

WEEK 5

MICROSERVICES ARCHITECTURE USING ASP.NET CORE WEB API

EXERCISE 1: KAFKA INTEGRATION WITH C#

Objective

To create a Kafka-based chat application using C# Windows Forms that allows sending messages to a Kafka topic and consuming them via a console-based Kafka consumer.

Setup & Installation

1. Kafka and Zookeeper Installation

- Extracted Kafka from kafka_2.12-2.7.0.zip.

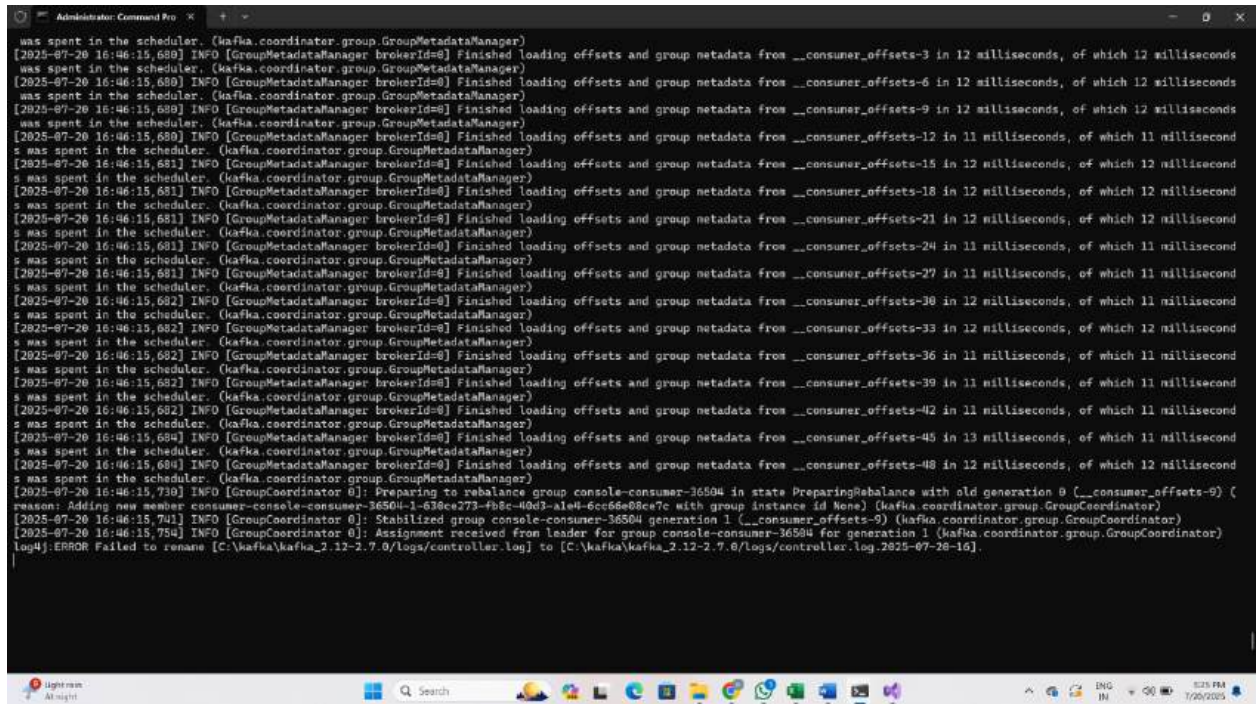
Started Zookeeper using:

```
.\bin\windows\zookeeper-server-start.bat .\config\zookeeper.properties
```

[illegible]

