SIGL
A Drawing Language

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Outline

- Introduction
  - What is SIGL?
  - Feature highlighting
- SIGL anatomy
  - Scanning and parsing
  - Overall design
  - Evaluation
- Testing

What is SIGL?

- Simple Image Generation Language: simple language for drawing 2D images

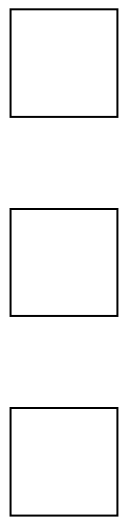
- Motivation
  - VRML language: standard 3D model specification
  - Lack of controlling flow
  - Repetition required
  - Only suitable for machine generation

- Introduce more control in form of C-like syntax

Drawing in SIGL

- Draw 3 vertically aligned boxes

```
for (i = 0;i < 3;++i)
{
    :translate(0, i * 2): {
        rectangle(0, 0, 1, 1);
    }
}
```



Features

- Drawing features
  - OpenGL-like drawing mechanism
  - Support commonly used primitives: lines, circle, ellipse, polygons
  - Transformations: translation, rotation, scale
- Language features
  - C-like language
  - Support nearly all C constructions (except for switch)
  - Data types: int, double, boolean, associative array
  - Dynamic type system, no type decoration
  - Static scoping
  - Applicative evaluation order

Grammar

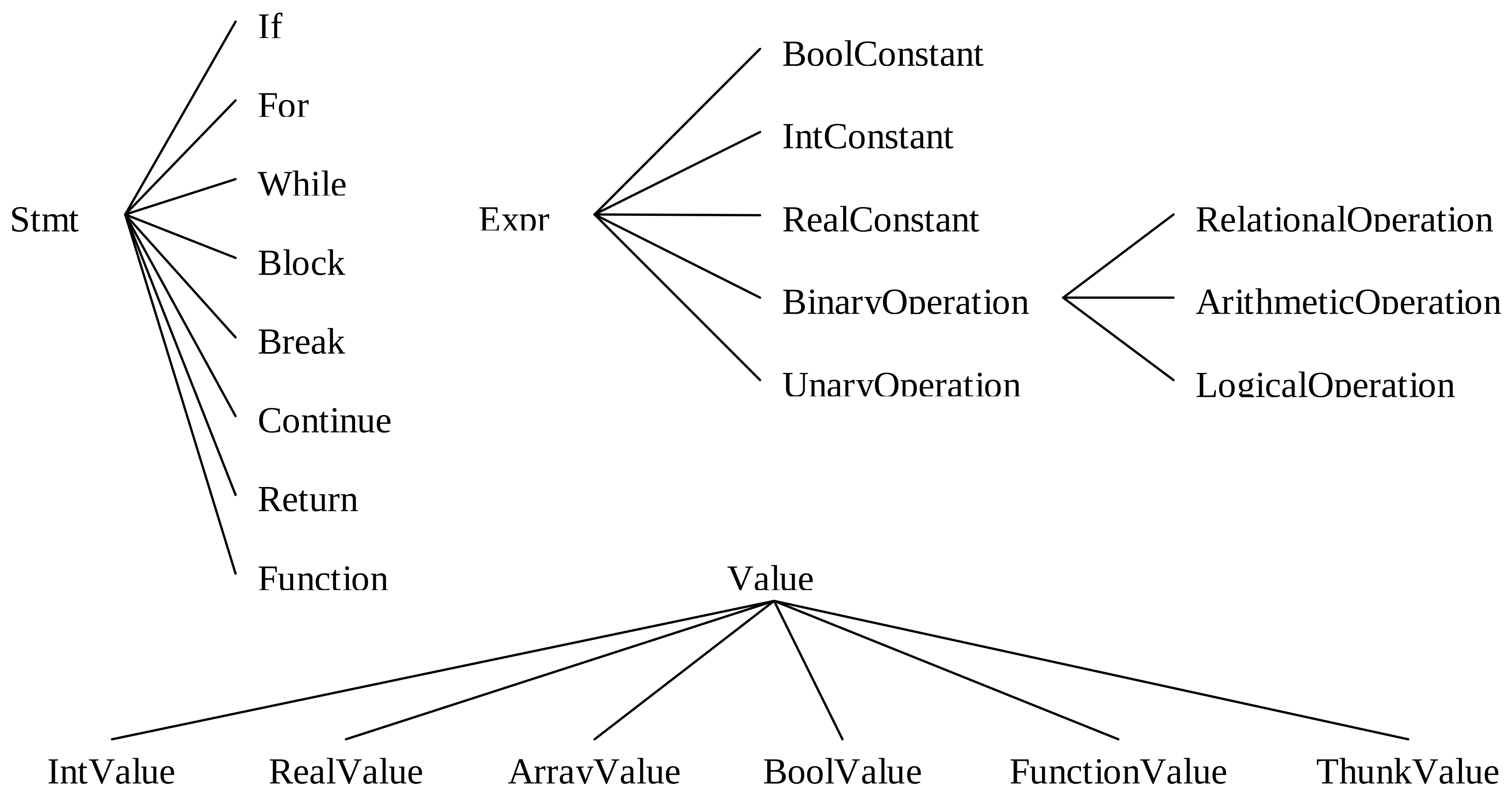
- C-like operators / comments / ID
  - Three types of operational tokens: Integer, real number, logical
- C-like arithmetic precedent etc.
  - Mult, Div, and Mod precedence over addition and subtraction
- C-like function declaration and flow control statements
  - for, if, while, break, continue, return, empty statement (;)

