

GOOL: A Generic Object-Oriented Language

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Introduction

Requirements

Creation

Implementation

Patterns

Conclusions

OO languages:

- Structurally similar

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- Mainly *shallow* syntactic differences

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OO languages:

- Structurally similar
- Mainly *shallow* syntactic differences
- Like Romance languages
- We tend to say similar things in all of them

The Goal



One language to express them all.

- Is it possible?
- Capture the meaning of **OO programs**
- DSL for domain of **OO programs**
- Currently targets Java, Python, C#, C++

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- **mainstream:** Most potential users

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- **expressivity:** Works for real examples

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- **readable:** Human beings are a target audience
- **idiomatic:** For readability, understandability
- **documented:** For readability, understandability
- **patterns:** More efficient coding
- **expressivity:** Works for real examples
- **common:** Reduce code duplication

Approach

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Start from real OO programs

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Start from real OO programs

What we can say vs. want to say vs. need to say

Readability Features

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Example: Blocks

- Semantically meaningless
- Reflect how people write programs

[example code would really help here —JC]

Some ingredients

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- Variables distinct from values (viz use/mention)

Some ingredients

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- Variables distinct from values (viz use/mention)
- Smart constructors for common idioms

GOOL Language

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Types

bool, int, float, char, string, infile (**read mode**), outfile (**write mode**), listType, obj

Variables

var, extVar, classVar, objVar, \$-> (**infix operator for objVar**), self, [listVar]

Values

valueOf (**value from variable**), litTrue, litFalse, litInt, litFloat, litChar, litString, ?!, ?&&, ?<, ?<=, ?>, ?>=, ?==, ?!=, #~, #/^, #—, #+, #-, #*, #/, #^, inlineIf, funcApp, extFuncApp, newObj, objMethodCall, [selfFuncApp, objMethodCallNoParams]

Statements

varDec, varDecDef, assign, &=, &+=, &-=, &++, &~-, break, continue, returnState, throw, free, comment, ifCond, ifNoElse, switch, for, forRange, forEach, while, tryCatch, block, body [bodyStatements (**single-block body**), oneLiner (**single-statement body**)]

List API

listAccess, at (**same as** listAccess), listSet, listAppend, listIndexExists, indexOf, listSlice

Scope

public, private

Binding

static_, dynamic_

Functions

function, method, param, pointerParam, mainFunction, docFunc, [pubMethod, privMethod]

State Variables

stateVar, constVar, [privMVar, pubMVar (**dynamic**), pubGVar (**static**)]

Classes

buildClass, docClass, [pubClass, privClass]

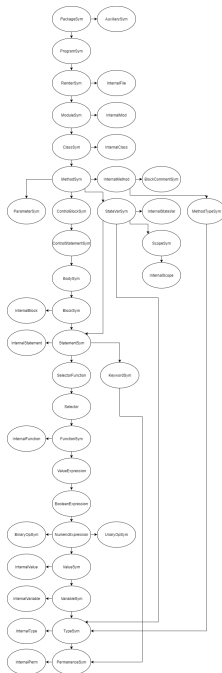
Packages

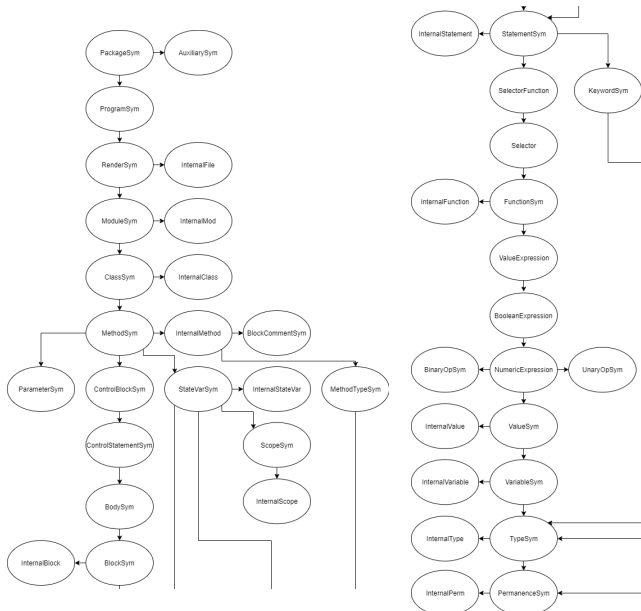
buildModule, fileDoc, docMod, prog, package, doxConfig, makefile

