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Coding Practice

Chapter 1: Clean Code

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What is clean code and best practices?

What is Clean Code?

Code that is easy to read, understand, and maintain. Reflects care and craftsmanship of the developer.

Key Principles:

- Simplicity.
- Readability.
- Minimal dependencies.
- Maintenance.

Characteristics of Clean Code

- Readable: Like a well-written story.
- Simple: Avoids unnecessary complexity.
- Tested: Ensures reliability through unit and acceptance tests.
- Focused: Each piece does one thing well.
- Minimal Dependencies: Explicit and kept to a minimum.

Why Clean Code?

Clean code is essential for the long-term success and maintainability of any software project

Maintainability

- **Easier to understand**: Clean code is easier for other developers (and your future self) to read and comprehend.
- **Quicker updates**: Developers can identify the purpose of each component quickly, making updates or modifications less error-prone.

Debugging and Testing

- **Fewer bugs**: Cleaner, more organized code reduces logical errors and unexpected behaviors.
- **Simplified testing**: Well-structured code with clear functions and responsibilities is easier to write unit tests for.

Collaboration

- **Teamwork-friendly**: Clean code is easier to work on collaboratively since everyone can understand it without requiring extensive explanations.
- **Consistent style**: Adhering to clean coding principles ensures consistency, which helps team members quickly adapt to the codebase.

Why Clean Code?

Scalability

- **Handles complexity better**: Clean code adheres to good design principles (e.g., SOLID principles), ensuring the project scales gracefully as new features are added.

Cost Efficiency

- **Reduces technical debt**: Clean code minimizes the cost of future refactoring.
- **Speeds up onboarding**: New developers can get up to speed faster when the code is easy to follow.

Professionalism

- **Reflects care and expertise**: Writing clean code demonstrates professionalism and attention to detail, fostering trust among peers and stakeholders.

Best Practices for Clean Code

Meaningful Names

- **Variables, Functions, and Classes:** Use descriptive names that convey purpose. Avoid ambiguous or overly abbreviated names.
- **Naming Conventions:** Follow consistent naming conventions (e.g., camelCase for variables, PascalCase for classes).

Bad Example:

```
// 'd' does not clearly describe the meaning of the variable
int d;
```

Good Example:

```
// Variable names are clear and easy to understand
int daysSinceLastLogin;
```

Best Practices for Clean Code

Keep Functions Small

- Functions should perform a single task and be as small as possible. If a function does more than one thing, it should be split.

Bad

```
public void ProcessUserData(User user)
{
    // Check user
    if (user == null) throw new ArgumentNullException();

    // Perform complex processing logic
    // Check logic
    // Data processing logic
    // Notification sending logic
    // Logging
}
```

Good

```
public void ProcessUserData(User user)
    {
        ValidateUser(user);
        ProcessUserLogic(user);
        SendUserNotification(user);
        LogAction(user);
    }

private void ValidateUser(User user) { /* validation logic */ }
private void ProcessUserLogic(User user) { /* processing logic */ }
private void SendUserNotification(User user) { /* notification sending logic */ }
private void LogAction(User user) { /* logging logic */ }
```

Best Practices for Clean Code

Write Readable Code

- **Indentation:** Properly indent the code for better readability.
- **Whitespace:** Use blank lines to separate code logically (e.g., between different sections of a function or class).
- **Comments:** Use comments to explain *why* something is done, not *what* is done, unless the code is complex or non-obvious.
- **Avoid unnecessary comments:** Let the code be self-explanatory where possible.

Bad

```
int a = 1000; // '1000' has no clear meaning
if (a == 1000) { /* do something */ }
```

Good

```
const int MaxRetries = 3; // Clearly named constant
if (retries == MaxRetries) { /* do something */ }
```

Best Practices for Clean Code

Avoid Duplication (DRY Principle)

- Don’t Repeat Yourself. If the same logic or code is used in multiple places, extract it into a function or method.
- Use functions, methods, or classes to abstract repetitive logic.

