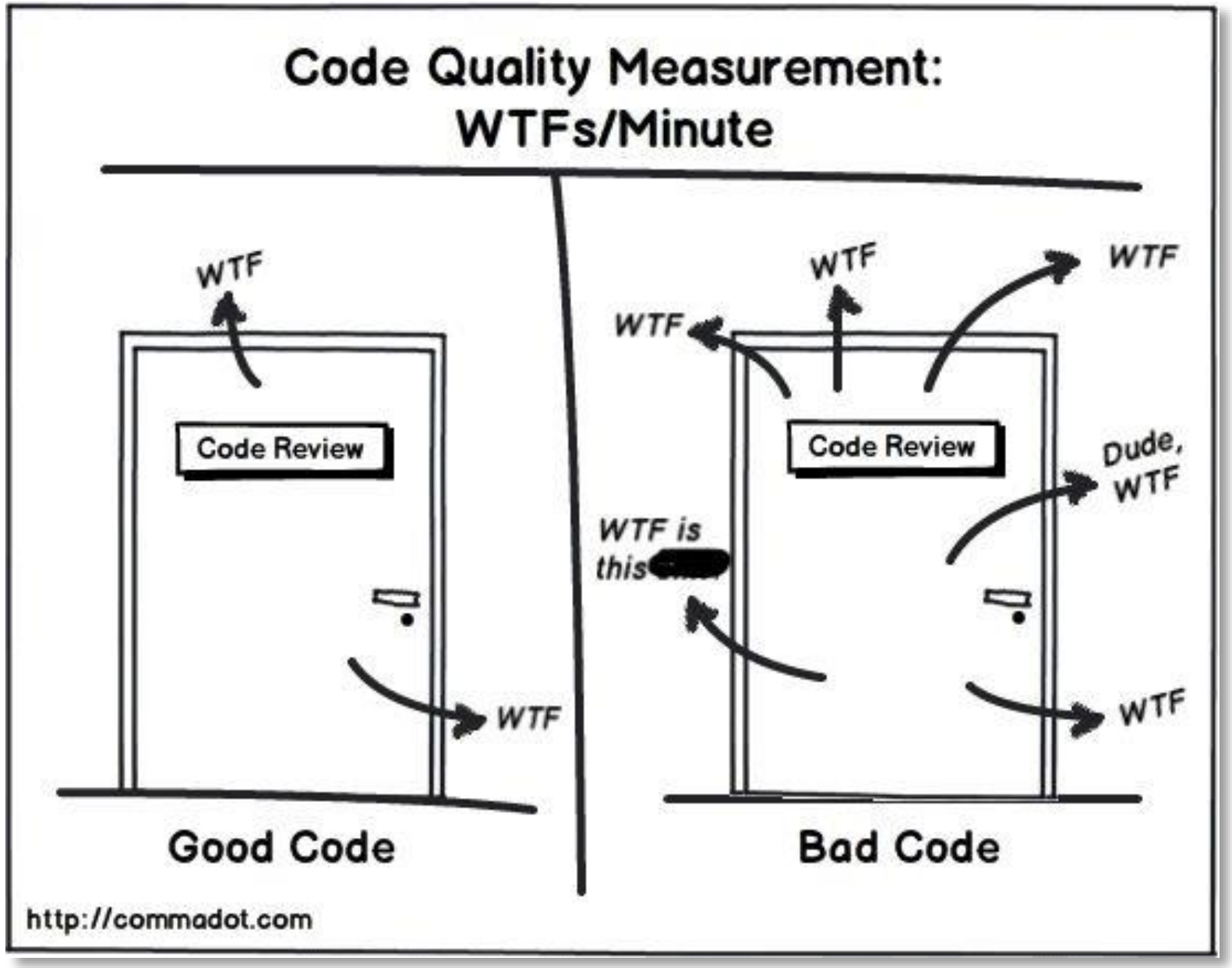
Module 04:

"Code Better C#"


Code Quality Measurement:
WTFs/Minute
WTF
Code Review
WTF
Good Code
WTF
WTF
WTF
WTF
Code Review
Dude,
WTF
WTF is
this
WTF
Bad Code
http://commadot.com

Agenda

- Introduction
- **Clean Code**
- Exception Do's and Don'ts
- Code Complexity
- Curing Primitive Obsession
- Summary

What is Clean Code?

