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Architect LINQ to SQL End-to-end

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Level: Advanced

MVP Microsoft Most Valuable Professional

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Agenda

- Build an n-tier application
  - Testable
  - Maintainable
  - Uses LINQ to SQL as the data access technology

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Agenda: Questions to Answer

- How do I use LINQ to SQL in an n-tier application?
- How should my tiers be organized?
- What are the best-practices for business objects?
- How do I use a base class for my entities?
- How do I do change auditing?
- What are the best practices for unit testing?
- What are my options for concurrency management?
- How does LINQ to SQL affect my ASP.NET code?
  - Or, what do I have to worry about from ASP.NET?

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How do I use LINQ to SQL in an n-tier Application?

- Use it as an object-relational mapping (ORM) technology
  - Save, Update, Load, and Delete database records without much code
- Always abstract away the existence of your ORM technology as much as possible
  - Little -- ideally no -- visible LINQ to SQL code
  - This means you should hide your L2Q entities
- Interface-driven programming
  - More maintainable
  - Easier to test

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How should my tiers be organized?

- My $0.02...
  - Use the Service Layer Pattern for the business tier
  - Model View Presenter (MVP) Pattern for the User Interface

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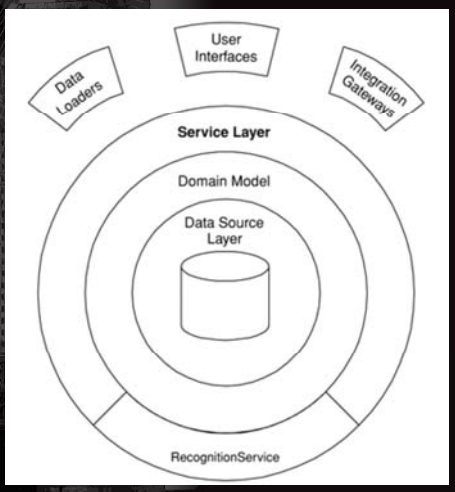
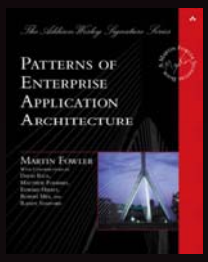
Service Layer Pattern



"Defines an application's boundary with a layer of services that establishes a set of available operations and coordinates the application's response in each operation."

-Randy Stafford



From "Patterns Of Enterprise Application Architecture" by Martin Fowler, Randy Stafford, et al. Chapter 9

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The Tiers

- Presentation tier
  - ASP.NET
  - Windows Forms
  - WPF
  - WCF Service
  - The "View" of MVP
- Presenter Tier
  - Handles the "conversation" between the presentation tier implementation and the business tier
  - Defines the "View" Interfaces
  - "Presenter" in MVP
- Business tier
  - Business object interfaces
  - Business objects
    - **LINQ to SQL entities**
    - **The "Model" in MVP**
  - Business facades
    - **Manipulate business objects**
    - **Handle requests for CRUD operations**
- Data Access Tier
  - LINQ to SQL as ORM
- Data Storage Tier
  - SQL Server

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Best Practices for Business Objects

- Use a common base class
  - Push common functionality into the base class
- Use a common base interface
- Each business object gets its own business interface

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Best Practices for Business Objects

- No Load(), Save(), or Delete() methods on the business objects
  - The business objects are lightweight
  - POJOs - plain old Java objects
  - They're smart (well, not completely dumb) data transfer objects
  - CRUD methods/operations are taken care of by the business facades
- Business facades use the Service Layer/Transaction Script pattern
  - The facades define all the operations available through the business tier
  - Should be at least 1 unit test per business façade operation

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Best Practices for Unit Testing

- Test success and failure cases
- Provide descriptive error message on asserts
- Create a base class that all your unit tests inherit from
- Make tests autonomous
  - Avoid dependencies between tests
  - Tests should not have to run in any particular order
- Don't assume what data is in or not in the database
  - Not knowing may cause false passes or fails

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Unit Testing: How do you KNOW what data is in the database?

