SOEN6441: Advanced Programming Practices

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Refactoring

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REFACTORING

Refactoring: what is it?

- **Definition:** Refactoring is a disciplined technique for restructuring an existing body of code, altering its internal structure without changing its externally observable behavior.

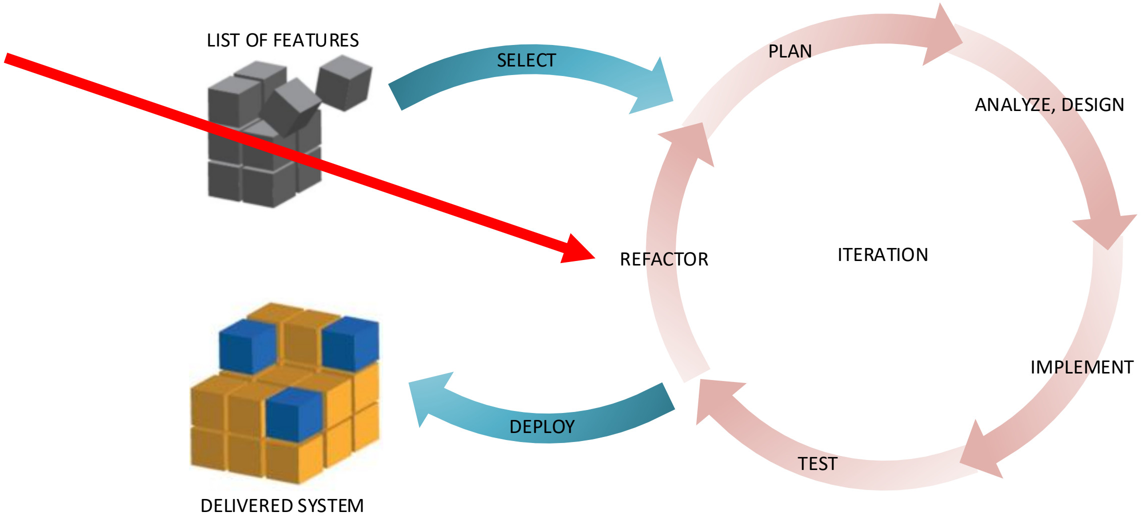
- Refactoring does not fix bugs, but it may help find bugs by scrutinizing code. It may also reduce the further introduction of bugs by cleaning-up code.

- Refactoring does not add new functionality to the system, but it will ease the further adding of new functionality.

- It is an essential part of agile software development such as Extreme Programming or incremental development.

Refactoring: when?

- Constantly during programming
  - Refactoring ought to be done continuously as “bad smells” are encountered during programming.
  - “Bad smells” are portions of design or code that are characterized as potentially confusing and identifies as refactoring targets.
- Between each build in agile software development methods
  - When using iterative or incremental development, a major refactoring stage should precede the beginning of the development of a new build. This will remove slight design problems and ease the addition of further functionality.



