The O of SOLID

The Open/Closed Principle

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The Open/Closed Principle

- Probably around since the late 1980's
  - Bertrand Meyer, *Object-Oriented Software Construction*, 1st edition. Prentice-Hall 1988, ISBN 0-13-629031-0
- What does it say?
  - *"Software entities (classes, modules, functions, etc.) should be open for extension, but closed for modification.*
    - *A module will be said to be open if it is still available for extension. For example, it should be possible to add fields to the data structures it contains, or new elements to the set of functions it performs.*
    - *A module will be said to be closed if [it] is available for use by other modules. This assumes that the module has been given a well-defined, stable description (the interface in the sense of information hiding)"* (Bertrand Meyer)
  - *"You should be able to extend the behavior of a system without having to modify that system."* (Robert C. Martin)
- What does it mean?
  - Software entities should be **both** open for extension **and** closed for modification
  - Open for Extension = It is possible to extend behavior
  - Closed for Modification = It is not necessary to modify manifestation (i.e. source code, compilation, etc.)

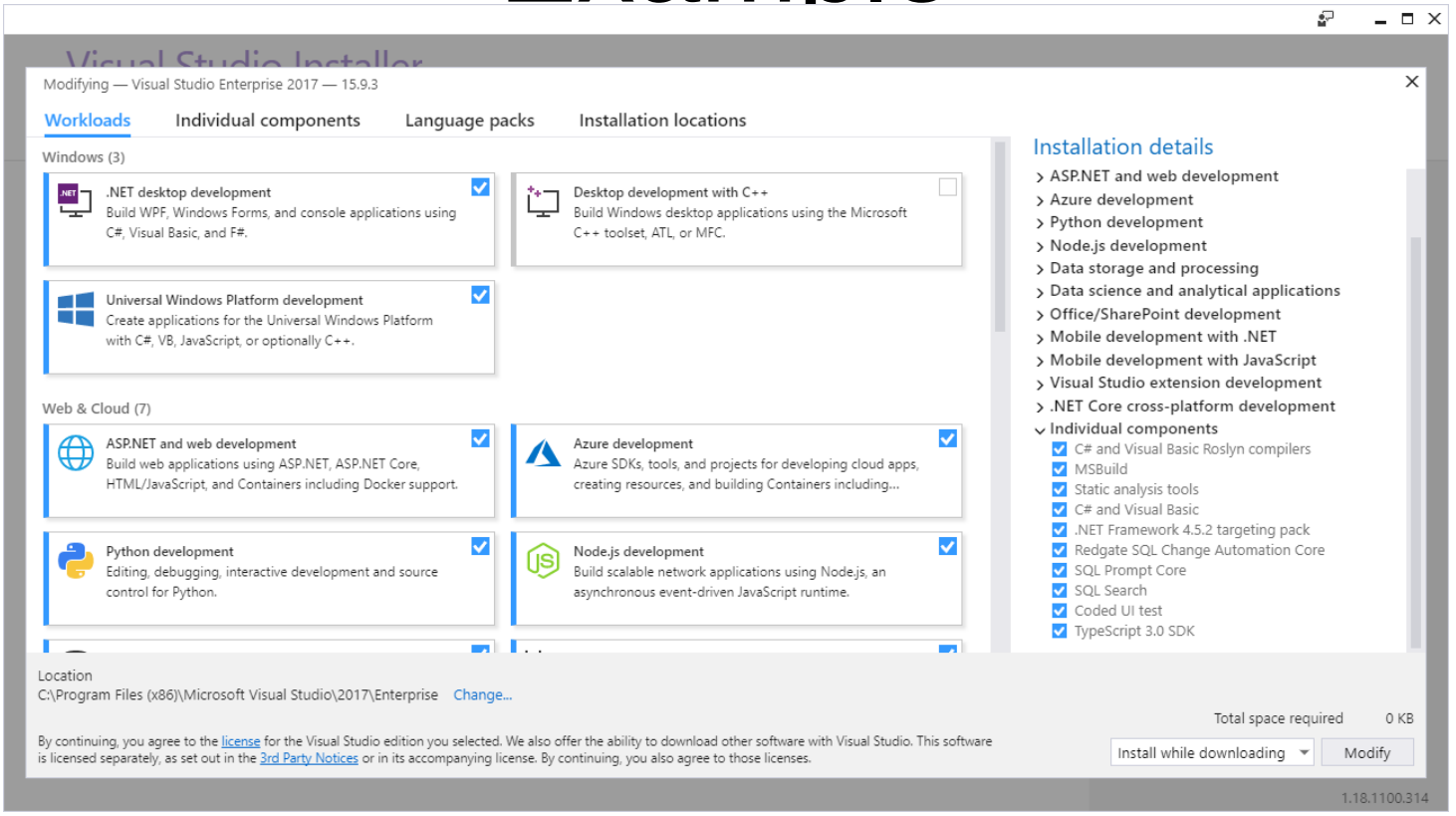
The Open/Closed Principle

- Why is it a “good” thing to adhere to?
  - Change of requirements is immanent through the life cycle of most software
  - Decreases change impact, i.e. number of modules to alter
    - This number should tend to 0 since you are just add new modules (replacing others)
    - Allows new features without the need to re-engineer / re-arrange exiting ones.
  - Decreases risk of regression because of human error, i.e. developer faults
    - Since change impact decreases
  - Increases a software designs capability for adaption to change
    - *… uhm, “agile”?*

