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Schedule

09:45	Zoom Meeting Starts
10:00	Training Begins (prompt)
11:30	Break
11:45	Training resumes
13:00	Lunch
14:00	Training resumes (prompt)
15:30	Break
15:45	Training resumes
17:00	End

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What To Expect Today

- Introduction to Refactoring
- The Refactoring Discipline
- Code Smells
  - Long Methods
  - Comments
  - Duplicate Code
  - Divergent Change & Large Classes
  - Message Chains
  - Long Parameter Lists
  - Data Clumps

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What To Expect Tomorrow

- More Code Smells
  - Primitive Obsession
  - Feature Envy & Data Classes
  - Switch Statements
- Legacy Code
- Refactoring Metrics
  - Code Quality Metrics
  - Software Delivery metrics
- Long-Form Refactoring
  - Refactoring Golf

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Introduction To Refactoring

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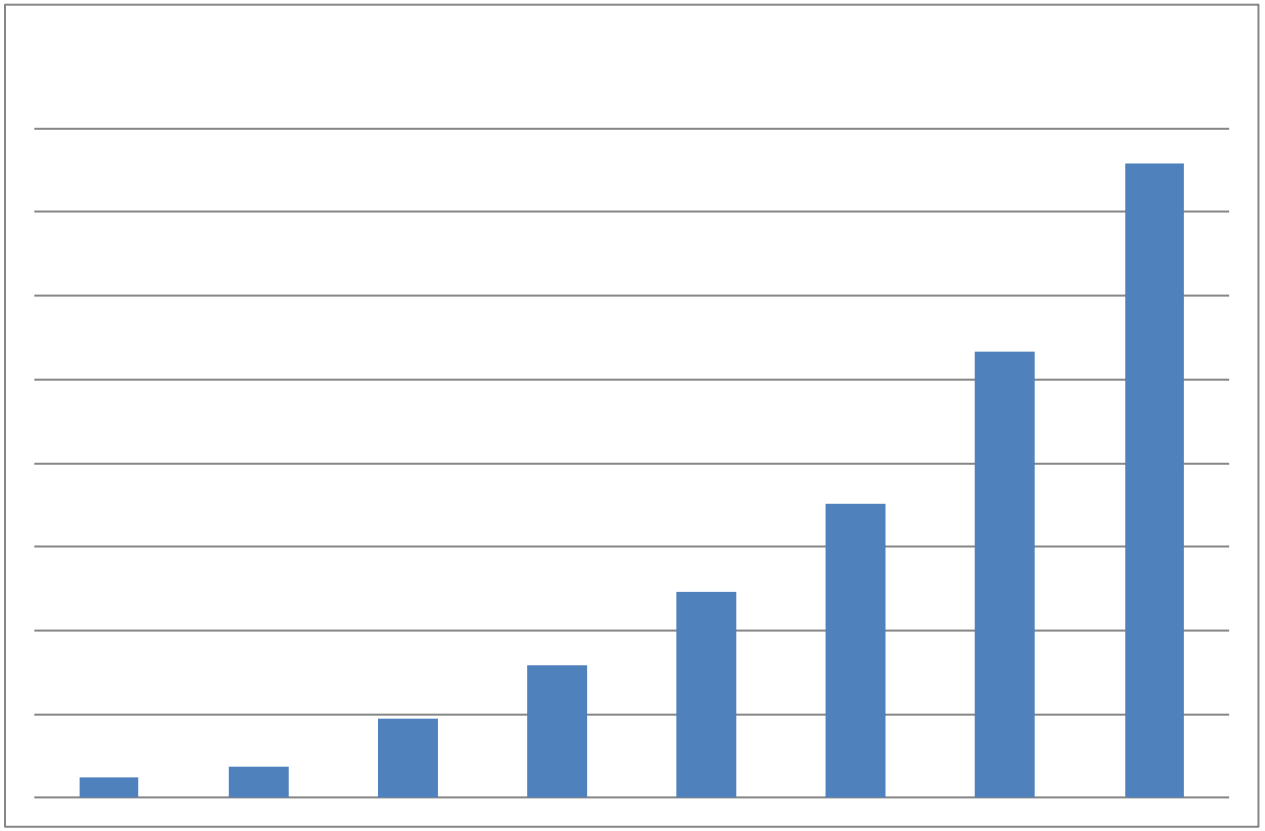
Delivery Lead Times



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What Makes Code Harder To Change?

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Readability

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Complexity

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Duplication

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Dependencies & The “Ripple Effect”