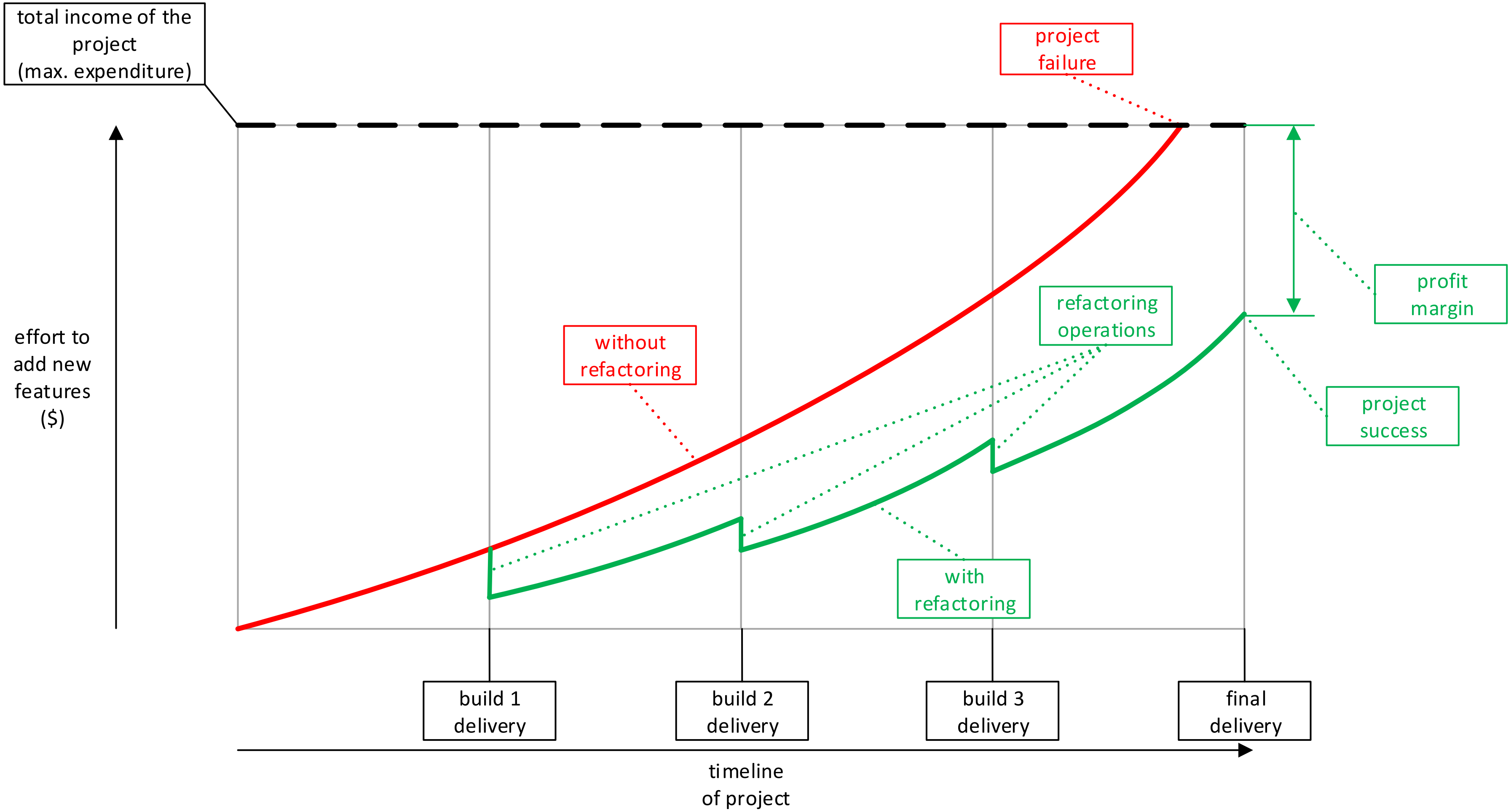
Refactoring: why?

- Refactoring is usually done to:
  - Improve quality
    - improve design quality
    - improve maintainability
    - improve extensibility
    - requires proper testing, so it improves testability
    - helps to find bugs
  - Improve productivity
    - improve code readability & comprehensibility
    - simplify code structure

Refactoring: why?

