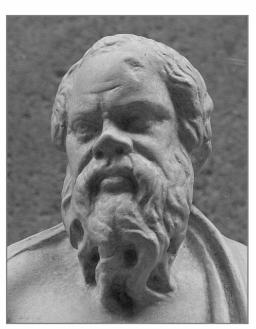
TCC and LCC

YEGOR BUGAYENKO

Lecture #8 out of 24 80 minutes

The slidedeck was presented by the author in this YouTube Video

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"Socrates: I am a lover of these processes of division and bringing together, as aids to speech and thought; and if I think any other man is able to see things that can naturally be collected into one and divided into many, him I follow after and walk in his footsteps as if he were a god."

— Plato. Phaedrus (Dialogue), 370 B.C.

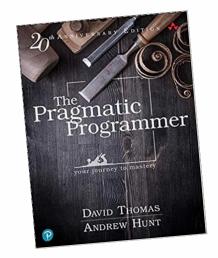




EDWARD YOURDON

"Module cohesion may be conceptualized as the <u>cement</u> that holds the processing elements of a module together. In a sense, a high degree of module cohesion is an indication of <u>close</u> approximation of inherent problem structure."

— Edward Yourdon and Larry Constantine. *Structured Design: Fundamentals of a Discipline of Computer Program and Systems Design.* Prentice Hall, 1979. doi:10.5555/578522

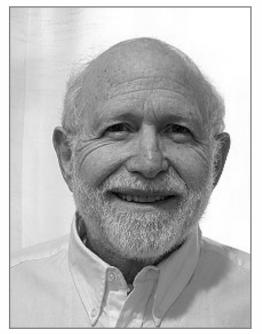




Andrew Hunt

"We want to design components that are self-contained: independent, and with a <u>single</u>, well-defined purpose."

— Andrew Hunt and Dave Thomas. *The Pragmatic Programmer: From Journeyman to Master.* Pearson Education, 1999. doi:10.5555/320326



James M. Bieman

"We define two measures of class cohesion based on the <u>direct</u> and <u>indirect</u> connections of method pairs: TCC and LCC."

— James M. Bieman and Byung-Kyoo Kang. Cohesion and Reuse in an Object-Oriented System. *SIGSOFT Software Engineering Notes*, 20(51):259–262, 1995. doi:10.1145/223427.211856

Connectivity Between Methods in a Class

3.1 Connectivity between methods

The direct connectivity between methods is determined from the class abstraction. If there exists one or more common instance variables between two method abstractions then the two corresponding methods are directly connected.

Two methods that are connected through other directly connected methods are indirectly connected. The indirect connection relation is the transitive closure of direct connection relation. Thus, a method M_1 is indirectly connected with a method M_n if there is a sequence of methods M_2 , M_3 , . . ., M_{n-1} such that

$$M_1 \delta M_2, \cdots, M_{n-1} \delta M_n$$

where $M_i \delta M_j$ represents a direct connection.

"An instance variable is directly used by a method M if the instance variable appears as a data token in the method M. The instance variable may be defined in the same class as M or in an ancestor class of the class. DU(M) is a set of instantce variables directly used by a method M."

Source: James M. Bieman and Byung-Kyoo Kang. Cohesion and Reuse in an Object-Oriented System. *SIGSOFT Software Engineering Notes*, 20(51):259–262, 1995. doi:10.1145/223427.211856

Tight and Loose Class Cohesion (TCC+LCC)

```
class Rectangle
int x, y, w, h;
int area()
return w * h;
int move(int dx, dy)
x += dx; y += dy;
int resize(int dx, dy)
w += dx; h += dy;
bool fit()
return w < 100
&& x < 100;
```

```
Max possible connections (NP):
```

$$N \times (N-1)/2 = 4 \times 3/2 = 6$$

Directly connected (NDC = 4):

area+fit, area+resize, move+fit, resize+fit

Indirectly connected (NIC = 2):

area+move, move+resize

$$TCC = NDC/NP = 4/6 = 0.66$$

 $LCC = (NDC+NIC)/NP = 6/6 = 1.00$

Collection and Reuse in an Object-Oriented System

**Dame M. Bernar and However, North (Register of Grouper of Collection Medical State Stat





STEVE McConnell

"Cohesion refers to how closely all the routines in a class or all the code in a routine support a central purpose—how focused the class is. The ideas of abstraction and cohesion are closely related—a class interface that presents a good abstraction usually has strong cohesion."

