EIU
TRƯỜNG ĐẠI HỌC
QUỐC TẾ
MIỀN ĐÔNG
EASTERN
INTERNATIONAL
UNIVERSITY

Backend Development

Chapter 3: Working with data

EIU

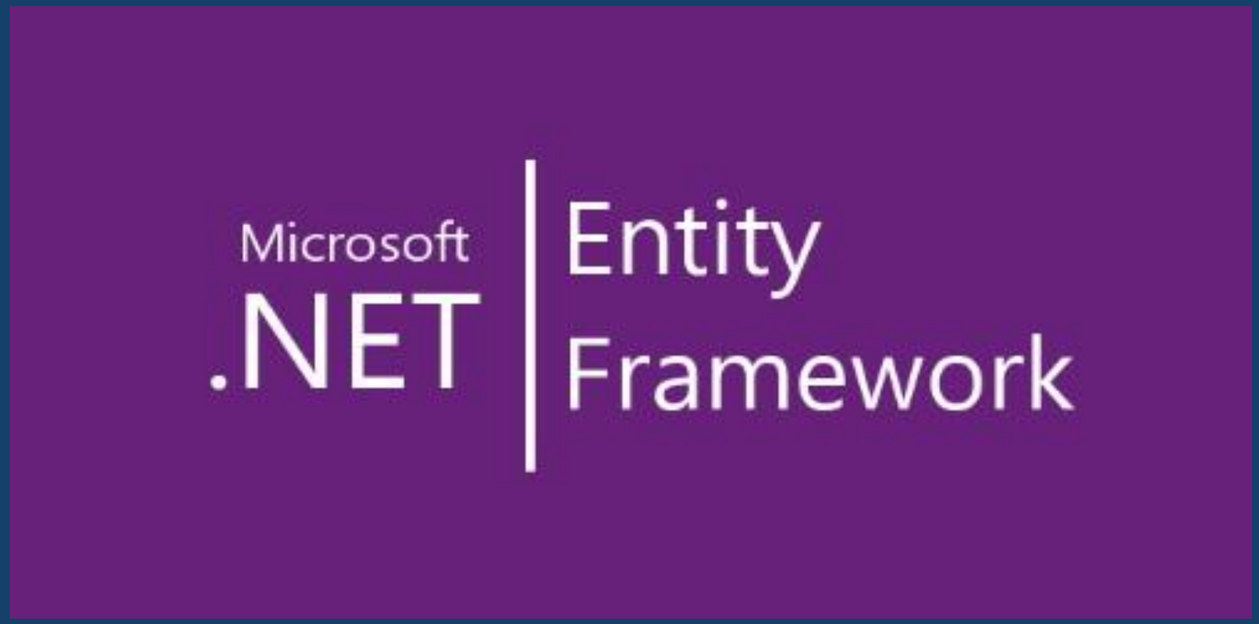
TABLE CONTENT

INTRODUCTION TO ENTITY FRAMEWORK

EIU

INTRODUCTION TO ENTITY FRAMEWORK

Entity Framework (EF) is an Object-Relational Mapper (ORM) for .NET, allowing developers to interact with databases using .NET objects rather than writing raw SQL queries. It simplifies data access by abstracting much of the database layer and translating C# code into SQL commands.



INTRODUCTION TO ENTITY FRAMEWORK

Key Features:

- Database Abstraction: EF allows you to work with data as strongly-typed .NET objects. Instead of interacting with raw database tables and columns, you use entities (classes) and their properties.
- Code-First Approach: In EF, you can define your database structure through C# classes (entities), and EF will generate the corresponding database schema.
- Database-First Approach: EF also supports generating C# classes from an existing database, making it easier to map database tables to entities.
- Querying Data: With LINQ (Language Integrated Query), you can write queries in C# that EF will translate into SQL and execute on the database.
- Change Tracking: EF keeps track of changes made to the objects and automatically generates the appropriate SQL commands to update the database.
- Migrations: EF provides a way to manage database schema changes over time. With migrations, you can evolve the database schema while preserving the existing data.

INTRODUCTION TO ENTITY FRAMEWORK

Entity Framework Versions

- EF 6.x: The classic, stable version of Entity Framework.
- EF Core: A lightweight, cross-platform version, offering better performance and additional features.