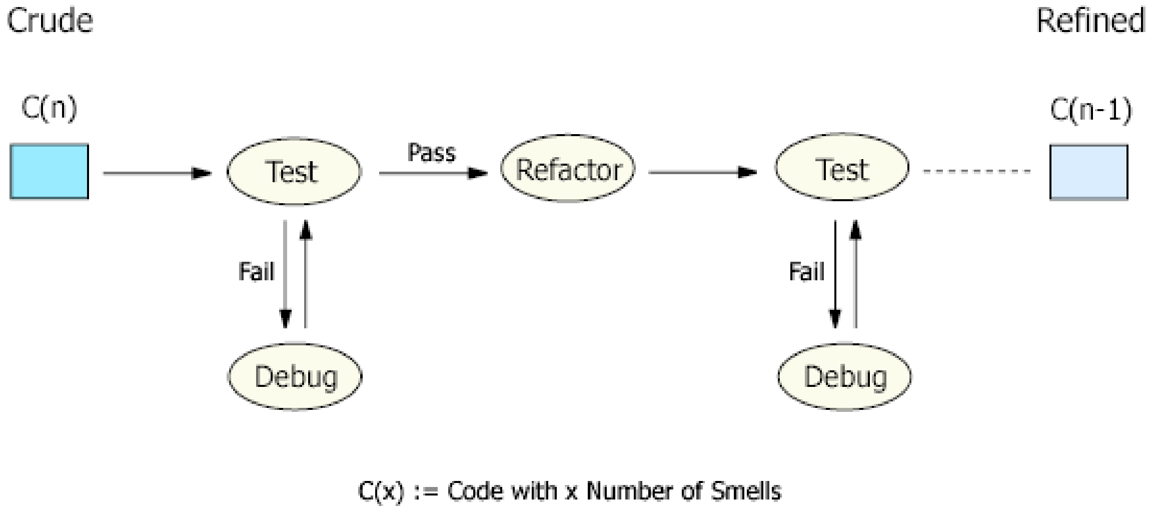
- Refactoring is usually done to:
  - Improve sustainability of development
    - By improving the code’s structural quality, reducing confusion and making the code more understandable, it reduces the effort involved in further development.
    - This is very important in agile software development methods, whose focus on productivity and changes are likely to create lower quality code.
    - Without refactoring, agile methods are likely to create code whose further development will be exponentially costly.

Effect of refactoring on a project



Refactoring: how?

- Each refactoring is implemented as a small behavior-preserving transformation.
- Behavior-preservation is achieved through pre- and post-transformation testing.
- Refactoring process: **test-refactor-test**



Refactoring: drawbacks

- **Cost Overhead:**
  - Refactoring is an add-on activity and therefore will incur extra cost in form of time, effort, and resource allocation, especially if elaborated design and code documentation is maintained.
    - However, when done sparingly and only on key issues, its benefits are greater than its overhead.
  - Automated documentation tools, code browsing tools, refactoring tools and testing tools will also diminish the refactoring overhead.

Refactoring: drawbacks

- **Requires Expertise:**
  - Refactoring requires some expertise and experience and considerable effort in going through the process, especially if proper testing is involved.
    - However, this overhead can be minimized by using refactoring tools and automated testing such as with a unit testing framework.

REFACTORING PATTERNS

Refactoring: examples

- **Encapsulate Downcast:** A method returns an object that needs to be downcasted by its callers. Refactor by moving the downcast to within the method.

```
Object lastReading() {
      …
      return readings.lastElement();
}
```

```
Reading lastReading() {
      …
      return (Reading) readings.lastElement();
}
```

Refactoring: examples

- **Consolidate Conditional Expression:** You have a sequence of conditional tests with the same result. Refactor by combining them into a single conditional expression and extract it.

```
double disabilityAmount() {
      if (_seniority < 2) return 0;
      if (_monthsDisabled > 12) return 0;
      if (_isPartTime) return 0;
      // compute the disability amount
```

```
double disabilityAmount() {
      if (isNotEligibleForDisability()) return 0;
      // compute the disability amount
```

Refactoring: examples

- **Consolidate Duplicate Conditional Fragments:** The same fragment of code is in all branches of a conditional expression. Refactor by moving it outside of the expression.

```
if (isSpecialDeal()) {
      total = price * 0.95;
      send();
} else {
      total = price * 0.98;
      send();
}
```

```
if (isSpecialDeal())
      total = price * 0.95;
else
      total = price * 0.98;
send();
```

