Qualifying Exam – Languages

Spring 2016

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 I: CS440

1. (25 points) For each of the following pairs of programming language issues, briefly explain the advantages and disadvantages of each alternative. Be brief and succinct (not more than a paragraph for each pair of issues); excessively long answers will be penalized.

    a. Compilation vs interpretation

    b. Strong static types vs weak static types

    c. Static types vs dynamic types

    d. Pointers vs references

    e. Lazy vs strict evaluation

2. (5 points) What advantages / disadvantages do LR(1) and LL(1) languages have with each other? Again, be brief.

3. (20 points) Consider the following regular language $\mathcal{L}$. Its alphabet is $\Sigma = \{0, 1, x\}$ and start symbol is S.

    $$S \to E\,F\,S \mid \varepsilon$$
    $$E \to x\,Y \mid x$$
    $$Y \to E\,x$$
    $$F \to 0\,F \mid G$$
    $$G \to G\,0 \mid G\,11 \mid 11\,F \mid 0 \mid 11$$

    a. (10 points) Give a regular expression for $\mathcal{L}$.

    b. (10 points) Give a finite automaton that accepts $\mathcal{L}$.

Part II: CS536

4. (9 points) Let S be a deterministic program, let p and q be predicates, let, $w_1 \equiv wp\,(S, q)$, and let $w_2 \equiv wlp\,(S, q)$. Give brief answers to the following questions.

    a. For $\{p\}\,S\,\{q\}$ to be totally correct, what property is necessary for p (relative to w_1 and / or w_2)?

    b. For $\{p\}\,S\,\{\neg q\}$ to be totally correct, what property is necessary for p (relative to w_1 and / or w_2)?

    c. If q is a tautology, what states does w_1 describe? What states does w_2 describe?

5. (8 points) Suppose *ndflag*() is a zero-argument function that nondeterministically returns true or false. Rewrite the loop **do** $B_1 \rightarrow S_1 \;[]\; B_2 \rightarrow S_2$ **od** using deterministic **while do**…**od**, **if**…**fi**, and *ndflag*().

6. (10 points) What is $wlp\,(\texttt{b[b[x]]} \; \texttt{:=} \; \texttt{b[y]} \; \{\texttt{b[b[x]]} \leq \texttt{b[z]}\})$? Use syntactic and logical transformations to simplify your answer (show your steps).

7. (8 points) Suppose $\{p_1\}\,S_1\,\{p_2\}\,S_2\,\{p_3\}$ and $\{q_1\}\,T_1\,\{q_2\}$ are sequentially correct outlines and that S_1, S_2, S_3, and T_1 are each atomic. What are the interference freedom checks for this pair of triples?

8. (9 points) What properties are necessary to ensure total correctness of
    $\{p\}\,S_1\,\{\boldsymbol{inv}\;r\}\,\{\boldsymbol{bd}\;e\}\;\boldsymbol{while}\;B\;\boldsymbol{do}\;S_2\;\boldsymbol{od}\;\{q\}$?

9. (6 points) Calculate $sp\,(\texttt{x < y}, \; \texttt{x := f(x, y);} \; \texttt{y := g(x, y)})$. Show your steps.