Lecture: SOLID Principles & Inter-class Relationships

ESS201: Programming II

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[Recap] Features of OOP (Object-Oriented Programming)

Summary: Features of OOP

Encapsulation: Reduce complexity + increase reusability

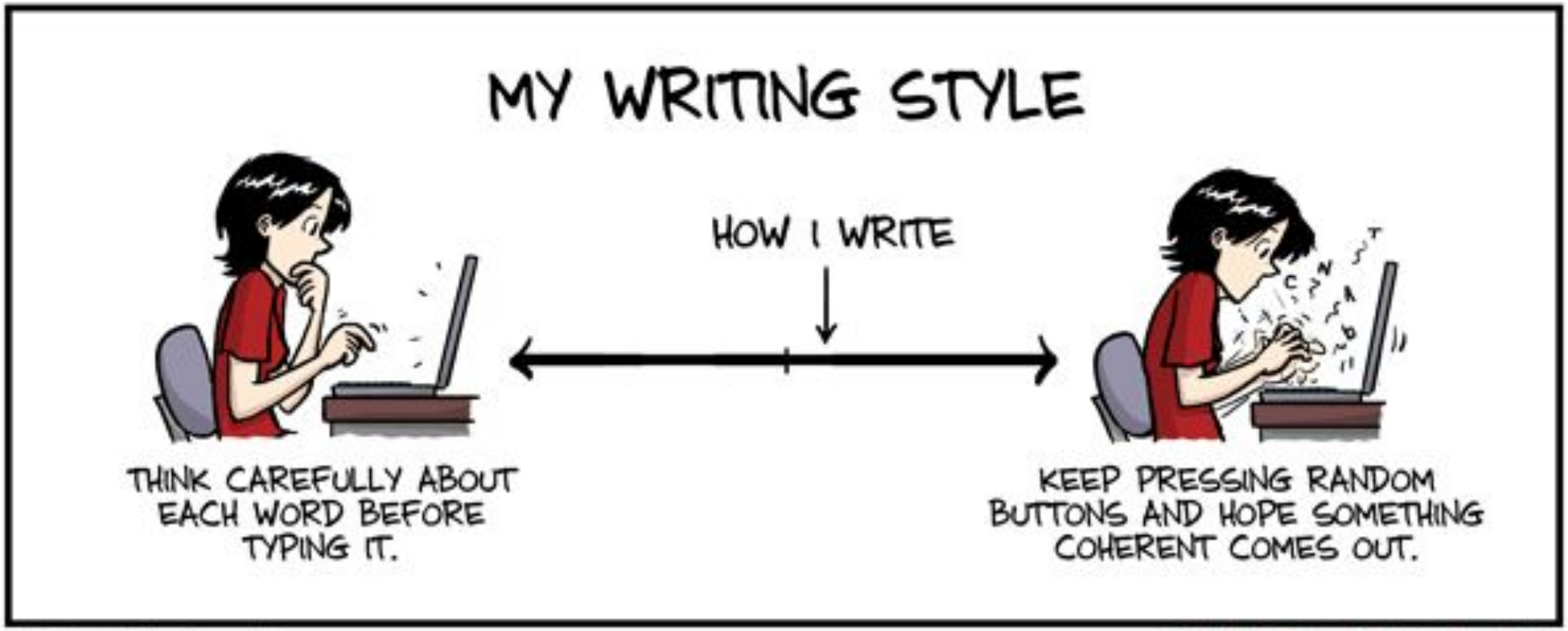
Abstraction: Reduce complexity + isolate impact of changes

Inheritance: Eliminate redundancy

Polymorphism: Refactor unnecessary inflexible switch/case statements

Courtesy:https://www.youtube.com/watch?v=pTB0EiLXUC8

SOLID Principles



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SOLID Principles

SOLID is an acronym which stands for the five basic principles which help to create good software architecture.

- **S** stands for **SRP** (Single responsibility principle)
- **O** stands for **OCP** (Open closed principle)
- **L** stands for **LSP** (Liskov substitution principle)
- **I** stand for **ISP** (Interface segregation principle)
- **D** stands for **DIP** (Dependency inversion principle)

Introduced by Robert Martin (author of “Clean Code”).

Originators of LSP is Barbara Liskov; and OCP is Bertrand Meyer.