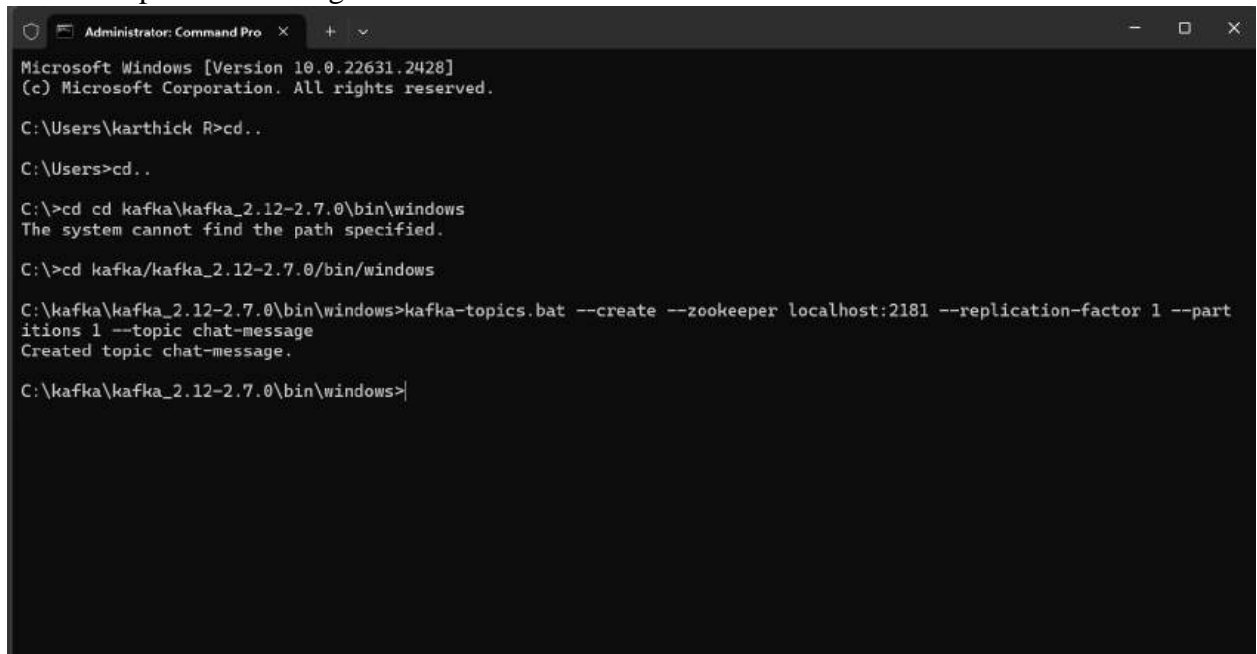
Started Kafka broker using:

.\bin\windows\kafka-server-start.bat .\config\server.properties



```
Administrator: Command Prompt
was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,680] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-3 in 12 milliseconds, of which 12 milliseconds
was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,680] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-6 in 12 milliseconds, of which 12 milliseconds
was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,680] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-9 in 12 milliseconds, of which 12 milliseconds
was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,680] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-12 in 11 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,681] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-15 in 12 milliseconds, of which 12 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,681] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-18 in 12 milliseconds, of which 12 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,681] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-21 in 12 milliseconds, of which 12 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,681] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-24 in 11 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,681] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-27 in 11 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,682] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-30 in 12 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,682] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-33 in 12 milliseconds, of which 12 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,682] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-36 in 11 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,682] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-39 in 11 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,682] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-42 in 11 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,684] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-45 in 13 milliseconds, of which 11 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,684] INFO [GroupMetadataManager brokerId=8] Finished loading offsets and group metadata from __consumer_offsets-48 in 12 milliseconds, of which 12 millisecond
s was spent in the scheduler. (kafka.coordinator.group.GroupMetadataManager)
[2025-07-20 16:46:15,700] INFO [GroupCoordinator 0]: Preparing to rebalance group console-consumer-36504 in state PreparingRebalance with old generation 0 (__consumer_offsets-9) (
reason: Adding new member consumer-console-consumer-36504-1-678ce273-f88c-40d3-ale8-6cc66e08ce7c with group instance id None) (kafka.coordinator.group.GroupCoordinator)
[2025-07-20 16:46:15,701] INFO [GroupCoordinator 0]: Stabilized group console-consumer-36504 generation 1 (__consumer_offsets-9) (kafka.coordinator.group.GroupCoordinator)
[2025-07-20 16:46:15,754] INFO [GroupCoordinator 0]: Assignment received from leader for group console-consumer-36504 for generation 1 (kafka.coordinator.group.GroupCoordinator)
log4j:ERROR Failed to rename [C:\kafka\kafka_2.12-2.7.0\logs\controller.log] to [C:\kafka\kafka_2.12-2.7.0\logs\controller.log.2025-07-20-16].
```

