SuperSet ID: 6364957

EF Core 8.0 Lab-Wise Implementation Solutions

Lab 1: Understanding ORM with a Retail Inventory System

Objective

Understand what ORM is and how EF Core helps bridge the gap between C# objects and relational tables.

1. What is ORM?

Object-Relational Mapping (ORM) is a programming technique that allows us to work with database data using object-oriented programming concepts.

How ORM maps C# classes to database tables:

- C# classes correspond to database tables.
- Properties of classes become table columns.
- Objects (instances of classes) represent table rows.
- Relationships between classes are mapped to foreign keys in the database.

Benefits:

- **Productivity:** Write less code and focus on business logic.
- **Maintainability:** Changes in one place reflect everywhere.
- **Abstraction:** No need to write complex SQL queries.

2. EF Core vs EF Framework:

Entity Framework Core (EF Core) and Entity Framework (EF Framework) are both object-relational mappers (ORMs) developed by Microsoft, but they differ significantly in their design and capabilities. EF Core is a modern, lightweight, and cross-platform ORM that supports Windows, Linux, and macOS, making it suitable for a wide range of applications. It is optimized for performance and offers modern features such as LINQ, asynchronous queries, and compiled queries, providing developers with greater flexibility and efficiency. In contrast, EF Framework (also known as Entity Framework 6) is a mature and feature-rich ORM, but it is limited to the Windows platform and is generally heavier, with fewer modern features and less flexibility. While EF Framework is stable and well-established, EF Core is more modular and adaptable to new technologies, making it the preferred choice for new projects that require cross-platform support and modern development practices.

3. EF Core 8.0 Features

- **JSON column mapping:** Store JSON data directly in database columns.
- **Improved performance:** Compiled models for faster startup.
- **Interceptors:** Better control over database operations.
- **Bulk operations:** Enhanced performance for batch operations.

Practical Implementation

Step 1: Creating Project

Create a new console project and navigate into it:

```
dotnet new console -n RetailInventory
cd RetailInventory
```

Step 2: Installing EF Core Packages

Adding the necessary EF Core packages:

```
dotnet add package Microsoft.EntityFrameworkCore.SqlServer
dotnet add package Microsoft.EntityFrameworkCore.Design
```

Output:

```
info : PackageReference for package 'Microsoft.EntityFrameworkCore.SqlServer' added
info : PackageReference for package 'Microsoft.EntityFrameworkCore.Design' added
```

Lab 2: Setting Up the Database Context for a Retail Store

Objective

Configure the database context and connect to SQL Server.

Steps

1. **Created a Models folder** in your project.
2. **Created the Category model** (Models/Category.cs):

CODE:

```
using System.ComponentModel.DataAnnotations;


namespace RetailInventory.Models
{
    public class Category
    {
        public int Id { get; set; }


        [Required]
        [StringLength(100)]
        public string Name { get; set; } = string.Empty;


        [StringLength(500)]
        public string? Description { get; set; }


        // Navigation property - One category has many products
        public virtual List<Product> Products { get; set; } = new List<Product>();
    }
}
```

- The `Category` class has properties for Id, Name, Description, and a navigation property for related products.

3. **Created the Product model** (Models/Product.cs):

CODE:

```
using System.ComponentModel.DataAnnotations;
using System.ComponentModel.DataAnnotations.Schema;


namespace RetailInventory.Models
{
    public class Product
    {
        public int Id { get; set; }
        [Required]
        [StringLength(200)]
```

```
        public string Name { get; set; } = string.Empty;
        [Column(TypeName = "decimal(18,2)")]
        public decimal Price { get; set; }
        public int StockQuantity { get; set; }
        // Foreign key
        public int CategoryId { get; set; }
        // Navigation property - Each product belongs to one category
        public virtual Category Category { get; set; } = null!;
    }
}
```

- The `Product` class includes Id, Name, Price, StockQuantity, CategoryId (foreign key), and a navigation property for its category.

4. **Created a Data folder** in your project.

5. **Created the AppDbContext** (Data/AppDbContext.cs):

