Navigating Dependency Lifetimes: A Practical Comparison of AddTransient, AddScoped, and AddSingleton in .NET

Shyamprasad Narapareddy · Follow
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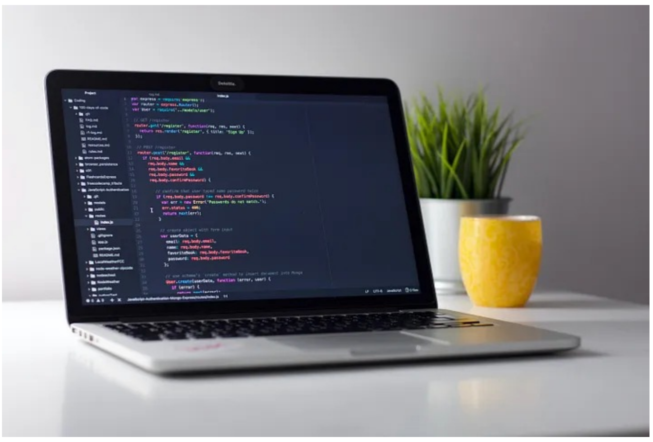
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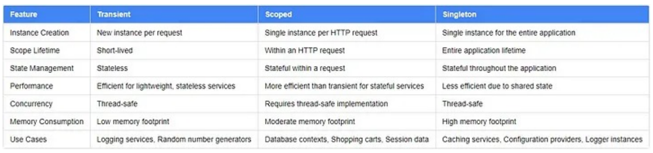
Dependency Injection (DI) is a pivotal element in constructing scalable and maintainable .NET applications, especially in the realm of Web APIs.

Choosing the appropriate scope depends on the nature of your service and its relationship with other dependencies.

Detailed Comparison of Scopes



Feature	Transient	Scoped	Singleton
Instance Creation	New instance per request	Single instance per HTTP request	Single instance for the entire application
Scope Lifetime	Short-lived	Within an HTTP request	Entire application lifetime
State Management	Stateless	Stateful within a request	Stateful throughout the application
Performance	Efficient for lightweight, stateless services	More efficient than transient for stateful services	Less efficient due to shared state
Concurrency	Thread-safe	Requires thread-safe implementation	Thread-safe
Memory Consumption	Low memory footprint	Moderate memory footprint	High memory footprint
Use Cases	Logging services, Random number generators	Database contexts, Shopping carts, Session data	Caching services, Configuration providers, Logger instances

Comparision of AddTransient vs AddScoped vs AddSingleton

C# Example: Demonstrating Different Scopes

Here’s an example illustrating the behavior of each scope:

```
public interface IOperationService
{
        Guid GetOperationId();
    }

    public class TransientService : IOperationService
    {
        public Guid GetOperationId()
        {
            return Guid.NewGuid();
        }
    }

    public class ScopedService : IOperationService
    {
        private readonly Guid _operationId;

        public ScopedService()
        {
            _operationId = Guid.NewGuid();
        }

        public Guid GetOperationId()
        {
            return _operationId;
        }
    }

    public class SingletonService : IOperationService
    {
        private readonly Guid _operationId;

        public SingletonService()
        {
            _operationId = Guid.NewGuid();
        }

        public Guid GetOperationId()
        {
            return _operationId;
        }
    }
```

```
    public class Startup
    {
        public void ConfigureServices(IServiceCollection services)
        {
            // Transient service
            services.AddTransient<IOperationService, TransientService>();

            // Scoped service
            services.AddScoped<IOperationService, ScopedService>();

            // Singleton service
            services.AddSingleton<IOperationService, SingletonService>();
        }
    }
```

Expected Behavior:
TransientService: Each call to *GetOperationId* will return a new GUID.
ScopedService: The same GUID will be returned within a single HTTP request, but different requests will receive different GUIDs.
SingletonService: The same GUID will be returned throughout the entire application lifetime.

Optimal selection of the dependency injection scope is essential in crafting efficient and resilient .NET Web APIs. Grasp the distinctions among `AddTransient`, `AddScoped`, and `AddSingleton`, and make a thoughtful choice of scope tailored to your service's requirements and behavior. Employing the right scope enables you to attain peak performance, effective state management, and efficient memory utilization.

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