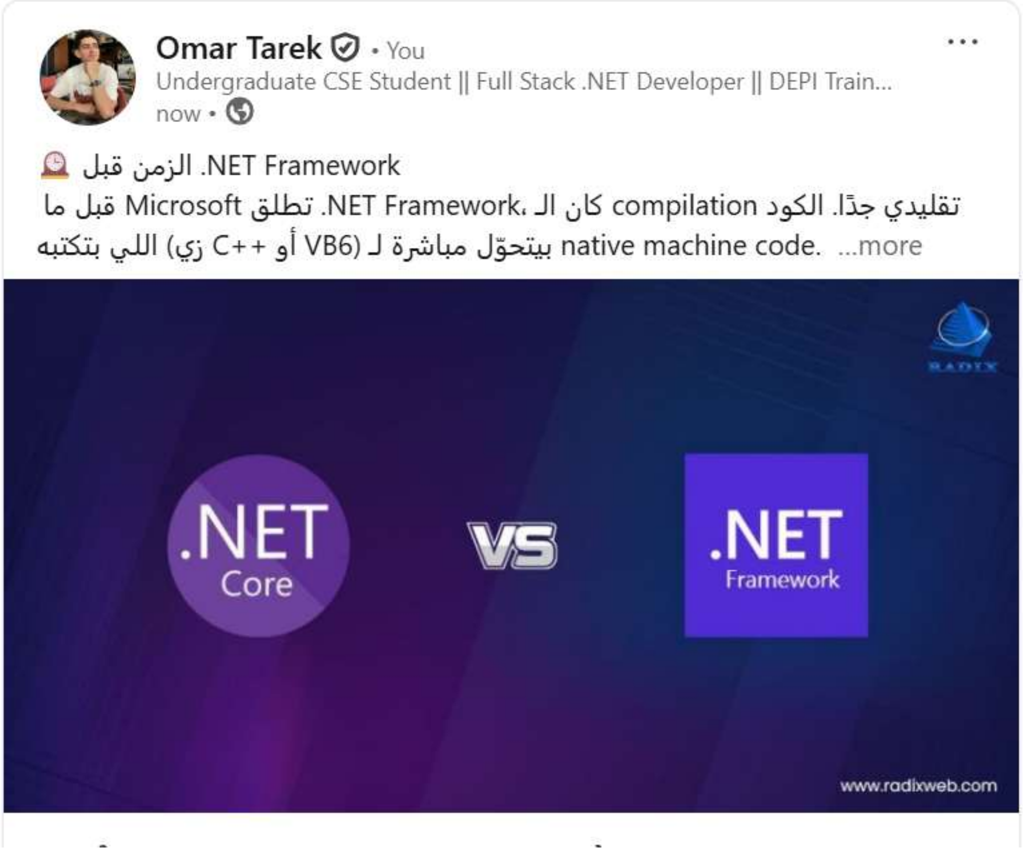
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now •

⏰ الزمن قبل .NET Framework

قبل ما Microsoft تطلق .NET Framework، كان الـ compilation تقليدي جدًا. الكود
اللي بتكتبه (زي C++ أو VB6) بيتحوّل مباشرة لـ native machine code. ...more

Report:

Overview of .NET Versions, Namespaces, .NET Core, and Solution Structure

1. .NET Versions

The .NET ecosystem has evolved significantly since its inception. Below is a summary of major version milestones:

Version	Description
.NET Framework	The original Windows-only implementation, ranging from 1.0 to 4.8.
.NET Core	A cross-platform, modular, and open-source rewrite of the .NET platform.
.NET 5	First unified platform replacing .NET Framework and .NET Core.
.NET 6	First LTS (Long-Term Support) release under unified .NET.
.NET 7	Focused on performance and cloud-optimized workloads (non-LTS).
.NET 8	Latest LTS version (as of 2025), improving AOT, cloud-native features, and support for cross-platform UI (e.g., MAUI).

.NET now follows an annual release cycle, with LTS versions supported for 3 years.

2. Namespaces

Namespaces in .NET serve as containers for logically grouped classes, interfaces, enums, and other types. They help avoid naming conflicts and organize code effectively.

Examples of common .NET namespaces:

- `System`: Core functions such as data types, exceptions, and console operations.
- `System.Collections`: Data structures like lists, dictionaries, queues, etc.
- `System.IO`: File and stream I/O operations.
- `Microsoft.AspNetCore`: Components for building web APIs and web applications in ASP.NET Core.
- `System.Threading`: Multithreading and asynchronous programming support.

