

Fall 2016 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: CS440

(1) (30 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) (6 points) interpreter vs compiler
- b) (6 points) LR(1) vs LL(1) parsing
- c) (6 points) parameter passing by value vs by reference
- d) (6 points) static scoping vs dynamic scoping
- e) (6 points) 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) Define a grammar (with BNF or well defined notations) that generates all expressions with balanced curly brackets (i.e. “{” and “}”). An expression contains a number of expressions enclosed in a pair of curly brackets.
- b) (5 points) Briefly describe how you would generate code to evaluate an expression acceptable by the grammar in a).

Part 2: CS 536

Below, assume p and q are predicates, S and T are statements, B and C are boolean expressions and t is an integer expression.

- (4) (9 points) Calculate $wp(b[x] := a; b[y] := b[z], b[x] \neq b[y])$, showing your steps. You may use syntactic and logical transformations to simplify your answer.
- (5) (8 points) Calculate $sp(x < y, IF)$ where $IF \equiv \text{if } x < z \text{ then } x := f(x, z) \text{ else } y := f(z, y) \text{ fi}$. Show your steps.
- (6) (9 points) List the properties necessary to ensure total correctness of $\{p_0\} S_1; \{\text{inv } q_1\} \{\text{bd } t\} \text{ while } B \text{ do } S_2 \text{ od}; S_3 \{q_2\}$
- (7) (8 points) What are the interference freedom checks for $\{p_1\} S_1; \{p_2\} S_2 \{p_3\}$ and $\{q_1\} T_1; \{q_2\} T_2 \{q_3\}$? (Assume the statements are each atomic.)
- (8) (8 points) Briefly discuss the important difference between the standard loop $\text{while } B \vee C \text{ do if } B \text{ then } S_1 \text{ else if } C \text{ then } T_1 \text{ fi fi}$ and the nondeterministic loop $\text{do } B \rightarrow S_1 \square C \rightarrow T_1 \text{ od}$.
- (9) (8 points) List all the deadlock-freedom checks for the parallel program $[\{p_1\} S_1; \{p_2\} \text{ await } B_1 \text{ do } \{p_3\} S_2 \{p_4\} \text{ end } \{p_5\} S_3; \{p_6\} \parallel \{q_1\} \text{ await } C_1 \text{ do } T_1 \text{ end}; \{q_2\} \text{ await } C_2 \text{ do } \{q_3\} T_4 \{q_4\} \text{ end}; T_2 \{q_5\}]$.