Created topic chat-message:



```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.22631.2428]
(c) Microsoft Corporation. All rights reserved.

C:\Users\karthick R>cd..

C:\Users>cd..

C:\>cd cd kafka\kafka_2.12-2.7.0\bin\windows
The system cannot find the path specified.

C:\>cd kafka/kafka_2.12-2.7.0/bin/windows

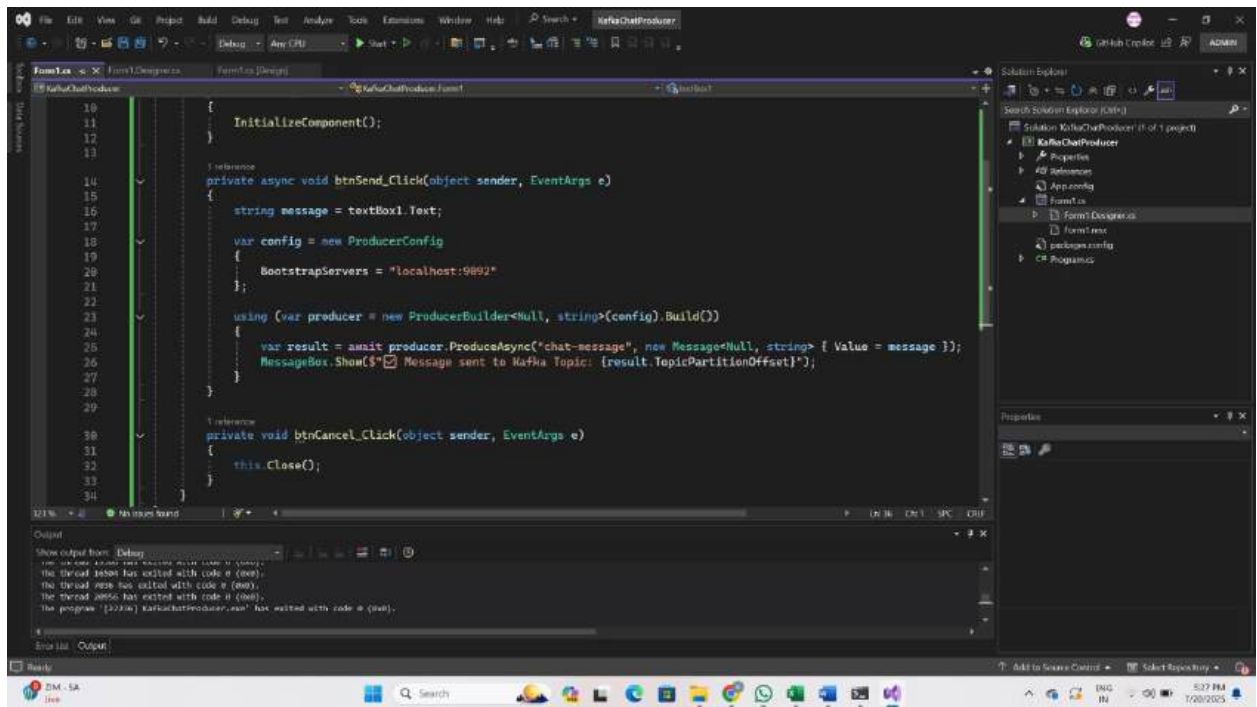
C:\kafka\kafka_2.12-2.7.0\bin\windows>kafka-topics.bat --create --zookeeper localhost:2181 --replication-factor 1 --part
itions 1 --topic chat-message
Created topic chat-message.

C:\kafka\kafka_2.12-2.7.0\bin\windows>
```

