

CSC 361

Mid-Term Examination

NAME: _____

This must be your work alone! You may seek assistance from your notes, books, and the Internet but not from another individual. If you have any questions, ask your instructor.

Please type as many of your answers as possible.
Due by Friday, March 2 at Noon!

Do not send the test to your instructor by way of email.

1. (12 points) Consider the following grammar:

```
<expr> -> <expr> + <id>
          | <id> * <expr>
          | (<expr>)
          | <id>
<id> -> A | B | C
```

Draw a Parse Tree for the expression

$A * B * (C+D)$

2. (5 points) Explain why the expression $(A * B) + (A + C)$ can not be derived from this grammar.

3. (10 points) Consider the grammar:

$S \rightarrow aS \mid Sa \mid a$. Why is it ambiguous? Consider aa .

4. (20 points) True or false?

- a. Pascal was designed by the Swiss Niklaus Wirth A) _____
- b. The “goto” statement in many programming languages goes against the rules governing structured languages. B) _____

- c. Red Hat Corporation developed the C programming language to be an internal product to be used to build the Unix operating system. C) _____
- d. PL/1 developed by IBM was not a great success but did concurrent programming and had extensive exception-handling features. D) _____
- e. A variable's lifetime is the same as its scope E) _____
- f. We should consider arrays as sequential access structures, and linked lists as direct access structures. F) _____
- g. A computer can consider a 32-bit standard 2's complement integer as the bit stream for an IEEE standard float value. G) _____
- h. Strings can have virtually any length in programming languages H) _____
- i. The syntax of a language is the language's grammar rules I) _____
- j. Ada Augusta Lovelace is considered the first computer programmer. J) _____

5. (10 points) Consider the FORTRAN variable array declaration *INTEGER ARR(1:2, 1:4)* and the C variable array declaration *int Arr[2][4]*;

They are each stored in essentially a linear form of 12 integer memory locations like

X							
----------	--	--	--	--	--	--	--

If the first memory location of the array is the place marked with X, above, write **F** in the memory location for the FORTRAN array element ARR(1,2) and C in the memory location for the C array element Arr[0][1].

6. (12 points)

Consider the following C++ - like program

<pre> int x; void F1() { int x = 100 F2(); x++; cout << x << endl; } void F2() { </pre>	<p>If we assume static scoping, what are the values of x that are output (beginning with the cout statement in F2?)</p>
	<p>If we assume dynamic scoping, what are the</p>

<pre> x = x - 2; cout << x << endl; } void main() { x = 10; F1(); cout << x << endl; } </pre>	<p>values of x that are output (beginning with the cout statement in F2?)</p>
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7. (15 points) Consider the grammar from your notes:

```

<assign> -> <id> = <expr>
<id> -> A|B|C
<expr> -> <id> + <expr>
        | <id> * <expr>
        | ( <expr> )
        | <id>

```

Fill in the blanks with the word *can* or the word *can't*. If the expression **can** be derived, show a left-most derivation.

- $C = A + B * C$ _____ be derived
- $C = C + (B * A)$ _____ be derived
- $C = ((A) + B)$ _____ be derived
- $A = (A + B) + (C * A)$ _____ be derived
- $B = A * B * C$ _____ be derived

8. (16 points) Translate the following C++ code **into primitive, virtual machine, C++ code**: (using only goto statements, if statements, and labels. -- no while, do-while, or for loops!)

```

cin << n << m;
while ( n < 100 )
{
    while ( m > 9 )
    {
        m--;
    }
    n++;
}

```

```
cout << n << m << endl;
```

Extra Credit: (up to 30 extra points)

I want you to invent a fixed data type for a language like C. Assume each digit is stored in BCD: binary coded decimal (4 bits for each digit). An important attribute for the fixed type would be the number of digits after the decimal point. Obviously, the computer would have to store the digits and the number of digits to the right of the decimal point all in the same variable. If we had a type designation like “fixed(5) price” that would mean that the variable price has 5 digits to the right of the decimal point. Explain as fully as possible how you might design this data type in terms of size of memory, how digits are stored, the number of fixed digits after the decimal recorded, etc. I will give up to 30 extra points for this answer.