Project Architecture

Web Applications Designs and Architectures, Repository Pattern, Automapper, Databases and ORM

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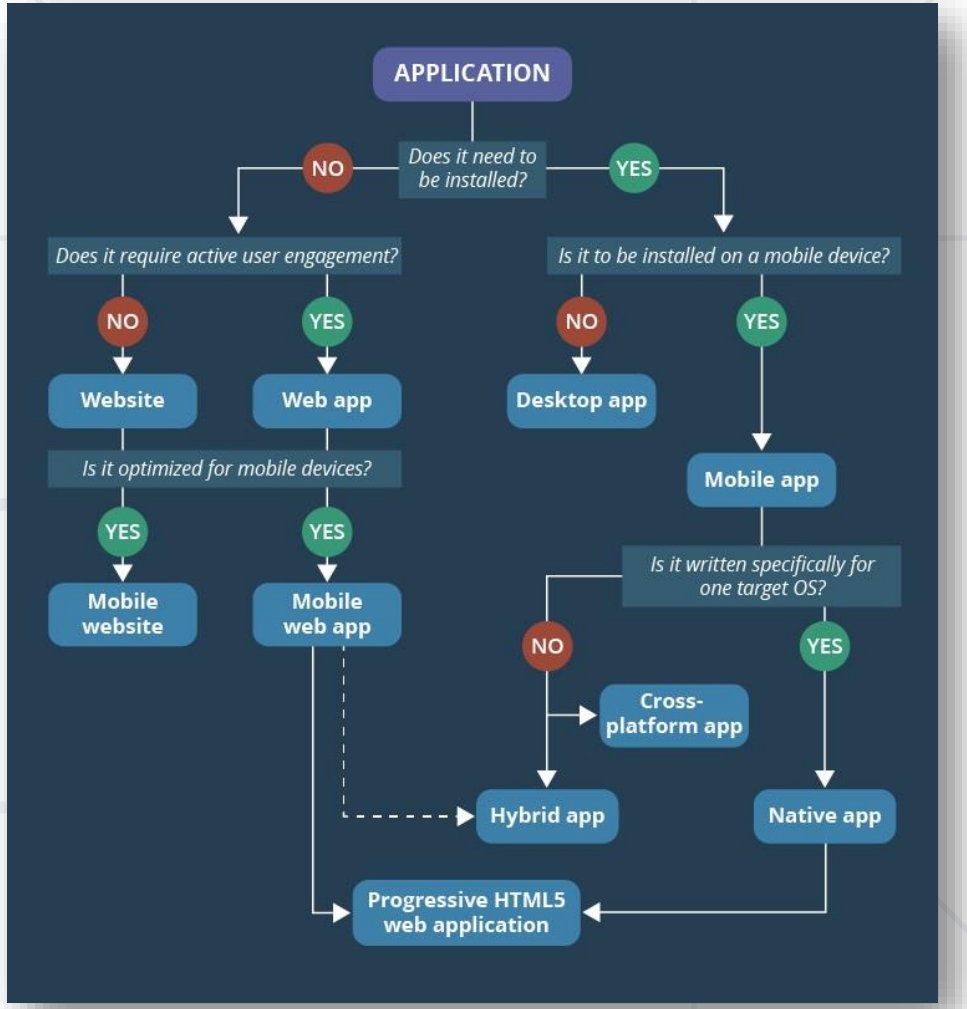
Web Application Designs

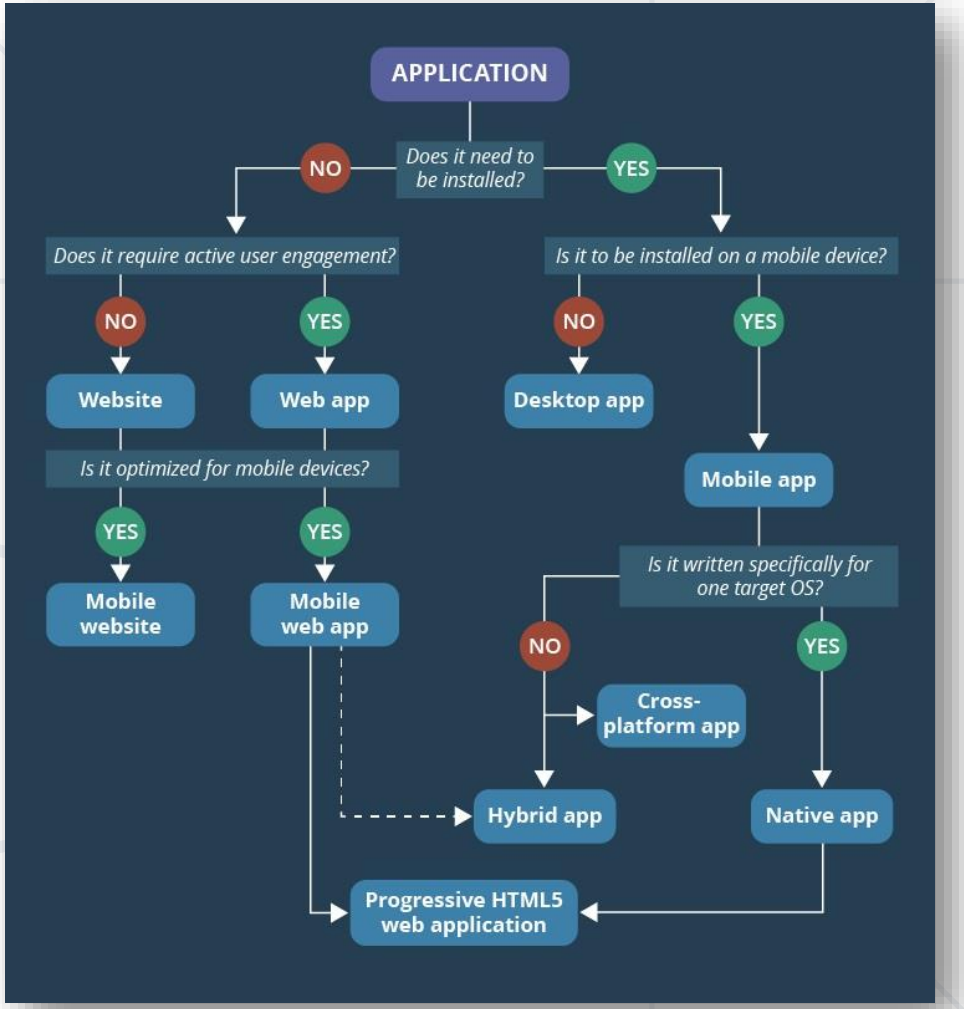
Web vs Desktop vs Mobile vs IoT

- **Desktop Application**
  - PRO: Can work offline, Has access to system resources
  - CON: Needs to be installed (updated) on each computer
- **Mobile Application**
  - PRO: App stores, Offline, Access to system resources
  - CON: Different platforms, Each update requires approval



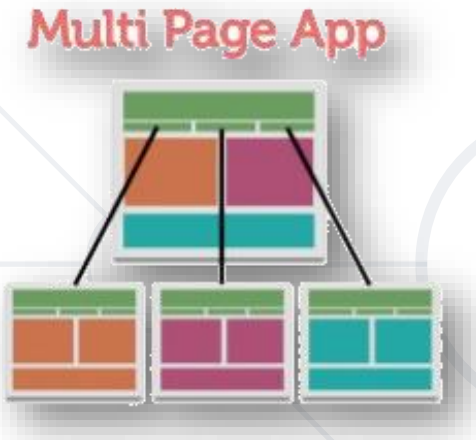
Web vs Desktop vs Mobile vs IoT

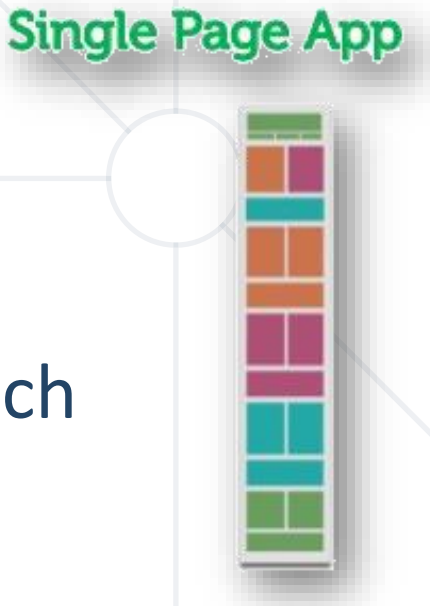
- **Web Application**
  - PRO: No need to be downloaded, installed or updated
  - CON: Require Internet, Limited system access
- **Internet-of-Things Application**
  - Smart home, wearables, cars, farming, cities, etc.
  - They require web access to send their data



