

CSE-304 Compiler Design

Fall '09

Second Mid-term Exam

November 13, 2009.

Duration: 55 minutes.

Maximum Score: 25

Name: _____

USB ID Number: _____

INSTRUCTIONS

Read the following carefully before answering any question.

- Make sure you have filled in your name and USB ID number in the space above.
 - Write your answers in the space provided; Keep your answers brief and precise.
 - The exam consists of 5 questions, in 10 pages (including this page) for a total of **25** points. Page 10 of the exam is intentionally blank.
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Question	Max.	Score
1.	6	
2.	5	
3.	7	
4.	3	
5.	4	
Total:	25	

1. [Total: 6 points]

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For this question, consider grammar G_1 with start symbol S given below:

$$S \rightarrow S S +$$

$$S \rightarrow \text{id}$$

a. (1 point) Show the parse tree for sentence `id id id + +`

b. (3 points) Show the set of all $LR(0)$ items for grammar G_1 .

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- c. (2 points) Give the $SLR(1)$ action table and goto table for G_1 .

2. **[5 points]** Consider the following grammar describing the language of binary numbers (with S as the start symbol):

$$S \longrightarrow B S$$

$$S \longrightarrow B$$

$$B \longrightarrow 0$$

$$B \longrightarrow 1$$

Write a syntax-directed definition, based on the above grammar, to find the *value* of a binary number. For example the value of 101010 is 42.

3. **[Total: 7 points]** Consider the following syntax directed definition written using the attribute grammar notation:

$$\begin{array}{lll}
 S & \rightarrow & A B C \quad \{S.x = B.y + C.x; \quad B.x = A.y\} \\
 A & \rightarrow & \mathbf{a} \quad \{A.y = 1\} \\
 B & \rightarrow & \mathbf{b} B \quad \{B_1.x = 2; \quad B.y = B_1.y + B.x\} \\
 B & \rightarrow & \epsilon \quad \{B.y = B.x\} \\
 C & \rightarrow & \mathbf{c} \quad \{C.x = 3\}
 \end{array}$$

- a. (2 points) For each of the attributes, state whether the attribute is synthesized or inherited.

Attribute	Synthesized/Inherited
$S.x$	
$A.y$	
$B.x$	
$B.y$	
$C.x$	

- b. (2 points) What is the value of attribute $S.x$ for sentence **abbc**?

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- c. (3 points) Show an encoding of the above syntax-directed definition in Yacc/Bison. For full credit, your Yacc/Bison specification should evaluate the attributes at the correct time (i.e. the value of an attribute must be computed before it is used).

4. [Total: 3 points] Consider the following C program fragment declaring six variables:

```
int **u, *v, w;  
int **x, *y, z;
```

If pointer arithmetic is disallowed (i.e. you cannot mix pointer and integer values, and cannot perform arithmetic on pointer values), which of the following expressions will be type correct?

In the table below, for those expressions which do not have type error, write the type of the expression; for those which have a type error, write “error”.

Expression	Type
<code>u = x</code>	
<code>x = &v</code>	
<code>w = **x + 1</code>	
<code>u = v + 1</code>	
<code>u = *w</code>	
<code>*u = &w</code>	

5. [Total: 4 points]

a. (2 points) Consider the following Java program:

```
class A {  
    static int x;  
    private int y;  
    public int z;  
    int f() {  
        int p;  
        p = this.y + this.z;  
        return p+A.x;  
    }  
}
```

For each of the following variables in the program, state where they will be stored at run-time (e.g. Code Area, Static Area, Stack or Heap).

Variable	Area
x	
y	
z	
p	

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- b. (2 points) Consider the following C function.

```
int f(int m, int n) {  
    int i, j;  
    i = m+n;  
    j = i*n;  
    return i+j;  
}
```

Consider a call `f(5, 10)`. Show the activation record for this call just before the `return` statement is evaluated.

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END OF EXAM