Example:

```
public class Student
{
    public int StudentId { get; set; }
    public string Name { get; set; }
    public int Age { get; set; }
}

public class SchoolContext : DbContext
{
    public DbSet<Student> Students { get; set; }
}
```

- Student is an entity class representing a table in the database.
- SchoolContext inherits from DbContext, which is the class responsible for interacting with the database.

You can then query the database as:

```
using (var context = new SchoolContext())
{
    var students = context.Students.ToList();
}
```

INTRODUCTION TO ENTITY FRAMEWORK

EF Workflows

- Code First: Define your models in code and generate the database schema from those models.
- Database First: Start with an existing database and generate models from it.
- Model First: Use a visual designer to design your models, which will generate both the database schema and the classes.

EF helps to minimize the impedance mismatch between the object-oriented world and relational databases, making it easier to manage data persistence and manipulation in your .NET application

CRUD OPERATIONS

CRUD OPERATIONS

Implement CRUD Functionality - ASP.NET with EF Core

CRUD Operations: Basic operations to Create, Read, Update, and Delete data from a database.
Goals: Learn how to implement these operations in an ASP.NET application using EF Core.

Prerequisites:

- Create an ASP.NET Core Project
- Set Up the Database Context (The previous chapter was completed in the model)
- Create the Model

CRUD OPERATIONS

1. What is CRUD?

- **C**reate → Add new data
- **R**ead → Retrieve data
- **U**pdate → Modify existing data
- **D**elete → Remove data

2. Tools Used:

- **.NET 8 SDK**
- **ASP.NET Core Web API**
- **Entity Framework Core (EF Core)**
- **SQL Server DB**

EIU

CRUD OPERATIONS

OPERATION	HTTP METHOD	ENDPOINT
Create	POST	/api/books
Read All	GET	/api/books
Read One	GET	/api/books/{id}
Update	PUT	/api/books/{id}
Delete	DELETE	/api/books/{id}

CRUD OPERATIONS

READ – GetAll()

```
[ApiController]
[Route("api/[controller]")]
public class BooksController : ControllerBase
{
    private readonly AppDbContext _context;

    public BooksController(AppDbContext context)
    {
        _context = context;
    }

    [HttpGet]
    public async Task<ActionResult<IEnumerable<Book>>> GetAll()
    {
        return await _context.Books.ToListAsync();
    }
```

CRUD OPERATIONS

READ – Get By Id

```
[HttpGet("{id}")]
public async Task<ActionResult<Book>> Get(int id)
{
    var book = await _context.Books.FindAsync(id);
    return book == null ? NotFound() : Ok(book);
}
```

EIU

CRUD OPERATIONS

CREAT

```
[HttpPost]
public async Task<ActionResult<Book>> Create(Book book)
{
    _context.Books.Add(book);
    await _context.SaveChangesAsync();
    return CreatedAtAction(nameof(Get), new { id = book.Id }, book);
}
```

EIU

CRUD OPERATIONS

UPDATE

```
[HttpPut("{id}")]
public async Task<IActionResult> Update(int id, Book book)
{
    if (id != book.Id) return BadRequest();
    _context.Entry(book).State = EntityState.Modified;
    await _context.SaveChangesAsync();
    return NoContent();
}
```

EIU

CRUD OPERATIONS

DELETE

```
[HttpDelete("{id}")]
public async Task<IActionResult> Delete(int id)
{
    var book = await _context.Books.FindAsync(id);
    if (book == null) return NotFound();
    _context.Books.Remove(book);
    await _context.SaveChangesAsync();
    return NoContent();
}
```

Controller Edit Action :

CRUD OPERATIONS

Recap:

- Implemented CRUD operations in an ASP.NET Core app using Entity Framework Core.
- Razor Views used to render forms and data for each operation (Create, Read, Update, Delete).
- Scaffolded the controller and views to quickly set up a functional web interface.

MIGRATIONS

MIGRATIONS

What are Migrations?

Migrations: A feature in Entity Framework Core (EF Core) to manage changes to the data model.

Purpose:

- Keeps the database schema in sync with the application's data model.
- Facilitates incremental updates without losing existing data.

Use Cases:

- Adding, modifying, or removing columns or tables.
- Changing relationships between entities.