Web Application Designs

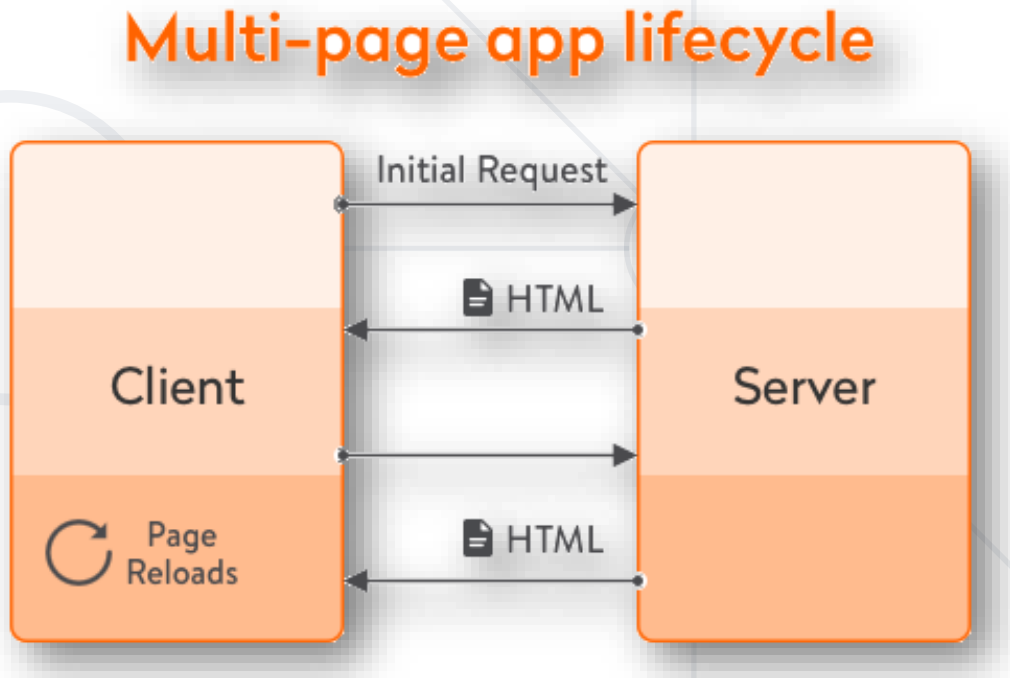
- **Web applications** are easy to install, use, update and are not bound to one device
  - In most cases, they are the preferable over desktop apps
- There are 2 participants in the web applications – **client** and **server**
- There are two main designs for web apps:
  - **Multi-Page application** (MPA) – the "traditional" approach
  - **Single-Page application** (SPA) – the "modern" approach





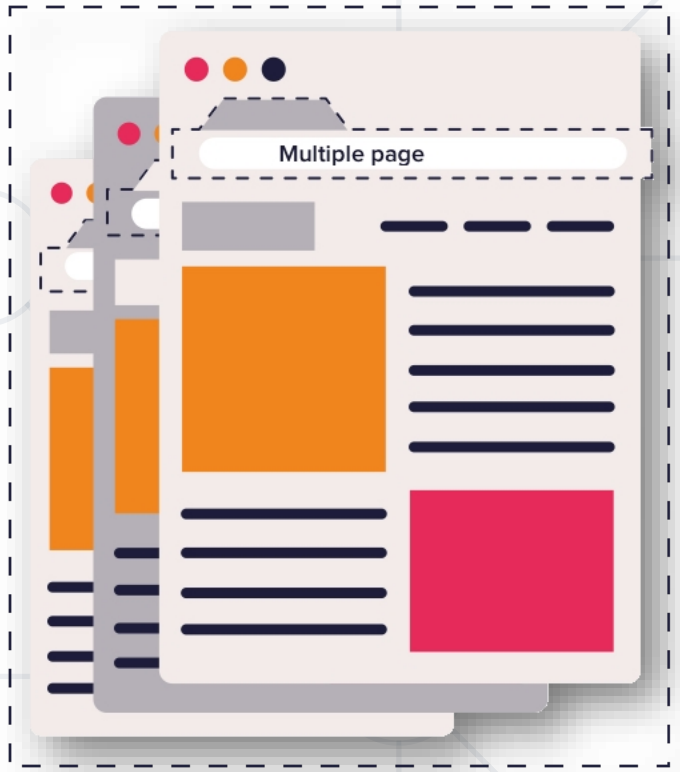
Multi-Page Applications

- **Multi-Page applications** work in a "**traditional**" way
  - Every change requests **rendering of a new page** in the browser
- Perform most of the application logic on the server
  - HTML is rendered on the server and returned as HTTP Response
    - AJAX and JavaScript may be used to add UI logic on the client
  - **ASP.NET Core MVC** and **Razor Pages** implement this approach



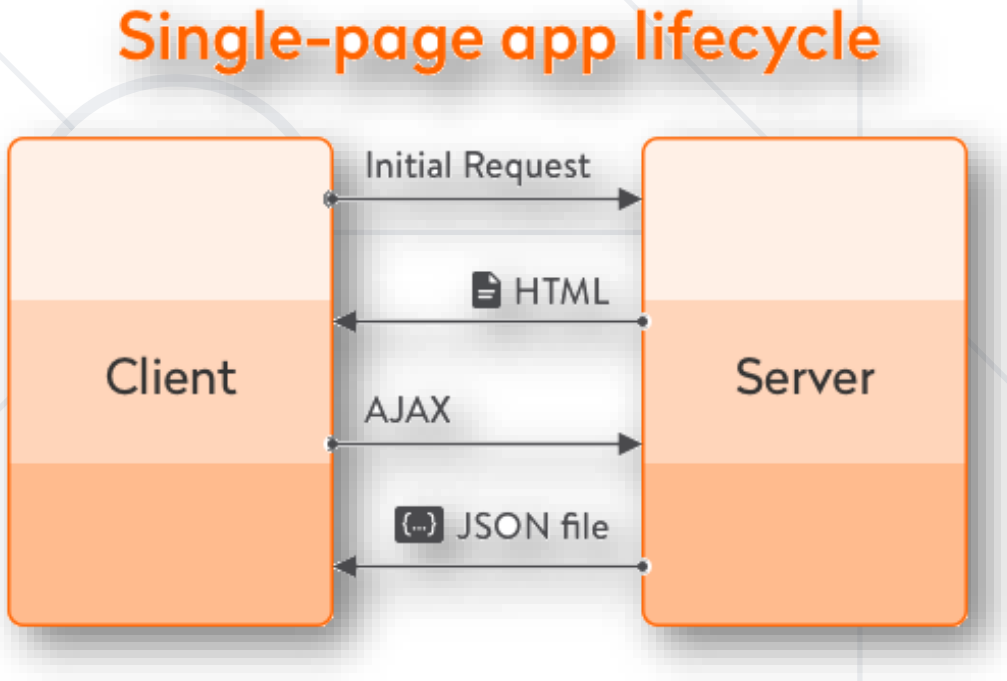
Multi-Page Applications

- **PRO**s of Multi-Page applications
  - Useful for every type of projects
  - Very good and easy for proper **SEO management**
  - Using consistent languages, tools and technologies
- **CON**s of Multi-Page applications
  - Front-end and back-end are tightly coupled
  - The development and maintenance is quite complex
  - Requires page (state) **reload** on user action (link, form submit)



