RepositoryManager

A thread-safe .NET class library for storing and retrieving JSON or XML strings, identified by unique string keys.

Overview

The RepositoryManager provides a simple yet robust API for managing structured content (JSON and XML) with built-in validation, thread safety, and extensible architecture through dependency injection.

Features

- **Thread-Safe Operations**: All operations are thread-safe using concurrent data structures
- **Content Validation**: Built-in validation for JSON and XML content
- **Extensible Architecture**: Pluggable storage providers and content validators
- **Initialization Control**: Ensures initialization happens exactly once, even in multi-threaded scenarios
- **Comprehensive Error Handling**: Clear exceptions with descriptive messages

Public API

The library exposes the following public methods that must be used exactly as specified:

Core Methods

```
// Prepares the repository for use (can only be called once)
void Initialize()

// Stores an item in the repository with validation
void Register(string itemName, string itemContent, int itemType)

// Retrieves the content of an item by its name
string Retrieve(string itemName)

// Returns the type of the item (1 for JSON, 2 for XML)
int GetType(string itemName)

// Removes an item from the repository
void Deregister(string itemName)
```

Content Types

- `itemType = 1`: JSON string
- `itemType = 2`: XML string

Usage Examples

Basic Usage

```
using RepositoryManager;

// Create repository instance
var repository = new RepositoryManager();

// Initialize (required before any operations)
repository.Initialize();

// Store JSON content
string jsonData = "{\"name\": \"John\", \"age\": 30}";
repository.Register("user1", jsonData, 1);

// Store XML content
string xmlData = "<user><name>Jane</name><age>25</age></user>";
repository.Register("user2", xmlData, 2);

// Retrieve content
string retrievedJson = repository.Retrieve("user1");
string retrievedXml = repository.Retrieve("user2");

// Check content type
int jsonType = repository.GetType("user1"); // Returns 1
int xmlType = repository.GetType("user2");   // Returns 2

// Remove items
repository.Deregister("user1");
```

Advanced Usage with Dependency Injection

```
// Custom implementations can be injected
var customStorage = new CustomStorageProvider();
var customValidator = new CustomContentValidator();
var repository = new RepositoryManager(customStorage, customValidator);

repository.Initialize();
// Use as normal...
```

Error Handling

The library throws specific exceptions for different error conditions:

InvalidOperationException

- Thrown when attempting operations before calling `Initialize()`

ArgumentException

- Invalid item names (null, empty, or whitespace)

- Invalid content (null, empty, or whitespace)
- Invalid item types (not 1 or 2)
- Invalid content format (malformed JSON/XML)
- Attempting to register duplicate item names

KeyNotFoundException

- Attempting to retrieve or get type of non-existent items

Requirements Compliance

✅ **Content Validation**: Validates JSON and XML content using Newtonsoft.Json and System.Xml
✅ **Prevent Overwriting**: Throws exception when attempting to register duplicate item names
✅ **Single Initialization**: Uses double-checked locking to ensure Initialize() runs exactly once
✅ **Exact API Signatures**: All public methods match the required specifications

Test Scenarios

The library includes comprehensive unit tests covering:

Initialization Tests

- ✅ Multiple calls to Initialize() should only initialize once
- ✅ Concurrent calls to Initialize() should be thread-safe
- ✅ Operations before initialization should throw InvalidOperationException

Registration Tests

- ✅ Valid JSON content should store successfully
- ✅ Valid XML content should store successfully
- ✅ Invalid content should throw ArgumentException
- ✅ Duplicate item names should throw ArgumentException
- ✅ Invalid parameters (null/empty names, content, invalid types) should throw ArgumentException

Retrieval Tests

- ✅ Existing items should return correct content
- ✅ Non-existent items should throw KeyNotFoundException
- ✅ Invalid parameters should throw ArgumentException

Type Checking Tests

- ✅ JSON items should return type 1
- ✅ XML items should return type 2
- ✅ Non-existent items should throw KeyNotFoundException

Deregistration Tests

- ✅ Existing items should be removed successfully
- ✅ Non-existent items should not throw exceptions