EIU

MIGRATIONS

Why Use Migrations?

- **Maintain Data Integrity**: Allows you to update the schema while preserving existing data.
- **Version Control**: Each migration acts as a version of the database schema, enabling easy tracking of changes.
- **Automation**: Simplifies database updates during development and deployment.

MIGRATIONS

Key Components of Migrations

1.Migration Class:

- Contains Up and Down methods.
- Up: Defines the operations to apply changes.
- Down: Defines the operations to revert changes.

2.Model Snapshot:

- A snapshot file representing the current state of the data model.
- Helps track what has changed since the last migration.

MIGRATIONS

Creating a Migration

- **Command to Create a Migration**:

```
dotnet ef migrations add MigrationName
```

- **Example**:
  - If you add a new column to an existing table, create a migration to apply that change.
- **Generated Files**:
  - A new migration file in the Migrations folder with the specified name.

MIGRATIONS

Applying Migrations

- **Command to Apply Migrations**:

```
dotnet ef database update
```

- **Outcome**:
  - Updates the database schema to match the current model.
  - Creates a special table (__EFMigrationsHistory) to track which migrations have been applied.

MIGRATIONS

Rolling Back Migrations

- **Command to Remove the Last Migration**:

```
dotnet ef migrations remove
```

- **Use Case**:
  - If a migration introduces errors, you can roll it back to restore the previous state.

MIGRATIONS

Conclusion

- **Summary**:
  - Migrations are essential for managing database schema changes in ASP.NET Core applications.
  - They enable developers to evolve their data models while preserving existing data and maintaining application stability.
- **Next Steps**:
  - Explore advanced migration scenarios such as seeding data and handling complex changes.

COMPLEX MODELS

COMPLEX MODELS

Overview

- Expand on a simple data model with additional entities and relationships.
- Customize the data model with formatting, validation, and database mapping rules.

COMPLEX MODELS

Customizing the Book Model

Goal:

• Customize the **Book** model by specifying **formatting**, **validation**, and **database mapping** rules using attributes.

DataType and DisplayFormat for Date Fields

Purpose:

• Customize how date fields, like **PublicationDate**, are displayed (date only, no time).

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

public class Book
{
    public int ID { get; set; }
    public string Title { get; set; }

    [DataType(DataType.Date)]
    [DisplayFormat(DataFormatString = "{0:yyyy-MM-dd}", ApplyFormatInEditMode = true)]
    public DateTime PublicationDate { get; set; }

    public string Author { get; set; }
}
```

COMPLEX MODELS

StringLength and Validation

Purpose:

Validate string input, like Title and Author, to ensure they aren’t too long.

```
using System.ComponentModel.DataAnnotations;

public class Book
{
    public int ID { get; set; }

    [StringLength(100, ErrorMessage = "Title can't be longer than 100 characters.")]
    public string Title { get; set; }