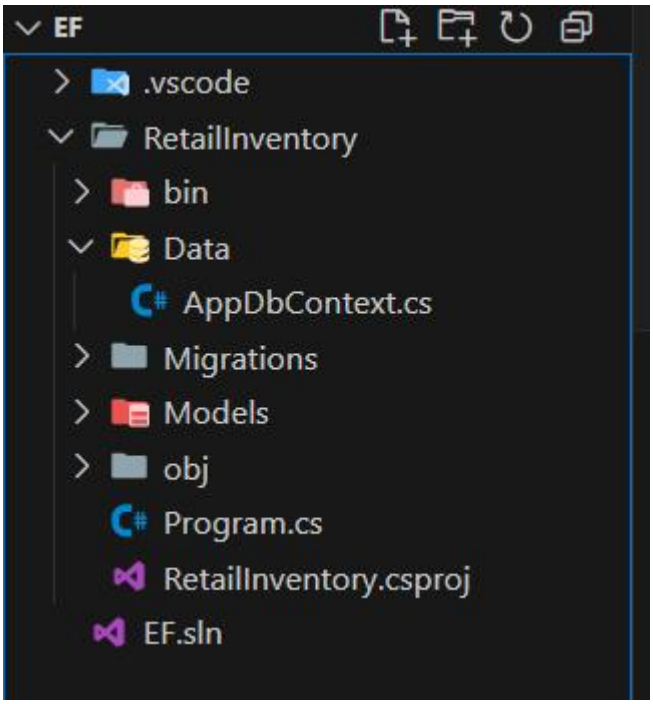
CODE:

```
using Microsoft.EntityFrameworkCore;
using RetailInventory.Models;

namespace RetailInventory.Data
{
    public class AppDbContext : DbContext
    {
        public DbSet<Product> Products { get; set; }
        public DbSet<Category> Categories { get; set; }

        protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
        {
            // Connection string for LocalDB
            string connectionString =
@"Server=(localdb)\mssqllocaldb;Database=RetailInventoryDB;Trusted_Connection=true;MultipleActiveResultSets=
true;";
            optionsBuilder.UseSqlServer(connectionString);
```

```
        }

        protected override void OnModelCreating(ModelBuilder modelBuilder)
        {
            // Configure relationships and constraints
            modelBuilder.Entity<Product>()
                .HasOne(p => p.Category)
                .WithMany(c => c.Products)
                .HasForeignKey(p => p.CategoryId);

            // Add indexes for better performance
            modelBuilder.Entity<Category>()
                .HasIndex(c => c.Name)
                .IsUnique();
        }
    }
}
```

- The `AppDbContext` class inherits from `DbContext` and defines `DbSet<Product>` and `DbSet<Category>`.
- The `OnConfiguring` method sets up the SQL Server connection string.
- The `OnModelCreating` method configures relationships and adds a unique index on category names.

Project structure:



Lab 3: Using EF Core CLI to Create and Apply Migrations

Objective

Learn to use EF Core CLI to manage database schema changes.

1. **Creating the initial migration UsinG:**

dotnet ef migrations add InitialCreate

   - This creates a `Migrations` folder with migration files.

2. **Apply the migration to create the database:**

dotnet ef database update

Result

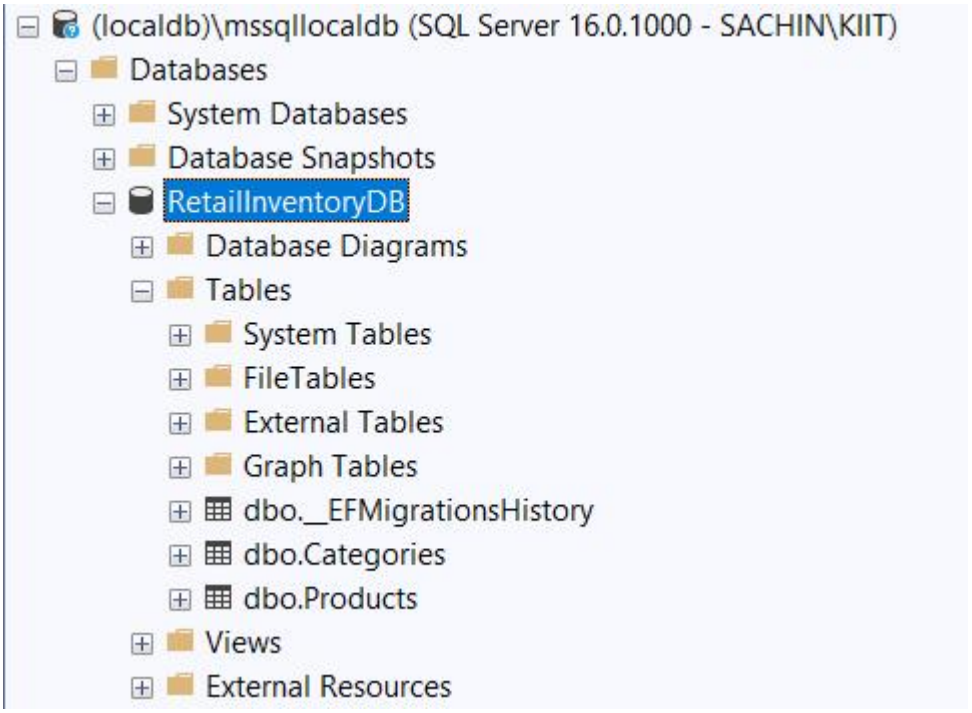
```
ry> dotnet ef migrations add InitialCreate
Build started...
Build succeeded.
Done. To undo this action, use 'ef migrations remove'
ry> dotnet ef migrations add InitialCreate
Build started...
Build succeeded.
Done. To undo this action, use 'ef migrations remove'
```

```
PS C:\Users\KIIT\OneDrive\Desktop\EF\RetailInventory> dotnet ef database update
 ef database update
Build started...
Build succeeded.
Acquiring an exclusive lock for migration application. See https://aka.ms/efcore-docs-migrations-lock for more information if this takes too long.
Applying migration '20250706092926_InitialCreate'.
Done.
```

3. **Verify database creation:**

    - Use SQL Server Management Studio to check for the `RetailInventoryDB` database and ensure the `Products` and `Categories` tables exist.