Example

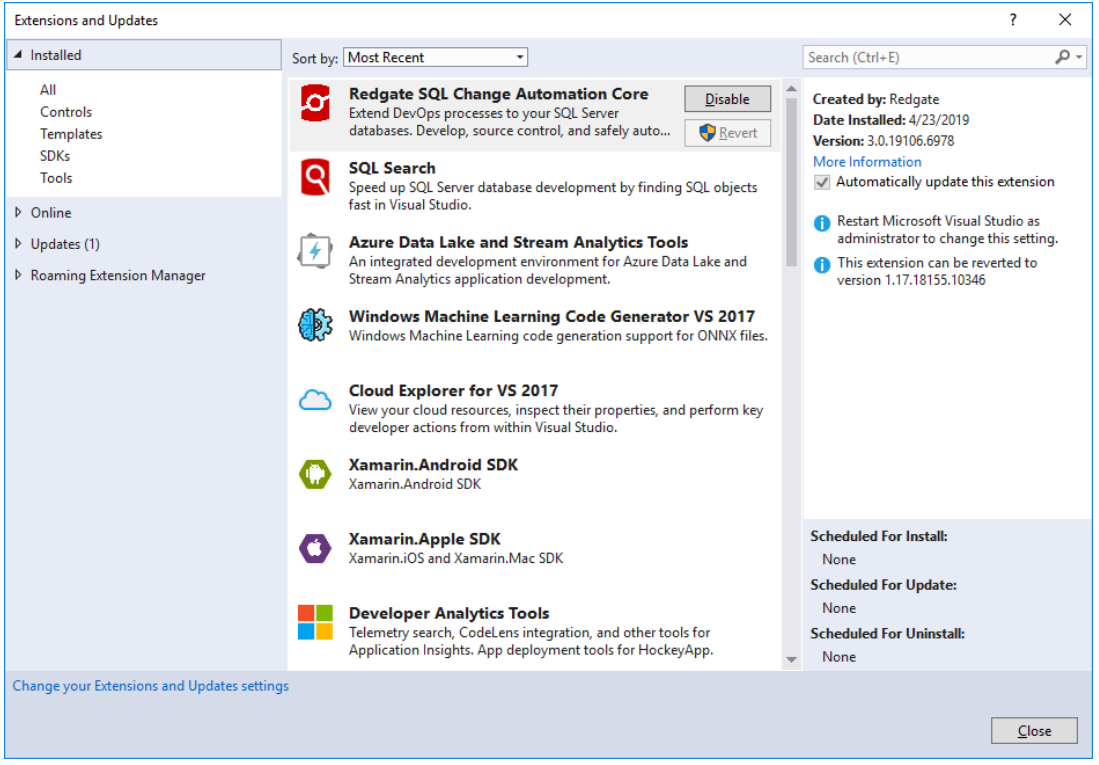
Plugin Architectures

Example