    [StringLength(50, ErrorMessage = "Author name can't be longer than 50 characters.")]
    public string Author { get; set; }
}
```

COMPLEX MODELS

Regular Expression for Validation

Purpose:

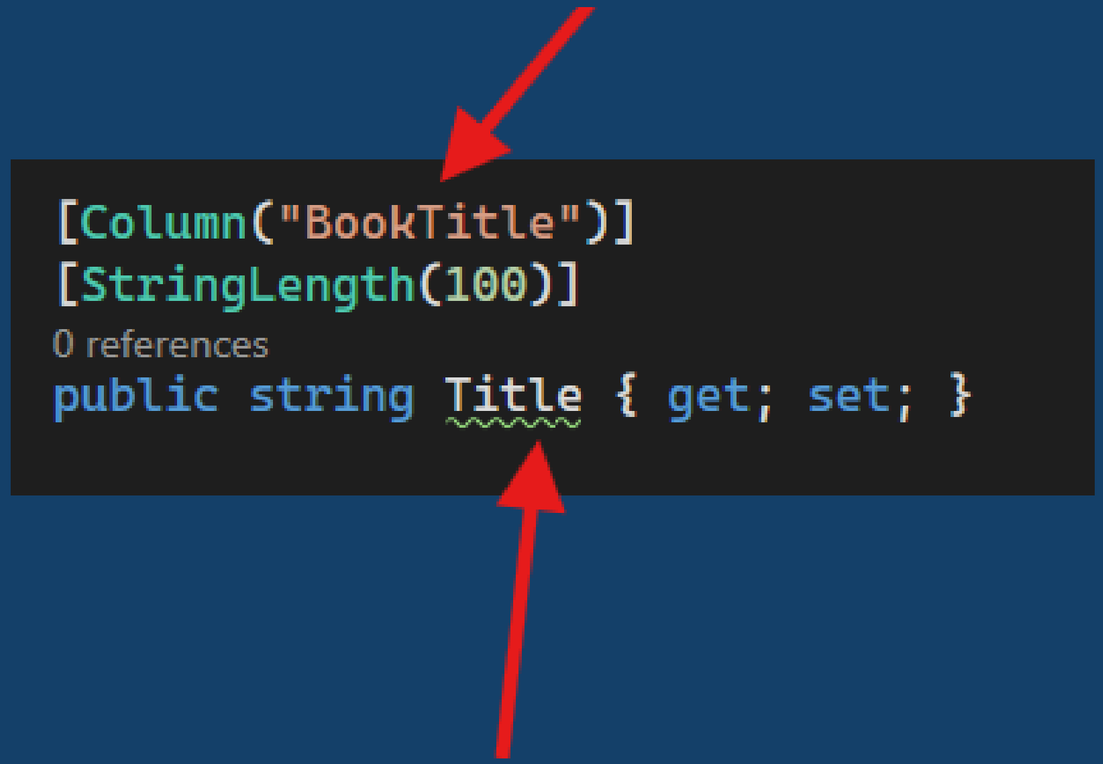
Enforce patterns for certain fields, such as ensuring Author names start with an uppercase letter.

COMPLEX MODELS

Column Attribute for Database Mapping

Purpose:

• Map properties in the **Book** class to custom column names in the database. For instance, mapping **Title** to BookTitle.



COMPLEX MODELS

The Required Attribute

Purpose:

• Ensure that important fields, like Title and Author, are not left blank.

The Display Attribute

Purpose:

• Customize the label text that is shown on forms and views for properties like Title, Author.

```
[RegularExpression(@"^[A-Z]+[a-zA-Z\s]*$", ErrorMessage = "Author name must start with a capital letter.")]
[Required(ErrorMessage = "Please enter an author name.")]
[Display(Name = "Author Name")]
[StringLength(50)]
5 references
public string Author { get; set; }
```

COMPLEX MODELS

The Key Attribute

Purpose:

•The Key attribute is used to explicitly define a primary key in an entity when it's not following the convention (e.g., when the property name is not Id or ClassNameId).

The Key Attribute in the Book Model

Scenario:

- Suppose the Book model uses a non-standard field, like BookCode, as the primary key instead of the conventional ID or BookId.
- Key Attribute: Marks BookCode as the primary key.
- This is useful when your primary key field has a non-standard name.
- By default, ASP.NET assumes properties named Id or BookId to be the primary key without the need for the Key attribute.
- Use the Key attribute when your primary key does not follow this convention (e.g., using BookCode instead of ID).

```
[Key]
0 references
public string BookCode { get; set; }
```

COMPLEX MODELS

The DatabaseGenerated attribute

The DatabaseGeneraated attribute with the None parameter on the Id property specifies that primary key values are provided by the user rather than generated by the database.

```
[Key]
[DatabaseGenerated(DatabaseGeneratedOption.None)]
9 references
public int Id { get; set; }
```

COMPLEX MODELS

Foreign Key & Navigation Properties in Book Entity

Goal:

- Understand how to define foreign key and navigation properties to establish relationships between entities, using Book as the primary example.

Foreign Key Property - Author

One-to-Many Relationship:

- A Book is written by one author, so we define a foreign key and a navigation property for the Author.

- **AuthorID** is the foreign key.
- **Author** is the navigation property that enables navigation to the related **Author** entity.

```
12 references
public class Book
{
    [Key]
    [DatabaseGenerated(DatabaseGeneratedOption.None)]
    9 references
    public int Id { get; set; }


    // Foreign Key
    0 references
    public int AuthorID { get; set; }

    // Navigation Property
    5 references
    public Author Author { get; set; }
```

COMPLEX MODELS

Foreign Key Property - Category

Many-to-One Relationship:

- A **Book** belongs to **one** category, but a **Category** can have **many** books.
- The CategoryID property is the foreign key.
- The Category property defines a one-to-many relationship between Category and Book.

