# Algorithms

## History, State, Behavior, Enemies of OOP

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Lecture #1 out of 10
90 minutes

- History
- Original Intent
- Object Thinking vs. Algorithms
- Enemies of Object Thinking
- How to Pass the Exam?
- Read and Watch

## WARNING!

In the pursuit of academic enlightenment within this course, it is paramount to caution that the doctrines disseminated may present a potentially hazardous venture if employed in real-life software projects. This inherent risk arises from the potential incongruity with the broadly accepted canon of object-oriented programming and recognized best programming practices. If one remains resolute in their decision to adapt their coding methodologies to align with the principles propagated in this course, it would be prudent to employ a certain degree of foresight. A humorous, yet sincere suggestion, would be to secure alternate employment prior to a possible premature termination of one's current professional engagement.

Written by me, edited by ChatGPT

Chapter #1:

# History

# Who started it?

Ivan Sutherland's seminal **Sketchpad** application was an early inspiration for OOP, created between 1961 and 1962 and published in his Sketchpad Thesis in 1963. Any object could become a "master," and additional instances of the objects were called "occurrences". Sketchpad's masters share a lot in common with JavaScript's prototypal inheritance.
(c) Wikipedia

# Who invented Objects, Classes, and Inheritance?


**Simula** was developed in the 1965 at the Norwegian Computing Center in Oslo, by Ole-Johan Dahl and Kristen Nygaard. Like Sketchpad, Simula featured objects, and eventually introduced classes, class inheritance, subclasses, and virtual methods. (c) Wikipedia

# Simula-67: Sample Code

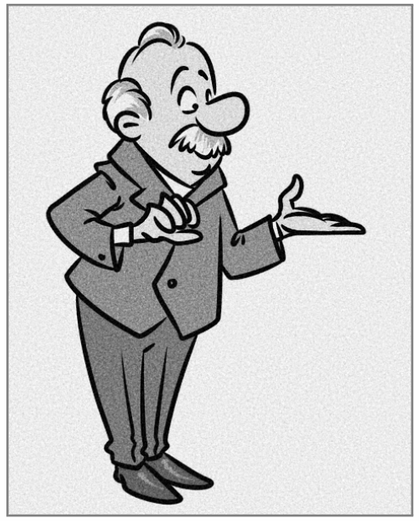
```
1  Class Figure;
2    Virtual: Real Procedure square Is Procedure square;;
3  Begin
4  End;
5  Figure Class Circle (c, r);
6    Real c, r;
7  Begin
8    Real Procedure square;
9    Begin
10     square := 3.1415 * r * r;
11   End;
12 End;
```

# Who coined the “OOP” term?

**Smalltalk** was created in the 1970s at Xerox PARC by Learning Research Group (LRG) scientists, including Alan Kay, Dan Ingalls, Adele Goldberg, Ted Kaehler, Diana Merry, and Scott Wallace. (c) Wikipedia

# Smalltalk: Sample Code

```
Object subclass: Account [
    | balance |
    Account class >> new [
        | r |
        r := super new. r init. ^r
    ]
    init [ balance := 0 ]
]
Account extend [
    deposit: amount [ balance := balance + amount ]
]
a := Account new
a deposit: 42
```



"Everyone will be in a favor of OOP. Every manufacturer will promote his products as supporting it. Every manager will pay lip service to it. Every programmer will practice it (differently). And no one will know just what it is."

— Tim Rentsch,
Object Oriented Programming,
ACM SIGPLAN Notices 17.9, 1982

# Who made it all popular?

**C++** was created by Danish computer scientist Bjarne Stroustrup in 1985, by enhancing C language with Simula-like features. C was chosen because it was general-purpose, fast, portable and widely used.

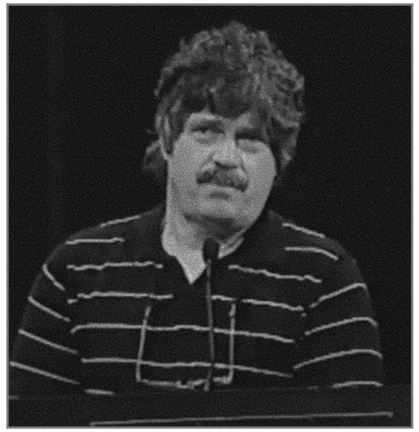
You may enjoy watching this one-hour dialog of Dr. Stroustrup and me.