— Steve McConnell. *Code Complete*. Pearson Education, 2004. doi:10.5555/1096143

Abstraction



• Color: red

• Weight: 120g

• Price: \$0.99



```
var file = {
  path: '/tmp/data.txt',
  read: function() { ... },
  write: function(txt) { ... }
}
```

The slide is taken from the "Pain of OOP" (2023) course.





"Isomorphism of the modules (objects) in problem and solution space is a desirable, in fact essential, quality for software."

— David West. *Object Thinking*. Pearson Education, 2004. doi:10.5555/984130

Inheritance vs. Cohesion

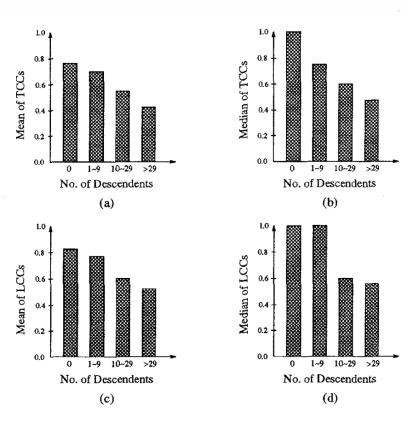


Figure 3: Number of descendents and Class Cohesion

"Our results show that the classes that are heavily reused via inheritance exhibit lower cohesion. We expected to find that the most reused classes would be the most cohesive ones."

Source: James M. Bieman and Byung-Kyoo Kang. Cohesion and Reuse in an Object-Oriented System. *SIGSOFT Software Engineering Notes*, 20(51):259–262, 1995. doi:10.1145/223427.211856

Inheritance is Code Reuse

```
class Manuscript {
  protected String body;
  void print(Console console) {
    console.println(this.body);
}

class Article
  extends Manuscript {
  void submit(Conference cnf) {
    cnf.send(this.body);
}
```

"The Article copies method print() and attribute body from the Manuscript, as if it's not a living organism, but rather a dead one from which we inherit its parts."

"Implementation inheritance was created as a mechanism for code reuse. It doesn't fit into OOP at all."

Source: Yegor Bugayenko. Inheritance Is a Procedural Technique for Code Reuse. https://www.yegor256.com/160913.html, sep 2016. [Online; accessed 22-09-2024]

Composition over Inheritance

```
class Manuscript
                                   class Manuscript
   protected String body;
                                      protected String body;
   void print(Console console)
                                     void print(Console console)
     console.println(this.body);
                                        console.println(this.body);
6 class Article
                                   6 class Article
   extends Manuscript
                                      Manuscript manuscript;
   void submit(Conference cnf)
                                      Article(Manuscript m)
     cnf.send(this.body);
                                        this.manuscript = m;
                                      void submit(Conference cnf)
                                        cnf.send(this.body);
                                   11
```

Wikipedia: https://en.wikipedia.org/wiki/Composition_over_inheritance

TCC+LCC can be calculated by a few tools:

- jPeek for Java
- C++ don't know
- Python don't know
- JavaScript don't know
- C# don't know

References

James M. Bieman and Byung-Kyoo Kang. Cohesion and Reuse in an Object-Oriented System. *SIGSOFT Software Engineering Notes*, 20(51): 259–262, 1995. doi:10.1145/223427.211856.

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https://www.yegor256.com/160913.html, sep 2016. [Online; accessed 22-09-2024].

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