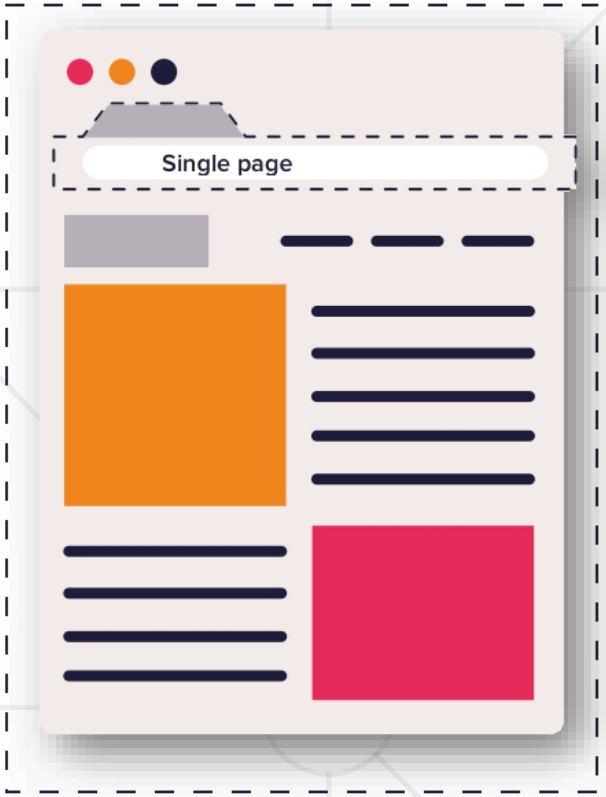
Single-Page Applications

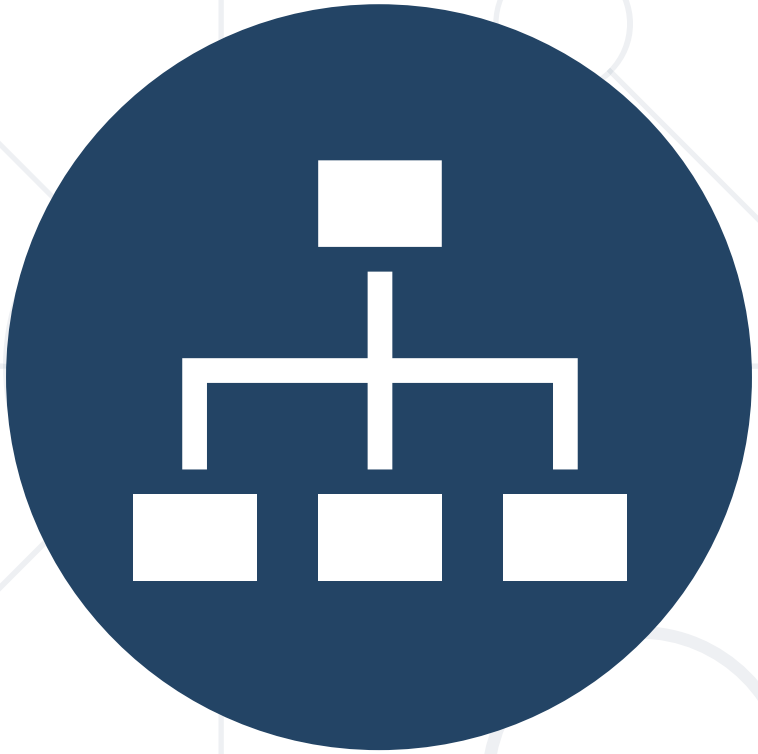
- **Single-Page applications** perform most of the **UI** in the browser
  - Does not require page reload during use
  - The **whole app is in one page** – content is changed dynamically
  - Examples: Gmail, Facebook, Instagram etc.
- **SPA** requests logic (JS, templates) and data independently
  - Back-end: ASP.NET Core Web API returning JSON data
  - Frond-end: Angular, React, Vue.js, Blazor, etc.



Single-Page Applications

- **PRO**s of Single-Page applications
  - Animated, east-to-navigate and more user-friendly
  - SPAs are **fast**, most resources are loaded only once
  - Easy to make a corresponding **mobile application**
    - Reusing the same Back-End
- **CON**s of Single-Page applications
  - Quite tricky, and not easy to make SEO of the app
  - Slow to download, because of **heavy front-end frameworks**
  - Compared to "traditional" apps, SPAs are **less secure**
  - In most cases, require the use of **2 completely different technologies**