Read more at: https://stackify.com/solid-design-principles/

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  "A class should only have a single responsibility, that is, only changes to one part of the software's specification should be able to affect the specification of the class."

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  "Increase the cohesion between things that change for the same reasons, decrease the coupling between those things that change for different reasons."

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"Software entities ... should be open for extension, but closed for modification."

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"A class is closed, since it may be compiled, stored in a library, baselined, and used by client classes. But it is also open, since any new class may use it as parent, adding new features. When a descendant class is defined, there is no need to change the original or to disturb its clients."

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"Objects in a program should be replaceable with instances of their subtypes without altering the correctness of that program."

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"It extends the Open/Closed principle and enables you to replace objects of a parent class with objects of a subclass without breaking the application. "

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  “Many client-specific interfaces are better than one general-purpose interface."

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  “Clients should not be forced to depend upon interfaces that they do not use."

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One should "depend upon abstractions, [not] concretions." Closely related to Hollywood Principle, “Don’t call us. We’ll call you.”

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“High-level modules should not depend on low-level modules. Both should depend on abstractions.”

“Abstractions should not depend on details. Details should depend on abstractions.”

Inter-class Relationships

Introduction

Once we have created classes in OOP, we can now have these classes interact in a given context. We will refer to these interactions as "inter-class relationships."

Types of inter-class relationships:

1. Composition
2. Aggregation
3. Association

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Types of inter-class relationships:

1. Composition: the object and its member have a strong part-whole relationship; characterized by "part-of" relationship.
2. Aggregation: a weaker form of composition, where the object and its member form a "has-a" relationship.
3. Association: a weaker form of aggregation, where the object and its member form a "uses-a" relationship.

Introduction

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Types of inter-class relationships:

1. Composition: The motherboard is a "part-of" the computer.
2. Aggregation: The desktop "has-a" monitor .
3. Association: The student "uses-a" supercomputer.

Property	Composition	Aggregation	Association
Relationship type	Whole/part	Whole/part	Otherwise unrelated
Members can belong to multiple classes	No	Yes	Yes
Members existence managed by class	Yes	No	No
Directionality	Unidirectional	Unidirectional	Unidirectional or bidirectional
Relationship verb	Part-of	Has-a	Uses-a

Image courtesy: https://www.learncpp.com/cpp-tutorial/10-4-association/

Composition vs Aggregation

In composition, part does not survive without the whole; unlike aggregation.

```
// composition
class Whole {
   Part part;
   // ...
};
```

```
// shared aggregation
class Whole {
   Part* part;
   // ...
};
```

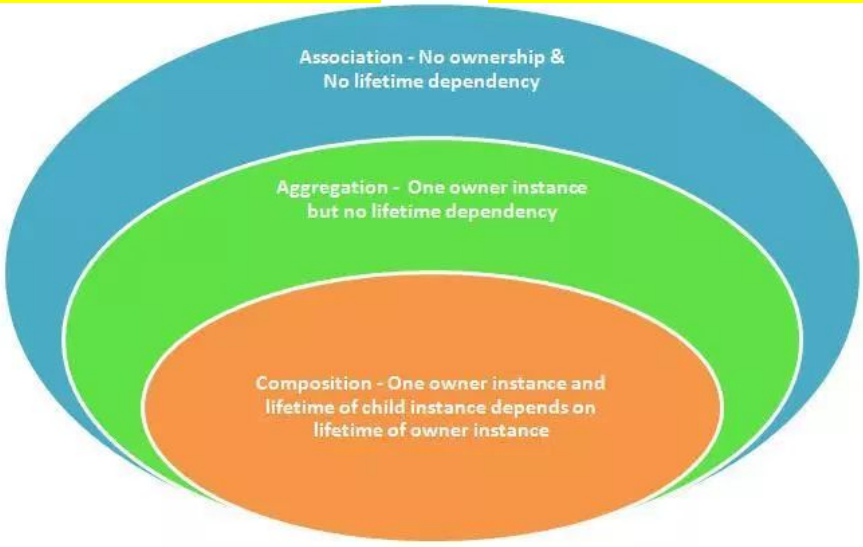

Image courtesy: https://dotnetfreakblog.wordpress.com/2014/01/11/concept-of-dependency-generalization-association-aggregation-composition-in-object-oriented-programming/