```
12 references
public class Book
{
    [Key]
    [DatabaseGenerated(DatabaseGeneratedOption.None)]
    9 references
    public int Id { get; set; }


    // Foreign Key for Category
    0 references
    public int CategoryID { get; set; }

    // Navigation Property for Category
    0 references
    public Category Category { get; set; }
```

COMPLEX MODELS

Foreign Key Property – Category

One-to-Many Relationship:

- A **Book** can be borrowed multiple times, so the navigation property for **Borrowings** is a collection.
- Borrowings is a collection that represents all instances when this book was borrowed.
- This defines a one-to-many relationship between Book and Borrowing.

```
12 references
public class Book
{
    [Key]
    9 references
    public int Id { get; set; }

    // Navigation Property for Borrowings
    0 references
    public ICollection<Borrowing> Borrowings { get; set; }
```

COMPLEX MODELS

Foreign Key Property – Category

Many-to-Many Relationship

- A Book can belong to multiple Genres, and a Genre can have many Books.
- BookGenres defines a many-to-many relationship between Book and Genre, where BookGenre is a join entity.

```
12 references
public class Book
{
    [Key]
    9 references
    public int Id { get; set; }

    // Many-to-Many Relationship with Genres
    0 references
    public ICollection<BookGenre> BookGenres { get; set; }
```

COMPLEX MODELS

Column Attribute in ASP.NET Core

Learn how to use the **Column attribute** to customize the SQL data type mapping for properties in an entity.

Column Attribute for Custom SQL Data Types

Changing Data Type Mapping:

- The **Column attribute** can change how a property in the entity maps to a SQL Server data type.
- Example: Mapping a decimal property to the **money** type in SQL Server for a **Book** price.
- Column mapping is generally not required, because the Entity Framework chooses the appropriate SQL Server data type based on the CLR type that you define for the property

Why Use It?

- Normally, the Entity Framework automatically maps .NET data types to the appropriate SQL Server types.
- However, in some cases, like currency, you may prefer to explicitly map a property to a specific SQL data type (e.g., **money** instead of **decimal**).

COMPLEX MODELS

Example - Mapping Book Price to SQL money Type

- Let’s assume you have a **Book** entity that includes a **Price** property. You want to store **Price** using SQL Server's **money** data type.

```
12 references
public class Book
{
    [Key]
    9 references
    public int Id { get; set; }


    // Use Column attribute to map Price to SQL Server 'money' type
    [Column(TypeName = "money")]
    0 references
    public decimal Price { get; set; }
```

COMPLEX MODELS

Applying Migrations

Purpose:

- Update the database to match the changes in the **Book** model.
- **Run these commands** to apply the changes such as StringLength, RegularExpression, and Column.