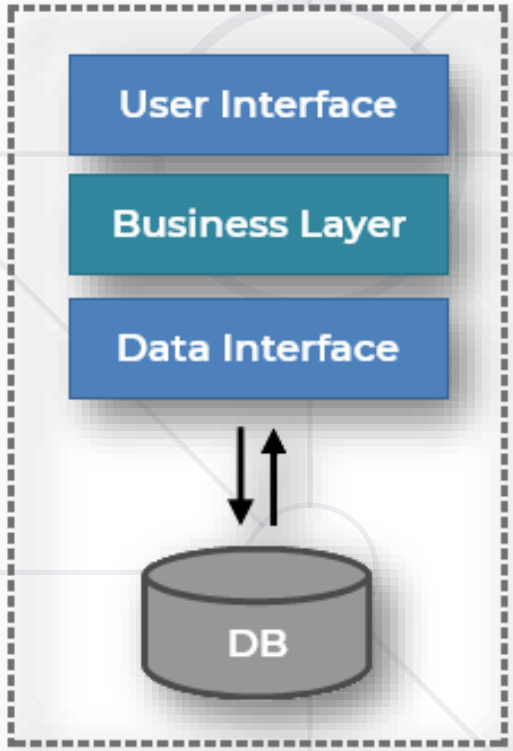




Web Application Architectures

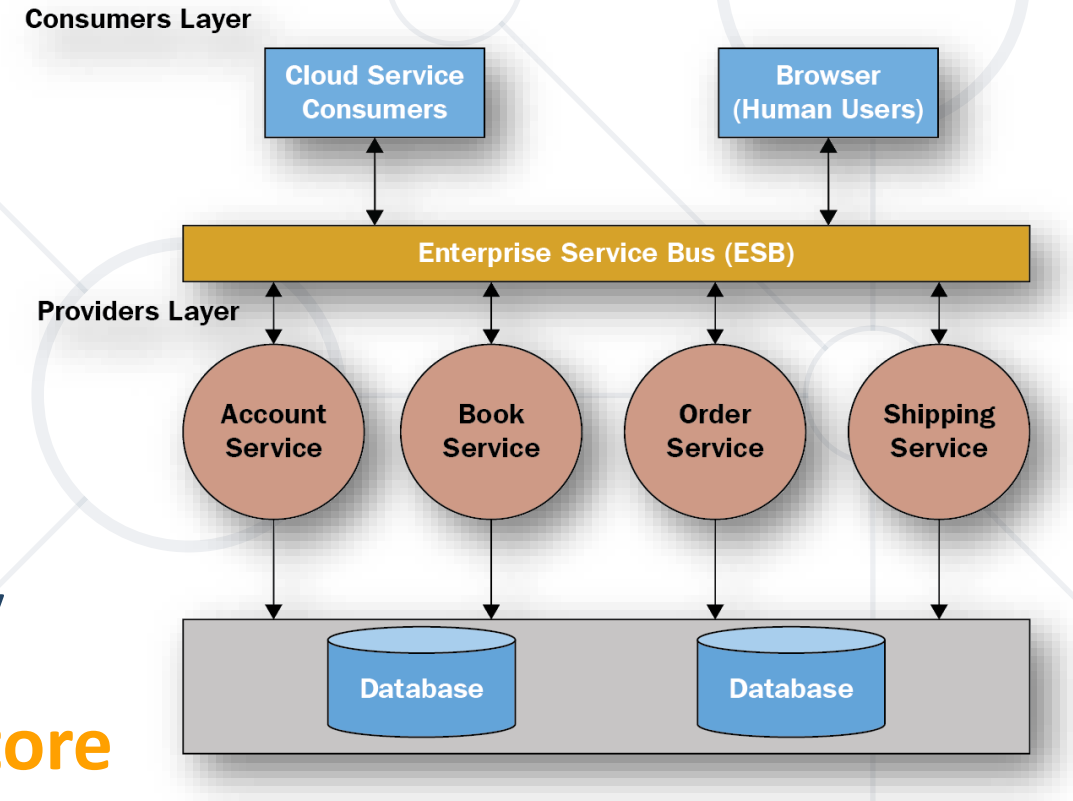
Monolithic Applications

- **Monolithic applications** are single-tiered applications
  - User interface and data access code are combined
  - The simplest form of architecture
- Deployment and maintenance is quite easy
  - Achieved due to lack of modularity and complexity
- **Monolithic apps** are recommended for small and mid-sized projects
  - Where the scope of functionality does not require abstractions
  - In most cases, monolith apps are not desired



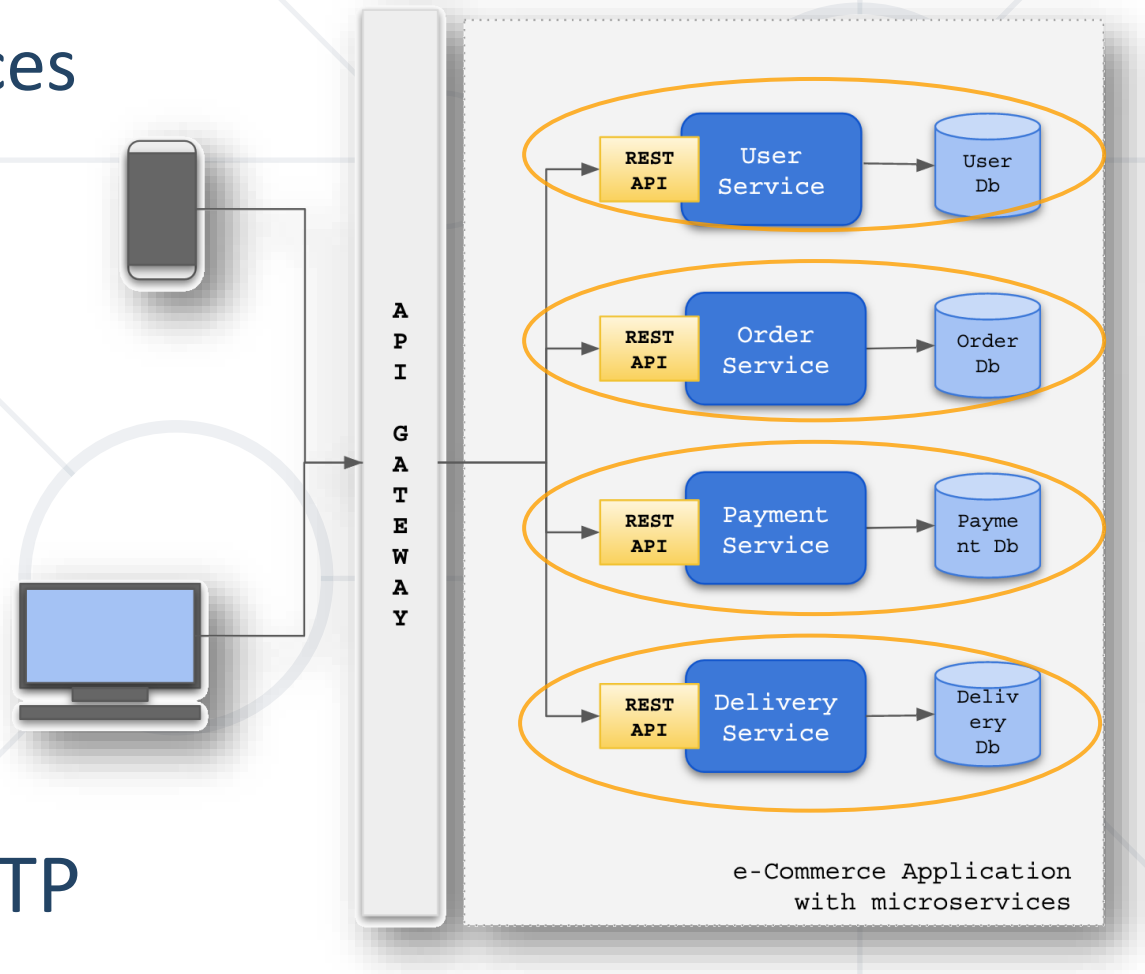
Service-Oriented Architectures (SOA)

- **Service-Oriented Architectures (SOA)**
  - Usually incorporate functions into smaller apps (**services**)
  - Communication is established over SOAP/XML, WS
    - Services communicate using **Enterprise Service Bus**
  - Services do **multiple activities** over a single scope of functionality
  - All services share **the same data store**



Microservices

- **Microservices** is an architecture based on **lots of small applications**
  - Collection of loosely coupled services
  - The size should be minimal
- Enables **continuous deployment**
  - Can be deployed independently
- All services **communicate directly**
- Every **service has its own store**
- Communication: REST, Web API, HTTP



SOA vs Microservices

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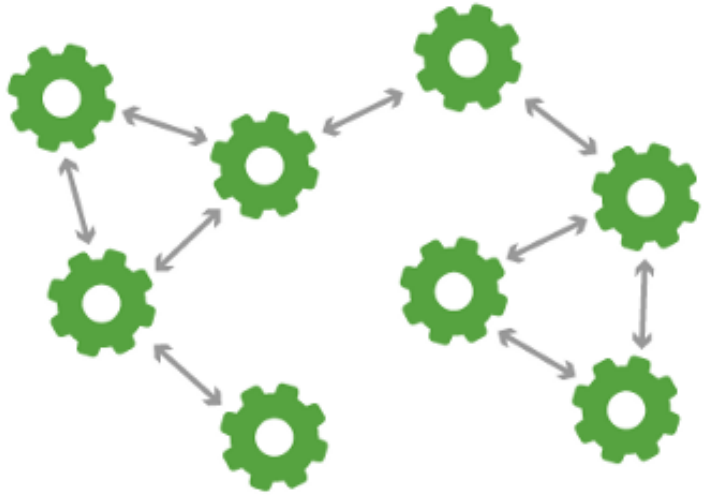
2000's

SERVICE ORIENTED ARCHITECTURE

SOA based applications are compromised of more loosely coupled components that use an Enterprise Services Bus messaging protocol to communicate between themselves.