Result of database schema:



Lab 4: Inserting Initial Data into the Database

Objective

Use EF Core to insert records using `AddAsync` and `SaveChangesAsync`.

Steps

1. **Updating Program.cs for data insertion:**

Code:

```
using Microsoft.EntityFrameworkCore;
```

```
using RetailInventory.Data;
using RetailInventory.Models;

namespace RetailInventory
{
    class Program
    {
        static async Task Main(string[] args)
        {
            Console.WriteLine("=== Retail Inventory System ===");
            Console.WriteLine("Lab 4: Inserting Initial Data");

            using var context = new AppDbContext();

            // Ensure database exists
            await context.Database.EnsureCreatedAsync();

            // Check if data already exists
            var existingCategories = await context.Categories.CountAsync();
            if (existingCategories > 0)
            {
                Console.WriteLine("Data already exists in database.");
                return;
            }

            Console.WriteLine("Inserting initial data...");

            // Create categories
            var electronics = new Category
            {
                Name = "Electronics",
                Description = "Electronic devices and accessories"
            };

            var groceries = new Category
            {
                Name = "Groceries",
                Description = "Food and household items"
```

```
};

// Add categories to context
await context.Categories.AddRangeAsync(electronics, groceries);

// Create products
var product1 = new Product
{
    Name = "Laptop",
    Price = 75000,
    StockQuantity = 10,
    Category = electronics
};

var product2 = new Product
{
    Name = "Rice Bag",
    Price = 1200,
    StockQuantity = 50,
    Category = groceries
};

var product3 = new Product
{
    Name = "Wireless Mouse",
    Price = 2500,
    StockQuantity = 25,
    Category = electronics
};

var product4 = new Product
{
    Name = "Organic Honey",
    Price = 450,
    StockQuantity = 30,
    Category = groceries
};
```

```
            // Add products to context
            await context.Products.AddRangeAsync(product1, product2, product3, product4);

            // Save all changes to database
            await context.SaveChangesAsync();

            Console.WriteLine("Data inserted successfully!");
            Console.WriteLine("\nInserted Categories:");
            Console.WriteLine($"- {electronics.Name} (ID: {electronics.Id})");
            Console.WriteLine($"- {groceries.Name} (ID: {groceries.Id})");

            Console.WriteLine("\nInserted Products:");
            Console.WriteLine($"- {product1.Name} - ₹{product1.Price} (ID: {product1.Id})");
            Console.WriteLine($"- {product2.Name} - ₹{product2.Price} (ID: {product2.Id})");
            Console.WriteLine($"- {product3.Name} - ₹{product3.Price} (ID: {product3.Id})");
            Console.WriteLine($"- {product4.Name} - ₹{product4.Price} (ID: {product4.Id})");
        }
    }
}
```

2. **Runing the application:**

dotnet run

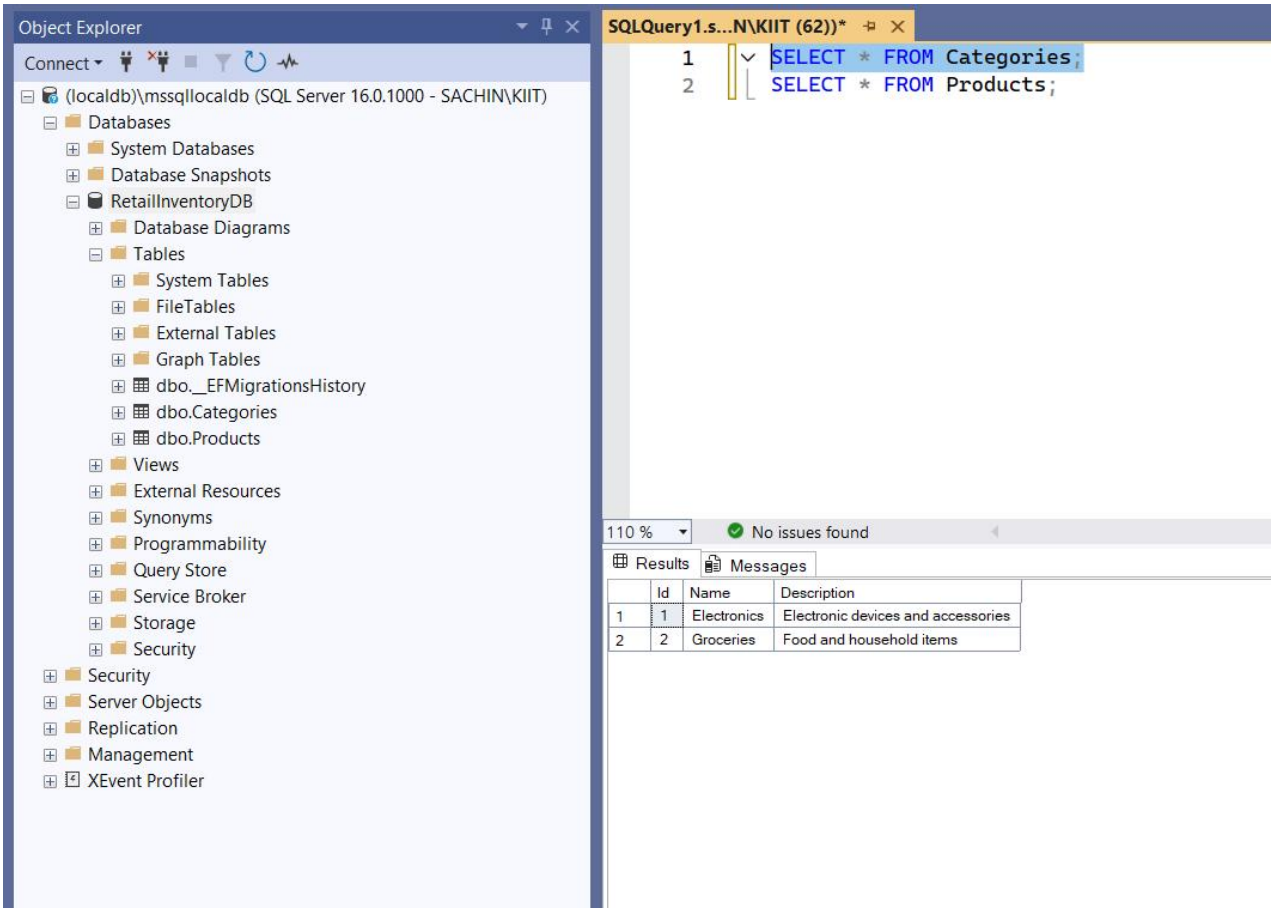
Output:

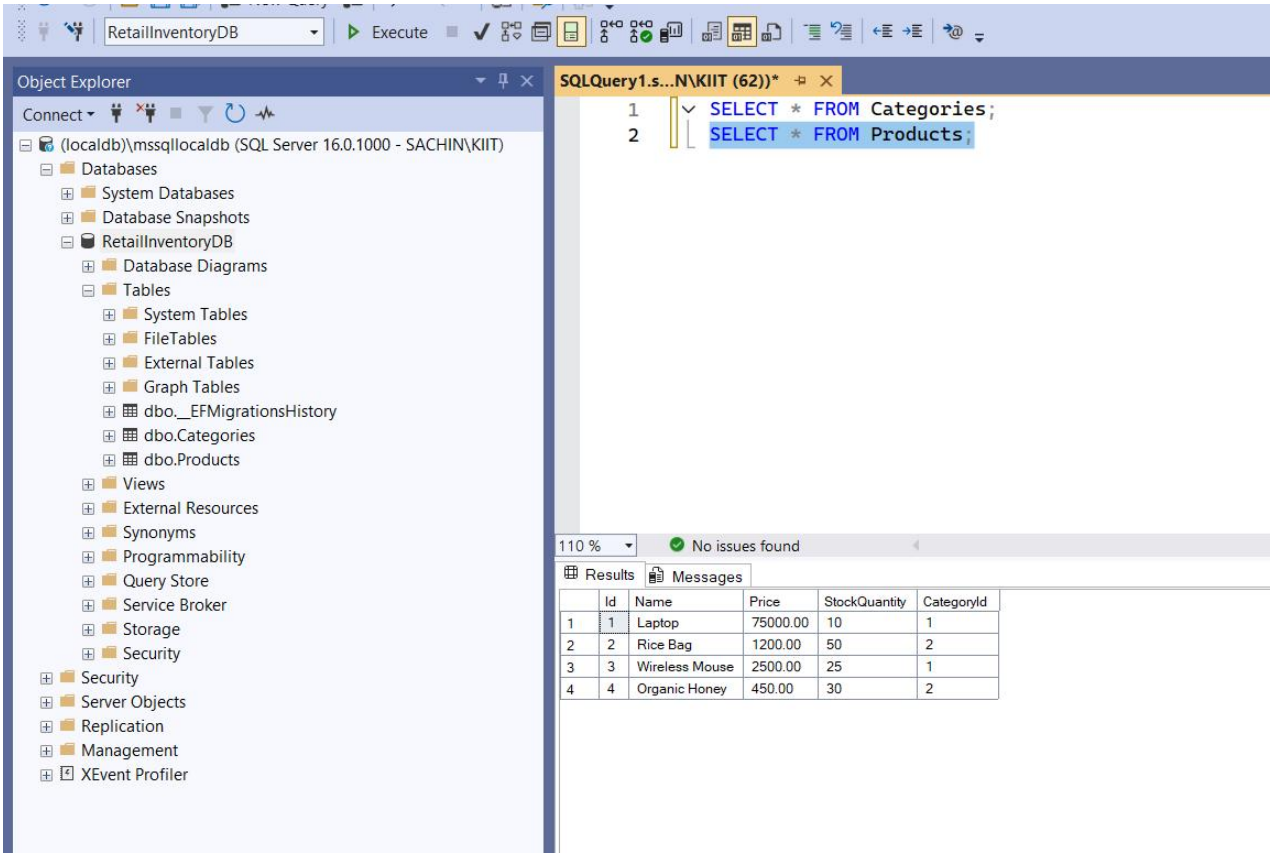
```
PS C:\Users\KIIT\OneDrive\Desktop\EF\RetailInventory> dotnet run
=== Retail Inventory System ===
Lab 4: Inserting Initial Data
Inserting initial data...
Data inserted successfully!

Inserted Categories:
- Electronics (ID: 1)
- Groceries (ID: 2)

Inserted Products:
- Laptop - ₹75000 (ID: 1)
- Rice Bag - ₹1200 (ID: 2)
- Wireless Mouse - ₹2500 (ID: 3)
- Organic Honey - ₹450 (ID: 4)
```

