Refactoring

based on *Code Complete* by Steve McConnell

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All successful software gets changed.

—Fred Brooks

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Myth

Software is written once and works flawlessly

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Reality

Code evolves and changes dramatically during development

Why
is refactoring necessary

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Solution

Refactor to adapt to changes and improve the overall quality

Cardinal Rule of Software Evolution

Internal quality should improve with code evolution

Why
is refactoring necessary

Cardinal Rule of Software Evolution

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Method

The tool to achieve this: Refactoring

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Internal quality should improve with code evolution

Method

The tool to achieve this: Refactoring

> *[Refactoring is] a change made to the internal structure of the software to make it easier to understand and cheaper to modify without changing its observable behavior.*
>
> —*Fowler(1999)*

Code Smells

Signs that code is bad or has degenerated through changes

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Duplicate Code

Some C++ Code:

```
Vector3D normalizedA=a/sqrt(a.x*a.x+a.y*a.y+a.z*a.z);

                                ⋮

Vector3D normalizedB=b/sqrt(b.x*b.x+b.y*b.y+b.z*b.z);
```

Code Smells

Signs that code is bad or has degenerated through changes

Duplicate Code

Refactored C++ Code:

```
Vector3D normalizedA=a.normalized();
Vector3D normalizedB=b.normalized();

                                  ⋮

Vector3D Vector3D::normalized(){
   return this/sqrt(x*x+y*y+z*z);
}
```

Code Smells

Signs that code is bad or has degenerated through changes

Setup & Takedown Code

Some C++ Code:

```
WithdrawalTransaction withdrawal;
withdrawal.SetAccountBalance(accountBalance);
withdrawal.SetWithdrawalAmount(withdrawalAmount);
ProcessWithdrawal(withdrawal);
accountBalance = withdrawal.GetAccountBalance();
withdrawalAmount = withdrawal.GetWithdrawalAmount();
```

Code Smells

Signs that code is bad or has degenerated through changes

Setup & Takedown Code

Refactored C++ Code:

```
ProcessWithdrawal(accountBalance,withdrawalAmount);
```

Code Smells

Signs that code is bad or has degenerated through changes

Many Parameters

Some C++ Code:

```
draw(box.getNumberVertices(),box.getVertices(),
    box.getIndices(),box.getVertexColors(),
    box.getModelMatrix());
```

Code Smells

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Many Parameters

Refactored C++ Code:

```
box.draw();
```

80/20 Rule

Do the 20% of possible refactorings that provide 80% of the benefit

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When

- After additions
- After fixes

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When

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Targets

- High complexity
- Error-prone

There is no code so big, twisted, or complex that maintenance can't make it worse

—Gerald Weinberg

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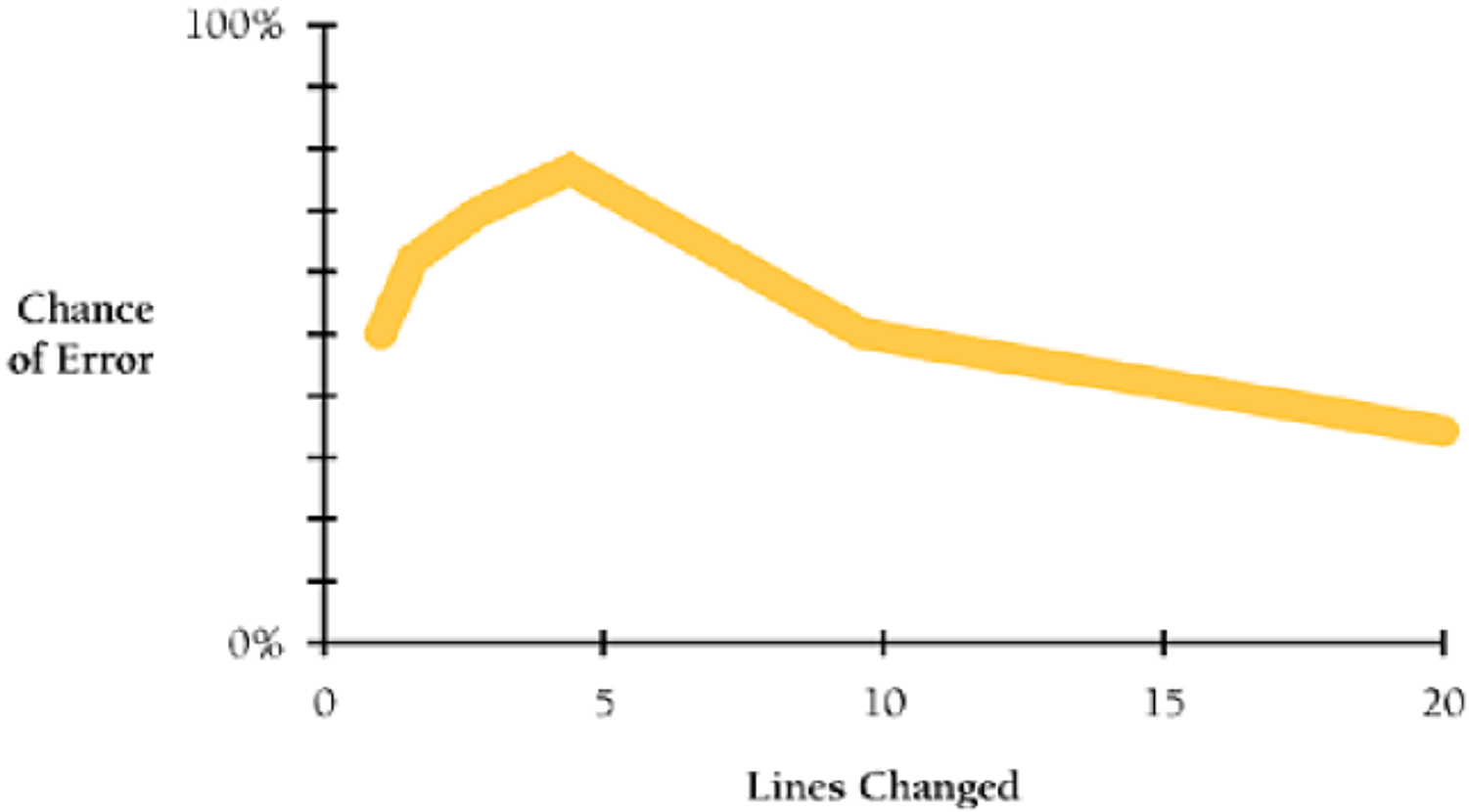
Refactoring Safety

Refactoring can cause more harm than good. Take precautions to prevent missteps

How
to refactor safely



—Weinberg(1983)

How
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- Backup

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Bad Times to Refactor

Refactoring does not affect a program's behavior. Tweaking broken code to make it work is hacking.

Conclusion

Refactoring during development is the best chance you'll get to improve your program, to make all the changes you'll wish you'd made the first time.

—Steve McConnell