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Refactoring

Improving The Internal Design Of Software To Make It Easier To Change

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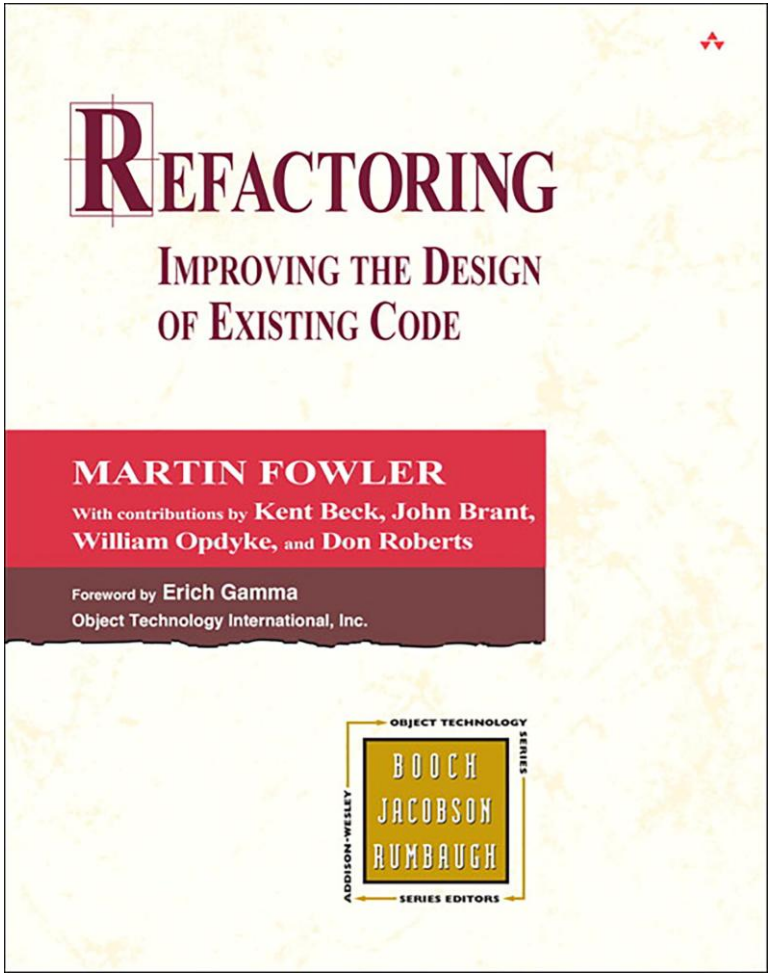