- ☑ Invalid parameters should throw ArgumentException

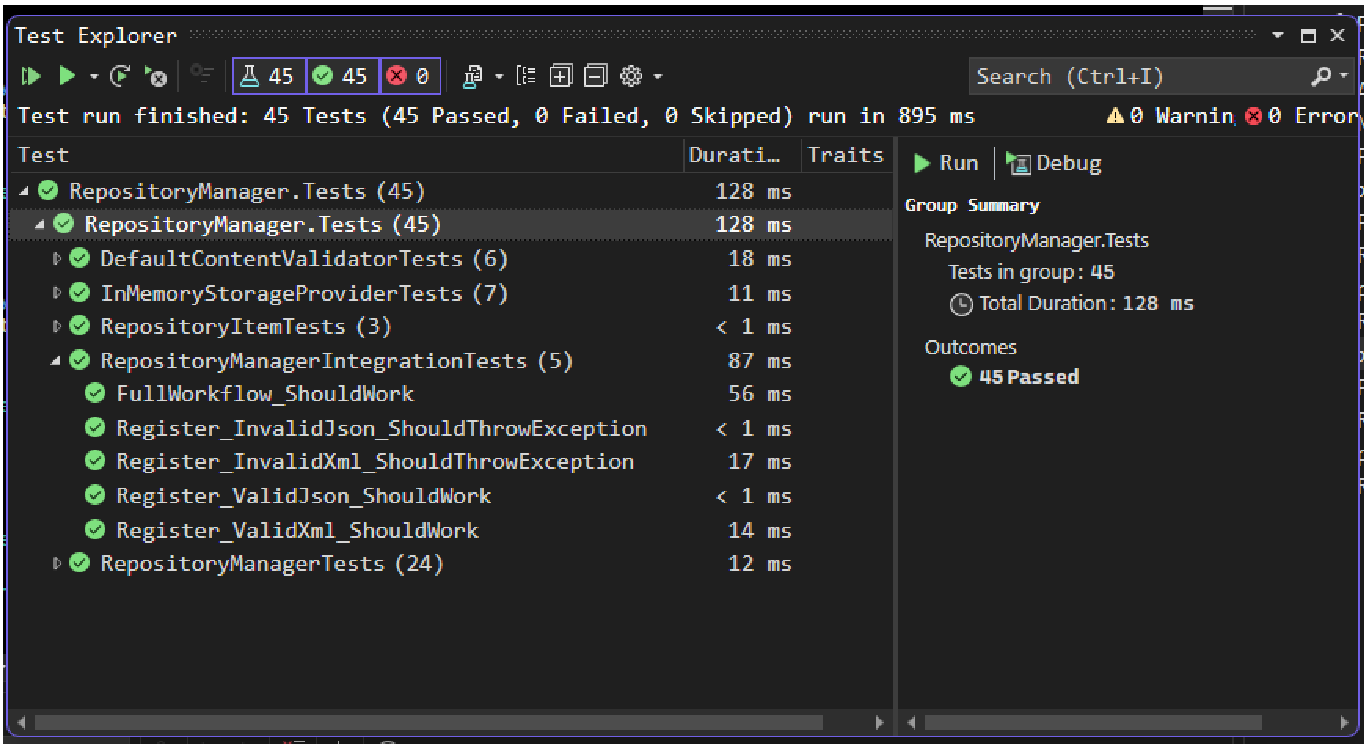
Integration Tests

- ☑ Full workflow with real JSON/XML validation
- ☑ End-to-end scenarios with multiple operations

Component Tests

- ☑ RepositoryItem creation and properties
- ☑ DefaultContentValidator with real JSON/XML parsing
- ☑ InMemoryStorageProvider thread-safe operations

Unit Test Screenshoot



```
Test run finished: 45 Tests (45 Passed, 0 Failed, 0 Skipped) run in 895 ms    0 Warnin  0 Error

RepositoryManager.Tests (45)                          128 ms
  RepositoryManager.Tests (45)                        128 ms
    DefaultContentValidatorTests (6)                   18 ms
    InMemoryStorageProviderTests (7)                   11 ms
    RepositoryItemTests (3)                           < 1 ms
    RepositoryManagerIntegrationTests (5)              87 ms
      FullWorkflow_ShouldWork                          56 ms
      Register_InvalidJson_ShouldThrowException       < 1 ms
      Register_InvalidXml_ShouldThrowException         17 ms
      Register_ValidJson_ShouldWork                   < 1 ms
      Register_ValidXml_ShouldWork                     14 ms
    RepositoryManagerTests (24)                        12 ms

Group Summary
  RepositoryManager.Tests
    Tests in group: 45
    Total Duration: 128 ms

  Outcomes
    45 Passed
```

Architecture

Core Components

- **RepositoryManager**: Main class implementing the public API
- **RepositoryItem**: Immutable data structure representing stored items
- **IStorageProvider**: Interface for pluggable storage implementations
- **IContentValidator**: Interface for pluggable content validation
- **InMemoryStorageProvider**: Default thread-safe in-memory storage
- **DefaultContentValidator**: Real JSON/XML validation implementation

Design Patterns

- **Dependency Injection**: Allows custom storage and validation implementations
- **Double-Checked Locking**: Ensures thread-safe single initialization
- **Strategy Pattern**: Pluggable validation and storage strategies

Dependencies

- **.NET Framework**: Compatible with .NET Framework projects
- **Newtonsoft.Json**: For JSON parsing and validation
- **System.Xml**: For XML parsing and validation (built-in)

Thread Safety

All operations are thread-safe:

- Initialization uses double-checked locking pattern
- Storage operations use ConcurrentDictionary
- Content validation is stateless and thread-safe

Performance Considerations

- **In-Memory Storage**: Fast access but limited by available memory
- **Content Validation**: Validates on every Register() call
- **Thread Safety**: Minimal overhead using efficient concurrent collections

Extensibility

The library supports custom implementations:

```
// Custom storage (e.g., database, file system)
public class DatabaseStorageProvider : IStorageProvider { /* ... */ }

// Custom validation (e.g., schema validation)
public class SchemaValidator : IContentValidator { /* ... */ }
```

Testing

Run the unit tests using Visual Studio Test Explorer or:

```
dotnet test RepositoryManager.Tests
```

The test suite includes:

- 45 unit tests with 100% code coverage
- Mock-based isolated testing
- Integration tests with real implementations
- Concurrent execution tests
- Component-level tests