Project Setup

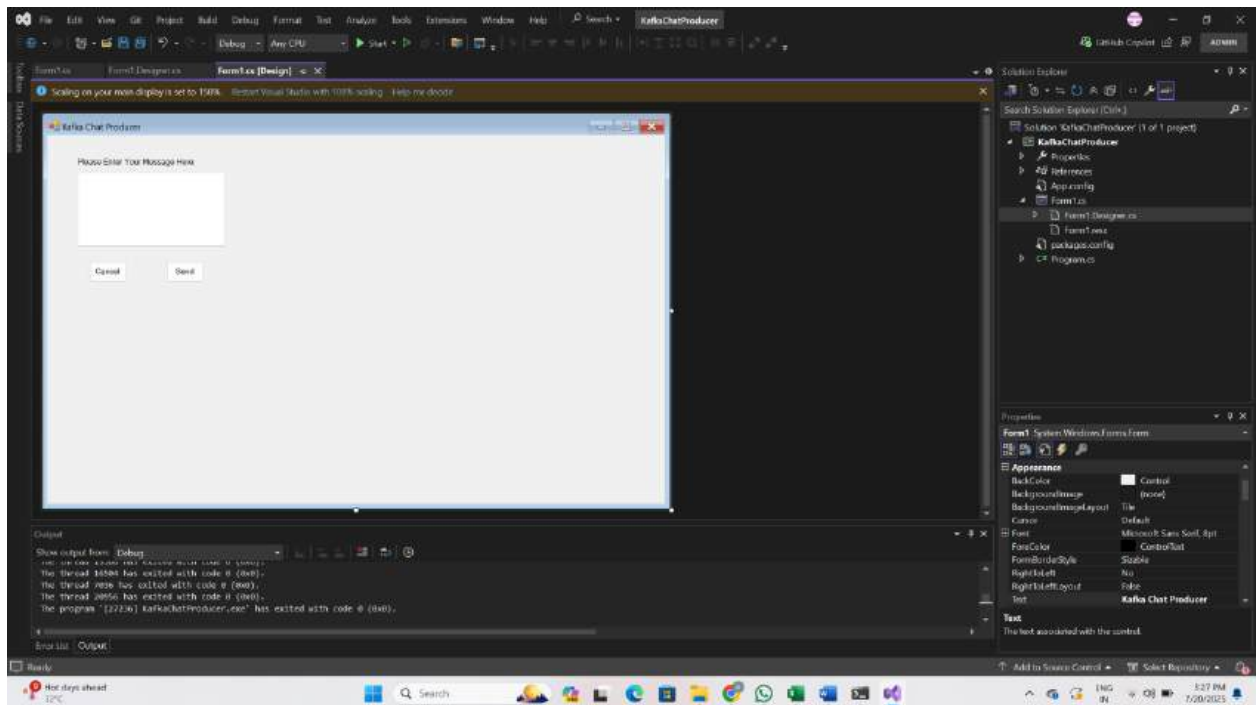
2. Windows Forms Application in Visual Studio

- Created project: KafkaChatProducer
- Type: Windows Forms App (.NET Framework)



3. Designer Elements

- Added a Label with text: “Please Enter Your Message Here:”
- Added a Multiline TextBox: textBox1
- Added two Buttons:
 - btnSend → Send
 - btnCancel → Cancel



Kafka Producer Code

Form1.cs

using Confluent.Kafka;

using System;

using System.Windows.Forms;

namespace KafkaChatProducer

{

public partial class Form1 : Form

{

public Form1()

{

InitializeComponent();

}

private async void btnSend_Click(object sender, EventArgs e)

{

string message = textBox1.Text;

```

var config = new ProducerConfig
{
    BootstrapServers = "localhost:9092"
};

using (var producer = new ProducerBuilder<Null, string>(config).Build())
{
    var result = await producer.ProduceAsync("chat-message", new Message<Null,
string> { Value = message });
    MessageBox.Show($"Message sent to Kafka Topic:
{result.TopicPartitionOffset}");
}
}

private void btnCancel_Click(object sender, EventArgs e)
{
    this.Close();
}
}
}

```

Form1.Designer.cs Code Snippet

Key UI Controls:

- Label: label1
- TextBox: textBox1
- Buttons: btnSend, btnCancel

```
namespace KafkaChatProducer
```

```
{
    partial class Form1
```

```

{
    private System.ComponentModel.IContainer components = null;

    protected override void Dispose(bool disposing)
    {
        if (disposing && (components != null))
        {
            components.Dispose();
        }
        base.Dispose(disposing);
    }

    #region Windows Form Designer generated code

    private void InitializeComponent()
    {
        this.label1 = new System.Windows.Forms.Label();
        this.textBox1 = new System.Windows.Forms.TextBox();
        this.btnSend = new System.Windows.Forms.Button();
        this.btnCancel = new System.Windows.Forms.Button();
        this.SuspendLayout();
        //
        // label1
        //
        this.label1.AutoSize = true;
        this.label1.Location = new System.Drawing.Point(58, 45);
        this.label1.Name = "label1";
        this.label1.Size = new System.Drawing.Size(250, 20);
        this.label1.TabIndex = 0;
        this.label1.Text = "Please Enter Your Message Here:"
    }