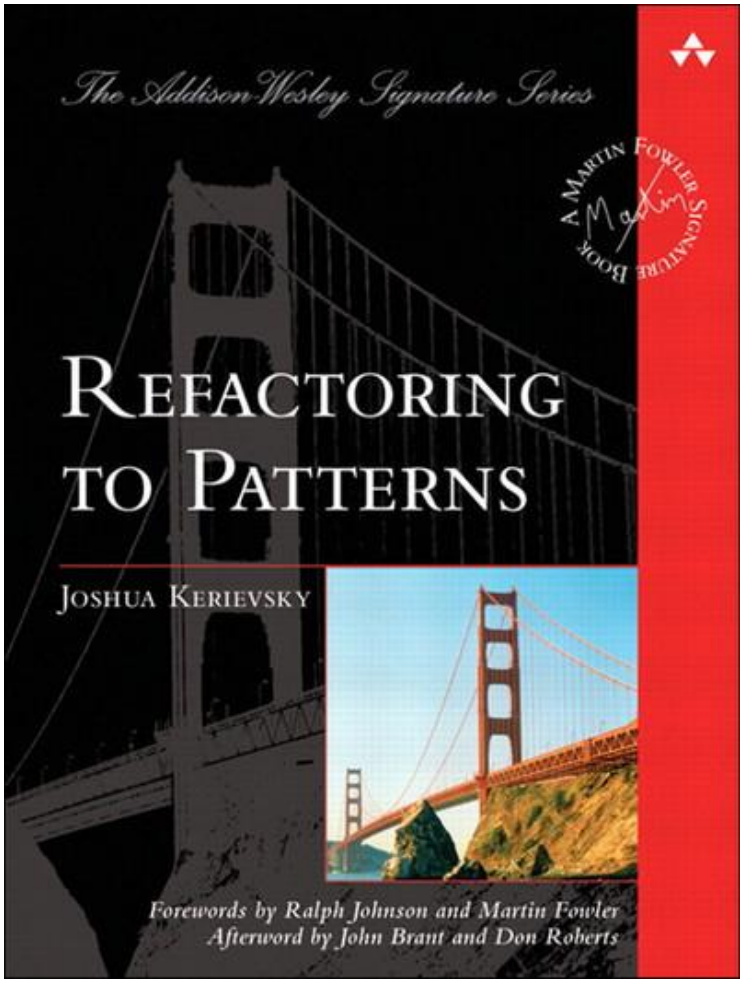

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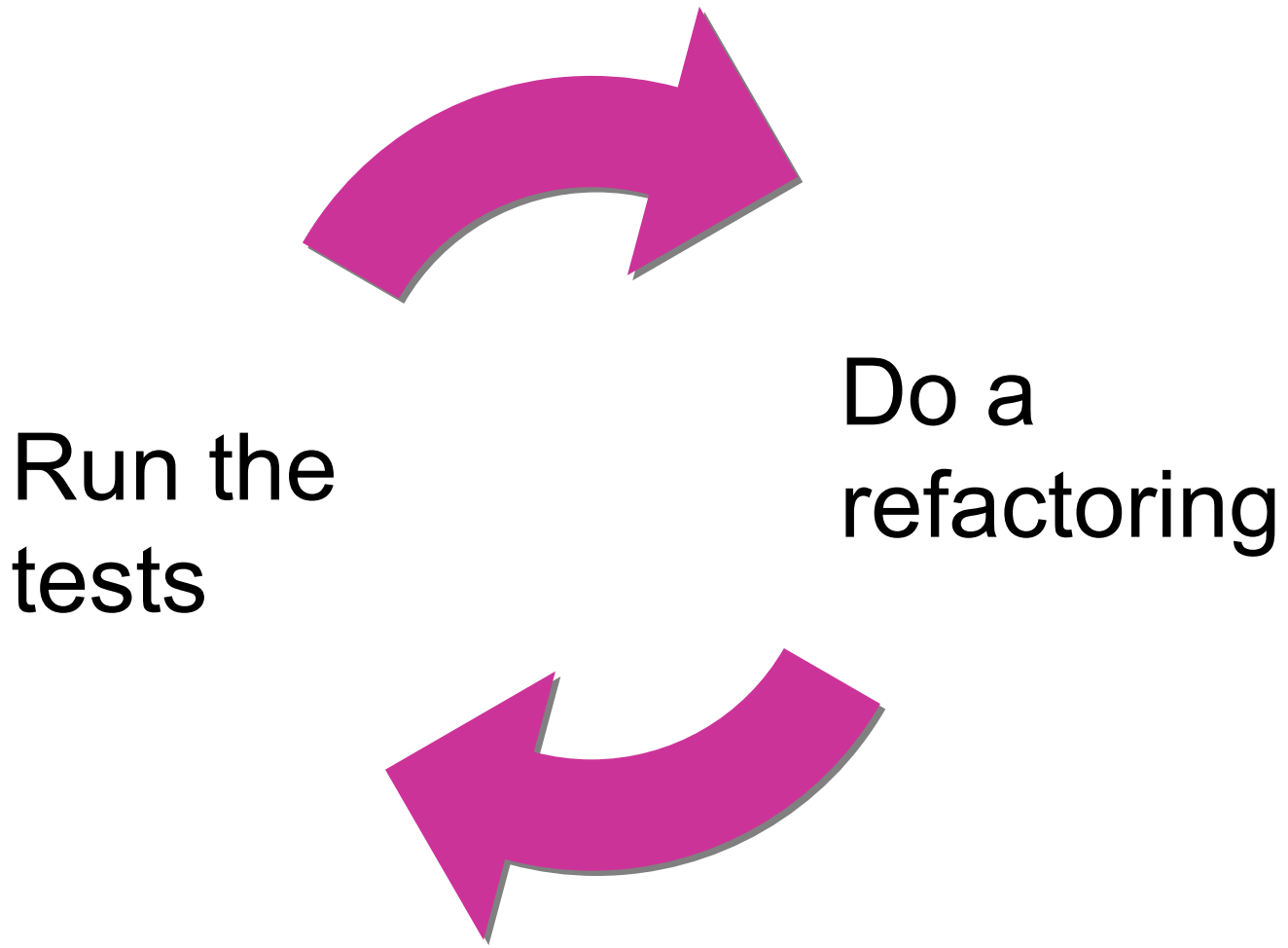
Refactoring Process



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Refactoring Habits

- Do one refactoring at a time
- Run the tests after every refactoring
- Refactor directly to well-defined goals
- Commit on green, revert on red
- **Never** refactor on a red light
- Use *predictable* automated refactorings whenever possible
- If sufficient tests don’t exist, write them before refactoring

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test && commit || revert

```
git add .
dotnet test && git commit -m "Working commit" || git reset --hard
```

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Code Smells

- …are indications of *increasing entropy* in your code
  - Increasing complexity
  - Increasing duplication
  - Increasing dependency issues
  - Decreasing comprehensibility
- As time goes on, code can become *rigid* and *brittle*

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Classes Of Code Smell

Complexity

- **Long Method**
- **Large Class**
- **Primitive Obsession**
- Data Clumps
- **Long Parameter Lists**

Responsibility Problems

- **Divergent Change**
- Shotgun Surgery
- **Data Class**

Couplers

- **Feature Envy**
- **Message Chains**
- Inappropriate Intimacy
- Middle Man

OO Abuses

- **Switch Statements**
- Temporary Field
- Refused Bequest
- Alternative Classes With Different Interfaces
- Parallel Inheritance Heirarchies

Redundancy

- Lazy Class
- **Duplicate Code**
- Dead Code
- Speculative Generality

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Primitive Refactorings (“Short-Form”)

	Applies To				
Rename	Any identifier				
Safe Delete	Any declaration or file				
Move	Method/Function	Field	Type	File	
Extract Method	Expression	Statement/Block			
Extract Class	Class				
Extract Superclass	Class				
Extract Interface	Class				
Change Signature	Method/Function				
Introduce Parameter	Expression				
Introduce Parameter Object*	Method				
Introduce Variable	Expression				
Introduce Field	Expression				
Inline	Class	Field	Method	Variable	Parameter

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* *Transform Parameters* in Rider

Composite Refactorings (“Long-Form”)

- Replace Method with Method Object
- Replace Conditional With Polymorphism
  - Replace Type Code With Strategy
- Replace Magic Literals With Enum
- Replace Parameter with Method
- Replace Data Value with Object
- Replace Array With Object
- Substitute Collaborator
- Hide Delegate
- Decompose Conditional
- Preserve Whole Object

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* *Transform Parameters* in Rider

Get The Source Code

https://github.com/jasongorman/csharp_code_smells

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Long Methods

- Extract Method
- Decompose Conditional
- Introduce Field

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Comments

- Rename Method/Variable/Class etc
- Extract Method, Class
- Introduce Variable, Field (inc. constant)
- Replace Magic Literals With Enum

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Duplicate Code

- Extract Method
- Extract Class
- Extract Superclass

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Divergent Change/Large Class