Bad

```
public void SaveUser(User user)
    {
        if (user.Name == null) throw new ArgumentNullException();
        if (user.Email == null) throw new ArgumentNullException();
        // Logic for saving users
    }

public void SaveOrder(Order order)
    {
        if (order.Name == null) throw new ArgumentNullException();
        if (order.Email == null) throw new ArgumentNullException();
        // Logic to save orders
    }
```

Good

```
public void SaveEntity(Entity entity)
    {
        ValidateEntity(entity);
        // Logic to save entities
    }

private void ValidateEntity(Entity entity)
    {
        if (entity.Name == null) throw new ArgumentNullException();
        if (entity.Email == null) throw new ArgumentNullException();
    }
```

Best Practices for Clean Code

Error Handling

- Properly handle exceptions or errors using try-catch blocks, and ensure you provide meaningful error messages.
- Avoid silent failure (e.g., swallowing exceptions without logging them).

Bad

```
try
    {
        // Handling logic
    }
catch (Exception)
    {
        // Handle the error without logging or reporting anything
    }
```

Good

```
try
    {
        // Handling logic
    }
catch (Exception)
    {
        // Handle the error without logging or reporting anything
    }


try
    {
        // Processing logic
    }
catch (Exception ex)
    {
        LogError(ex);
        throw new CustomException("An error occurred while processing your request", ex);
    }

private void LogError(Exception ex)
    {
       // Log error details for easy debugging
    }
```

Best Practices for Clean Code

Single Responsibility Principle

- A class or function should have one responsibility. If you find yourself adding multiple concerns to a single class, refactor it.

Bad

```
0 references
public class UserManager
    {
        0 references
        public void RegisterUser(User user) { /* User registration logic */ }
        0 references
        public void SendWelcomeEmail(User user) { /* Welcome email sending logic */ }
    }
```

Good

```
1 reference
public class UserManager
    {
        1 reference
        private readonly EmailService _emailService;

        0 references
        public UserManager(EmailService emailService)
            {
                _emailService = emailService;
            }

        0 references
        public void RegisterUser(User user) { /* User registration logic */ }
    }

2 references
public class EmailService
    {
        0 references
        public void SendWelcomeEmail(User user) { /* Logic for sending welcome email */ }
    }
```

Best Practices for Clean Code

Keep It Simple (KISS Principle)

- Strive for simplicity in your code. Avoid over-complicating logic or solutions that could be solved in simpler ways.

Bad

```
public bool IsUserEligibleForDiscount(User user)
{
    if (user.Age > 18 && user.Age < 65 && user.MembershipType == "Gold" || user.MembershipType == "Platinum" || user.MembershipType == "Silver")
    {
        return true;
    }
    return false;
}
```

Good

```
public bool IsUserEligibleForDiscount(User user)
{
    var eligibleMemberships = new[] { "Gold", "Platinum", "Silver" };
    return user.Age > 18 && user.Age < 65 && eligibleMemberships.Contains(user.MembershipType);
}
```

Best Practices for Clean Code

Use Version Control Properly

- Commit code often with meaningful commit messages. This helps to track changes, revert if needed, and collaborate with others.

Bad

```
Commit message: "Fixed stuff"
```

Good

```
Commit message: "Fix issue #123: Resolve null reference exception in UserService"
Commit message: "Add validation for email format in registration form"
Commit message: "Update README.md with setup instructions"
```

Best Practices for Clean Code

9. Refactor Regularly

- Refactor your code frequently to improve readability, performance, and maintainability.
- Use automated tests to ensure refactoring does not introduce bugs.

10. Unit Testing

- Write unit tests for your functions and methods. This ensures your code works as expected and helps to identify issues early.
- Keep tests independent, isolated, and focused on one unit of work.

Best Practices for Clean Code

11. Avoid Magic Numbers and Strings

- Replace magic numbers (literal constants) or hardcoded strings with named constants or enums.

```
Bad Example:
public double CalculatePrice(double price)
{
    return price * 1.25; // What is 1.25? Magic number
}


Good Example:
public double CalculatePrice(double price)
{
    const double TaxRate = 1.25;
    return price * TaxRate;
}
```

12. Consistent Formatting

- Use consistent code formatting tools like linters or formatters to ensure code consistency across your project.