# C++: Sample Code

```
class Figure {
  virtual float square() = 0;
};
class Circle : public Figure {
  Circle(float c, float r) : c(c), r(r) {};
  float square() { return 3.1415 * r * r; };
private:
  float c, r;
};
```

"There are as many definitions of OOP as there papers and books on the topic"

— Ole Lehrmann Madsen et al.,
What Object-Oriented Programming May Be—And What It Does Not Have to Be, ECOOP'89



“I made up the term ‘object-oriented,’ and I can tell you I didn’t have C++ in mind”

— Alan Kay, OOPSLA’97

There was an interesting debate between Alan Kay and a few readers of my blog, in the comments section under this blog post: Alan Kay Was Wrong About Him Being Wrong

# What happened later?

C++ was released in 1985. And then...

Erlang 1986
Eiffel 1986
Self 1987
Perl 1988
Haskell 1990
Python 1991
Lua 1993

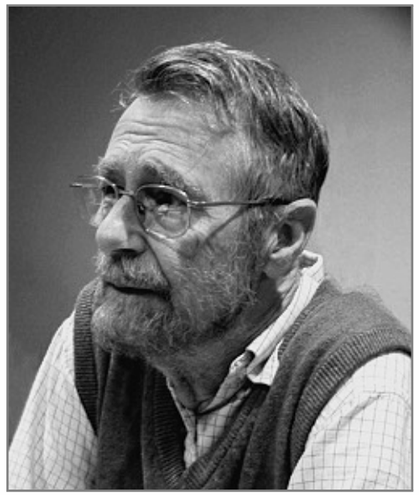
JavaScript 1995
Ruby 1995
Java 1995
Go 1995
PHP3 1998
C# 2000
Rust 2010
Swift 2014

“There is no uniformity or an agreement on the set of features and mechanisms that belong in an OO language as the paradigm itself is far too general”

— Oscar Nierstrasz,
A Survey of Object-Oriented Concepts, 1989

# Incomplete list of OOP features, so far:

- Polymorphism
- Nested Objects
- Traits
- Templates
- Generics
- Invariants
- Classes
- NULL
- Exceptions
- Operators
- Methods
- Static Blocks
- Virtual Tables
- Coroutines
- Monads
- Algebraic Types
- Annotations
- Interfaces
- Constructors
- Destructors
- Lifetimes
- Volatile Variables
- Synchronization
- Macros
- Inheritance
- Overloading
- Tuple Types
- Closures
- Access Modifiers
- Pattern Matching
- Enumerated Types
- Namespaces
- Modules
- Type Aliases
- Decorators
- Lambda Functions
- Type Inference
- Properties
- Value Types
- Multiple Inheritance
- Events
- Callbacks
- NULL Safety
- Streams
- Buffers
- Iterators
- Generators
- Aspects
- Anonymous Objects
- Anonymous Functions
- Reflection
- Type Casting
- Lazy Evaluation
- Garbage Collection
- Immutability

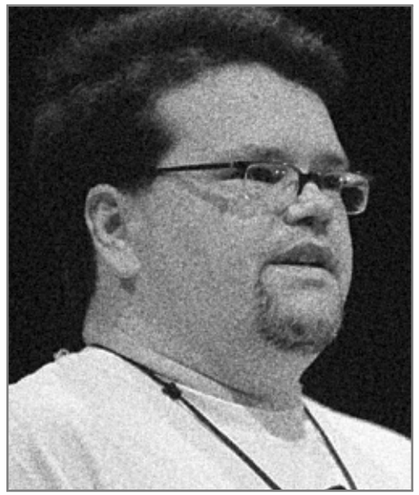


“Object oriented programs are offered as alternatives to correct ones... Object-oriented programming is an exceptionally bad idea which could only have originated in California.”

— Edsger W. Dijkstra, 1989

“C++ is a horrible language. . . C++ leads to really, really bad design choices. . . In other words, the only way to do good, efficient, and system-level and portable C++ ends up to limit yourself to all the things that are basically available in C.”

— Linus Torvalds, 2007
Creator of Linux



"OO seems to bring at least as many problems to the table as it solves"

— Jeff Atwood, 2007
Co-founder of Stack Overflow

“I think that large objected-oriented programs struggle with increasing complexity as you build this large object graph of mutable objects. You know, trying to understand and keep in your mind what will happen when you call a method and what will the side effects be.”

— Rich Hickey, 2010
Creator of Clojure

> The complexity of object-oriented code remains its primary drawback

“Reading an OO code you can’t see the big picture and it is often impossible to review all the small functions that call the one function that you modified”

— Asaf Shelly, 2015
Flaws of Object Oriented Modeling

"Object oriented programming promotes ease in designing reusable software but the long coded methods makes it unreadable and enhances the complexity of the methods"

— Zeba Khanam, 2018
Barriers to Refactoring: Issues and Solutions, International Journal on Future Revolution in Computer Science & Communication Engineering

> Thus, we don't know anymore what exactly is object-oriented programming, and whether it helps us write better code :(

You can find more quotes in this blog post of mine: What's Wrong With Object-Oriented Programming?