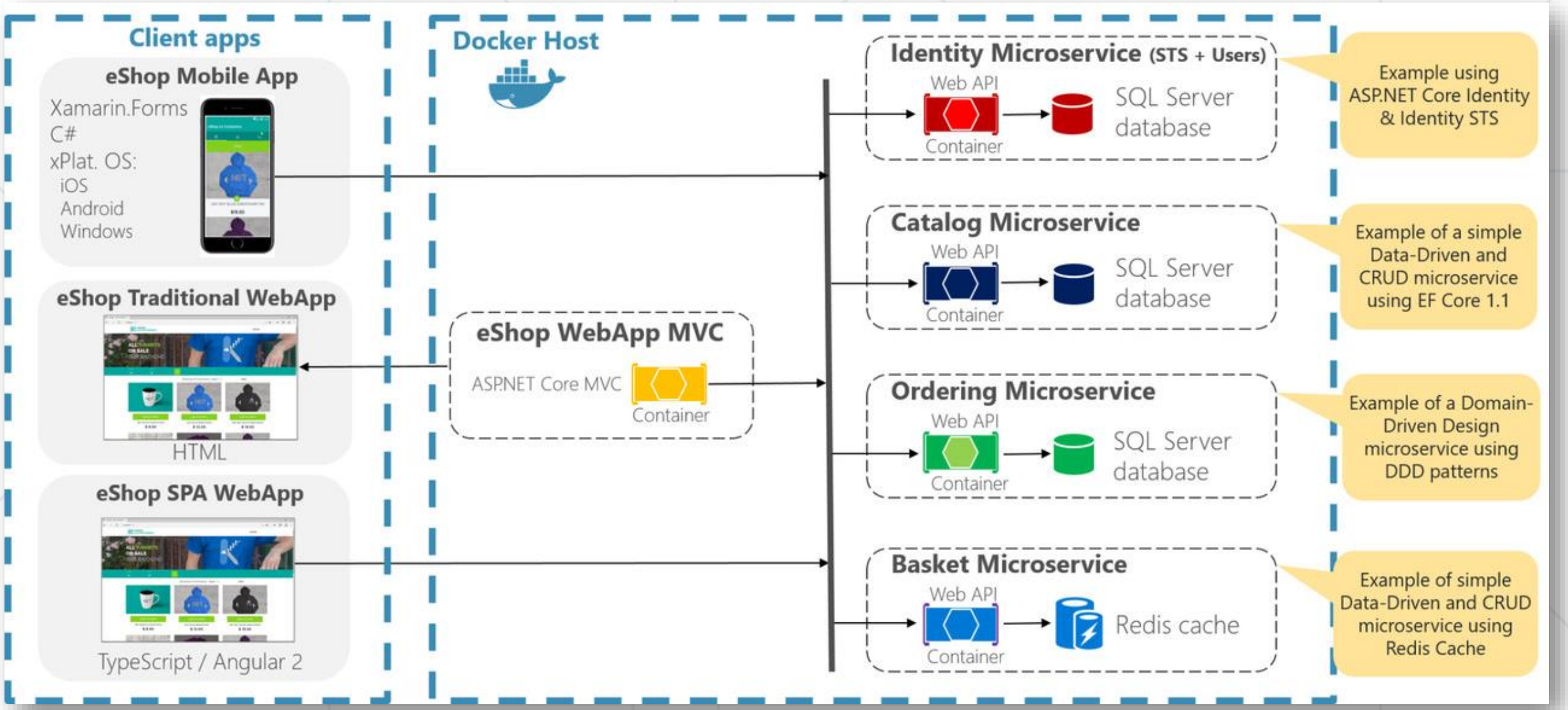
2010's

MICROSERVICES ARCHITECTURE



Microservices are a number of independent application services delivering one single functionality in a loosely connected and self-contained fashion, communicating through light-weight messaging protocols such as HTTP, REST or Thrift API.

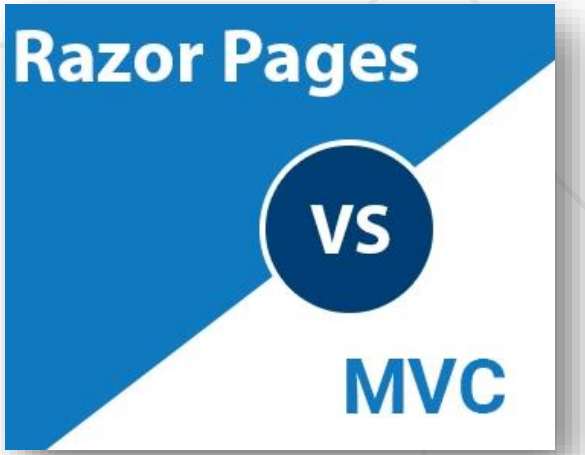
Example Microservices App



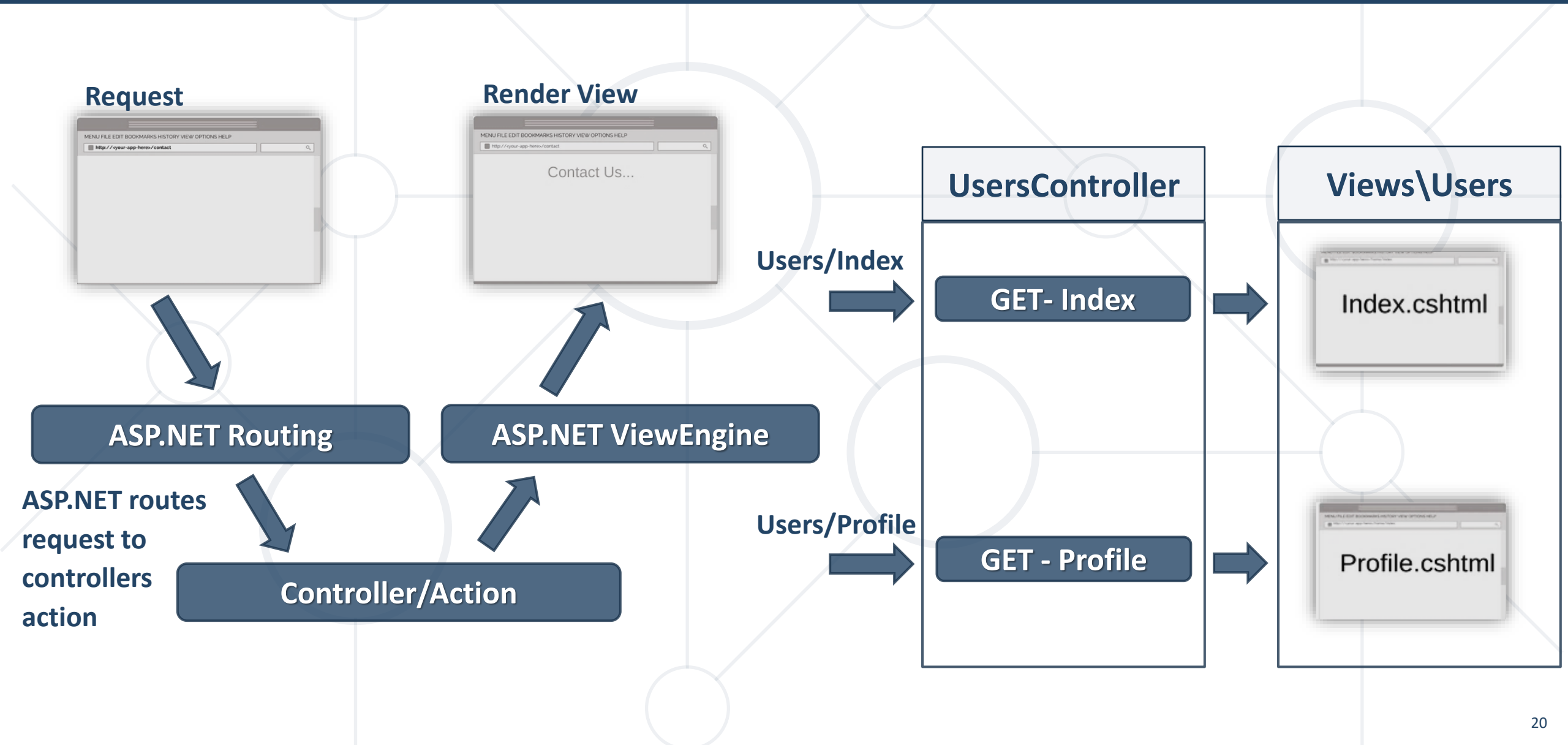
ASP.NET Core MVC vs Razor Pages

ASP.NET Core MVC vs Razor Pages

- Apart from **MVC**, **ASP.NET Core** provides another approach
  - Enter **Razor Pages**! A **Model-View-ViewModel**-like framework
- **Razor Pages** are similar to View Components
  - **Model** & **Controller** code is included in the **Page** itself
  - Enables two-way data binding and simpler development
  - Perfect for simple applications
    - With read-only functionality or simple data input
  - The single responsibility is strong