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Naming conventions and styles in C# Programming Language

Best Practices for Clean Code

C# Coding Standards and Naming Conventions

Object Name	Notation	Length	Plural	Prefix	Suffix	Abbreviation	Char Mask	Underscores
Namespace name	PascalCase	128	Yes	Yes	No	No	[A-z][0-9]	No
Class name	PascalCase	128	No	No	Yes	No	[A-z][0-9]	No
Constructor name	PascalCase	128	No	No	Yes	No	[A-z][0-9]	No
Method name	PascalCase	128	Yes	No	No	No	[A-z][0-9]	No
Method arguments	camelCase	128	Yes	No	No	Yes	[A-z][0-9]	No
Local variables	camelCase	50	Yes	No	No	Yes	[A-z][0-9]	No
Constants name	PascalCase	50	No	No	No	No	[A-z][0-9]	No
Field name Public	PascalCase	50	Yes	No	No	Yes	[A-z][0-9]	No
Field name Private	_camelCase	50	Yes	No	No	Yes	_[A-z][0-9]	Yes
Properties name	PascalCase	50	Yes	No	No	Yes	[A-z][0-9]	No
Delegate name	PascalCase	128	No	No	Yes	Yes	[A-z]	No
Enum type name	PascalCase	128	Yes	No	No	No	[A-z]	No

Best Practices for Clean Code

Do use PascalCasing for class names and method names:

```
0 references
public class ClientActivity
{
    0 references
    public void ClearStatistics()
    {
        //...
    }
    0 references
    public void CalculateStatistics()
    {
        //...
    }
}
```

Best Practices for Clean Code

Do use camelCasing for method arguments and local variables:

```
public class UserLog
{
    0 references
    public void Add(LogEvent logEvent)
    {
        int itemCount = logEvent.Items.Count;
        // ...
    }
}
```

Best Practices for Clean Code

Do not use Hungarian notation or any other type identification in identifiers

```
// Correct
int counter;
string name;

// Avoid
int iCounter;
string strName;
```

Best Practices for Clean Code

Do not use Screaming Caps for constants or readonly variables:

```
// Correct
0 references
public const string ShippingType = "DropShip";
// Avoid
0 references
public const string SHIPPINGTYPE = "DropShip";
```

Best Practices for Clean Code

Use meaningful names for variables. The following example uses binhduongCustomers for customers who are located in Binh Duong:

```
var binhduongCustomers = from customer in customers
  where customer.City == "Bình Dương"
  select customer.Name;
```

Best Practices for Clean Code

Avoid using Abbreviations. Exceptions: abbreviations commonly used as names, such as Id, Xml, Ftp, Uri.

```
// Correct
UserGroup userGroup;
Assignment employeeAssignment;
// Avoid
UserGroup usrGrp;
Assignment empAssignment;
// Exceptions
CustomerId customerId;
XmlDocument xmlDocument;
FtpHelper ftpHelper;
UriPart uriPart;
```

Best Practices for Clean Code

Do use PascalCasing or camelCasing (Depending on the identifier type) for abbreviations 3 characters or more (2 chars are both uppercase when PascalCasing is appropriate or inside the identifier).:

```
HtmlHelper htmlHelper;
FtpTransfer ftpTransfer, fastFtpTransfer;
UIControl uiControl, nextUIControl;
```

Best Practices for Clean Code

Do not use Underscores in identifiers.
Exception: you can prefix private fields with an underscore:

```
1    // Correct
     0 references
2    public DateTime clientAppointment;
     0 references
3    public TimeSpan timeLeft;
4    // Avoid
     0 references
5    public DateTime client_Appointment;
     0 references
6    public TimeSpan time_Left;
7    // Exception (Class field)
     0 references
8    private DateTime _registrationDate;
```

Best Practices for Clean Code

Do use predefined type names (C# aliases) like int, float, string for local, parameter and member declarations. Do use .NET Framework names like Int32, Single, String when accessing the type's static members like Int32.TryParse or String.Join.

```
1   // Correct
2   string firstName;
3   int lastIndex;
4   bool isSaved;
5   string commaSeparatedNames = String.Join(", ", names);
6   int index = Int32.Parse(input);
7   // Avoid
8   String firstName;
9   Int32 lastIndex;
10  Boolean isSaved;
11  string commaSeparatedNames = string.Join(", ", names);
12  int index = int.Parse(input);
13
```