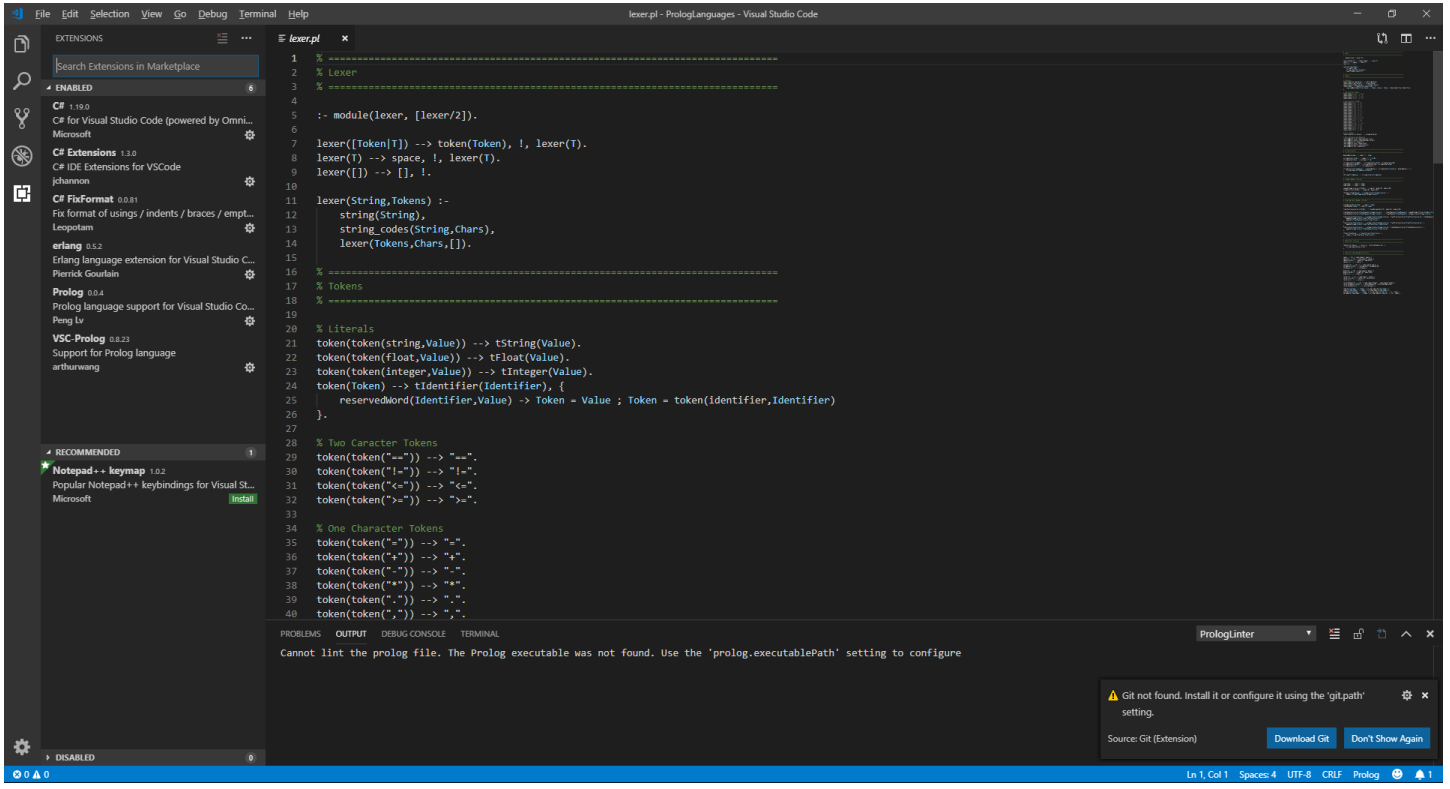
Visual Studio

Example



Visual Studio (Marketplace)