The MVC Approach



The MVC Approach

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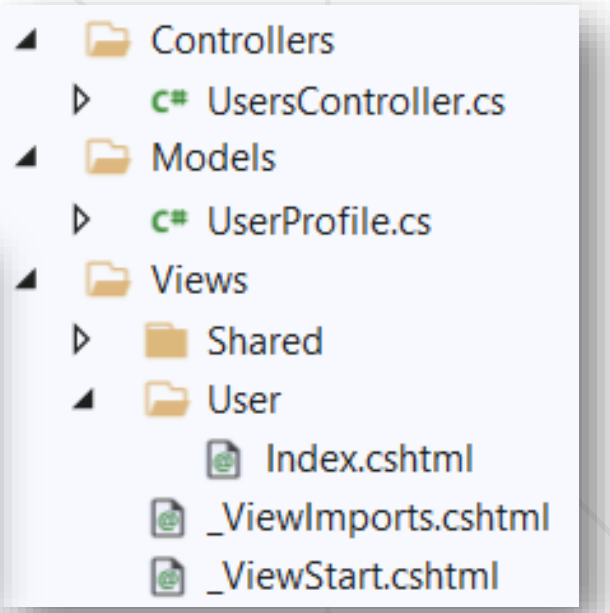
```
public class UsersController : Controller
{
    0 references
    public IActionResult Index()
    {
        // This would normally be extracted from the database
        var model = new UserProfile
        {
            FirstName = "Jon",
            LastName = "Hilton"
        };

        return View(model);
    }
}
```

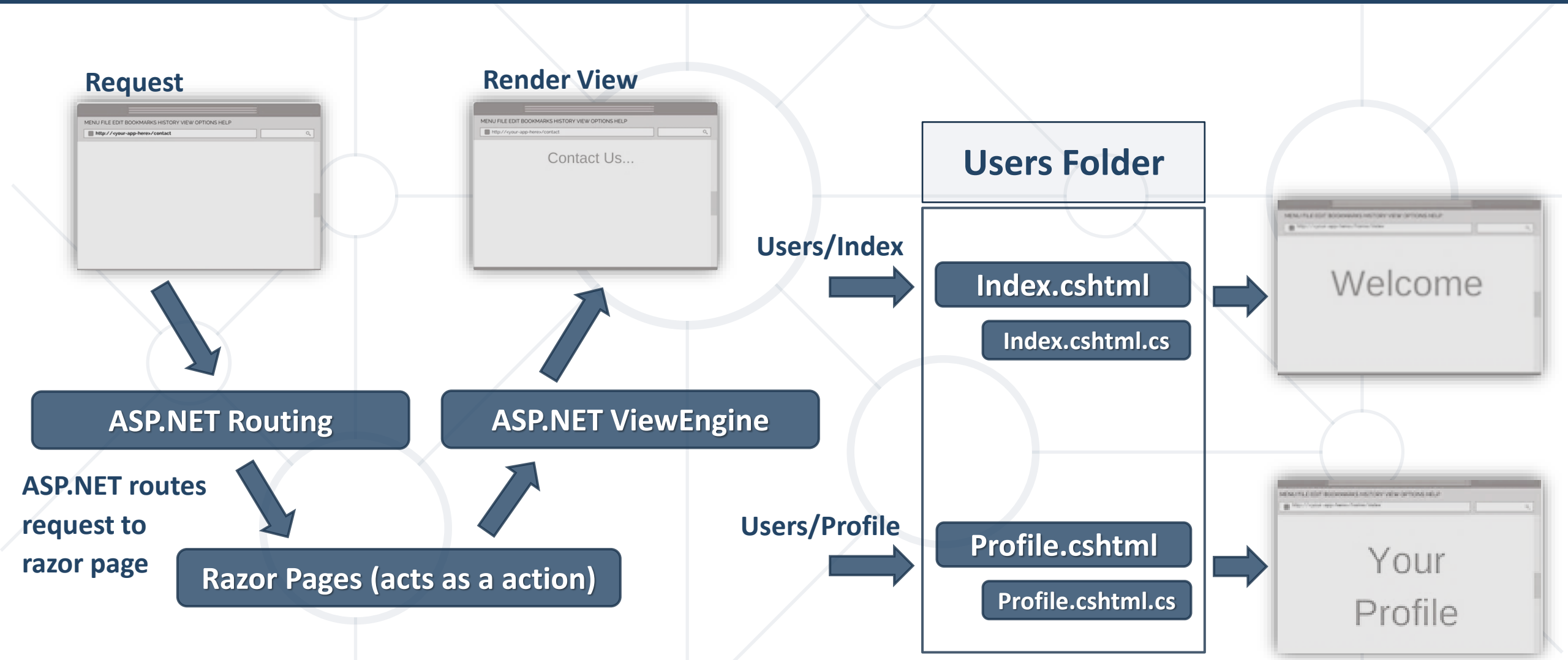
Index.cshtml*

```
@model UserProfile

<h1>Welcome</h1>

<p>Hey @Model.FirstName!</p>
```

```
public class UserProfile
{
    public string FirstName { get; set; }

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



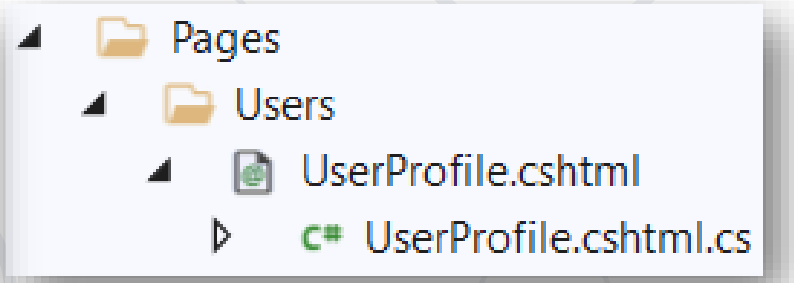
The Razor Pages Approach



The Razor Pages Approach

- Every **Razor Page** consists of
  - A view template (**.cshtml**), which acts as a view
  - A functional (**.cs**) file, which acts as its model + controller action

```
public class UserProfileModel : PageModel
{
    public string FirstName { get; set; }

    public string LastName { get; set; }

    public void OnGet()
    {
        // This would normally be extracted from the database
        FirstName = "Jon";
        LastName = "Hilton";
    }
}
```



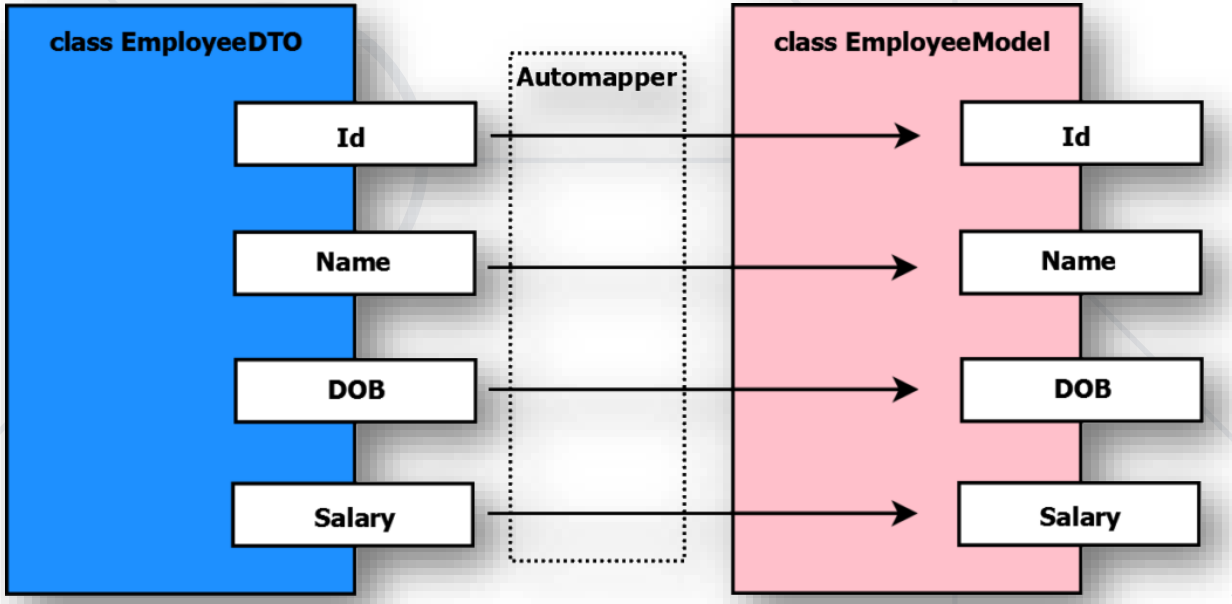
UserProfile.cshtml*