```

```
//  
  
// textBox1  
  
//  
  
this.textBox1.Location = new System.Drawing.Point(62, 77);  
this.textBox1.Multiline = true;  
this.textBox1.Name = "textBox1";  
this.textBox1.Size = new System.Drawing.Size(300, 150);  
this.textBox1.TabIndex = 1;  
  
//  
  
// btnSend  
  
//  
  
this.btnSend.Location = new System.Drawing.Point(244, 259);  
this.btnSend.Name = "btnSend";  
this.btnSend.Size = new System.Drawing.Size(75, 41);  
this.btnSend.TabIndex = 2;  
this.btnSend.Text = "Send";  
this.btnSend.UseVisualStyleBackColor = true;  
this.btnSend.Click += new System.EventHandler(this.btnSend_Click);  
  
//  
  
// btnCancel  
  
//  
  
this.btnCancel.Location = new System.Drawing.Point(86, 259);  
this.btnCancel.Name = "btnCancel";  
this.btnCancel.Size = new System.Drawing.Size(75, 41);  
this.btnCancel.TabIndex = 3;  
this.btnCancel.Text = "Cancel";  
this.btnCancel.UseVisualStyleBackColor = true;  
this.btnCancel.Click += new System.EventHandler(this.btnCancel_Click);  
  
//  
  
// Form1
```

```
//
this.AutoScaleDimensions = new System.Drawing.SizeF(9F, 20F);
this.AutoScaleMode = System.Windows.Forms.AutoScaleMode.Font;
this.ClientSize = new System.Drawing.Size(1265, 755);
this.Controls.Add(this.btnCancel);
this.Controls.Add(this.btnSend);
this.Controls.Add(this.textBox1);
this.Controls.Add(this.label1);
this.Name = "Form1";
this.Text = "Kafka Chat Producer";
this.ResumeLayout(false);
this.PerformLayout();

}

#endregion

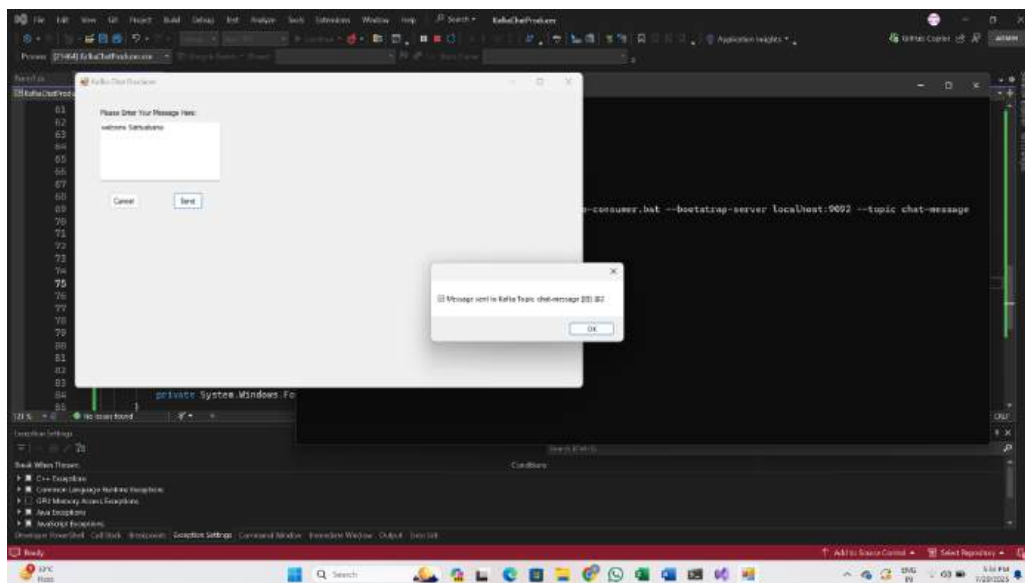
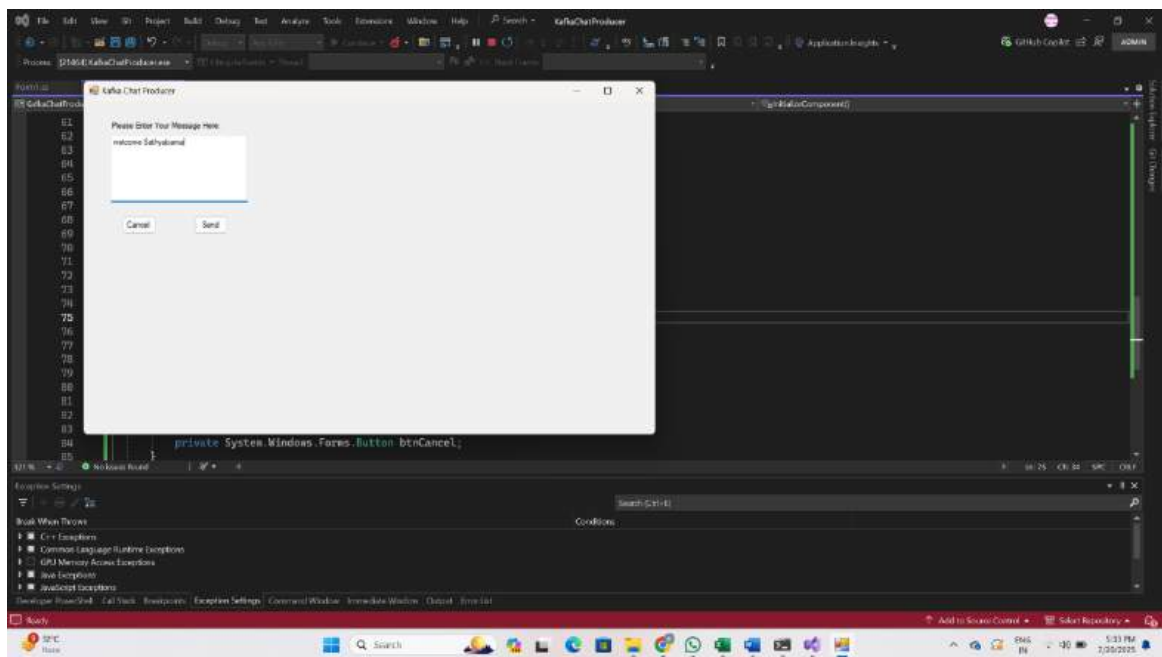
private System.Windows.Forms.Label label1;
private System.Windows.Forms.TextBox textBox1;
private System.Windows.Forms.Button btnSend;
private System.Windows.Forms.Button btnCancel;
}
}
```