3. **Verify in SQL Server:**

   - Use SQL queries to check the contents of the `Categories` and `Products` tables.

Output:





Lab 5: Retrieving Data from the Database

Objective

Use `Find`, `FirstOrDefault`, and `ToListAsync` to retrieve data.

Steps

1. **Updating Program.cs for data retrieval:**
    - Ensure the database and data exist.
    - Retrieve all products and display them.
    - Find a product by ID.
    - Find expensive products (e.g., price above ₹50,000).
    - Find products by category (e.g., Electronics).
    - Display categories with product counts.

CODE:

```
using Microsoft.EntityFrameworkCore;
using RetailInventory.Data;
using RetailInventory.Models;

namespace RetailInventory
{
    class Program
    {
        static async Task Main(string[] args)
        {
            Console.WriteLine("=== Retail Inventory System ===");
            Console.WriteLine("Lab 5: Retrieving Data from Database\n");

            using var context = new AppDbContext();

            // Ensure database and data exist
            await context.Database.EnsureCreatedAsync();
            await EnsureDataExistsAsync(context);

            // Lab 5 Operations
            await RetrieveAllProductsAsync(context);
            await FindProductByIdAsync(context);
            await FindExpensiveProductAsync(context);
            await FindProductsByCategoryAsync(context);
            await DisplayCategoryWithProductsAsync(context);
        }

        static async Task EnsureDataExistsAsync(AppDbContext context)
        {
            var count = await context.Products.CountAsync();
            if (count == 0)
            {
                Console.WriteLine("No data found. Inserting sample data...");

                var electronics = new Category { Name = "Electronics", Description = "Electronic devices" };
                var groceries = new Category { Name = "Groceries", Description = "Food items" };
```

```
            await context.Categories.AddRangeAsync(electronics, groceries);

            var products = new List<Product>
            {
                new Product { Name = "Laptop", Price = 75000, StockQuantity = 10, Category =
electronics },
                new Product { Name = "Rice Bag", Price = 1200, StockQuantity = 50, Category =
groceries },
                new Product { Name = "Wireless Mouse", Price = 2500, StockQuantity = 25, Category =
electronics },
                new Product { Name = "Organic Honey", Price = 450, StockQuantity = 30, Category =
groceries }
            };

            await context.Products.AddRangeAsync(products);
            await context.SaveChangesAsync();
            Console.WriteLine("Sample data inserted.\n");
        }
    }

    // 1. Retrieve All Products
    static async Task RetrieveAllProductsAsync(AppDbContext context)
    {
        Console.WriteLine("=== 1. RETRIEVE ALL PRODUCTS ===");

        var products = await context.Products
            .Include(p => p.Category)  // Include related category data
            .ToListAsync();

        Console.WriteLine($"Total products found: {products.Count}");
        Console.WriteLine($"{"Name",-15} {"Price",-10} {"Stock",-8} {"Category",-12}");
        Console.WriteLine(new string('-', 50));

        foreach (var p in products)
        {
            Console.WriteLine($"{p.Name,-15} ₹{p.Price,-9} {p.StockQuantity,-8} {p.Category.Name,-12}");
        }
        Console.WriteLine();
```

```
}

// 2. Find Product by ID
static async Task FindProductByIdAsync(AppDbContext context)
{
    Console.WriteLine("=== 2. FIND PRODUCT BY ID ===");

    // Find product with ID 1
    var product = await context.Products
        .Include(p => p.Category)
        .FirstOrDefaultAsync(p => p.Id == 1);

    if (product != null)
    {
        Console.WriteLine($"Product found:");
        Console.WriteLine($"ID: {product.Id}");
        Console.WriteLine($"Name: {product.Name}");
        Console.WriteLine($"Price: ₹{product.Price}");
        Console.WriteLine($"Stock: {product.StockQuantity}");
        Console.WriteLine($"Category: {product.Category.Name}");
    }
    else
    {
        Console.WriteLine("Product not found!");
    }
    Console.WriteLine();
}

// 3. Find Expensive Products
static async Task FindExpensiveProductAsync(AppDbContext context)
{
    Console.WriteLine("=== 3. FIND EXPENSIVE PRODUCTS ===");

    // Find products above ₹50000
    var expensive = await context.Products
        .Include(p => p.Category)
        .FirstOrDefaultAsync(p => p.Price > 50000);
```