```
@page
@model UserProfileModel

<h1>Welcome</h1>

<p>Hey @Model.FirstName!</p>
```

AutoMapper

AutoMapper

- **AutoMapper** is a library built to simplify object mapping
  - **Easily imported** in ASP.NET Core
  - Added as a **dependency to the DI**
  - Gets rid of ugly property setters
  - Easy to use in code
  - Highly flexible
  - Easily configurable
  - Used in millions of projects



AutoMapper Setting

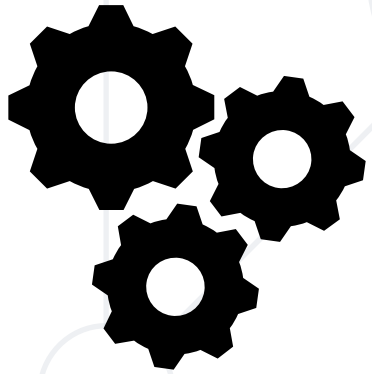
- Setting up the **AutoMapper** in your **ASP.NET Core** project

```
Install-Package AutoMapper.Extensions.Microsoft.DependencyInjection
```

  - This will also install the main **AutoMapper** NuGet package

- Registering **AutoMapper** as a dependency in the DI

```
builder.Services.AddAutoMapper(typeof(Program));
```



```
public class HomeController : Controller
{
    private readonly IMapper mapper;

    public HomeController(IMapper mapper)
    {
        this.mapper = mapper;
    }
    ...
}
```

AutoMapper Mapping

- Using the **AutoMapper** in your **ASP.NET Core** project

```
public class User
{
    public int Id { get; set; }

    public string FirstName { get; set; }

    public string LastName { get; set; }

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

```
public class UserViewModel
{
    public string FirstName { get; set; }

    public string LastName { get; set; }

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

The mapping class should inherit `Profile`

```
public class MappingProfile : Profile
{
    0 references
    public MappingProfile()
    {
        CreateMap<User, UserViewModel>();
    }
}
```

Create the mapping between User and UserViewModel

AutoMapper (Business Logic)

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- Without **AutoMapper**

```
public class UsersController : Controller
{
    0 references
    public IActionResult Index()
    {
        // Populate the user details from DB
        var user = GetUserDetails();
        var userViewModel = new UserViewModel()
        {
            Email = user.Email,
            FirstName = user.FirstName,
            LastName = user.LastName
        };
        return View(userViewModel);
    }
}
```

Ugly, mistake-prone, unreadable

- With **AutoMapper**

```
public class UsersController : Controller
{
    private readonly IMapper mapper;
    public UserController(IMapper mapper)
        => this.mapper = mapper;
    public IActionResult Index()
    {
        // Populate the user details from DB
        var user = GetUserDetails();
        UserViewModel userViewModel =
            this.mapper.Map<UserViewModel>(user);
        return View(userViewModel);
    }
}
```

Clean, beautiful, simple

Easily modifiable

Commonly-syntaxed

Abstracting the Data Access Logic

Repository Pattern

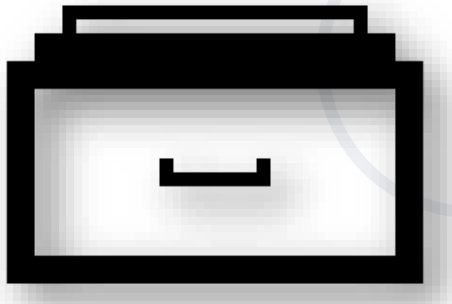
Repository Pattern

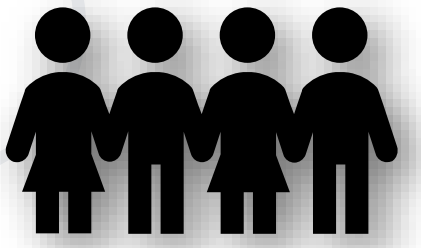
- **Repositories** are components that encapsulate data access logic
  - They **centralize** common data access functionality
  - They provide better **maintainability** and **testability**
  - They decouple the data access infrastructure from the **Domain layer**
- For each **aggregate**, you should define one **Repository**
  - Repositories, basically, allow you to populate data **in-memory**
  - Data is mapped from database to **Domain Entities**
  - Once in-memory, entities can be changed and **persisted back**

Repository Pattern

- Normally you implement specific **Interface-Class** pairs
  - There are other ways, though. Like **Generic Repositories**, for example

```
public interface IRepository<TEntity>
{
    IQueryable<TEntity> All();
    void Add(TEntity entity);
    void Update(TEntity entity);
    void Delete(TEntity entity);
    Task<int> SaveChangesAsync();
}
```





```
public class EfRepository<TEntity> : IRepository<TEntity>
{
   private ApplicationContext context;
   private DbSet<TEntity> dbSet;

   public StudentRepository(ApplicationContext context)
   {
      this.context = context;
      this.dbSet = this.Context.Set<TEntity>();
   }