Developers can also define custom namespaces to reflect their domain architecture and maintain modularity.

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3. .NET Core

.NET Core was introduced as a modern, lightweight, and cross-platform successor to the .NET Framework.

Key Features:

- Cross-platform: Runs on Windows, Linux, and macOS.
- CLI Tools: Full command-line interface support for development and deployment.
- Modular Runtime: Applications can include only required packages, reducing overhead.
- Open Source: Actively developed in the open on GitHub.
- Performance: Optimized for high-performance scenarios, such as microservices and cloud-native apps.

.NET Core was officially unified under the ".NET" branding starting with .NET 5.

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4. Solution Structure in .NET

In .NET development, a **Solution (.sln)** is a container that holds one or more related projects. Each project may be a class library, web application, console app, test project, or more.

Typical Structure:

```
bash
```

```
CopyEdit
MySolution/
│
├── MyApp.Web/            # ASP.NET Core Web Application
│   └── Startup.cs
│   └── Program.cs
│
├── MyApp.Core/           # Class Library for business logic
│   └── Services/
│   └── Models/
│
├── MyApp.Infrastructure/ # Data access layer
│   └── Repositories/
│
├── MyApp.Tests/          # Unit and integration tests
│   └── MyApp.Tests.csproj
│
└── MySolution.sln        # Solution file
```

This separation of concerns supports modular development, easier testing, and better maintainability in large applications.

Summary

This report covered the evolution and structure of the .NET ecosystem, highlighting:

- The progression from .NET Framework to modern .NET
- The importance and usage of namespaces
- The role and advantages of .NET Core
- Standard solution organization in professional .NET projects

This knowledge is essential for developing scalable, modern .NET applications, especially in enterprise or cross-platform environments.

BONUS

What is JITting?

JIT (Just-In-Time) compilation is a process used by the .NET runtime (CLR) to convert **Intermediate Language (IL)** code into **native machine code** at runtime. This happens **when a method is called for the first time**.

How It Works:

1. The developer compiles C#/VB.NET code → this produces IL inside assemblies (.dll, .exe).
2. When the application runs, the CLR uses the JIT compiler to translate IL into native code **just before execution**.

3. The compiled native code is cached in memory for subsequent use (no need to recompile during that session).

Benefits of JIT:

- Allows .NET apps to run on any platform that has a compatible CLR.
- Enables runtime optimizations based on the executing environment (e.g., CPU architecture).
- Reduces initial build complexity by delaying machine-specific compilation.

Downsides of JITting

While flexible, JIT compilation introduces some **performance costs**, especially during:

- **Application startup**: First-time method calls trigger JIT compilation, which can delay response.
- **Cold start scenarios** (e.g., serverless functions or APIs): JIT can lead to noticeable latency.
- **Memory usage**: Native code produced by the JIT is stored in memory, increasing the app's footprint over time.

Techniques to Reduce or Eliminate JIT Overhead

To improve performance and reduce reliance on runtime JITting, .NET provides several mechanisms:

1. ReadyToRun (R2R) Images

- Precompiles IL to native code at publish time using `crossgen` or `crossgen2`.
- Speeds up startup by reducing the need for JIT at runtime.
- Used in ASP.NET Core and many enterprise apps.
- Enabled with the `PublishReadyToRun` flag during build:

```
bash
CopyEdit
dotnet publish -c Release -r win-x64 /p:PublishReadyToRun=true
```

2. Tiered Compilation

- Introduced in .NET Core.
- Starts with a quick, minimally optimized version (Tier 0), then upgrades frequently used methods to a more optimized version (Tier 1) in the background.
- Balances startup time and long-term performance.
- Enabled by default in modern .NET versions.

3. Ahead-of-Time (AOT) Compilation

- Compiles all IL to native code **at build time**, fully removing the JIT step.
- Useful for scenarios like:
  - Small containers
  - Cold start–sensitive cloud functions
  - Mobile apps
- Supported via **Native AOT** (available in .NET 7+), using:

```
bash
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dotnet publish -r linux-x64 -c Release /p:PublishAot=true
```

4. Profile-Guided Optimization (PGO)

- .NET can collect runtime data to guide compilation decisions (hot paths, loops, branches).
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