

# CS4120/4121/5120/5121—Spring 2022

## Homework 3

### Semantic Analysis

Due: Monday, February 21, 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 Ed 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 - length(y) > 0) { return x }`
- (b) `while (y & f(x,y) > 0) { x = x + f(y,x) ; return x }`
- (c) `a: int[] = b[0] ; 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)
```

To fit the full derivation onto a page, you may split it into subderivations. If you need help with L<sup>A</sup>T<sub>E</sub>X, [this sample](#) may be useful.

### 3. Inference rules

Suppose Xi were extended with a new `do-until` statement:

```
do s until (e)
```

The `do-until` statement executes the statement *s* and stops iterating once *e* evaluates to `true`. In particular, *s* is evaluated at least once, and *e* is evaluated at the end of each execution of *s*. Consequently, the following program is safe, and it prints the string “132”.

```
1 use conv
2 use io
3
4 main(args: int[][] ) {
5   x:int = 0
6   y:int = 0
7   do {
8     y = x + 1
9     x = y + 1
10    z:int = x*y
11  } until (z > 100)
12  println(unparseInt(x * y))
13 }
```

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.