Best Practices for Clean Code

Do use implicit type var for local variable declarations. Exception: primitive types (int, string, double, etc) use predefined names.

```
1    var stream = File.Create(path);
2    var customers = new Dictionary();
3    // Exceptions
4    int index = 100;
5    string timeSheet;
6    bool isCompleted;
```

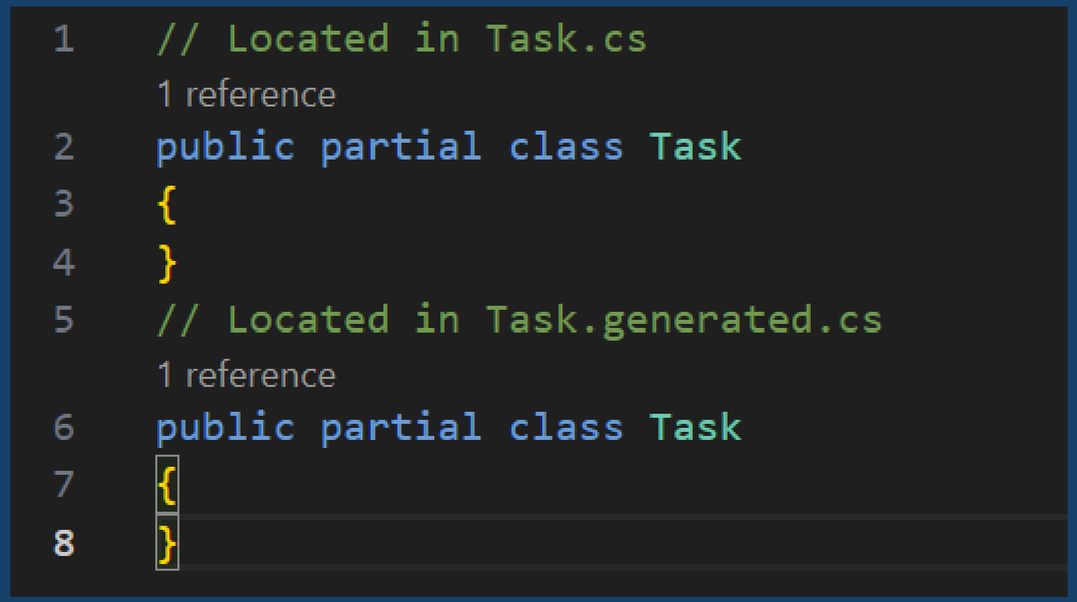
Best Practices for Clean Code

Do use noun or noun phrases to name a class.

```
0 references
1   public class Employee
2   {
3   }
    0 references
4   public class BusinessLocation
5   {
6   }
    0 references
7   public class DocumentCollection
8   {
9   }
```

Best Practices for Clean Code

Do name source files according to their main classes. Exception: file names with partial classes reflect their source or purpose, e.g. designer, generated, etc.



Best Practices for Clean Code

Do organize namespaces with a clearly defined structure:

```
// Examples
namespace Company.Technology.Feature.Subnamespace
{
}
namespace Company.Product.Module.SubModule
{
}
namespace Product.Module.Component
{
}
namespace Product.Layer.Module.Group
{
}
```

Best Practices for Clean Code

Do vertically align curly brackets:

```
1   // Correct
    0 references
2   class Program
3   {
        0 references
4       static void Main(string[] args)
5       {
6           //...
7       }
8   }
9
```

Best Practices for Clean Code

Do declare all member variables at the top of a class, with static variables at the very top.

```
// Correct
public class Account
{
  public static string BankName;
  public static decimal Reserves;
  public string Number { get; set; }
  public DateTime DateOpened { get; set; }
  public DateTime DateClosed { get; set; }
  public decimal Balance { get; set; }
  // Constructor
  public Account()
  {
    // ...
  }
}
```

Best Practices for Clean Code

Do use singular names for enums. Exception: bit field enums.

```
// Correct
public enum Color
{
  Red,
  Green,
  Blue,
  Yellow,
  Magenta,
  Cyan
}
// Exception
[Flags]
public enum Dockings
{
  None = 0,
  Top = 1,
  Right = 2,
  Bottom = 4,
  Left = 8
}
```

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