- Extract Class
- Replace Method With Method Object

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Message Chains

- Hide Delegate
  - Extract Method
  - Move Method
- Substitute Collaborator

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Long Parameter Lists

- Replace Parameter with Method
- Introduce Parameter Object
- Preserve Whole Object

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Primitive Obsession

- Replace Data Value With Object
- Replace Array With Object

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Feature Envy

- Extract Method
- Move Method
- Move Field

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Data Classes

- Move Method
- Move Field

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Refactoring To Patterns

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Switch Statements

- Replace Type Code With Strategy

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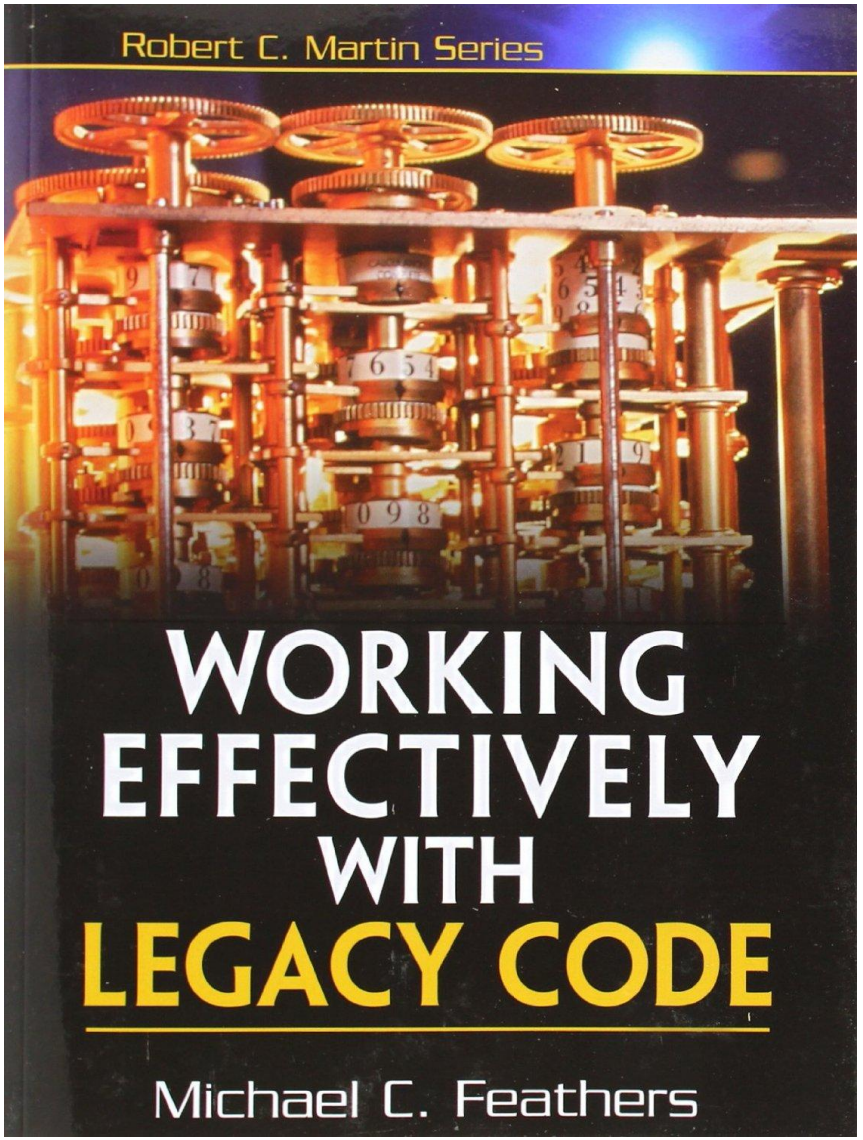
TDD & Legacy Code



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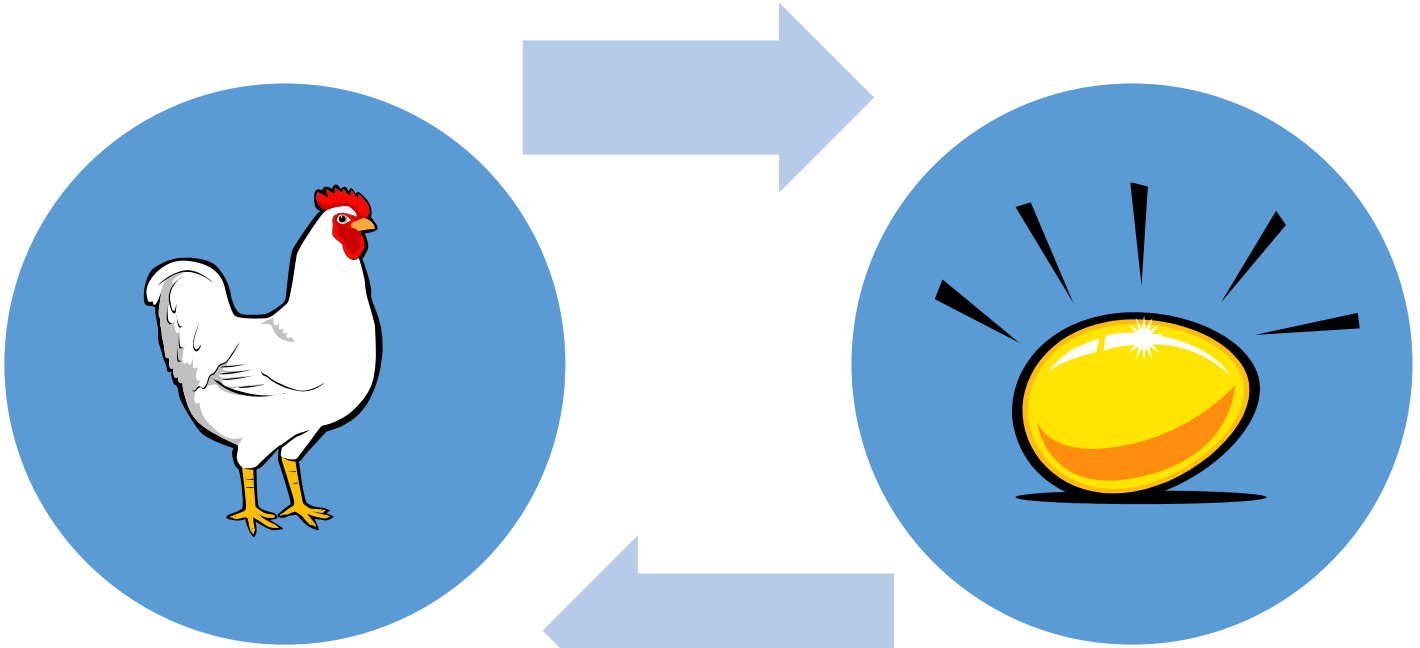
Catch 22