Chapter #2:

# Original Intent

“The contemporary mainstream understanding of objects (which is not behavioral) is but a pale shadow of the original idea and anti-ethical to the original intent”

— David West,
Object Thinking, 2004

You may enjoy watching our conversation with Dr. West: part I and part II.

> A system is a composition of objects that are abstractions, which hide data and expose behavior*

* This is how I understand the original intent.

# 1) What is an “abstraction”?

- Color: red
- Weight: 120g
- Price: $0.99

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

We deal with an abstraction as if it was a real thing, but eliminating unnecessary details. We do `file.read()` instead of “open file handler for data.txt, read byte by byte, store in byte buffer, wait for the end of file, return the result.”

# How many abstractions are needed?

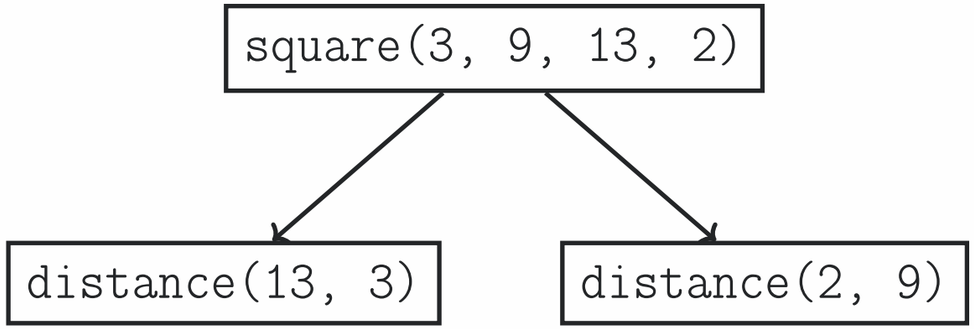
```
int square(x1, y1, x2, y2) {
  int w = x2 - x1;
  if (w < 0) { w = w * -1; }
  int h = y2 - y1;
  if (h < 0) { h = h * -1; }
  return w * h;
}
```

```
int distance(left, right) {
  int d = right - left;
  if (d < 0) { d = d * -1; }
  return d;
}
int square(x1, y1, x2, y2) {
  return distance(x2, x1)
    * distance(y2, y1);
}
```

There are two abstractions at the right snippet (“square” and “distance”), while only one abstraction at the left one (just “square”).

# Levels of abstraction

```
1 int distance(left, right) {
2   int d = right - left;
3   if (d < 0) { d = d * -1; }
4   return d;
5 }
6 int square(x1, y1, x2, y2) {
7   return distance(x2, x1)
8     * distance(y2, y1);
9 }
```




Higher level abstractions must not know and/or rely on semantics of lower level abstractions.

# 2) What is “data hiding”?

```
f = new File("/tmp/data.txt");
// The data escapes the object! :(
p = f.getPath();
FileUtils.deleteFile(p);
```

```
f = new File("/tmp/data.txt");
// The boolean data escapes too :)
done = f.delete();
assert(done);
```

Obviously, some data must escape your objects.

# 3) What is “behavior exposing”?

This is so called “anemic” object:

```
var user = {
  login: 'jeff',
  password: 'swordfish',
  age: 32
}
function print(u) {
  console.log(`Hello, ${u.login},
    you are ${u.age} today!`);
}
print(user);
```

This object is “alive”:

```
var user = {
  login: 'jeff',
  password: 'swordfish',
  age: 32,
  print: function() {
    console.log(`Hello, ${this.login},
      you are ${this.age} today!`);
  }
}
user.print();
```

# An object as a function

```
int distance(left, right) {
  int d = right - left;
  if (d < 0) { d = d * -1; }
  return d; }
int square(x1, y1, x2, y2) {
  return distance(x2, x1)
    * distance(y2, y1); }
```

```
class Distance {
  private int r; private int l;
  Distance(l, r) { l = l; r = r; }
  int value() {
    int d = right - left;
    if (d < 0) { d = d * -1; }
    return d; } }
int square(x1, y1, x2, y2) {
  return new Distance(x2, x1).value()
    * new Distance(y2, y1).value(); } }
```

The Java object `Distance` on the right snippet is semantically equivalent to the C function `distance()` on the left one.