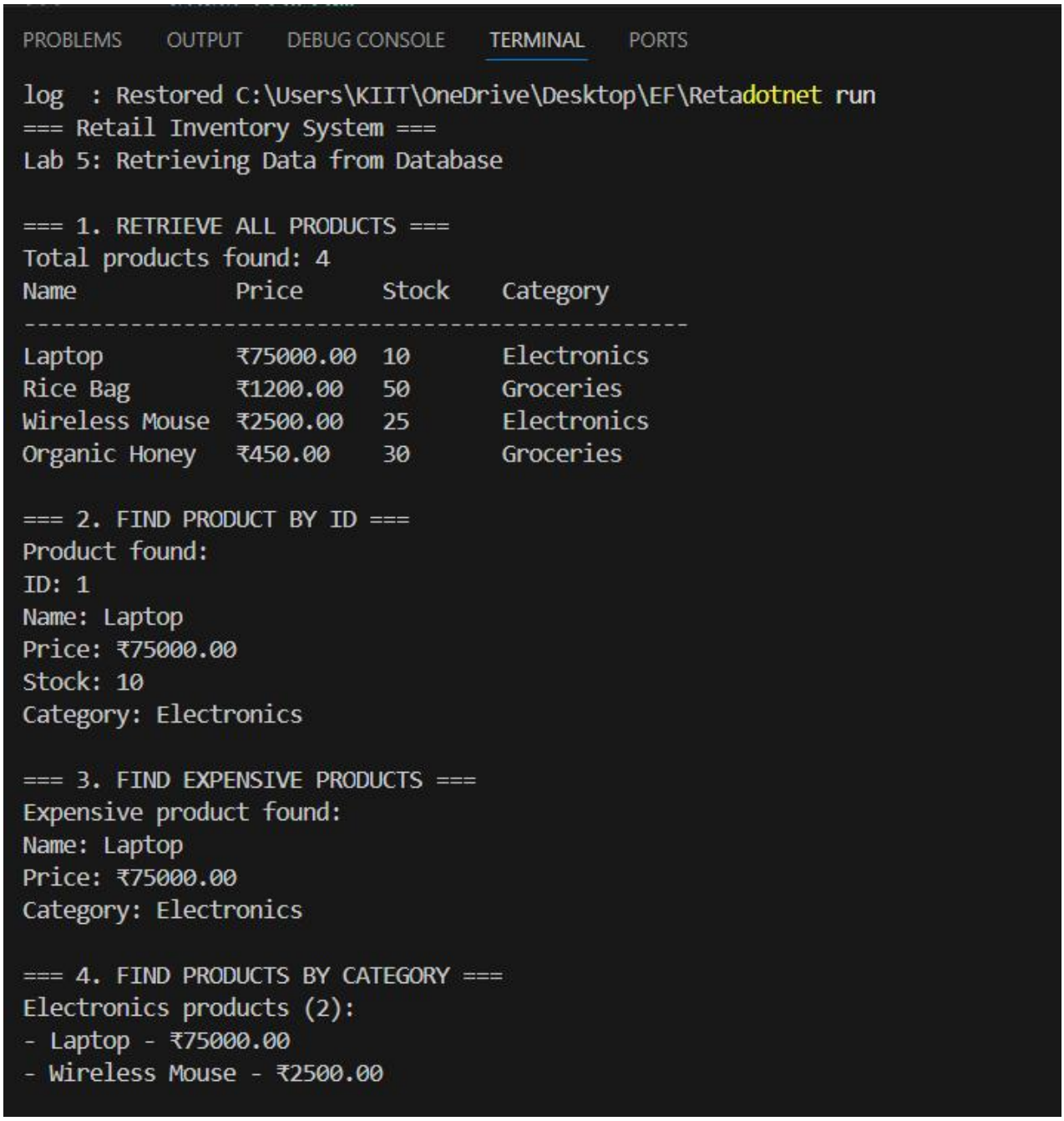
```
        if (expensive != null)
        {
            Console.WriteLine($"Expensive product found:");
            Console.WriteLine($"Name: {expensive.Name}");
            Console.WriteLine($"Price: ₹{expensive.Price}");
            Console.WriteLine($"Category: {expensive.Category.Name}");
        }
        else
        {
            Console.WriteLine("No expensive products found!");
        }
        Console.WriteLine();
    }

    // 4. Find Products by Category
    static async Task FindProductsByCategoryAsync(AppDbContext context)
    {
        Console.WriteLine("=== 4. FIND PRODUCTS BY CATEGORY ===");

        // Find all electronics products
        var electronicsProducts = await context.Products
            .Include(p => p.Category)
            .Where(p => p.Category.Name == "Electronics")
            .ToListAsync();

        Console.WriteLine($"Electronics products ({electronicsProducts.Count}):");
        foreach (var product in electronicsProducts)
        {
            Console.WriteLine($"- {product.Name} - ₹{product.Price}");
        }
        Console.WriteLine();
    }

    // 5. Display Categories with Product Count
    static async Task DisplayCategoryWithProductsAsync(AppDbContext context)
    {
        Console.WriteLine("=== 5. CATEGORIES WITH PRODUCT COUNT ===");
```