Need to refactor to make code unit testable

No automated tests to support refactoring

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5-Step Process

1. Identify What Code Needs To Change
2. Refactor Code To Make It Unit-Testable
3. Write Unit Tests
4. Make The Change
5. Apply The “Boy Scout Rule”

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Refactoring Metrics

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Code Metrics

Indicators of Maintainability

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Dimensions of Maintainability

- Complexity
- Coupling & Cohesion
- Duplication
- Readability

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Code Quality Metrics - Complexity

- Lines of code
- Cyclomatic complexity
- No. of Methods, Classes etc.
- Halstead metrics
- Maintainability Index

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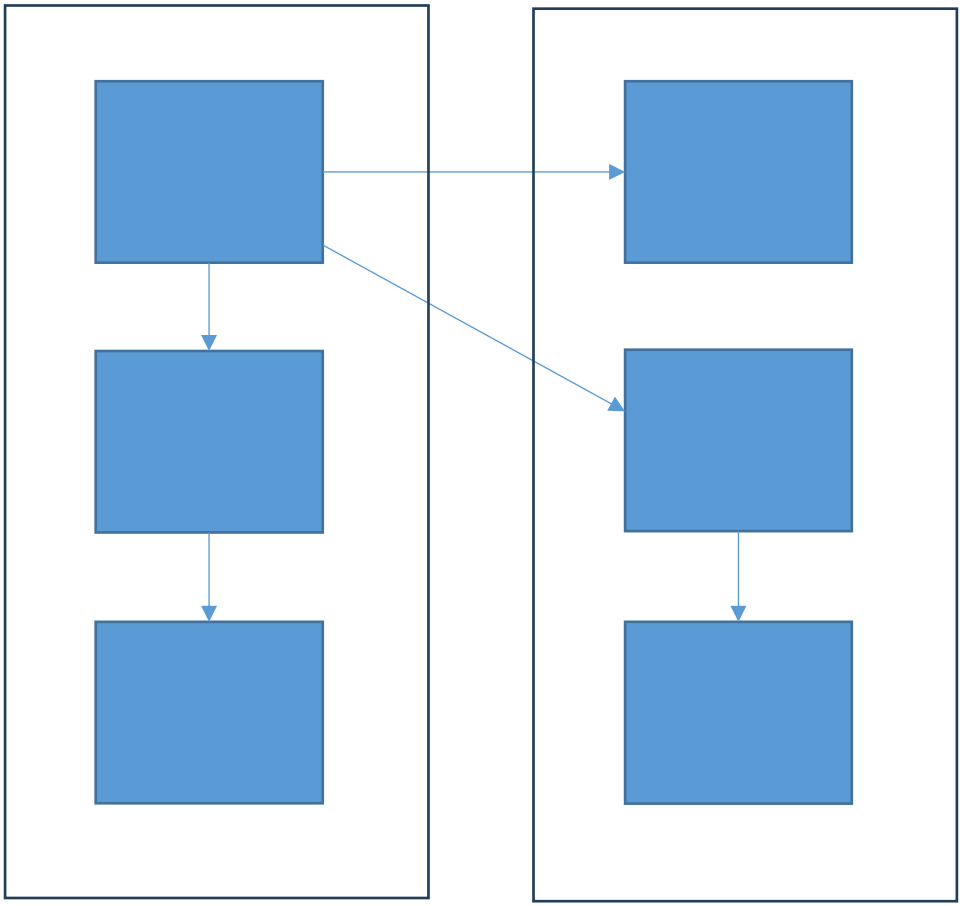
Code Quality Metrics – Coupling & Cohesion



Various Static Analysis Tools e.g., NDepend

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Code Quality Metrics - Duplication

```
public void Credit(float amount)
{
    balance += amount;
    transactions.Add(new Transaction(true, amount));
    DateTime now = DateTime.Now;
    lastTransactionDate = now.Date + "/" +
                          now.Month + "/" +
                          now.Year;
}

public void Debit(float amount)
{
    balance -= amount;
    transactions.Add(new Transaction(true, -amount));
    DateTime now = DateTime.Now;
    lastTransactionDate = now.Date + "/" +
                          now.Month + "/" +
                          now.Year;
}
```

Code Similarity Finder
https://simian.quandarypeak.com/

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Code Quality Metrics – Readability Testing

```
int[] numbers = {2,0,7,13,3,2,9,15,4}
var min = Int32.MaxValue;
     for (var i = 0; i < numbers.length; i++) {
          int number = numbers[i];
          if (number < min)
               min = number;
  }
  Console.WriteLine(min);
```

What will the output of this code be?

