SetC

A Language for Set Theory

Heather Preslier

Introduction/Motivation

- Language based in C
- Compiled down to LLVM
- Goals:
  - Simplify the formulation of complex algorithms by creating a concise language that mirrors set notation
  - Simplify the handling and manipulating of sets
  - Remove the need for type declarations
  - Maintain functionality for basic programming

Syntax

- Syntax inspired by set theoretic notation
- Full type inference
- Built-in functionality for the manipulation and operation of sets
- Overloaded operators

```
def remove_duplicates(a){
     b = [];
     (0<=i<#a |  a[i]?b == false)
     b = b + [a[i]];
     print(b); /* print the new set */
     return b;
}
```

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Type inference

Function inference

Built-in set operators

Type inference

Set Theoretic Iterator

overloaded operators

Comments

StdLib Function

Syntax

- File extension: .sc
- Required main function
- Types: bools, ints, floats, strings, sets
- Initialization by assignment
    - Inferred types are bound after initialization
    - Empty set types are bound after **first** use
- Functions
    - Need only be preceded by the keyword `def`
    - Functions types and parameters are inferred
    - Sets are pass by reference

example1.sc:

```
a = “setc”; /* global */

def main(){
  b = 3; /* initialization */
  c = [];
  c = c + [b]; /* c -> int */
  d = func(c);
  print(d); /* true */

def func(a) {
  a[0] = 5;
  return true;
}
```

Special Features

- Optimizations of functions
    - Some functions will not be semantically checked and code will not be generated
- Standard Library/Built-In Functionality
    - Print functionality for all types
    - Intersection (*), union (&), difference(-), append(+), slice(:), set, in(?), cardinality(#) operations for sets
    - Split function: string -> set
    - File I/O: open, close, read, write

example2.sc:

```
def main(){
  a = [1,2,3];
  b = [1,4,2];
  a * b;     /* [1,2] */
  a + b;     /* [1,2,3,1,4,2]*/
  a & b;     /* [1,2,3,4] */
  a - b;     /* [3] */
  a[1:3];    /* [2,3] */
  2?a;       /* true */
  a[1:3];    /* [2,3] */
  #a;        /* 3 */
  print(a); /* 1 2 3 */
  c = “hello world”;
  d = split(c, “ ”);
      /* d -> set */
```

Tasks

Semantics:

- Constraints
  - Precedence
- Overloading operators and functions
  - Considering the IR
- Type Inference algorithm
  - Third time's the charm
- Sets/empty set
  - Type inference of an empty set
  - Compile time vs. runtime decision

Code Generation:

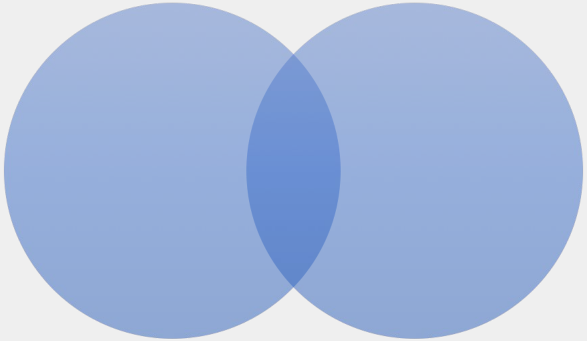
- Sets
  - Pointer implementation
  - Length: compile time vs. runtime decision

Testing:

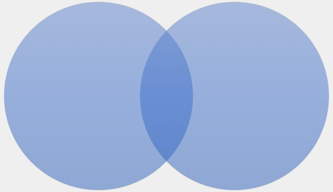
- Unit and Integration testing
- 102 tests total

Lessons Learned

- Need to consider the IR more when making design and implementation choices for the language



Demos



Demo 1: Basic functionality

- Bubble Sort Algorithm

Demo 2: Function inference

- GCD algorithm
- Euler’s phi function
- Coprimality of sets

Demo 3: Algorithm

- Perceptron Learning Algorithm