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Course: CSDS 337 - Compiler Design
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Problem Set - 4
ID: 123456789
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Number of hours delay for this Problem Set: Put hours here
Cumulative number of hours delay so far: Put hours here

I discussed this homework with: Put names here

Problem 1 - 15 points
Suppose that we have a production $A \to BCD$. Each of the four nonterminals A , B, C, and D have two attributes: s is a synthesized attribute, and i is an inherited attribute. For each of the sets of rules below, tell whether (i) the rules are consistent with an S-attributed definition (ii) the rules are consistent with an L-attributed definition, and (iii) whether the rules are consistent with any evaluation order at all?

a $A : s = B : i + C : s.$

b $A : s = B : i + C : s$ and $D : i = A : i + B : s.$

c $A : s = B : s + D : s.$

d $A : s = D : i, \quad B : i = A : s + C : s, \quad C : i = B : s,$ and $D : i = B : i + C : i.$

Solution:

a

b

c

d

Problem 2 - 15 points
Construct the DAG for the expression $((x + y) - ((x + y) * (x - y))) + ((x + y) * (x - y))$

Solution: Your solutions go here

Problem 3 - 15 points
Translate the arithmetic expression $a + (b + c)$.

a A syntax tree.

b Quadruples.

c Triples.

d Indirect triples.

Solution:

a

b

c

d

Problem 4 - 20 points
A real array $A[i; j; k]$ has index i ranging from 1 to 4, j ranging from 0 to 4, and k ranging from 5 to 10. Reals take 8 bytes each. If A is stored row-major, starting at byte 0, find the location of:

a $A[3; 4; 5]$

b $A[1; 2; 7]$

c $A[4; 3; 9]$.

Repeat the above if A is stored in column-major order.

Solution:
Row-major:

a

b

c

Column-major:

a

b

c

Problem 5 - 20 points
Add rules to the syntax-directed definition of Fig. 1 for the following control-flow constructs:

PRODUCTION	SEMANTIC RULES
$P \rightarrow S$	$S.next = newlabel()$ $P.code = S.code \mid\mid label(S.next)$
$S \rightarrow$ **assign**	$S.code =$ **assign**$.code$
$S \rightarrow$ **if** (B) S_1	$B.true = newlabel()$ $B.false = S_1.next = S.next$ $S.code = B.code \mid\mid label(B.true) \mid\mid S_1.code$
$S \rightarrow$ **if** (B) S_1 **else** S_2	$B.true = newlabel()$ $B.false = newlabel()$ $S_1.next = S_2.next = S.next$ $S.code = B.code$ $\mid\mid label(B.true) \mid\mid S_1.code$ $\mid\mid gen('\texttt{goto}'\ S.next)$ $\mid\mid label(B.false) \mid\mid S_2.code$
$S \rightarrow$ **while** (B) S_1	$begin = newlabel()$ $B.true = newlabel()$ $B.false = S.next$ $S_1.next = begin$ $S.code = label(begin) \mid\mid B.code$ $\mid\mid label(B.true) \mid\mid S_1.code$ $\mid\mid gen('\texttt{goto}'\ begin)$
$S \rightarrow S_1\ S_2$	$S_1.next = newlabel()$ $S_2.next = S.next$ $S.code = S_1.code \mid\mid label(S_1.next) \mid\mid S_2.code$

Figure 1: Rules to the syntax-directed definition

- A repeat-statement **repeat** S **while** B.
- A for-loop **for** $(S_1; B; S_2)S_3$.

Solution:

Problem 6 - 15 points
Translate the following expressions using the ifFalse mechanism:

a if $(a == b \quad \&\& \quad c == d \quad || \quad e == f) \quad x == 1;$

b if $(a == b \quad || \quad c == d \quad || \quad e == f) \quad x == 1;$

c if $(a == b \quad \&\& \quad c == d \quad \&\& \quad e == f) \quad x == 1;$

Solution:

a

b

c