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Complexity As A (Rough) Indicator Of Readability

- Halstead Difficulty
- Cyclomatic Complexity

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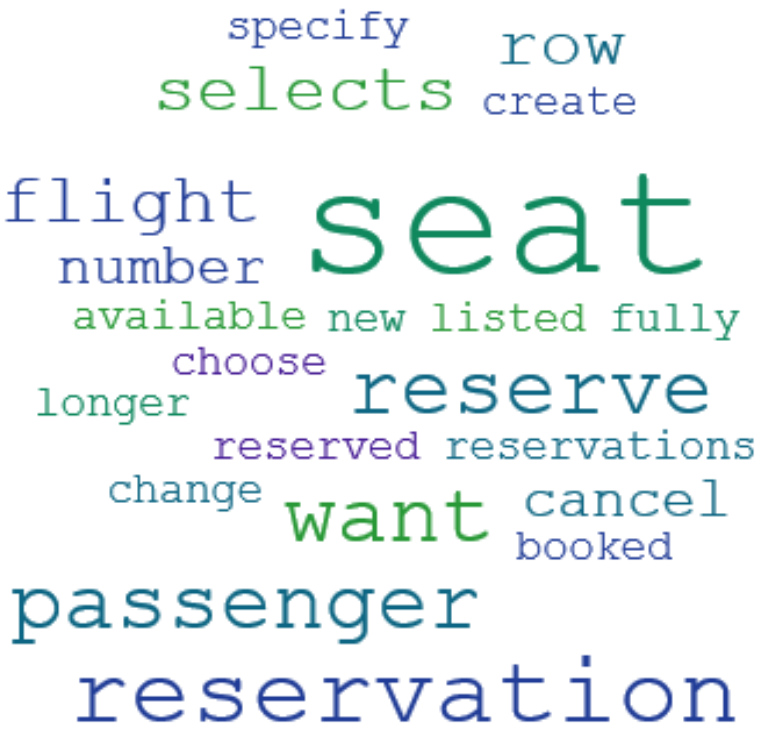
Conceptual Correlation

```
public class PlaceRepositoryTests {

  @Test
  public void allocateFlagsPlaceForUser() {
    PlaceRepository placeRepository =
                        new PlaceRepository();
    User user = new User();
    Place place =
          placeRepository.allocate("A", 1, user);
    assertEquals(user, place.flaggedFor());
  }

}
```

```
public class FlightSeatingTests {

  @Test
  public void seatIsReservedForPassenger() {
    FlightSeating seating = new FlightSeating();
    Passenger passenger = new Passenger();
    SeatReservation reservation
            = seating.reserve("A", 1, passenger);
    assertEquals(passenger,
                    reservation.getPassenger());
  }

}
```



.NET Standard POC
https://github.com/jasongorman/Conceptual

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Automated Code Smell Detection

- Roslyn Code Analysis
- SonarQube (C# plugin)
- NDepend

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Software Delivery Metrics

The Pay-Off For Refactoring

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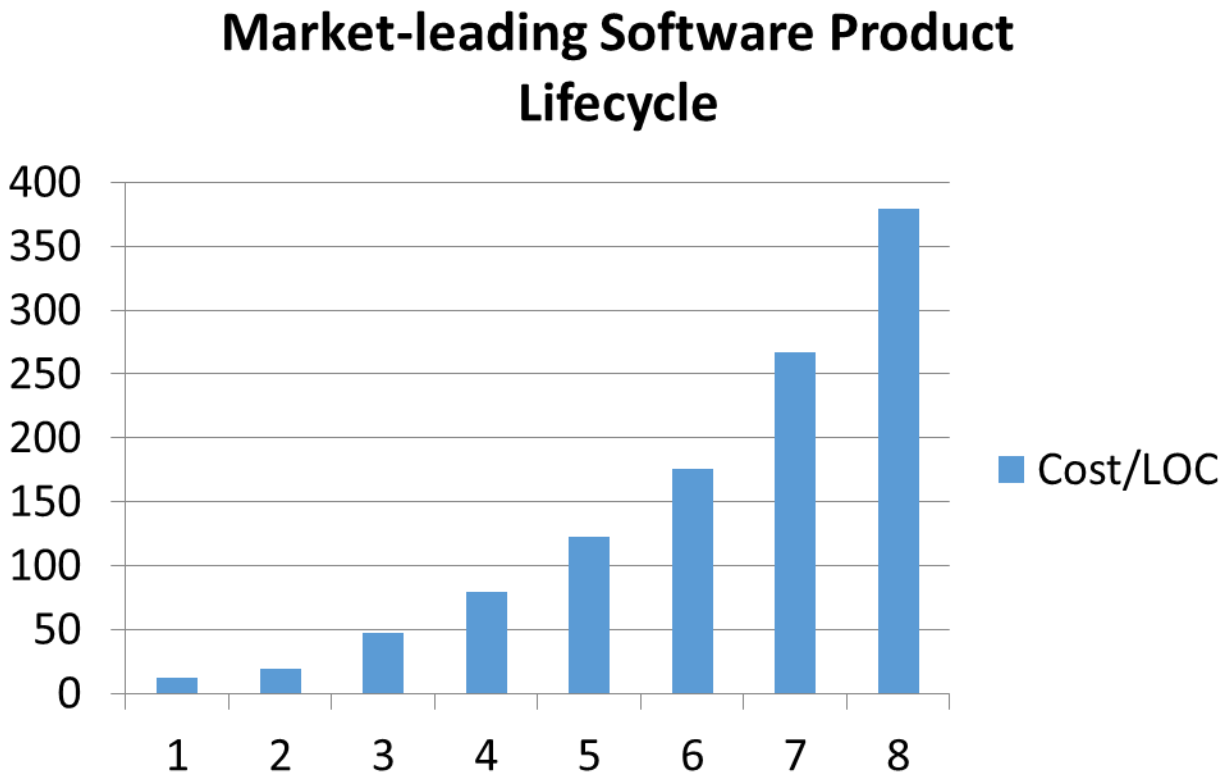
Cost of Change

