWT
Token",
      Type = SecuritySchemeType.Http
    });
    options.AddSecurityRequirement(new
OpenApiSecurityRequirement
    {
      {
        new OpenApiSecurityScheme
        {
          Reference = new OpenApiReference
          {
            Id = "Bearer",
            Type = ReferenceType.SecurityScheme
          }
        },
        new List<string>()
      }
    });
  });
}
```

Open the **Program.cs** file and locate the following lines

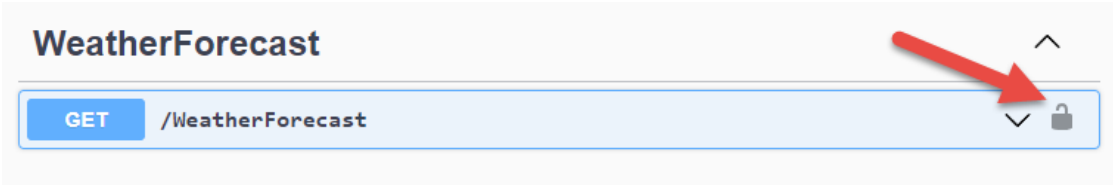
```
// Configure Open API (Swagger)
// More Info: https://aka.ms/aspnetcore/swashbuckle
builder.Services.AddEndpointsApiExplorer();
builder.Services.AddSwaggerGen();
```

Change the above lines of code to the following:

```
// Add & Configure Open API (Swagger)
builder.Services.ConfigureOpenAPI();
```

Try it Out

Run the application and you should now see a lock icon on each API call.



Click on the **GET /api/SecurityTest/AuthenticateUser** button and enter the following inputs.

```
Name: johnk
Password: password
```

Copy just the bearer token to the clipboard.

Click on the **lock icon** next to the **GET /api/WeatherForecast.**

Copy the bearer token into the input field and click the **Authorize** button.

Click the Close button.

Click the **GET /api/WeatherForecast** button and the call should now work.

Lab 9: Add Claims to Token and Secure an Endpoint

Open the **ServiceExtension.cs** file and locate the ConfigureJwtAuthorization() method and replace the return statement with the following code in **bold**.

```
public static IServiceCollection
ConfigureJwtAuthorization(this IServiceCollection
services)
{
  return services.AddAuthorization(options =>
  {
    options.AddPolicy("GetCustomersClaim", policy =>
policy.RequireClaim("GetCustomers"));
    options.AddPolicy("GetACustomerClaim", policy =>
policy.RequireClaim("GetACustomer"));
    options.AddPolicy("SearchClaim", policy =>
policy.RequireClaim("Search"));
    options.AddPolicy("AddCustomerClaim", policy =>
policy.RequireClaim("AddCustomer"));
    options.AddPolicy("UpdateCustomerClaim", policy =>
policy.RequireClaim("UpdateCustomer"));
  });
}
```

Open the **CustomerController.cs** file and locate the Get() method

Add an [Authorize] attribute that looks like the following:

```
[Authorize(Policy = "GetCustomersClaim")]
```

Try it Out

Click on the **GET /api/SecurityTest/AuthenticateUser** button and enter the following inputs.

```
Name: johnk
Password: password
```

Copy just the bearer token to the clipboard.

Click on the **lock icon** next to the **GET /api/Customer**.

Copy the bearer token into the input field and click the **Authorize** button.

Click the **Close** button.

Click the **GET /api/Customer** button and you should get a 500 Error.

When using Claims, if you are not authorized to make that call a 403 – Forbidden status code is returned.

Open the ErrorController.cs file and add a new switch statement to handle the 403 status code.

```
case 403:
  msg = $"You are forbidden from accessing this route:
'{msg}'";
  ret = StatusCode(StatusCodes.Status403Forbidden, msg);
  break;
```

Try the above steps again using johnk's bearer token. You should now receive a 403 status code and the error message you just added to the switch statement.

Enter a Valid User

Click on the lock icon next to the **GET /api/Customer**

Click the Logout button.

Click on the **GET /api/SecurityTest/AuthenticateUser** button and enter the following inputs.

```
Name: pauls
Password: password
```

Copy just the bearer token to the clipboard.

Click on the lock icon next to the **GET /api/Customer**.

Copy the bearer token into the input field and click the **Authorize** button

Click the **Close** button.

Click the **GET /api/Customer** button and you should now get a list of customers.