```bash
dotnet ef migrations add CustomizeBookModel
dotnet ef database update
```

**(Optional) Run this command to switch to the database if you are using code-first approach; otherwise, skip this command.*

INHERITANCE

INHERITANCE

Implementing Inheritance in ASP.NET Core with EF Core

- Learn how to model inheritance in the database using Entity Framework Core with ASP.NET Core.

Why Use Inheritance?

- Inheritance helps organize related entities more efficiently by sharing common properties across different classes.
- Example: In a bookstore, both **EBook** and **PrintBook** can share properties like Title and Author, but have distinct attributes (e.g., **file size** for **EBook** and **weight** for **PrintBook**).

Key Inheritance Patterns:

- **Table-per-Hierarchy (TPH)**: One table is used for all entities in the hierarchy, with a discriminator column to differentiate types.
- **Table-per-Type (TPT)**: Each entity type has its own table, with relationships between the tables.

INHERITANCE

Table-per-Hierarchy (TPH) Inheritance Pattern

What is TPH?

- **TPH** stores all types in a single database table. It adds a **discriminator column** to specify the type of entity.

Example:

You have a base class **Book** with two derived types **EBook** and **PrintBook**.

Configuration in EF Core:

modelBuilder.Entity<EBook>().HasBaseType<Book>();

modelBuilder.Entity<PrintBook>().HasBaseType<Book>();

This creates a single table **Books** in the database, with an additional discriminator column to distinguish between **EBook** and **PrintBook**.

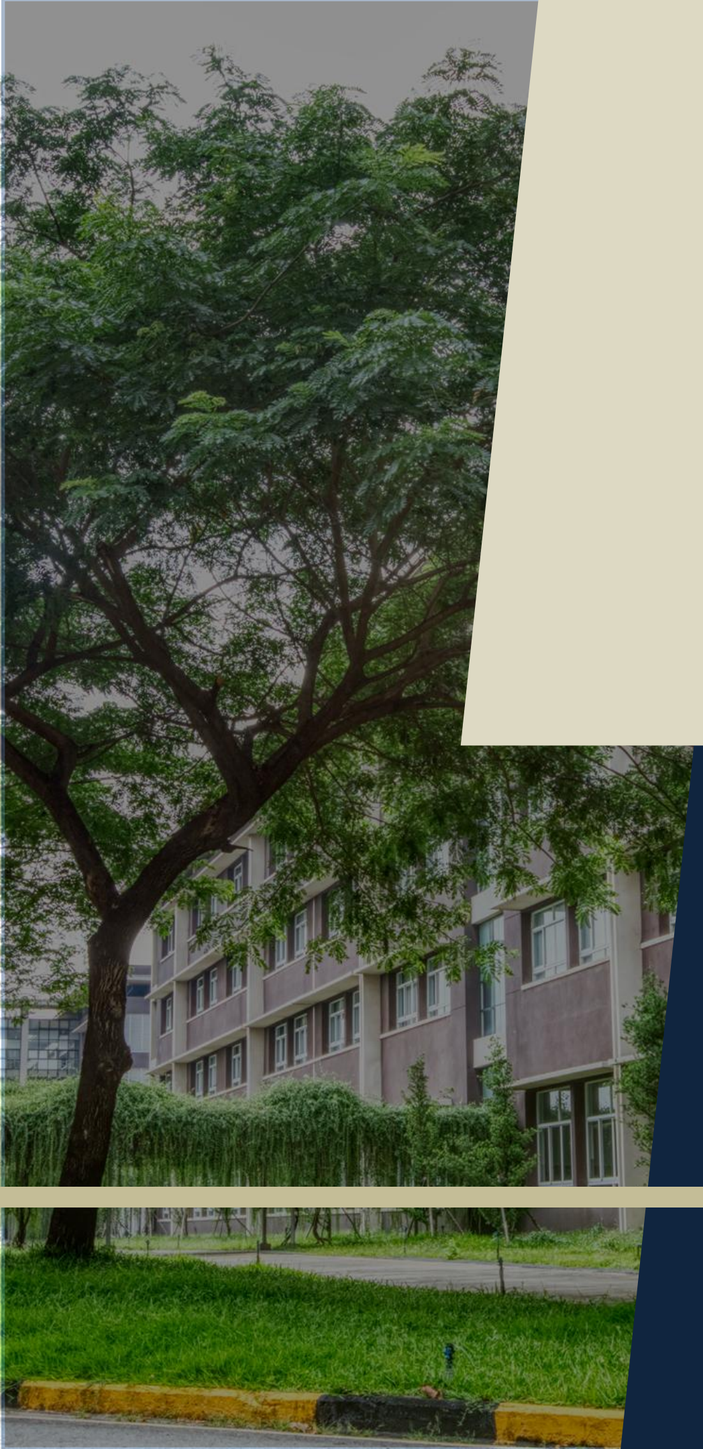
```
0 references
public class EBook : Book
{
    0 references
    public double FileSizeMB { get; set; }
}

0 references
public class PrintBook : Book
{
    0 references
    public double WeightKg { get; set; }
}
```

INHERITANCE

TPH Database Table Example

In TPH, the table will look like this:

BookID	Title	Author	FileSizeMB	WeightKg	Discriminator
1	Digital Book	John Smith	5.2	NULL	EBook
2	Paper Book	Jane Doe	NULL	0.75	PrintBook



EIU
TRƯỜNG ĐẠI HỌC
QUỐC TẾ
MIỀN ĐÔNG
EASTERN
INTERNATIONAL
UNIVERSITY

Start your future at EIU

Thank You