Big programs

CS 2110

Fall 2016

Announcements

- optional final (details soon)

Programs in the real world

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Corollary: code will be read by many different people

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- trees have depth log n

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- interfaces
  - by using a narrow interface, all irrelevant details hidden (e.g. Set<E> or Collection <E> or Iterable <E>)

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- Organize code
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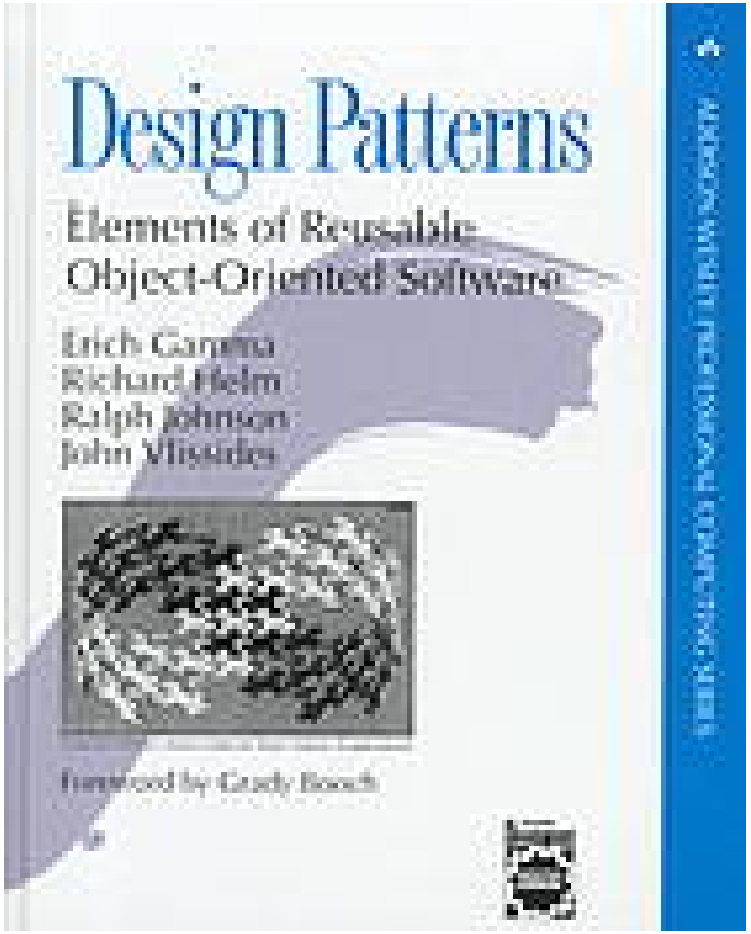
- Reduce dependencies (decouple)
  - The fewer names a reader needs to know while reading your code, the better.

Design patterns

- Ideas for structuring code to help organize and decouple code
- Read "Gang of Four book" (Design Patterns by Gamma, Helm, Johnson, Vlissides)



- Examples: Observer, MVC, Visitor, ...

Code organization example: Visitor pattern

- Recall expression trees:

```
interface Expr { ... }

class Sum implements Expr {
  Expr left ; Expr right ; ...
}

class Product implements Expr {
  Expr left ; Expr right ; ...
}

class Number implements Expr {
  int value ; ...
}
```

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- What might we do with them?
  - evaluate, print infix, print postfix
  - simplify
  - generate code, type check, optimize
  - transmit over network

Code organization example: Visitor pattern

- put these all in Expr?

```
interface Expr {
  int evaluate();
  String infix();
  String postfix();
  Expr simplify();
  void generateCode(CompilerState c);
  void typeCheck(Type t);
  void transmit(NetworkConnection conn);
}
```

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- Yuck
  - Dependencies
  - Have to think about everything in one place

Code organization example: Visitor pattern

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Code organization example: Visitor pattern

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```
package interp;
class Evaluator {
  int evaluateSum(Sum s) { ... }
  int evaluateProduct(Product p) { ... }
  int evaluateNumber(Number n) { ... }
}
```

```
package net;
class Transmitter {
  void transmitSum(Sum s) { ... }
  void transmitProduct(Product p) { ... }
  void transmitNumber(Number n) { ... }
}
```

Code organization example: Visitor pattern

Let's make a common interface

```
package interp;
class Evaluator implements Visitor {
  int visitSum(Sum s) { ... }
  int visitProduct(Product p) { ... }
  int visitNumber(Number n) { ... }
}
```

```
package net;
class Transmitter implements Visitor {
  void visitSum(Sum s) { ... }
  void visitProduct(Product p) { ... }
  void visitNumber(Number n) { ... }
}
```

Code organization example: Visitor pattern

We can use generics to make the return types match

```
package interp;
class Evaluator implements Visitor<Integer> {
  Integer visitSum(Sum s) { ... }
  Integer visitProduct(Product p) { ... }
  Integer visitNumber(Number n) { ... }
}
```

```
package net;
class Transmitter implements Visitor<Void> {
  Void visitSum(Sum s) { ... }
  Void visitProduct(Product p) { ... }
  Void visitNumber(Number n) { ... }
}
```

Code organization example: Visitor pattern

The implementation of each visitor is easy:

```
class Evaluator implements Visitor<Integer> {
  Integer visitSum(Sum s) {
    return s.left.visit(this) + s.right.visit(this);
  }

  Integer visitProd(Prod p) {
    return s.left.visit(this) * s.right.visit(this);
  }

  Integer visitNumber(Number n) { return n.value; }
}
```

Using the visitors is easy too:

```
// instead of "int result = expr.eval();"
int result = expr.visit(new Evaluator());

// instead of "expr.transmit();"
expr.visit(new Transmitter());
```

Code organization example: Visitor pattern

With these ideas, can write down the right interfaces:

```
interface Visitor <R> {
  R visitSum(Sum s);
  R visitProduct (Product p);
  R visitNumber(Number n);
}

interface Expr {
  <R> R visit( Visitor <R> v);
}
```

The implementation of visit is trivial:

```
class Sum implements Expr {
  Expr left ;
  Expr right ;

  <R> R visit( Visitor <R> v) { return v.visitSum( this ); }
}
```

Summary:

- To first order of approximation, your code will last forever
- Write code to be read and extended
- Think about what a reader needs to think about to understand your code.
- Design patterns can help