Fall 2018 Qualifying Exam – Languages

Your Test ID Number: _____

Instructions

Write your test id number above and on each page of your answers. Read the problems carefully and write answers to all of them. This exam is closed book and closed notes.

Part 1: CS 440

(1) (30 = 5* 6 points) For each pair of programming language terminologies in the following, give the main difference between them and the main advantage of one over the other. For example, in the first pair, you will give the main difference between an interpreter and a compiler, an advantage of the interpreter, and an advantage of the compiler.

a) Interpreter vs compiler

b) LR(1) vs LL(1) parsing

c) Exception type checking as in Java vs. no exception type checking as in C#.

d) Recursion vs. iteration

e) Static type checking vs dynamic type checking

(2) (10 points) Most programming languages (e.g. C++ and Java) use a "termination model" to specify control flow after an exception is raised in the middle of a try block. Statements in the rest of the try block will be skipped; control goes directly to the catch block.

a) (3 points) What is wrong with the following fragment of code?

```
try {
        socket.close();
        connection.close ();
        inputStream.close ();
} catch (Exception e) {
        …       //exception handling code
}
```

b) (3 points) Rewrite the code fragment in a) to correct its defects.

c) (4 points) Describe an unpleasant aspect of your solution to part (b) and suggest a small language change to remove it.

(3) (10 points)

a) (5 points) The following two code fragments are similar except that parameter passing in (i) is by value and in (ii) is by reference. What is the value of `y` at the end of the program fragments? Give one pro and one con for each of these two parameter passing methods.

(i)
```
{int y = 1;
   void foo (value x) {
          x = x+1;
          }
   foo(y);
   }
```

(ii)
```
{int y = 1;
   void foo (ref x) {
       x = x + 1;
       }
   foo(y);
   }
```

b) (5 points) Consider the following code fragment in which block `B` is nested inside `A`. What is the value of `x` at the end of the code fragment if the scoping rule is *static* (or *lexical*)? Or if the scoping rule is *dynamic*? One pro and one con for each approach.

```
A: { int x = 0;
    void fie() {
        x = 1;
    }
    B: {
        fie();
    }
}
```

Part 2: CS 536

(1) (4 points) Using the standard Hoare Logic rules, calculate the weakest p for the triple below. (Note the program is nondeterministic.) Show your work.

{p} if $x \geq 0 \rightarrow x := x+1 \; \square \; y > 0 \rightarrow y := y-1$ fi $\{y \geq x\}$

(2) (8 points) Using the definition of wp do the calculation below. Show your work. You may use logical equivalences to simplify your work.

wp(b[x] := b[y]; b[y] := b[1], b[x] < b[y])

(3) (8 points) Using the definition of sp do the calculation below. Show your work. You may use logical equivalences to simplify your work.

sp(a < b < c, a := a/b; a := a*c)

(4) (14 points) Complete the program below: Add an invariant, bound function, and final postcondition and expand to a full proof outline for total correctness. (Some, but not all, of the missing conditions are indicated below.)

$\{m = m_0 \geq 0\}$
x := 0; {inv ???} {bd ???}
while $m \geq 1$ do
    {???} x := x+n; m := m-1 {???}
od
{???}

(5) (8 points) List the interference freedom tests for the following collection of three programs. Assume S, T, and U are atomic

- {p} S {q]
- {r} T {p}
- $\{p \wedge r\}$ U $\{q \vee r\}$

(6) (8 points)
(a) List the deadlock-freedom tests for the following parallel program outline.
(b) Discuss briefly: How should the outline be changed to ensure deadlock-freedom?

$\{x = y = 1\}$
[{T} await y > 0 then x := 2 end $\{x \neq 0\}$
|| {T} await x > 0 then y := 2 end $\{y \neq 0\}$]
$\{x \neq 0 \wedge y \neq 0\}$