# Identity, State, Behavior

```
class Circle {
  private float radius;
  Circle(float r) {
    radius = r; }
  void getRadius() {
    return radius; }
  void setRadius(float r) {
    radius = r; }
  float square() {
    return 3.14 * radius * radius; }
}
```

```
// Identity:
c1 = new Circle(42.0);
c2 = new Circle(42.0);
c1 != c2;

// State:
c1 = new Circle(42.0);
c2 = new Circle(42.0);
c1.getRadius() == c2.getRadius();

// Behavior:
c1 = new Circle(42.0);
c2 = new Circle(-42.0);
c1.square() == c2.square();
```

# State vs. Behavior

```
class Circle {
  private float r;
  void setR(float r) { this.r = r; }
  float getR() { return this.r; }
}
class FigureUtils {
  static float calcuateSquare(Circle c) {
    return 3.14 * c.getR() * c.getR();
  }
}
Circle c = new Circle();
c.setR(42.0);
float s = FigureUtils.square(c);
```

```
class Circle {
  private float r;
  Circle(float r) { this.r = r; }
  float square() {
    return 3.14 * this.r * this.r;
  }
}
Circle c = new Circle(42.0);
float s = c.square();
```

How to decide what is state and what is behavior?

# 4) What is “composition”?

```
canvas = new Canvas();
canvas.addCircle(new Circle(42));
canvas.draw();
```

```
canvas = new Canvas();
circle = new Circle(42);
circle.drawOn(canvas);
```

What is composition? What is the “right” composition?

Chapter #3:

# Object Thinking vs. Algorithms

# While-Do loop

```
1  buffer = []
2  while true
3    c = STDIN.readchar
4    break if c == "\n"
5    if buffer.length > 3
6      STDOUT.puts buffer.join
7      buffer = []
8    end
9    buffer << c
10 end
```

```
1 $ echo 'Hello, world!' | ruby a.rb
2 Hell
3 o, w
4 orld
```

# Buffer abstraction

```
buffer = []
while true
  c = STDIN.readchar
  break if c == "\n"
  if buffer.length > 3
    STDOUT.puts buffer.join
    buffer = []
  end
  buffer << c
end
```

```
class Buffer
  def initialize; @data = []; end
  def push(c)
    if @data.length > 3
      STDOUT.puts @data.join
      @data = []
    end
    @data << c
  end
end
buffer = Buffer.new
while true
  c = STDIN.readchar
  break if c == "\n"
  buffer.push c
end
```

# Loop abstraction

```
class Buffer
  def initialize; @data = []; end
  def push(c)
    if @data.length > 3
      STDOUT.puts @data.join
      @data = []
    end
    @data << c
  end
end
buffer = Buffer.new
while true
  c = STDIN.readchar
  break if c == "\n"
  buffer.push c
end
```

```
class Buffer
  # the same
end
class Pull
  def initialize(b); @buf = b; end
  def again
    c = STDIN.readchar
    return false if c == "\n"
    @buf.push c
    true
  end
end
buffer = Buffer.new
pull = Pull.new(buffer)
while pull.again; end
```

# Loop abstraction

```
1  class Buffer
2    # the same
3  end
4  class Pull
5    def initialize(b); @buf = b; end
6    def again
7      c = STDIN.readchar
8      return false if c == "\n"
9      @buf.push c
10     true
11   end
12 end
13 buffer = Buffer.new
14 pull = Pull.new(buffer)
15 while pull.again; end
```

```
1  class Buffer
2    # the same
3  end
4  class Pull
5    # the same
6  end
7  class Pulls
8    def initialize(p); @pull = p; end
9    def fetch
10     while @pull.again; end
11   end
12 end
13 Pulls.new(Pull.new(Buffer.new)).fetch
```

# Object composition

```
class Buffer
  def initialize; @data = []; end
  def push(c)
    if @data.length > 3
      STDOUT.puts @data.join
      @data = []
    end
    @data << c
  end
end

class Pull
  def initialize(b); @buf = b; end
  def again
    c = STDIN.readchar
    return false if c == "\n"
    @buf.push c
    true
  end
end

class Pulls
  def initialize(p); @pull = p; end
  def fetch
    while @pull.again; end
  end
end

Pulls.new(
  Pull.new(
    Buffer.new
  )
).fetch
```

Chapter #4:

# Enemies of Object Thinking

# What makes us think as algorithms

Global scope (static methods)

Anemic objects (getters)

Mutability (setters)

Workers (“-er” suffix)

NULL references

Type casting (reflection)

Inheritance

Chapter #5:

# How to Pass the Exam?

# Make a software project, which...

... is larger than 5,000 lines of functional code,

... compiles and works,

... doesn't have static methods,

... has no getters or public attributes,

... doesn't use NULL references,

... has only immutable objects,

... doesn't use inheritance.

Otherwise, just attend 75% of all lectures and you will get your "C".

Chapter #6:

# Read and Watch

## Read and watch:

David West, Object Thinking, 2004

Yegor Bugayenko, Elegant Objects, 2016

Read my 80+ blog posts about OOP, here

Watch my 15+ lectures about OOP, on YouTube

“Object Thinking” meetup, watch on YouTube.