Example

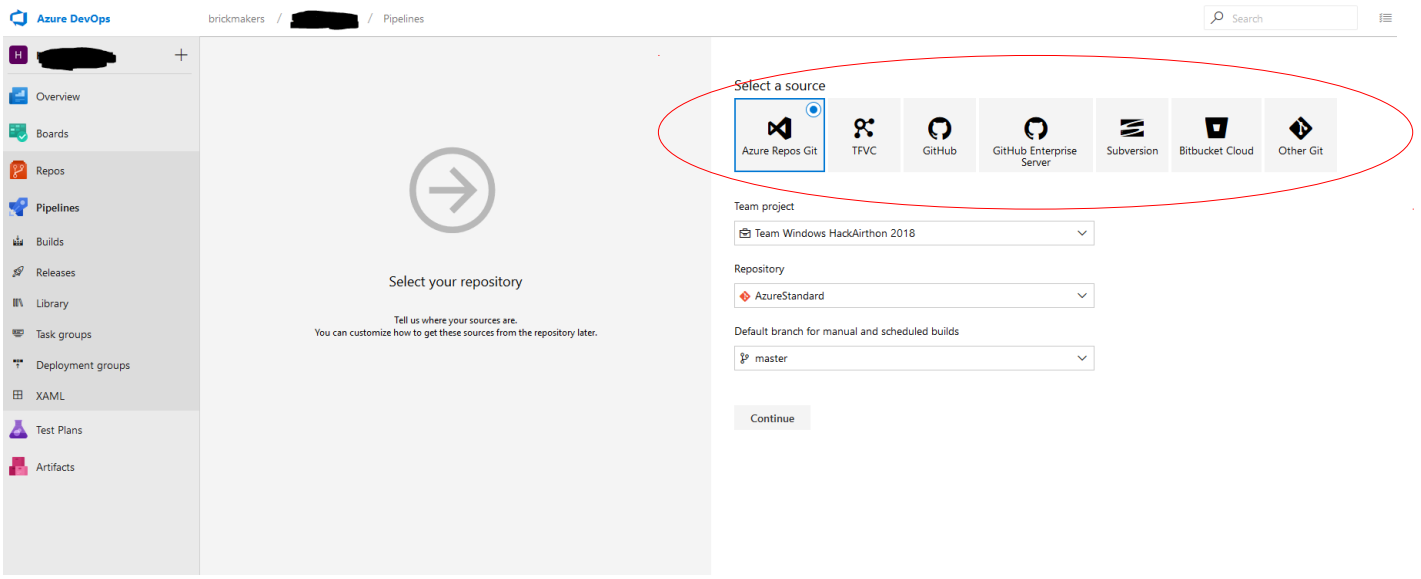


Visual Studio Code

Example

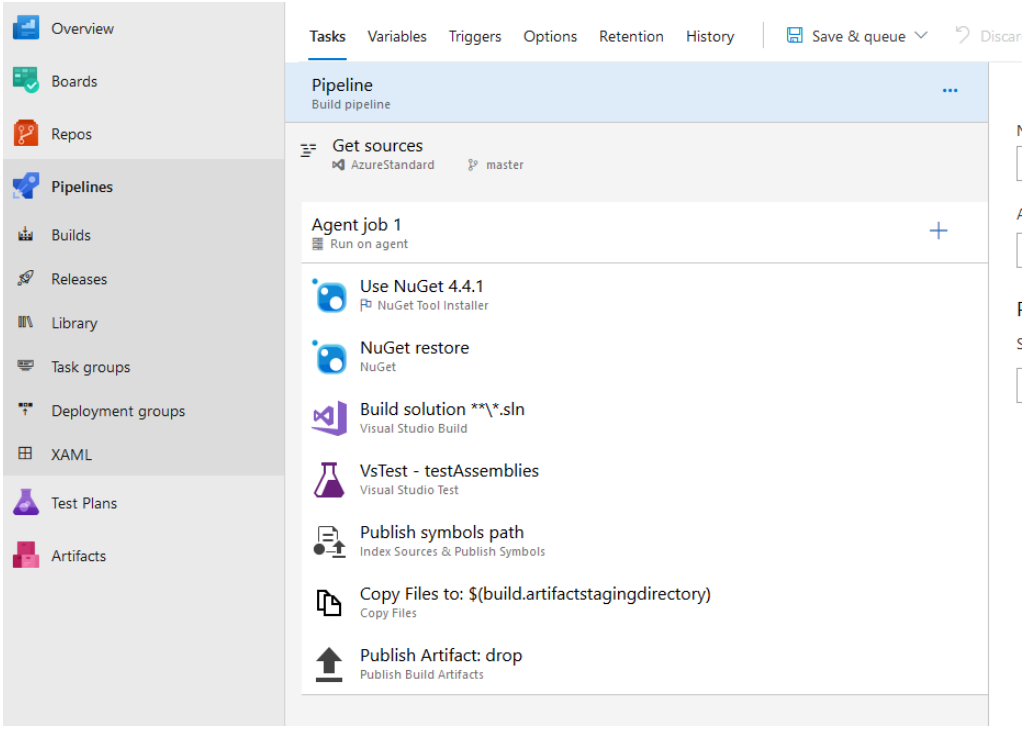
- Other (modern) IDEs also make heavy use of plugin architectures
  - IntelliJ
  - eclipse
  - Rider
  - ...