- Make sure the database is empty before each test runs
- Any required data for the test is put into the database as part of the test

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Clearing the database: Option #1

- DELETE every row in each table before the test
  - Problem: You have to worry about FK constraints
  - Problem: you have to write/maintain the DELETE script

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Clearing the database: Option #2

- Keep track of any row you write to the database and delete it after the test
- Bug prone
- Your business tier code could create records that you don't know about
- $0.02: you don't want or need to worry about all those rows
- Tough to analyze faults: If your test fails and you want to look at the data in the database after the test, it's not there.

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Clearing the database: Option #3

- Create a database TRANSACTION at the start of the unit test and call ROLLBACK at the end of the test
- Inserted data isn't written to disk until COMMIT is called
  - Can't be read from a different database connection because the records are locked
  - Can't verify the data using a separate connection
- Tough to analyze faults: If your test fails and you want to look at the data in the database after the test, it's not there.

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There's got to be a better way.

- LINQ to SQL to the rescue!

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DataContext Saves The Day

- DataContext can manage the schema for you
  - Enables Model-First development
- DataContext methods
  - DatabaseExists()
  - DeleteDatabase()
  - CreateDatabase()

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Unit Tests and DataContext Schema Management

- In your unit test base class
  - Define TestInitialize() method and mark it with [TestInitialize()] attribute
  - In TestInitialize(), call DeleteDatabase() then CreateDatabase()
- Any records from previous test executions are gone
- Data is still there after the test executes
- Side benefit: your database is always in sync with the business object design
  - No hunting down object-relational schema mismatch errors

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Code Demo 1

- Create a unit test project
- Create a business project
  - Add Entities
- Create a unit test base class
- Add TestInitialize() to base class
- Write a unit test to create a Person

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The Business Tier

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Best Practice: Hide the Implementation Details

- Right now, LINQ to SQL is fully exposed
- We're exposing the entities
- We're relying on non-business tier code to do the data access calls

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Best Practice: Hide the Implementation Details

- Business tier should be more service-based
  - Create Person
  - Save Person
  - Get List of Person objects
  - Get Person By Id
- Why?
  - We can test that functionality
  - We can re-use the functionality
  - Calling code doesn't have to worry about the implementation details --> it just works
- How?
  - Create a business façade object

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Code Demo 2

- Create a PersonFacade that wraps the data context operations
- Create unit tests and implementations for
  - Create Person
  - Save Person
  - Get List of Persons
  - Get Person By Id

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Best Practice: Hide the Implementation Details

- We're still exposing the LINQ to SQL entities
- Makes it difficult for us to modify the entities
  - Changes to the entities ripple out of the business tier
- We should hide the entities behind interfaces

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Code Demo 3

- After the demo, LINQ to SQL will be wrapped inside of the Business Tier
- Create partial class implementation for Person
- Create IPerson interface
- Make Person implement IPerson
- Make PersonFacade use IPerson instead of Person
- Update unit tests to use interfaces

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Best Practice: Common Code Should Be In a Base Class

- We've just been handed some requirements:
  - All business objects should record
    - **Who created them**
    - **When were they created**
    - **Who last modified them**
    - **When were they last modified**
  - All business objects should have a primary key property "Id"
  - All business objects should implement optimistic concurrency
    - **Easiest way is to do this using the LastModified column**

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Business Base with LINQ to SQL

- Ideal BusinessBase implementation

```
public abstract class BusinessBase
{
    public virtual int Id { get; set; }
    public virtual DateTime CreatedDate { get; set; }
    public virtual DateTime ModifiedDate { get; set; }
    public virtual string CreatedBy { get; set; }
    public virtual string ModifiedBy { get; set; }
}
```

- Property implementations are in BusinessBase
- Too bad that LINQ to SQL won't let you
- Can't "map" the properties

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Business Base with LINQ to SQL

- Make the properties "abstract"

```
public abstract class BusinessBase
{
    /*
     * This won't work
     *
    public virtual int Id { get; set; }
    public virtual DateTime CreatedDate { get; set; }
    public virtual DateTime ModifiedDate { get; set; }
    public virtual string CreatedBy { get; set; }
    public virtual string ModifiedBy { get; set; }
    */

    public abstract int Id { get; set; }
    public abstract DateTime CreatedDate { get; set; }
    public abstract DateTime ModifiedDate { get; set; }
    public abstract string CreatedBy { get; set; }
    public abstract string ModifiedBy { get; set; }
}
```

- "Abstract" forces derived classes to implement those properties

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How do I populate the business base fields?