Refactoring: examples

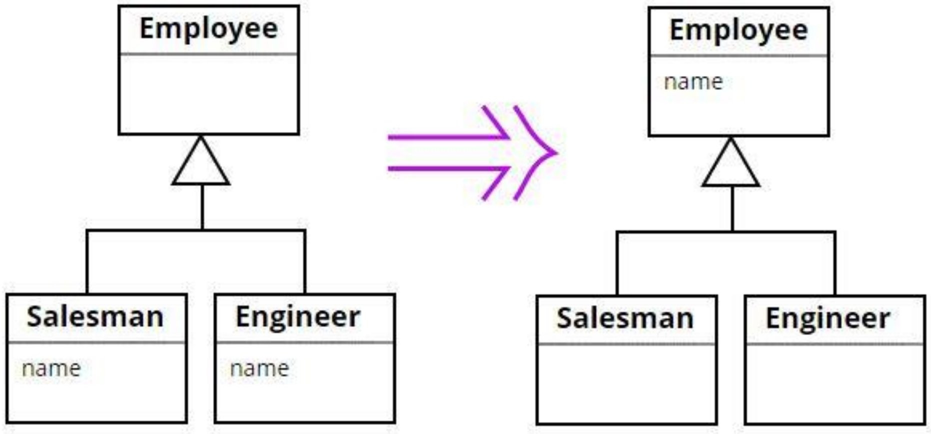
- **Rename Method:** The name of a method does not reveal its purpose. Refactor it by changing the name of the method.

```
int getInvCdtLmt(){
…
}
```

```
int getInvoiceableCreditLimit(){
…
}
```

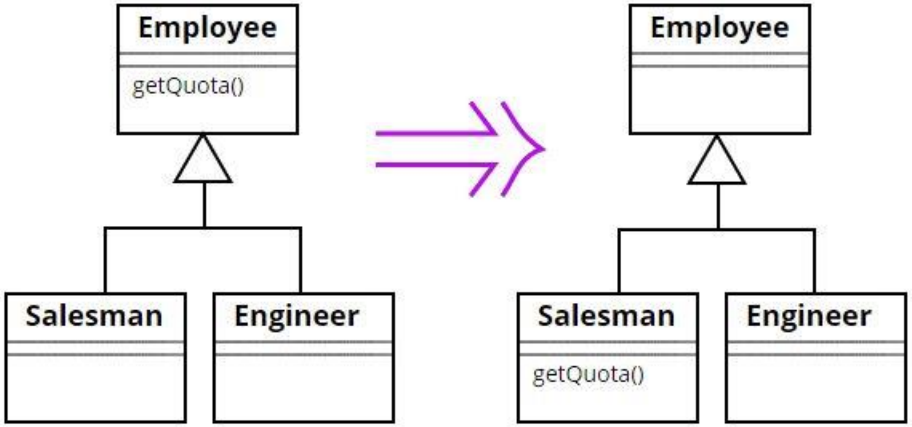
Refactoring: examples

- **Pull Up Field:** Two subclasses have the same field. Refactor it by moving the field to the superclass.



Refactoring: examples

- **Push Down Method:** Behavior on a superclass is relevant only for some of its subclasses. Refactor it by moving it to those subclasses.



Refactoring: practice

- Some refactorings are controversial.
- Some refactorings are arguably not improving code quality.
- Some refactorings can in fact be counter-productive when applied blindly, especially in incremental or iterative development, where design is evolving.
- Have your team adopt a set of refactorings to be applied, and make sure that refactorings are applied in a productive manner.
- Apply in combination with the application of design patterns.
- Use refactoring tools to automate changes, e.g. Eclipse refactoring, and JUnit testing framework.
- For build 2 and 3, you will have to report on the refactoring operations applied between builds.

Refactoring in the project

- A refactoring operation should be done **before** you start working on a new build.
- Establish a list of potential refactoring targets (e.g. 15) using different sources:
  - Code inspections.
  - Discussions among developers.
  - Code review tools.
- Select actual refactoring targets from the list of potential refactoring operations:
  - There may be very numerous potential targets.
  - Select only a few (e.g. 5) actual targets that are likely to have the most positive effects.
  - Tests should be available for all actual refactoring targets.

Refactoring in the project

- For each actual refactoring target:
  - Assess the completeness of the tests that apply to the code being refactored, write more tests if necessary.
  - Run the tests to ensure that the code behaves correctly before the refactoring operation.
  - Determine what transformation you will apply.
  - Apply the refactoring on the code.
  - Run the tests to ensure that the code still behaves correctly after the refactoring operation.

References

- Source Making. Refactoring. http://sourcemaking.com/refactoring
- Martin Fowler, Kent Beck, John Brant, William Opdyke, Don Roberts. *Refactoring: Improving the Design of Existing Code*. Addison-Wesley Professional, 1999. ISBN-13: 978-0201485677.
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