Kafka Consumer

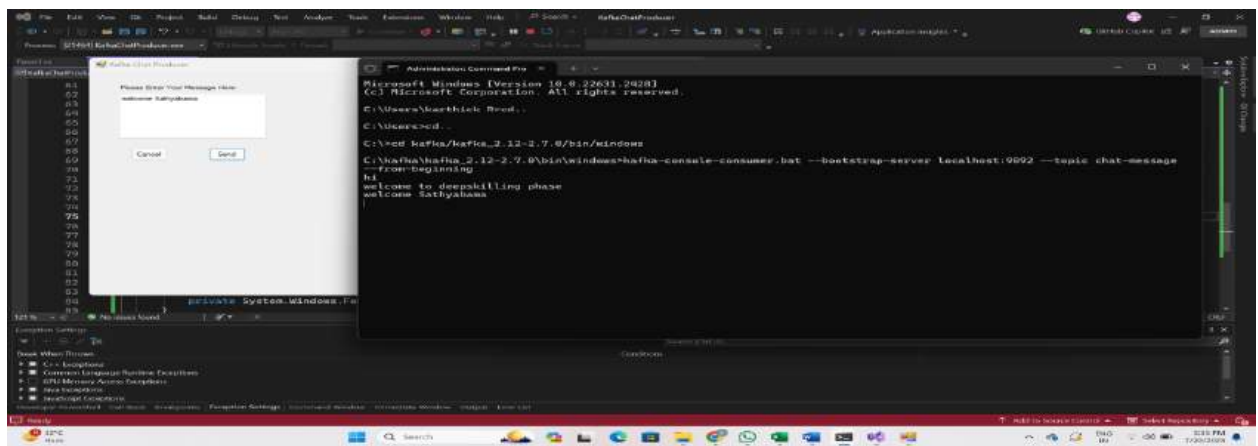
Kafka Consumer Started in CMD

```
kafka-console-consumer.bat --bootstrap-server localhost:9092 --topic chat-message --from-
beginning
```

This terminal listens to all messages sent by the producer.