- The DataContext has partial methods for each entity
  - Insert*EntityName*()
  - Update*EntityName*()
  - Delete*EntityName*()
- Provide implementation for these methods
- Populate the values
- WARNING: Don't forget to call ExecuteDynamicInsert(), ExecuteDynamicUpdate(), and/or ExecuteDynamicDelete()
  - If you provide a partial implementation for above methods but don't call ExecuteDynamic*Xyz*() then NOTHING will get written to the database.

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Code Demo 4: Common Base Class

- Create BusinessBase class
- Create IBusinessBase interface
- Create partial implementations to populate the values
- Adjust “Inheritance Modifier” on the entities
- Create tests to verify business base logic
- HINT: Notice that when we run the tests that the database schema gets updated

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The User Interface

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User Interfaces: The Redheaded Stepchild of the Unit Testing World

- Not easy to automate the UI testing
- Basically, automating button clicks
- UI's almost have to be tested by a human
  - Computers don't understand the "visual stuff"
  - Colors, fonts, etc are hard to unit test for
  - "This doesn't look right" errors
- The rest is:
  - Exercising the application
  - Checking that fields have the right data
  - Checking field visibility

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Best Practice: UI Unit Testing

- Solve the problem by not solving the problem
- Minimize what you can't automate

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User Interface Testing: The Presenters & Views

- Model View Presenter (MVP) models the conversation between UI implementation and the Business Tier
- For each real UI that you want, create a C# "view" interface
  - Any fields that appear on the screen go on this interface
- Presenter Façade will know how to
  - Load, Save business objects
  - Populate the UI from the business objects
  - Populate the business objects from the UI
- Business & UI Tiers abstracted from each other

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Unit Testing the MVP

- Create a "stub" implementation of the “view” interfaces
  - IPersonSearch
  - IPersonDetail
- The “Presenter” = Editor Façade
- Unit test the Editor Façade methods that manipulate the C# interfaces
  - InitializeBlank()
  - LoadById()
  - Save()
  - Search()

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Best Practice for MVP “View” Design

- Avoid referencing business objects or business interfaces on “View” interfaces
- Favor scalar types
- If necessary, create UI specific interfaces
  - If the business tier has “IPerson”
  - Create “IPersonInfo” for UI
  - Keeps needs of the UI separate from the needs of the Business Tier
- ASP.NET: This almost guarantees your application is stateless

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Code Demo 5

- Implement PersonEditorFacade, IPersonSearch, IPersonDetail
- Test functionality via stubs
- Create an ASP.NET implementation

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Why is this more testable?

- Each page/screen only has to get/set the value from interface property into the right display control
- UI does not know anything about business objects
- Doesn't know about any details of loading or saving
- Doesn't have to know about validation
- All this logic goes into the editor façade and testable via unit test

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Cleanup and ASP.NET

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Clean Up After Yourself

- Best practice: If you're done with an object and it's IDisposable, call Dispose()
  - Or wrap the reference in a using() { }
- DataContext implements IDisposable
- DataContext needs to get rid of its database connection

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DataContext Cleanup is Tricky in ASP.NET

- You don't exactly know when you're done with the DataContext
- If you call Dispose() too soon,
  - Lazy loaded collections may fail or error
  - Unusual behavior and lost saves

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Handle Cleanup In ASP.NET

- Share a single DataContext per HTTP Request
  - Sharing a single DataContext is helpful for non-ASPX apps, too
- Close it at the end of the request
- How do you know when the request is finished?
  - Create an HTTP Module (IHttpModule)
  - HTTP Module hooks in to ASP.NET and is notified when the request is finished
  - Call DataContext.Dispose() from the Close() method on the http handler

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Code Demo 6: HTTP Module

- Create an HTTP Module
- Implement Close()
- Hook it in to the ASP.NET application using Web.config

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Summary

- N-Tier application
- Testable
  - Database is consistent for each test
  - Tested business tier
  - Tested user interface functionality
- LINQ to SQL is hidden
  - You could change out the ORM implementation with ease
  - No “leaky abstraction”
- Handling DataContext management in ASP.NET
  - Releasing the connection reliably

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Questions?

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