CS4120/4121/5120/5121—Spring 2016
Homework 3
Semantic Analysis
Due: Monday, February 29, 11:59PM

0 Updates

- None yet; watch this space.

1 Instructions

1.1 Partners

You may work alone or with *one* partner on this assignment. But remember that the course staff is happy to help with problems you run into. Use Piazza for questions, attend office hours, or set up meetings with any course staff member for help.

1.2 Homework structure

All problems are required of all students.

2 Problems

1. **Symbol tables**

   For each of the following Xi terms, give a typing context in which it type-checks, or explain why no such typing context exists.

   (a) `if (x + 2 == 4) { return x }`

   (b) `while (f(x,y)) x = x + f(y,x)`

   (c) `a: int[] = b z = {3, f}[y]`

2. **Type checking**

   Suppose that function `f` is declared with this signature:

   ```
   f(x: bool, y: bool): int, int[]
   ```

   Show the full typing derivation for the following Xi statement:

   ```
   x:int, _ = f({true,false,true}[1], 0==1-1)
   ```

3. **Inference rules**

   Suppose Xi were extended with a new `foreach` statement:

   `foreach (`*x* `in` *e*`)` *s*

The expression e must evaluate to an array. The `foreach` statement executes the statement s once for each element of the array, with the variable x bound to the array element at index $i - 1$ on iteration i. The variable x is newly introduced by this form and is in scope only within the loop body. It may not shadow any previous declaration of x.

For example, the program on the left-hand side would produce the output on the right-hand side:

```
1 use conv
2 use io
3
4 main(args: int[][]) {
5   a: int[] = { 3, 4, 5 }
6   foreach (x in a) {
7     println(unparseInt(x*10))
8   }
9 }
```

```
30
40
50
```

Give a suitable inference rule in the style of the Xi type system specification to describe the typing of this new statement form.

3 Submission

Submit your solution as a PDF file on CMS. This file should contain your name, your NetID, all known issues you have with your solution, and the names of anyone with whom you have discussed the homework.