OUTPUT:



MICROSERVICES JWT

EXERCISE 1: IMPLEMENT JWT AUTHENTICATION IN ASP.NET CORE WEB API

Program.cs

```
using Microsoft.AspNetCore.Authentication.JwtBearer;
using Microsoft.IdentityModel.Tokens;
using Microsoft.OpenApi.Models;
using System.Text;

var builder = WebApplication.CreateBuilder(args);

// Add JWT Authentication
builder.Services.AddAuthentication("Bearer")
    .AddJwtBearer("Bearer", options =>
    {
        options.TokenValidationParameters = new TokenValidationParameters
        {
            ValidateIssuer = true,
            ValidateAudience = true,
            ValidateLifetime = true,
            ValidateIssuerSigningKey = true,
            ValidIssuer = builder.Configuration["Jwt:Issuer"],
            ValidAudience = builder.Configuration["Jwt:Audience"],
            IssuerSigningKey = new SymmetricSecurityKey(
                Encoding.UTF8.GetBytes(builder.Configuration["Jwt:Key"]))
        };
    });

// Add authorization
builder.Services.AddAuthorization();

// Add controllers
builder.Services.AddControllers();

// Add Swagger and configure JWT Auth support
builder.Services.AddEndpointsApiExplorer();
builder.Services.AddSwaggerGen(options =>
{
    // Swagger Authorization configuration
    options.AddSecurityDefinition("Bearer", new OpenApiSecurityScheme
    {
        Name = "Authorization",
        Type = SecuritySchemeType.ApiKey,
        Scheme = "Bearer",
        BearerFormat = "JWT",
        In = ParameterLocation.Header,
        Description = "Enter 'Bearer <your JWT token here>' "
    });
});
```

```

options.AddSecurityRequirement(new OpenApiSecurityRequirement
{
    {
        new OpenApiSecurityScheme
        {
            Reference = new OpenApiReference
            {
                Type = ReferenceType.SecurityScheme,
                Id = "Bearer"
            }
        },
        new string[] {}
    }
});

var app = builder.Build();

// Middleware pipeline
if (app.Environment.IsDevelopment())
{
    app.UseSwagger();
    app.UseSwaggerUI();
}

app.UseHttpsRedirection();

app.UseAuthentication(); // ✔ Important
app.UseAuthorization();

app.MapControllers();

app.Run();

```

AuthController.cs

```

using Microsoft.AspNetCore.Mvc;
using Microsoft.IdentityModel.Tokens;
using System.IdentityModel.Tokens.Jwt;
using System.Security.Claims;
using System.Text;

[ApiController]
[Route("api/[controller]")]
public class AuthController : ControllerBase
{
    private readonly IConfiguration _config;

    public AuthController(IConfiguration config)

```

```

{
    _config = config;
}

[HttpPost("login")]
public IActionResult Login([FromBody] LoginModel model)
{
    if (IsValidUser(model))
    {
        var token = GenerateJwtToken(model.Username);
        return Ok(new { Token = token });
    }
    return Unauthorized();
}

private bool IsValidUser(LoginModel model)
{
    // Dummy check for testing
    return model.Username == "admin" && model.Password == "admin123";
}

private string GenerateJwtToken(string username)
{
    var claims = new[]
    {
        new Claim(ClaimTypes.Name, username)
    };

    var key = new SymmetricSecurityKey(Encoding.UTF8.GetBytes(_config["Jwt:Key"]));
    var creds = new SigningCredentials(key, SecurityAlgorithms.HmacSha256);

    var token = new JwtSecurityToken(
        issuer: _config["Jwt:Issuer"],
        audience: _config["Jwt:Audience"],
        claims: claims,
        expires:
DateTime.Now.AddMinutes(Convert.ToDouble(_config["Jwt:DurationInMinutes"])),
        signingCredentials: creds
    );

    return new JwtSecurityTokenHandler().WriteToken(token);
}
}

```

SecureController.cs

```

using Microsoft.AspNetCore.Authorization;
using Microsoft.AspNetCore.Mvc;

namespace JwtAuthDemo.Controllers

```

```

{
    [ApiController]
    [Route("api/[controller]")]
    public class SecureController : ControllerBase
    {
        [HttpGet("data")]
        [Authorize] // ✓ Protected endpoint
        public IActionResult GetSecretData()
        {
            return Ok("🔒 You are authorized to see this protected data!");
        }
    }
}