Example



Azure DevOps Build Pipelines: VCS

Example



Azure DevOps Build Pipelines: Agent Jos

Example

Higher-order functions

Example

```
const twice = (f, v) => f(f(v));
const add3 = v => v + 3;

twice(add3, 7); // 13
```

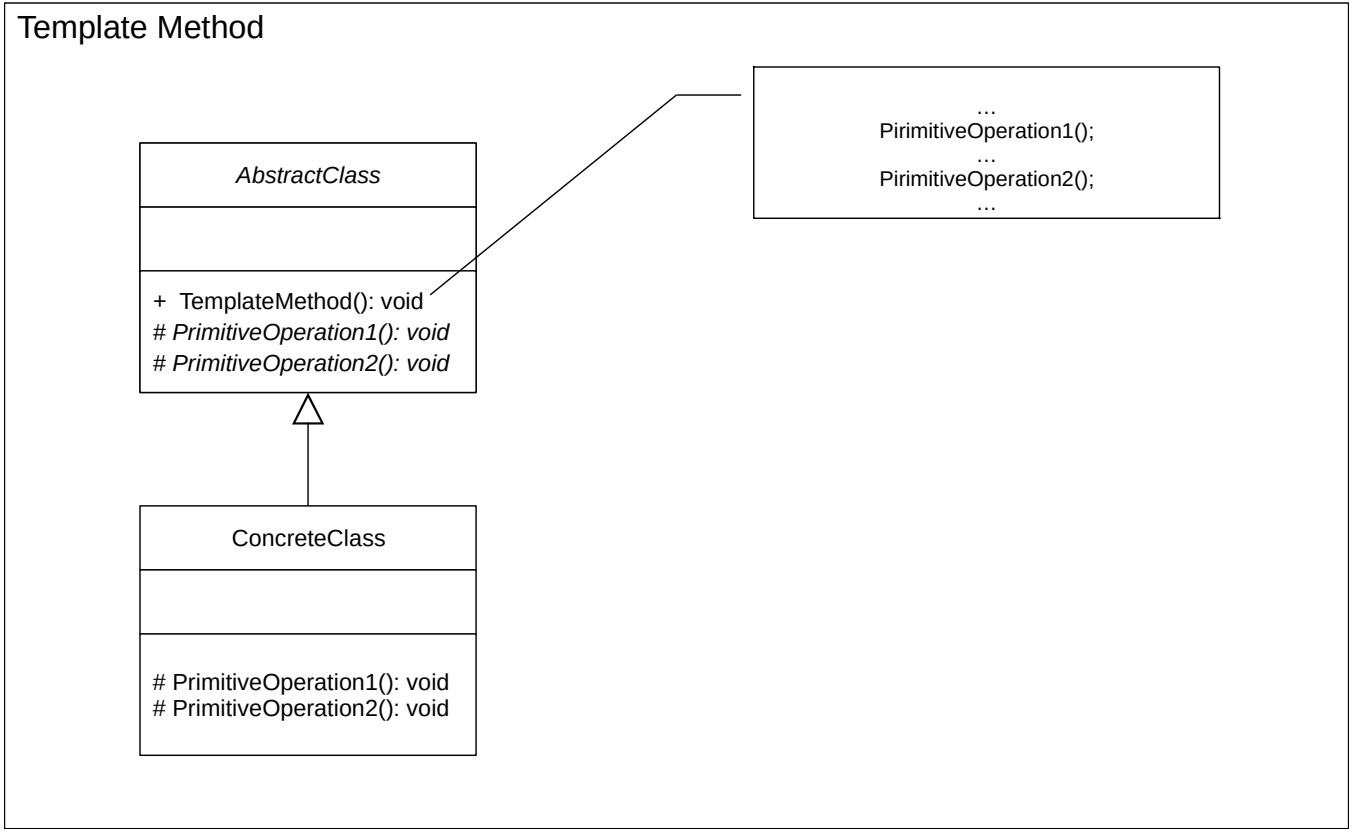
```
Func<Func<int,int>,Func<int,int>> twice = f => x => f(f(x));
Func<int,int> plusThree = x => x + 3;

Console.WriteLine(twice(plusThree)(7)); // 13
```

