Reading Questions Set 4
Symbolic Execution and Finite Precision Analysis

15-819O: Program Analysis
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Due: Wednesday, March 3, 2013 (1:00 pm)

10 points total

Read the following papers:

- Khoo Yit Phang, Bor-Yuh Evan Chang, and Jeffrey S. Foster. Mixing Type Checking and Symbolic Execution. PLDI 2010.
  http://www.cs.colorado.edu/~bec/papers/pldi10-mix.pdf
  When reading, focus primarily on the formalization of symbolic execution in section 3.1.

- Eric Goubault and Sylvie Putot. Static Analysis of Finite Precision Computations. VMCAI 2011.
  http://www.lix.polytechnique.fr/Labo/Sylvie.Putot/Publications/vmcai11.pdf

Answer the questions below in a text file that you email to the instructor (aldrich@cs.cmu.edu) with subject "RQ 4":

Question 1 (5 points).

Symbolically execute the following program, which is given in the language of the first paper, and also in the equivalent C code. Give the result of symbolic execution as a pair <S′; s>.

```
1  // code in the language of the paper
2  foo(int y, int z)
3    let w = y;
4    let x = ref (w + z);
5    if (!x == y)
6      x := !x + z;
7    x
8
9  // equivalent C code
10 foo(int y, int z)
11   int w = y;
12   int *x = malloc(sizeof(int));
13   *x = w + z;
14   if (*x == y)
15     *x = *x + z;
16   return x;
```

Question 2 (5 points).

Consider the following program, in which all variables hold IEEE 754 double-precision floating point numbers:

$$x := [0, 5]$$
$$y := 2 * x$$
$$z := 10 - y$$
$$w = x + z$$

As with Example 1 in the second paper, compute the range of w using (A) interval analysis and (B) relational analysis. Finally, choose one of these two techniques (say which) and (C) compute the error of y. Show your work on all parts (A)-(C).

Notes: When computing the error, assume round-to-nearest mode. You may also assume some fixed values for δ_r and δ_a from Equation 1 in the paper (e.g. 0.001 and 0.00001) but if anyone wants to find or compute the actual values from the IEEE standard I am curious what they are.