- Cost of adding, modifying or deleting a line of code
  - Total development cost (e.g., per week) / code churn (e.g., per week)



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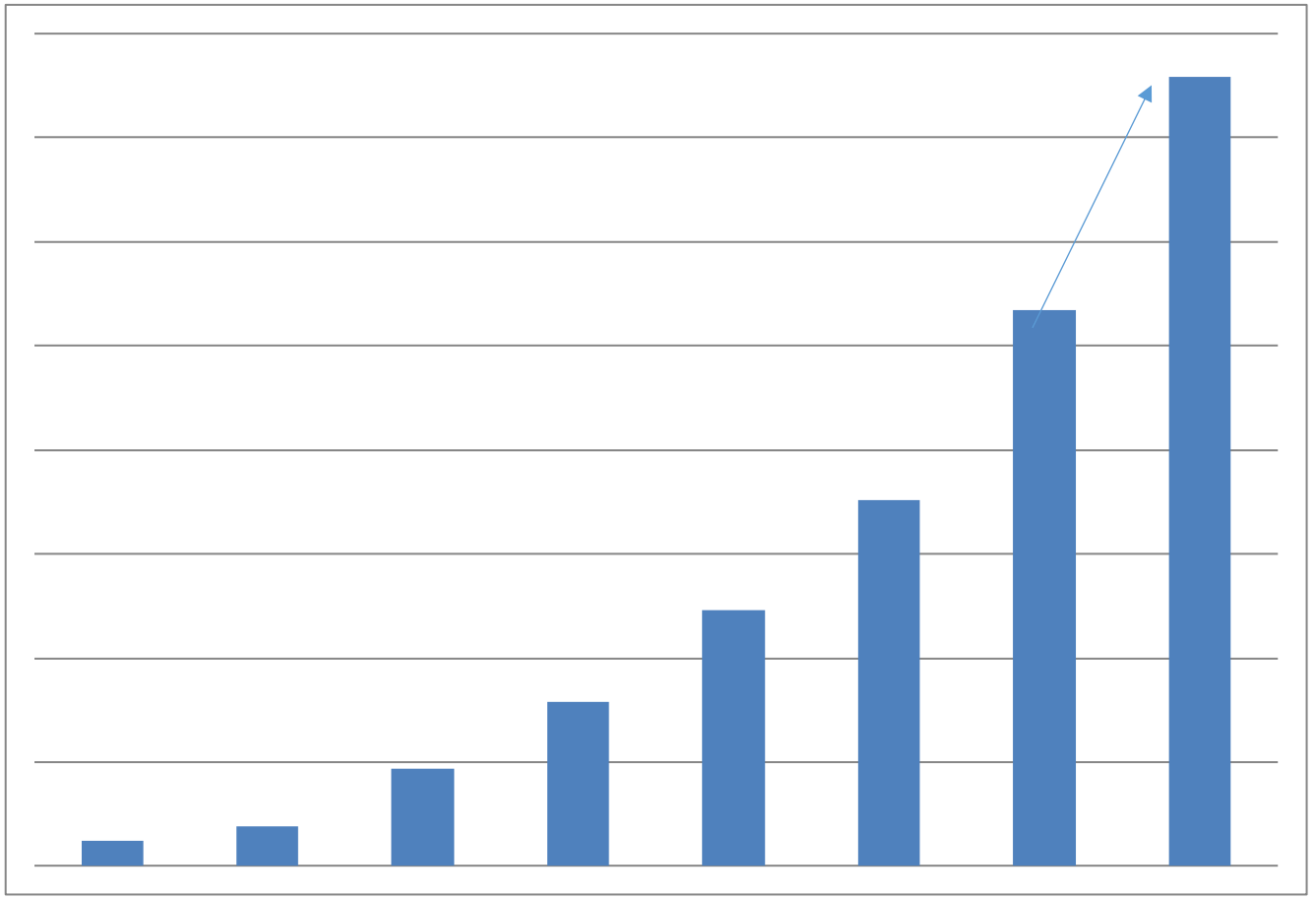
Sustainability of Delivery

- Power Law distribution of lead time over time

$$\frac{52}{44} = 1.18$$



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Business Metrics – Delivery Lead Time