Higher-order functions

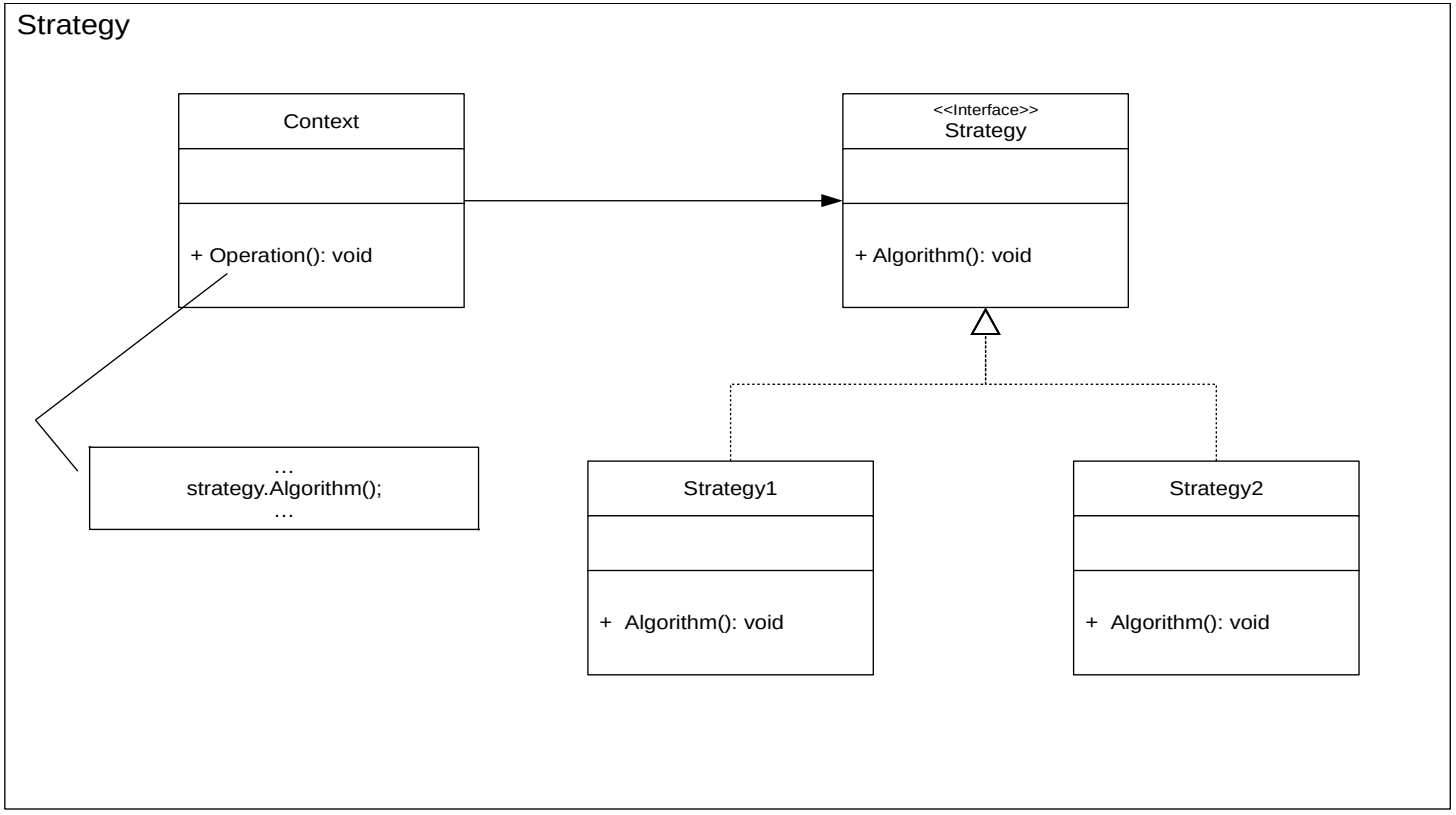
Example

A non-exclusive list of Open/Closed Gang of 4 Patterns

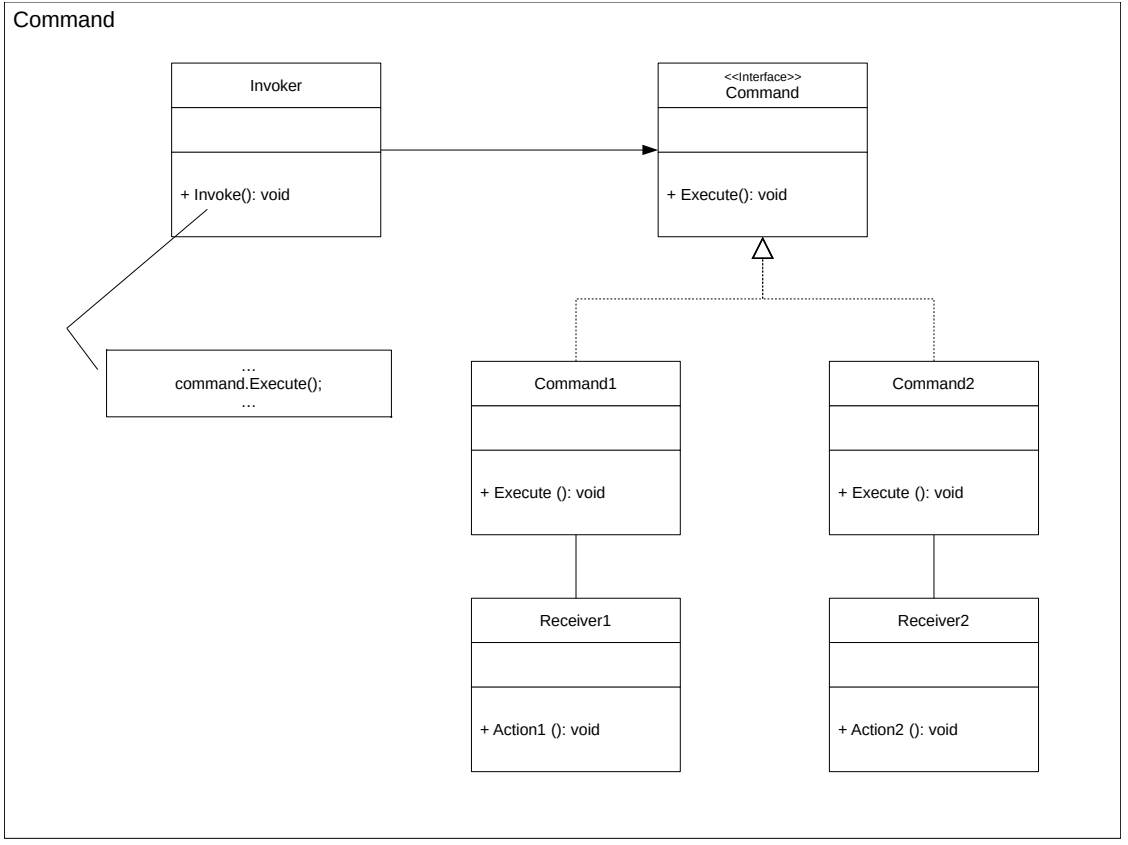
Example


Template Method
AbstractClass
+ TemplateMethod(): void
# PrimitiveOperation1(): void
# PrimitiveOperation2(): void
ConcreteClass
PrimitiveOperation1(): void
PrimitiveOperation2(): void
…
PirimitiveOperation1();
…
PirimitiveOperation2();
…