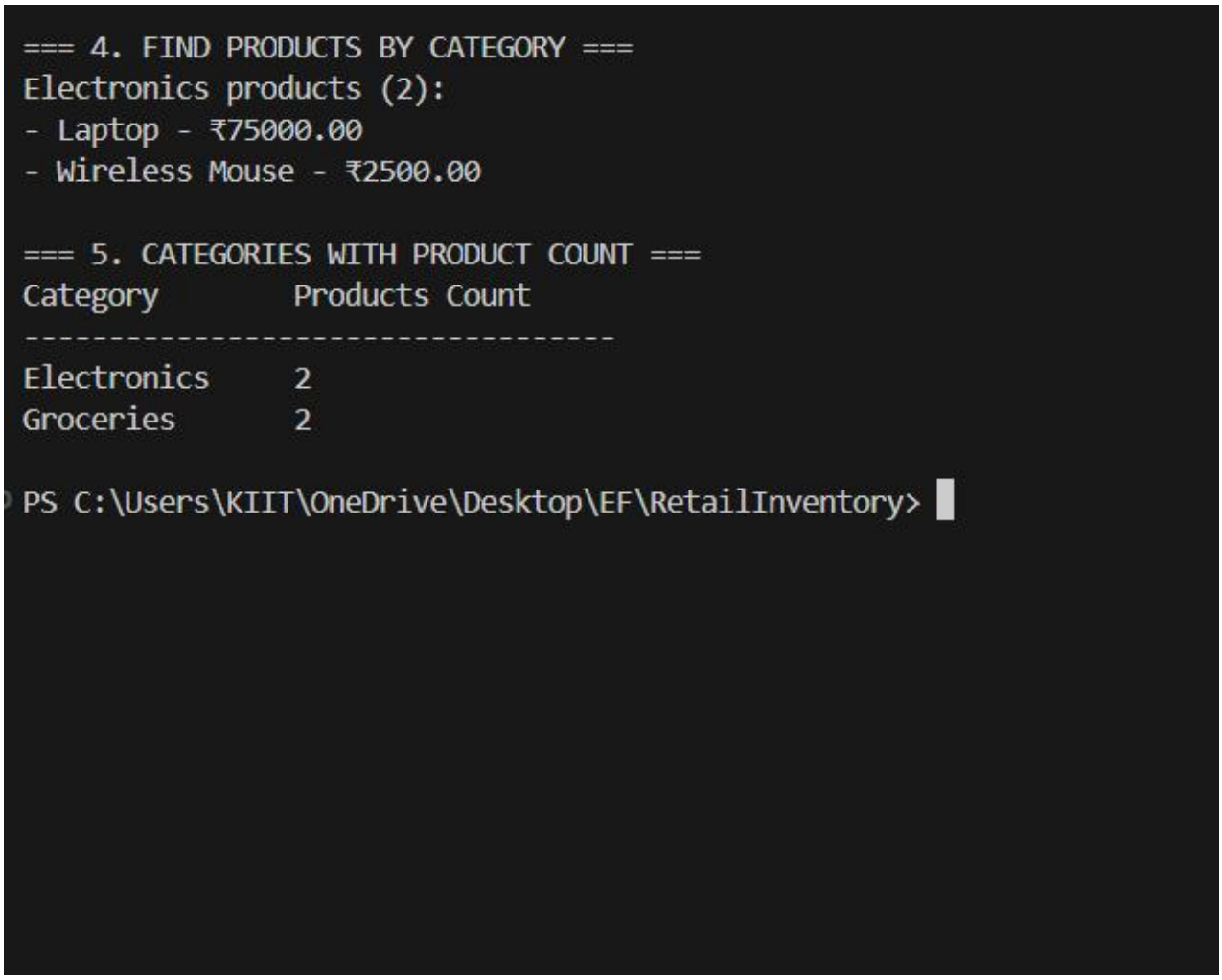
```
            var categories = await context.Categories
                .Include(c => c.Products)
                .ToListAsync();

            Console.WriteLine($"{"Category",-15} {"Products Count",-15}");
            Console.WriteLine(new string('-', 35));

            foreach (var category in categories)
            {
                Console.WriteLine($"{category.Name,-15} {category.Products.Count,-15}");
            }
            Console.WriteLine();
        }
    }
}
```