Tagless with type families – 2 Layers of abstraction

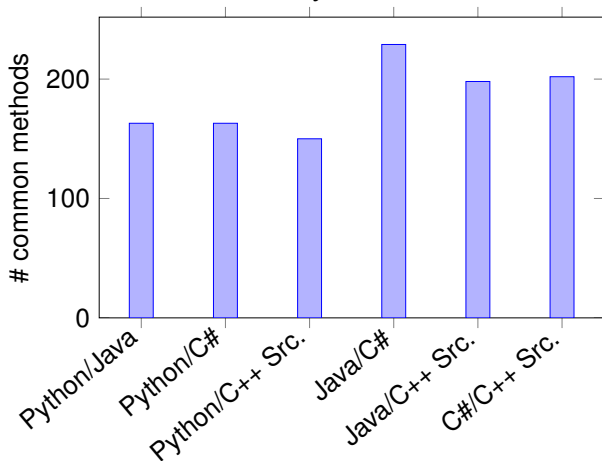
- ① Over target language
- ② Over language-specific representational data structures

```
class (TypeSym repr) => VariableSym repr where
  type Variable repr
  var :: Label -> repr (Type repr)
      -> repr (Variable repr)
```





- 43 classes, 328 methods
- 300 functions that abstract over commonalities
- 40% more common methods between Java and C# than Java and Python



Things we need/want to say

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- Command line arguments
- Lists
- I/O
- Procedures with Input/Output/Both parameters
- Getters and setters
- Design patterns

Example: List Slicing

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GOOL: *hideous, we know*

```
listSlice sliced (valueOf old) (Just $ litInt 1)
      (Just $ litInt 3) Nothing
```

Python:

```
sliced = old[1:3:]
```

Example: List Slicing

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Java:

```
ArrayList<Double> temp = new ArrayList<Double>(0);
for (int i_temp = 1; i_temp < 3; i_temp++) {
    temp.add(old.get(i_temp));
}
sliced = temp;
```

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C#:

```
List<double> temp = new List<double>(0);
for (int i_temp = 1; i_temp < 3; i_temp++) {
    temp.Add(old[i_temp]);
}
sliced = temp;
```

Example: List Slicing

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C++:

```
vector<double> temp(0);
for (int i_temp = 1; i_temp < 3; i_temp++) {
    temp.push_back(old.at(i_temp));
}
sliced = temp;
```

Example: Setters

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GOOL:

setMethod "FooClass" foo

Python:

```
def setFoo(self, foo):  
    self.foo = foo
```

Example: Setters

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GOOL:

setMethod "FooClass" foo

Java:

```
public void setFoo(int foo) throws Exception {  
    this.foo = foo;  
}
```

Example: Setters

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GOOL:

```
setMethod "FooClass" foo
```

C#:

```
public void setFoo(int foo) {  
    this.foo = foo;  
}
```

Example: Setters

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GOOL:

setMethod "FooClass" foo

C++:

```
void FooClass::setFoo(int foo) {  
    this—>foo = foo;  
}
```


- More types
- Smarter generation using State monad - ex. import statements
- Interface with external libraries
- User-decisions - ex. which type to use for lists?
- More patterns

[Split into a slide for each? Or pick a couple important ones and just do a slide for each of those? —BM]

Language of Design

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Drasil project

- Generate scientific software
- Design language allows users to influence design
- GOOL is the backend

Complete Example

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Projectile program

Design 1

- Documented
- Bundled inputs

Design 2

- Logging
- More modular

We currently use GOOL to generate some examples of scientific software (glass breakage, projectile simulation)

Together new:

- Idiomatic code generation
- Human-readable, documented code generation
- Coding patterns are language idioms

With respect to “The Goal” — It is possible