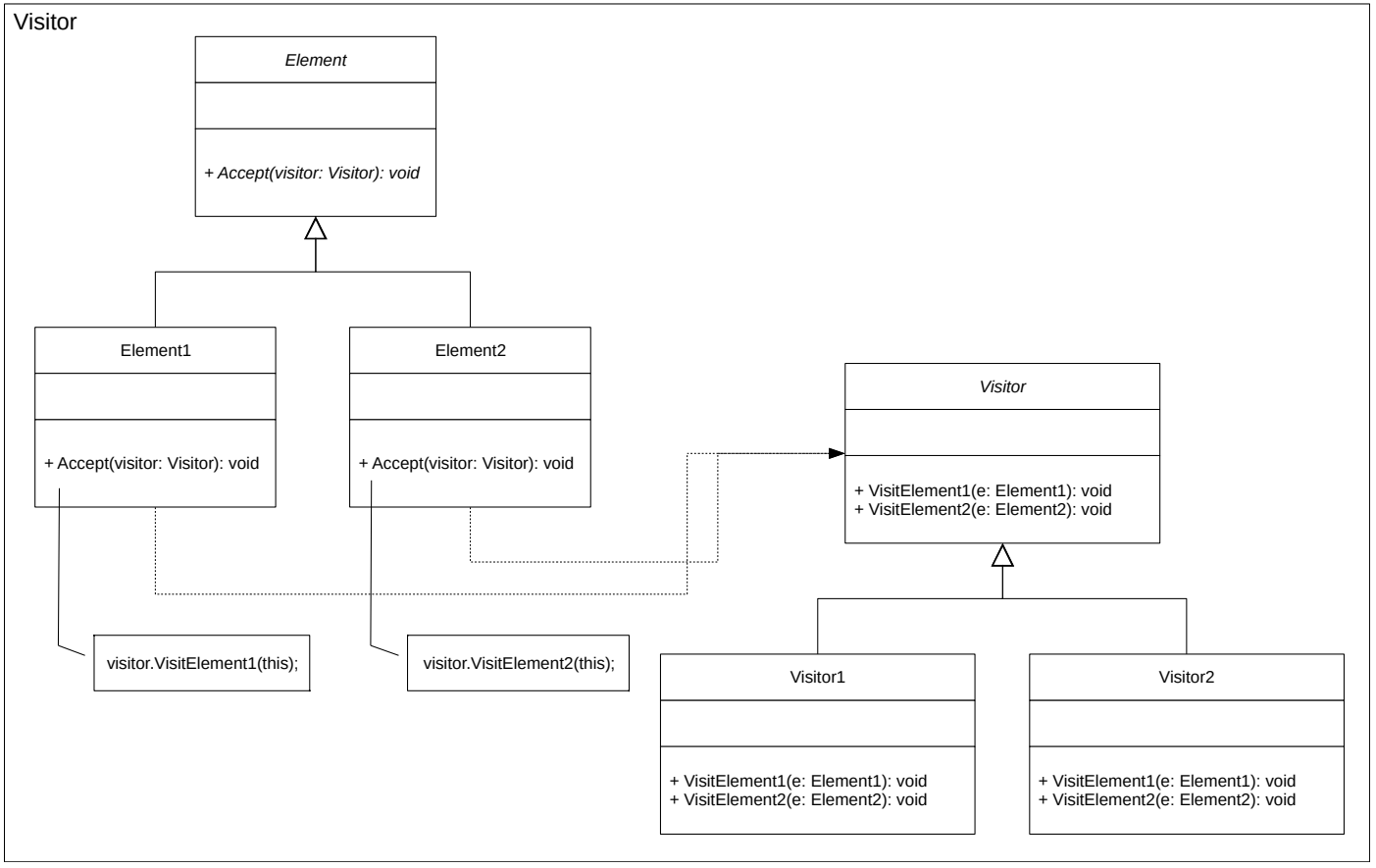
Example


Strategy
Context
+ Operation(): void
<<Interface>>
Strategy
+ Algorithm(): void
…
strategy.Algorithm();
…
Strategy1
+ Algorithm(): void
Strategy2
+ Algorithm(): void

Example


Command
Invoker
+ Invoke(): void
<<Interface>>
Command
+ Execute(): void
...
command.Execute();
...
Command1
+ Execute (): void
Command2
+ Execute (): void
Receiver1
+ Action1 (): void
Receiver2
+ Action2 (): void

Example


Visitor
Element
+ Accept(visitor: Visitor): void
Element1
+ Accept(visitor: Visitor): void
Element2
+ Accept(visitor: Visitor): void
Visitor
+ VisitElement1(e: Element1): void
+ VisitElement2(e: Element2): void
visitor.VisitElement1(this);
visitor.VisitElement2(this);
Visitor1
+ VisitElement1(e: Element1): void
+ VisitElement2(e: Element2): void
Visitor2
+ VisitElement1(e: Element1): void
+ VisitElement2(e: Element2): void

Thanks!

References

- Robert C. Martin. 2003. Agile Software Development, Principles, Patterns, and Practices, Prentice Hall.