2. **Run the application:**

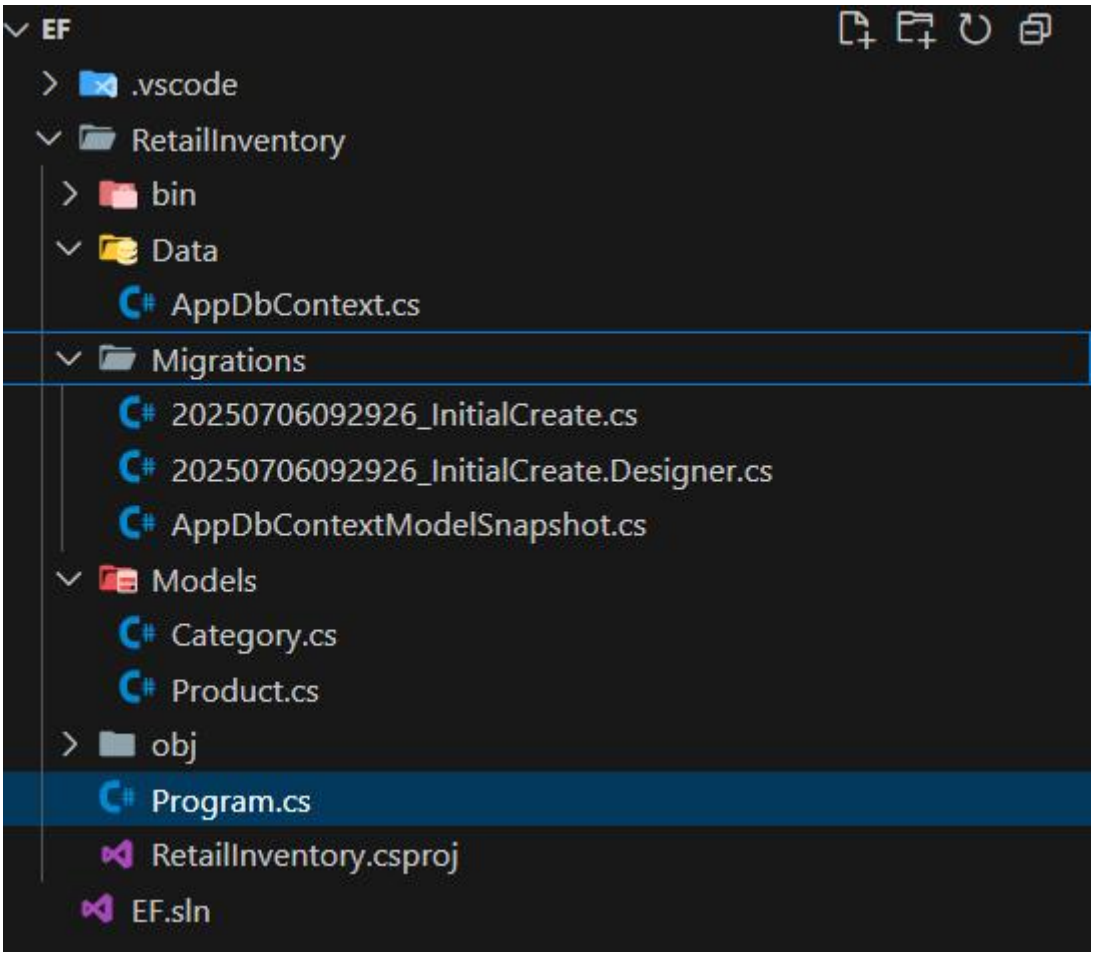
dotnet run

Output:


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
PORTS
log : Restored C:\Users\KIIT\OneDrive\Desktop\EF\Retadotnet run
=== Retail Inventory System ===
Lab 5: Retrieving Data from Database
=== 1. RETRIEVE ALL PRODUCTS ===
Total products found: 4
Name Price Stock Category
Laptop ₹75000.00 10 Electronics
Rice Bag ₹1200.00 50 Groceries
Wireless Mouse ₹2500.00 25 Electronics
Organic Honey ₹450.00 30 Groceries
=== 2. FIND PRODUCT BY ID ===
Product found:
ID: 1
Name: Laptop
Price: ₹75000.00
Stock: 10
Category: Electronics
=== 3. FIND EXPENSIVE PRODUCTS ===
Expensive product found:
Name: Laptop
Price: ₹75000.00
Category: Electronics
=== 4. FIND PRODUCTS BY CATEGORY ===
Electronics products (2):
- Laptop - ₹75000.00
- Wireless Mouse - ₹2500.00


=== 4. FIND PRODUCTS BY CATEGORY ===
Electronics products (2):
- Laptop - ₹75000.00
- Wireless Mouse - ₹2500.00
=== 5. CATEGORIES WITH PRODUCT COUNT ===
Category Products Count
Electronics 2
Groceries 2
PS C:\Users\KIIT\OneDrive\Desktop\EF\RetailInventory>

Complete Project Structure:



Summary of Learning Objectives Achieved

Lab 1: Understanding ORM

- Learned what ORM is and its benefits.
- Understood the differences between EF Core and EF Framework.
- Explored new features in EF Core 8.0.

Lab 2: Database Context Setup

- Created entity models with proper relationships.
- Configured the database context and connection string.
- Set up navigation properties.

Lab 3: Database Migrations

- Used EF Core CLI to create and apply migrations.
- Verified database schema creation.

Lab 4: Data Insertion

- Used `AddAsync` and `AddRangeAsync` methods.
- Implemented `SaveChangesAsync` for persisting data.
- Established relationships between entities.

Lab 5: Data Retrieval

- Used `ToListAsync()` to get all records.
- Used `FindAsync()` and `FirstOrDefaultAsync()` for specific queries.
- Used `Include()` to load related data.