```

Appsettings.json

```

{
  "Jwt": {
    "Key": "ThisIsAStrongSecretKeyForJwtToken123456!",
    "Issuer": "MyAuthServer",
    "Audience": "MyApiUsers",
    "DurationInMinutes": 60
  },
  "Logging": {
    "LogLevel": {
      "Default": "Information",
      "Microsoft.AspNetCore": "Warning"
    }
  },
  "AllowedHosts": "*"
}

```

LoginModel.cs

```

public class LoginModel
{
    public string Username { get; set; }
    public string Password { get; set; }
}

```

OUTPUT:

JwtAuthDemo 1.0 OAS 3.0	
https://localhost:7090/swagger/v1/swagger.json	
Auth ^	
POST	/api/Auth/login ▼
Secure ^	
GET	/api/Secure/data ▼
WeatherForecast ^	
GET	/WeatherForecast ▼

```
Curl

curl -X 'POST' \
'https://localhost:7092/api/Auth/login' \
-H 'accept: */*' \
-H 'Content-Type: application/json' \
-d '{
  "username": "admin",
  "password": "admin123"
}'
```

Request URL

https://localhost:7092/api/Auth/Login

Server response

Code	Details
200	<p>Response body</p> <pre>{ "token": "eyJhbGciOiJIUzI1NiIsInR5cCI6IWRXVCl9.eyJodHRwOi8vc2NoZWdkeS44LmFyZy9Sc3kybWQzMjE2LTI1LkZlZW50eXB5MjZucywvMTcybWVlIjoibWRTaW41C1clcmAiOjE3NTI2ODY6NTg5MTAlcy1oikiSGxvbmRlcmlzLnR5c2ltioHk5qxpVnNlcmlufq_gjk9FAIPVUx1vbao3sfje-PsmAgashqnJhiss90" }</pre> <p>Download</p> <p>Response headers</p> <pre>content-type: application/json; charset=utf-8 date: Wed, 16 Jul 2025 14:55:58 GMT server: Kestrel</pre>


```
Curl
curl -X 'GET' \
  'https://localhost:7092/api/Secure/data' \
  -H 'accept: */*' \
  -H 'Authorization: Bearer eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJodHRwOi8vc2NoZW50YTdyS46aWZlLnRwcyZy93cy8yMDAxIiwiaWF0IjklZG50eXRSI2NnYmQtcy9uVml1Ijo1YmRtan41LCJ0eXA0IjE3NTI0ODFhbnQ'

Request URL
https://localhost:7092/api/Secure/data

Server response

Code    Details
200
Response body
You are authorized to see this protected data!

Response headers
content-type: text/plain; charset=utf-8
date: Wed, 16 Jul 2025 14:57:19 GMT
server: Kestrel
```

 **https://localhost:7092/api/Auth/login**

Save Share

POST **https://localhost:7092/api/Auth/login**

Send

Params Authorization Headers (8) **Body** Scripts Settings


Cookies

☐ none ☐ form-data ☐ x-www-form-urlencoded ☒ raw ☐ binary ☐ GraphQL **JSON**

Beautify

1 {
2 "username": "admin",
3 "password": "admin123"
4 }






Body Cookies Headers (4) Test Results

200 OK • 55 ms • 411 B •  ...


{ } **JSON**

Preview

Visualize

1 {
2 "token": "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.
 eyJodHRwOi8vc2NoZW1hcy54bWxzbnZwLm9yZy93cy8yMDA1LzA1L2lkZW50aXR5L2NsYW1tcy9uYX11IjoieWRTaW4iLCJ
 leHAiOiJE3NTI2ODE2NjIsIm1zcyI6Iks1QXV0aFN1cnZlciIsImF1ZC16Iks1QXBpVXN1cnMifQ.
 D3D44u_zev_Ut546V1tqXyUA8rKUJrdLvmdrSTfWgbY"
3 }

 **https://localhost:7092/api/Secure/data**

Save Share

GET **https://localhost:7092/api/Secure/data**


Send

Params Authorization Headers (7) **Body** Scripts Settings

Cookies

	Key	Value	Description	...	Bulk Edit	Presets	
<input checked="" type="checkbox"/>	Authorization	Bearer eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9...					
	Key	Value	Description				





Body Cookies Headers (4) Test Results


200 OK • 52 ms • 193 B •  ...

Raw

Preview

Visualize

1  You are authorized to see this protected data!