   public IQueryable<TEntity> All() => this.DbSet;
   public void Add(TEntity entity) => this.DbSet.Add(entity);
   public void Update(TEntity entity) { ... }
   public void Delete(TEntity entity) { ... }
   public Task<int> SaveChangesAsync() { ... }
}
```

Databases & ORMs

Object Relational Mapper (ORM)

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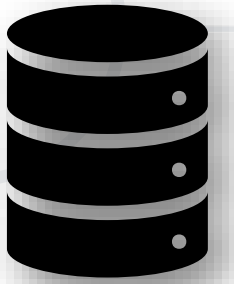
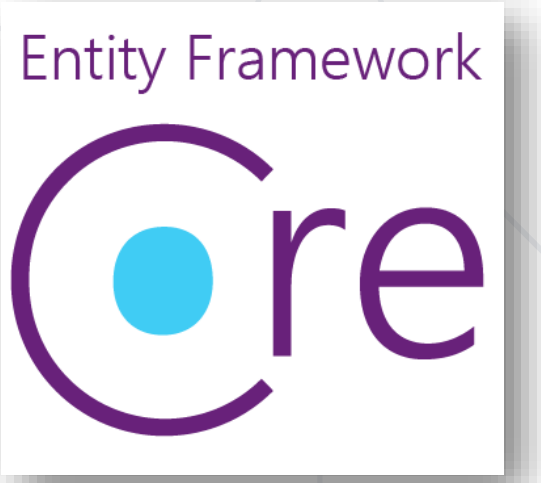
- **Entity Framework Core** is an **Object Relational Mapper** (ORM)
  - Creates a layer between your applications and data source
  - Maps the data to relational objects
- EF Core has a lot of essential and convenient features
  - Generates complex, optimized queries for your convenience
    - Translated from LINQ expression and cached
  - Manages the unit of work for you
  - Tracks changes in the Entities



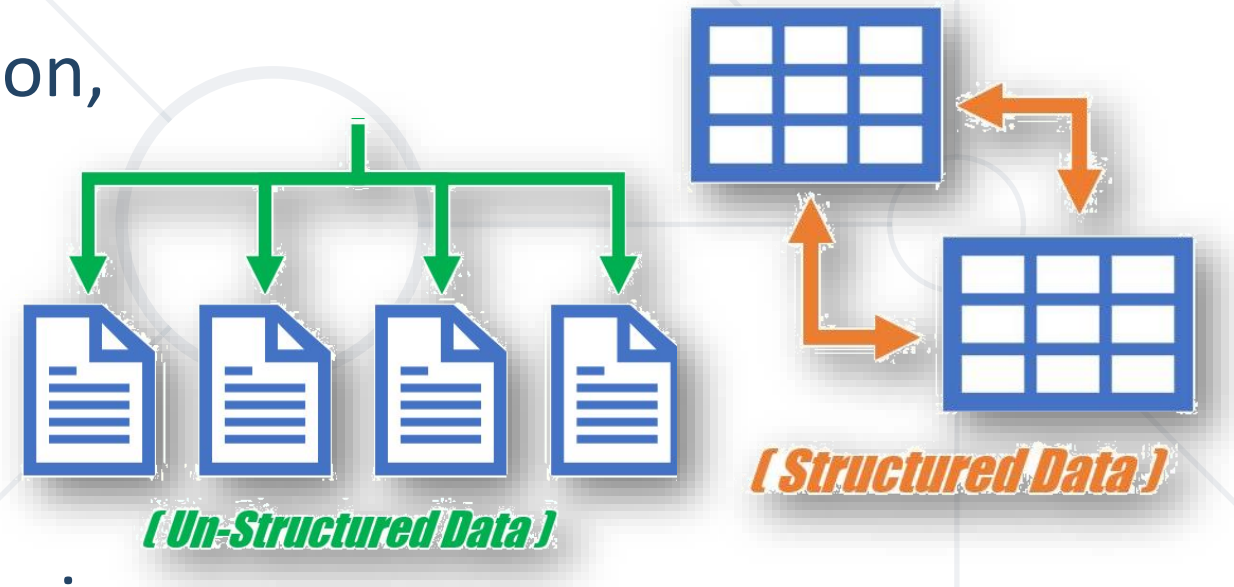


Dapper

- But EF Core pays a cost for all of its features...
  - And that cost is performance
  - But there must be a faster alternative
- Enter **Dapper**! The Open-source Micro ORM
  - A lightweight micro ORM, and a very fast performing one
  - Dapper is "Closer to the metal"
  - Complex querying might be exceptionally hard
    - Not suited for lazy developers

Databases

- Developing an application requires the **choice of a database**
  - One of the most important decisions in the development
  - Two choices: **relational** (SQL) or **non-relational** (NoSQL) data structure
- **SQL** databases use **Structured Query Language** (SQL)
  - Data definition, Data manipulation, Querying, Programmability etc.
- **NoSQL** databases use dynamic schema for unstructured data
  - Data can be stored as Columns, Documents, Graphs, Key-Value pairs



SQL

- **SQL** is extremely powerful, versatile, widely used
  - A safe choice, especially for complex querying
  - Very fast performing, even with large sets of data
- On the other hand, SQL can be **restrictive**
  - **Predefined schemas** are required to determine the data structure
  - All of the data must follow that predefined data structure
  - This requires significant up-front preparation and planning

Col1	Col2	Col3
Data	Data	Data
Data	Data	Data
Data	Data	Data

NoSQL

- **NoSQL databases** have their advantages and disadvantages too
  - You can create documents without pre-defining their structure
  - Each document can have its own unique structure
  - You can add fields on the go
- The drawbacks are also important to be noted
  - Lack of standardization
  - Lack of data consistency

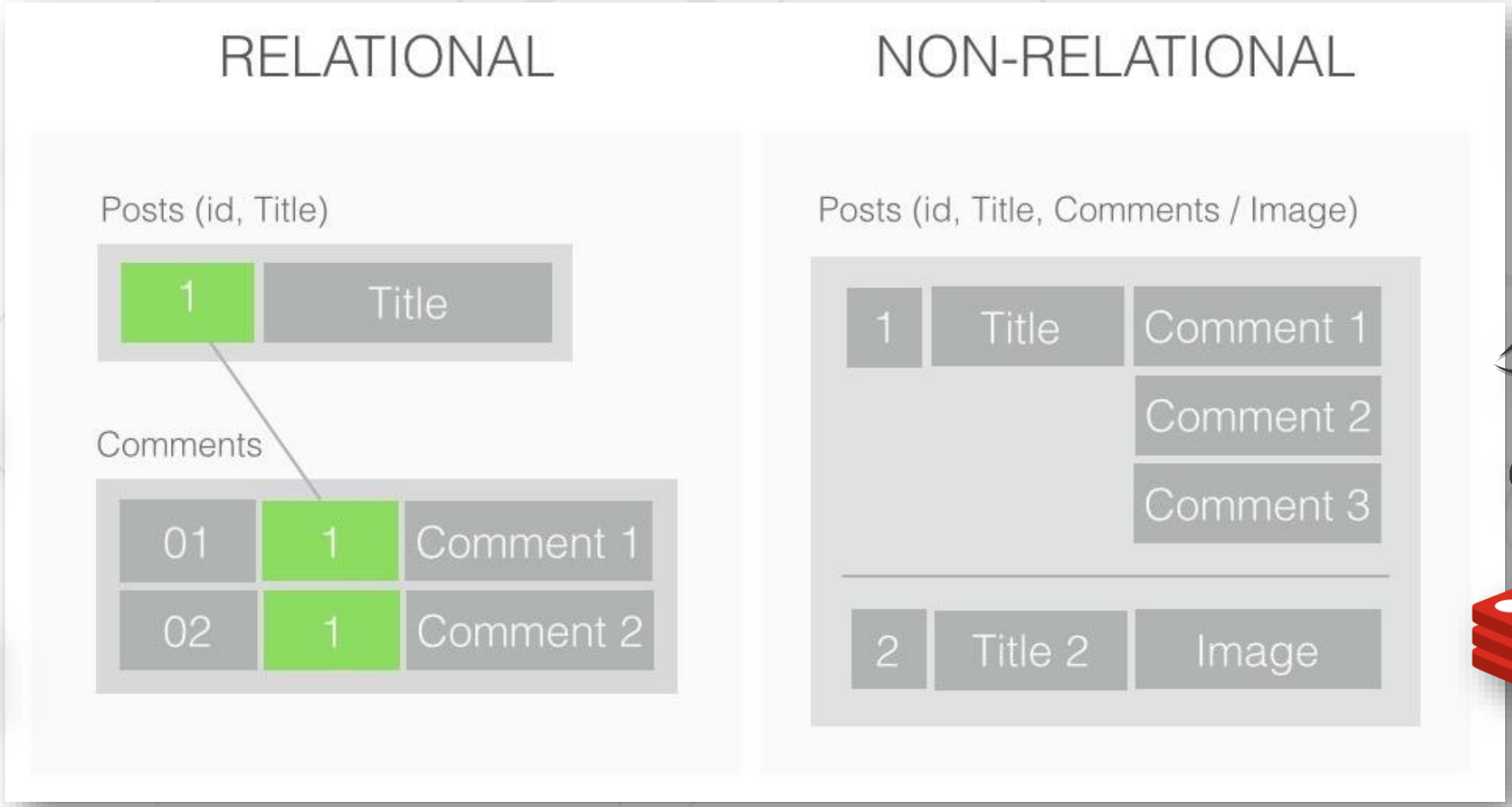
Document 1

```
{
  "prop1": data,
  "prop2": data,
  "prop3": data
}
```

Document 2

```
{
  "prop1": data,
  "prop2": data,
  "prop3": data
}
```

SQL and NoSQL



Summary

- Web Application Designs - MPAs vs SPAs
- Web Application Architectures
  - Monolith vs SOA vs Microservices
- ASP.NET Core MVC vs Razor Pages
- Repository Pattern
- AutoMapper
- Databases & ORMs
  - ORM vs Micro-ORM and SQL vs NoSQL

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