Final Exam

Programming Language Concepts

May 4, 2020

1. (10 points) Write code for a state diagram to recognize the floating-point literals, integer literals, string literals and variable names of any programming language that was developed after 1990.

2. (10 points) Write an CFG, EBNF or BNF for Java; the tool you create only need to cover the following expressions and show the proper order of operations:

   –boolean expressions

   –assignment statements

   –mathematical expressions

3. (10 points) Write recursive descent parser routines for the rules created above.

4. (10 points) Explain the four criteria for proving the correctness of a logical pretest loop construct of the form "while B do S end". And prove the correctness of the following:

```
 a = 1;
 b = 1;
 while( b <= n ){
    a = a * x;
    b = b + 1;
}
{ a = x ^ n }
```

5. (5 points) In a letter to the editor of CACM, Rubin (1987) uses the following code segment as evidence that the readability of some code with gotos is better than the equivalent code without gotos. This code finds the first row of an n by n integer matrix named x that has nothing but zero values.

```
for (i = 1; i <= n; i++) {
    for (j = 1; j <= n; j++)
        if (x[i][j] != 0)
            goto reject;
    println ('First all-zero row is:', i);
    break;
    reject:
}
```

   Rewrite this code without gotos in Java. Compare the readability of your code to that of the example code.

6. (10 points) Consider the following programming problem: The values of three integer variables—first, second, and third—must be placed in the three variables max, mid, and min, with the obvious meanings, without using arrays or user-defined or predefined subprograms. Write two solutions to this problem, one that uses nested selections and one that does not. Compare the complexity and expected reliability of the two.

7. (5 points) Compare the tombstone and lock-and-key methods of avoiding dangling pointers and memory leakage, from the points of view of safety and implementation cost.

8. (10 points) Consider the following C program segment.

```
j = -3;
for (i = 0; i < 3; i++) {
   switch (j + 2) {
     case 3:
     case 2: j--; break;
     case 0: j += 2; break;
         default: j = 0;
   }
   if (j > 0) break;
   j = 3 - i
}
```

a)Rewrite it using no gotos or breaks.

b)Rewrite the C program segment using if and goto statements in C

c) Rewrite the C program segment in Java without using a switch statement

d)Write and explain the operational semantics C program segment

9. (30 points) Analyze a language introduced in the last 15 years, for its:

readability, writability, reliability

In this analysis you must also address the following, and the problems that are introduced by making the choices that language did:

Keywords

Data type

Control Structures

Expressions

- unary, binary, trinary, combinations

- assignment

- logic

- order or operations

Compare the selected language to Java .

For 10points extra credit analyze how the language you chose handles syntax and semantics

_____ 45 points