- Make code readable
- Reflect intent
- Express yourself in code

- Originally:
  - Published set of rules

- Modern interpretation:
  - Subjective set of recommendations
  - Broadly accepted as becoming technology-specific

> "Even bad code can function. But if code isn't clean, it can bring a development organization to its knees"
>
> - Clean Code by Robert C. Martin

CBC#1: Early Return Principle

- Turn failed guard clauses into quick returns
- One of the steps to avoid deeply nested structures

CBC#2: Use Nonnullable Reference Types

- (Non)nullability of reference types make C# powerfully expressible
  - Use it! Always..! (All the time! No buts... ☺)
- This will actually remove quite many guard clauses altogether

- Prefer using the **`required`** keyword instead of multiple overloads of constructors
  - The **`init`** accessor is your friend

CBC#3: Name Booleans Positively

- Always name boolean variables, fields, and methods as
  - `IsXxx`
  - `HasYyy`

- Use positive version of boolean proposition
  - Better for complex boolean expressions
  - Avoids double negatives

CBC#4: Merge Multiple If-statements

- Enhance readability and conciseness by collapsing
  - If-statements
  - Boolean expressions

CBC#5: Replace Boolean Expressions with Descriptive Methods

- Introduce more variables and methods if necessary
  - Provide "comments in code"
  - Are searchable
  - Minimize need for actual textual comments

CBC#6: Use LINQ for Conciseness

- Always prefer LINQ for precision, reusability, and clarity
- Don’t worry about micro-optimizations…!

CBC#7: No Magic Numbers or Strings

- Replace magic numbers with constants
- Replace magic strings with enums

CBC#8: Prefer String Interpolation over Concatenation

- Type-safe and more performant alternative to concatenation
- Use raw string literals for structured strings

CBC#9: Express Fields and Primary Constructors

- In general:
  - Use **_xxx** for fields and **xxx** for variables
- In primary constructors
  - Use **_xxx** when captured
  - Use **xxx** when not captured.

CBC#10: Embrace Pattern Matchings

- Readability in syntax duality
  - Object initializers create
  - Pattern matchings check

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CBC#11: Throw Custom Exceptions

- Never throw generic Exceptions!
- At least throw specific exception
- But prefer throwing custom exceptions
  - Can use contextual information in Exception, e.g. OrderId
  - Can match on such information in
    - Exception when clauses
    - Pattern matching

Lippert's Exception Taxonomy

- Eric Lippert classifies exceptions into four exception categories

- Fatal
- Boneheaded
- Vexing
- Exogenous

- Stephen Cleary expands of this classification in
  - https://blog.stephencleary.com/2011/03/exception-types.html

Fatal Exceptions

- **Definition:** Fatal exceptions are *not your fault*, and you *cannot sensibly clean up from them*.
- **Examples:** Out of memory, thread aborted.
- **Resolution:** Don't catch; let them crash the program.
- **Design:** Don't ever throw fatal exceptions directly.

Boneheaded Exceptions

- **Definition:** Boneheaded exceptions are *violations of the API*, and are *bugs in your code*.
- **Examples:** Argument is null, index out of range.
- **Resolution:** Don't catch; fix them in the code.
- **Design:** Use code contracts for boneheaded exceptions; do not document the specific exception type.

Vexing Exceptions

- **Definition:** Vexing exceptions are due to *bad design decisions*, thrown in *non-exceptional situations*.
- **Examples:** Parsing errors.
- **Resolution:** Avoid calling vexing functions; if not possible, catch the vexing exception.
- **Design:** Don't ever throw vexing exceptions.

Exogenous Exceptions

- **Definition:** Exogenous exceptions are from *unpredictable, external influences*.
- **Examples:** File not found, resource already in use.
- **Resolution:** Always catch and handle.
- **Design:** Throw exogenous exceptions as necessary; document the specific exception type.

Alternative: Result Object Pattern

- Some people advocate the Result Object Pattern as an alternative to using exceptions

- Pattern:
  - Create a return type to be returned from method
  - Contains
    - Result type (when processing was success)
    - Error indication (when processing was unsuccessful)

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Code Metrics Values in Visual Studio

- Visual Studio can generate code metrics data to measure complexity and maintainability of your code

- Main metrics are:
  - Maintainability Index
  - Cyclomatic Complexity
  - Depth of Inheritance
  - Class Coupling

- Additionally:
  - Lines of Source Code
  - Lines of Executable Code

- https://learn.microsoft.com/en-us/visualstudio/code-quality/code-metrics-values?view=vs-2022

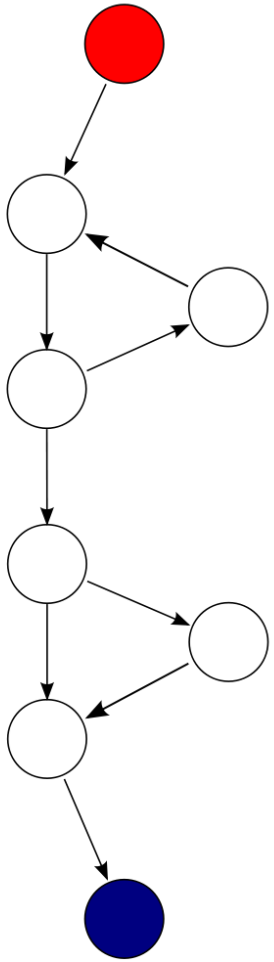
How to Generate Code Metrics Values

- Generate code metrics in Visual Studio via
  - **`Analyze`** > **`Calculate Code Metrics`**