Parser - Walker

- Build AST tree in 2 steps
  - Build default ANTLR tree (Parser)
    ```
    while_stmt : "while"^ LPAREN! expr RPAREN! stmt ;
    ```
  - Transform default AST tree into object tree (Walker)
    ```
    #("while" e1=expr s1=stmt { s = new While(e1, s1); } )
    ```
- Store location of the expressions for debugging purposes.

  ```
  #(LOR a=expr b=expr { e = new LogicalOperation("||", a, b);
  e.setLine(#LOR.getLine()); e.setColumn(#LOR.getColumn()); } )
  ```
- The object tree makes Walker simpler, allows language flexibility

Class Hierarchy



Type checking

- Expressions are evaluated into Values
- Type-checking is done using Values
- Example: “%” operator
  - Evaluate left hand side to `val1`
  - Evaluate right hand side to `val2`
  - Check that both `val1` and `val2` are both of type IntValue

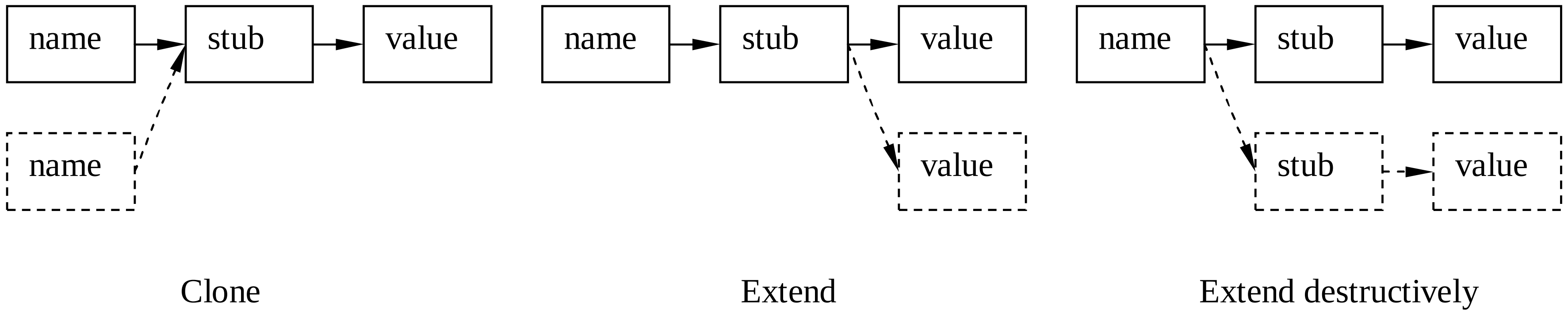
Environment

- Stored current states of the program
- Components:
  - Symbol table
  - Drawing canvas (this includes colors, etc.)
  - Current transformation
  - Break, continue, return flag

Symbol table

- Desired behavior

```
x = 1; // x is bound to 1
{
    x = 5; // x is bound to 5
    y = 6; // x is bound to 5, y is bound to 6
}
// x is bound to 5, y is unbound
```



Functions

- Functions are first-order entities in SIGL
  - Can be passed as arguments to other functions
- Function declarations are evaluated into FunctionValues
- FunctionValue: tuple of 2 values `fv = (f,env)`
  - The function `f` itself
  - A cloned environment `env` of the environment at which the function is declared
- Handle recursive function: bind destructively f to `fv` in `env`

Function call evaluation

- Retrieve FunctionValue associated with the given name
- Execute the function (stored in FunctionValue)
  - Static scoping: using the environment stored in FunctionValue
  - Dynamic scoping: using the current environment
- Evaluation order
  - Applicative order: evaluate each argument expressions and pass to the function
  - Normal order: create a ThunkValue
    - ThunkValue: tuple (`expr,env`)

Modified access in symbol table

- ThunkValue should only be evaluated once
- Access is called:
  - Get the value
  - If the value is ThunkValue
    - Evaluate `expr` in ThunkValue using `env` in ThunkValue
    - Replace ThunkValue in symbol table with new value
  - return value

Built-in functions

- Don't need to change lexer/parser
- Implement as FunctionValue
- Automatically loaded

Testing

- Some unit testing using JUnit
- Peer-review
- Big-bang testing

Thank you

Questions?