- Elapsed time from a feature being requested to a working implementation available to end users
  - Agile teams (Continuous Delivery) – hours -> weeks
  - Waterfall teams (“Big bang” rollouts) – months -> years

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Business Metrics – Delivery Lead Time

- Elapsed time from a feature being requested to a working implementation available to end users
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  - Waterfall teams (“Big bang” rollouts) – months -> years

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Refactoring Golf

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The Game

```
public void debit(float amount) {

      // deduct amount from balance
      balance -= amount;

      // record transaction
      transactions.add(new Transaction(true,
          amount));

      // update last debit date
      Calendar calendar = Calendar.getInstance();

      lastDebitDate = calendar.get(Calendar.DATE)
          + "/" +
      calendar.get(Calendar.MONTH) + "/" +
      calendar.get(Calendar.YEAR);
}
```

```
public void debit(float amount) {
      deductAmountFromBalance(amount);
      recordTransaction(amount);
      updateLastDebitDate();
}
```

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Scoring (Per Move)

- 1 point – for each automated refactoring
- 1 point – for each cut & paste
- 1 point – for any code edit done using shortcuts (e.g. CTRL+F)
- 0 points – for code formatting (e.g., deleting a blank line)

PENALTIES

- 2 points – for every change to a line of code done manually
- x2 – for any move made while the code can't pass the tests
- 2 points – for copying and pasting code

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Get The Code

https://github.com/jasongorman/CSharp_RefactoringGolf

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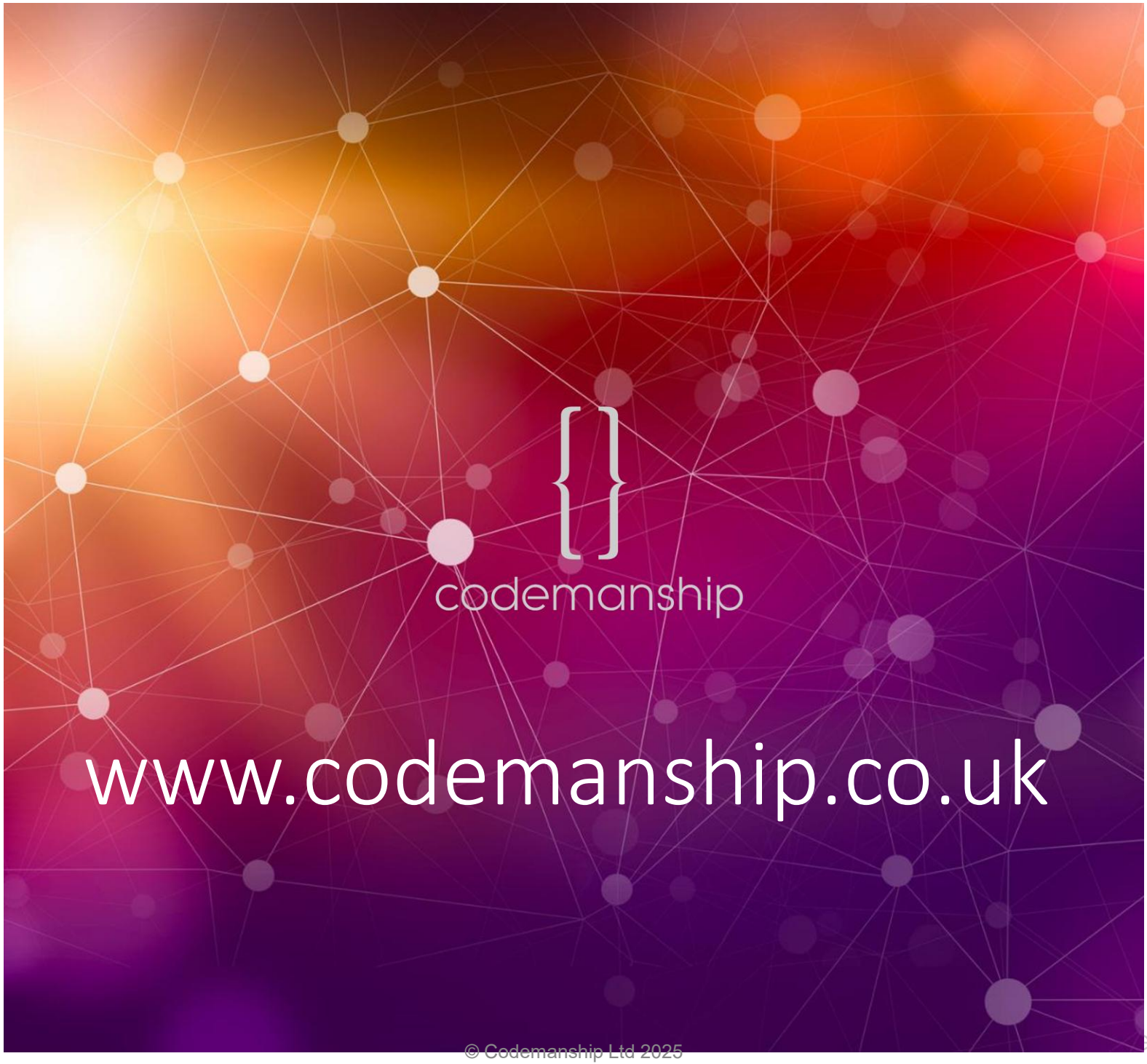

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