- Alternatively;
  - Enable .NET code quality analyzers in Solution Explorer or **`EditorConfig`** file
  - Command line

Cyclomatic Complexity

- Measures the amount of decision logic in a source code function
  - ~ number of paths through a method
- Influenced by boolean operators, `if`, `switch`, `while`, …
- Lower is good
- Higher is bad
  - indicates more tests needed to cover it
  - indicates harder to maintain



Maintainability Index

- Calculates an index value between 0 and 100 that represents the relative ease of maintaining the code
  - ~ Complexity per program parts

Size of program's size in "bits"

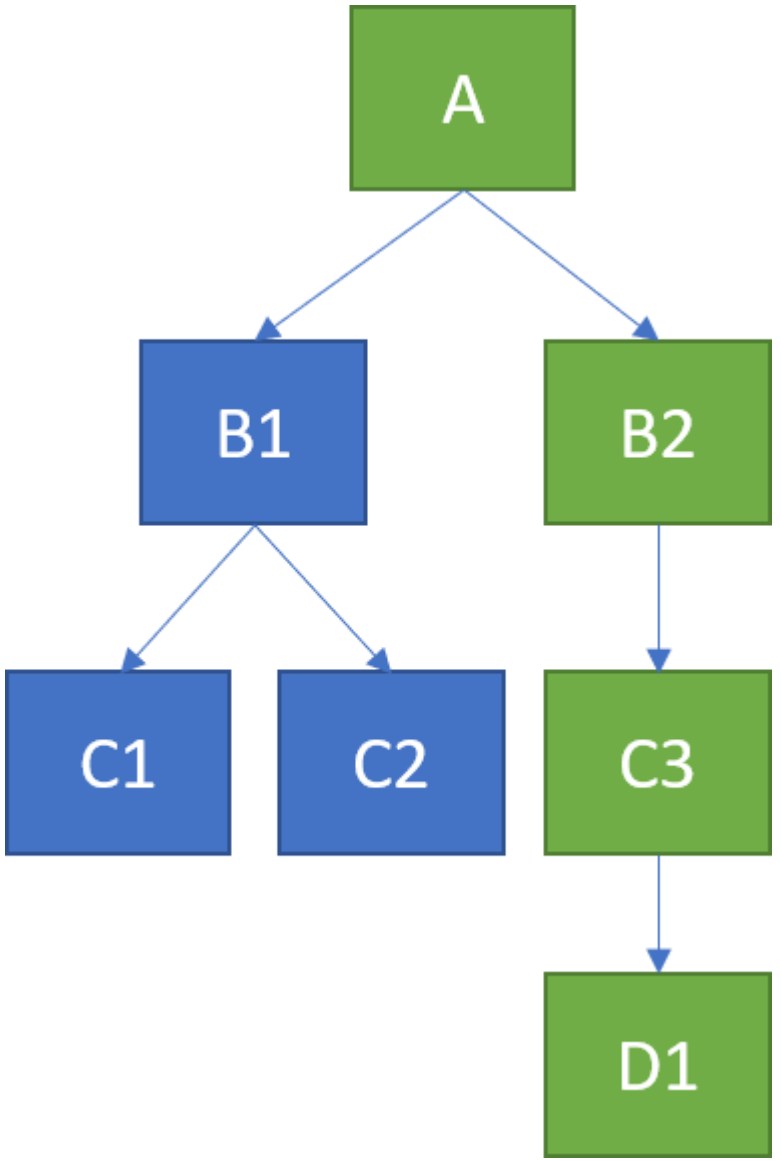
Maintainability Index = Max(
  0,
  (171 - 5.2 * ln(*Halstead Volume*)
    - 0.23 * (*Cyclomatic Complexity*)
    - 16.2 * ln(*Lines of Code*)
)*100 / 171
)

- Higher is good
  - 0-9 10-19 20-100

Depth of Inheritance

- Measures the depth of longest inheritance chain from root to leaf classes

- Lower
  - implies less complexity but also the possibility of less code reuse through inheritance.
- Higher
  - implies more potential for code reuse through inheritance but also higher complexity with a higher probability of errors in the code.



Class Coupling

- Measures the coupling to unique classes through
  - parameters, local variables, return types, method calls, generic or template instantiations, base classes, interface implementations, fields defined on external types, and attribute decoration
- ~ how many “custom” types the class uses

- Lower is good
  - High cohesion and low coupling is preferred

- Higher is bad
  - Difficult to reuse and maintain due to interdependencies on other types

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What is Primitive Obsession?

- ”Primitive Obsession” ~ Code smell where primitive data types only are used for modelling your domain classes and objects
- String is not your friend!
- Type-safety is lost
- Validation logic is scattered and/or duplicated

Doctor's Prescriptions

- Cure primitive obsession by
  - Create value objects
    - Validation
  - Create strongly-typed id types
    - Type-safety
  - Refactor scattered algorithms into Strategy objects
- Consider reusability and/or "frameworks" for value objects and types

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