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// Assignment - 5

Ans 1:-

(a) Arithmetic Operators:-

• Arithmetic expressions are represented as a sequence of statements which using temporaries for the intermediate values.

• Attributes used are : $id.loc$, $E.loc$, $num.val$, $gentemp()$, $emit(result, arg1 op, arg2)$

ex:- $a = 4 + 5 * 6$

Reduction

- $E \rightarrow num$
- $E \rightarrow num$
- $E \rightarrow num$
- $E \rightarrow E * E$
- $E \rightarrow E_1 + E_2$
- $S \rightarrow id$

TAC

$t00 = 4$

$t01 = 5$

$t02 = 6$

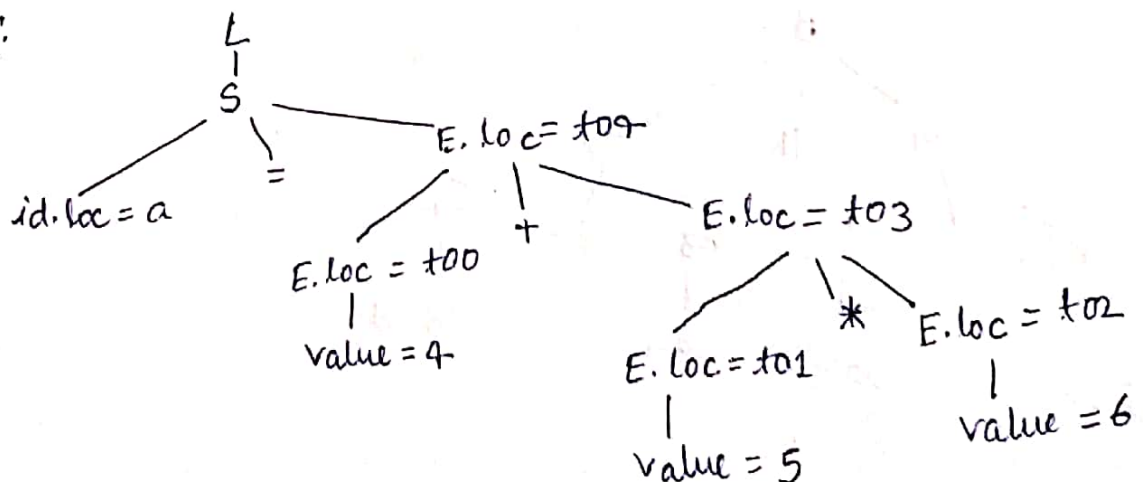
$t03 = t01 * t02$

$t04 = t00 + t03$

$a = t04$

~~Parse~~ ~~Tree~~

Parse tree:



(b) Boolean Operators :-

- Attributes used in boolean expressions are : $B.loc$, $B.trueList$, $B.falseList$, $M.instr$, $makeList(i)$, $merge(P_1, P_2)$, $backpatch(P, i)$
- Boolean expressions having 2 types of translation.
 - by value
 - by control flow

Eg:- ~~Eg~~ Translation by control value:

$a < b \parallel c == d$

Reductions

$B_1 \rightarrow E_1 \text{ relop } E_2$

$B_2 \rightarrow E_3 \text{ relop } E_4$

$B \rightarrow B_1 \parallel B_2$

TAC

100: if $a < b$ go to 104

101: goto 102

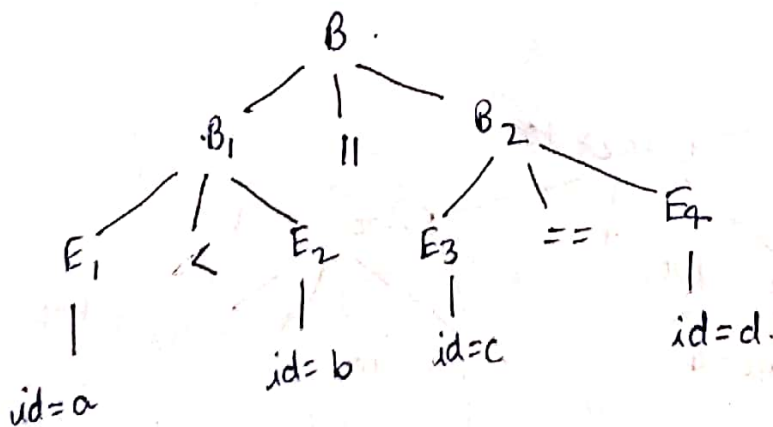
102: if $c == d$ goto 104

103: goto 105

104: goto 000 (true)

105: goto 000 (false)

Parse tree :-



(c) Array References:-

→ Grammar for array expression uses both right and left recursion.

→ Attributes used in array expression: $A.loc$, $A.array$, $A.type$

→ Elements $A[i]$ begins in locations $(base\ address + p * i)$ where p is the size of each element in Array A and base address is the relative address of the storage allocated for A .

Ex:- ~~int x[2][3], a, b, x[2][3];~~
 $a = b + x[i][j];$

Reductions

TAC

$E_2 \rightarrow id_b$

$t01 = i * 12$

$E_4 \rightarrow id_j$

$t02 = j * 4$

$A_2 \rightarrow id_x[E_4]$

$t03 = t01 + t02$

$E_5 \rightarrow id_j$

$t4 = x[t3]$

$A_1 \rightarrow A_2[E_5]$

$t5 = b + t4$

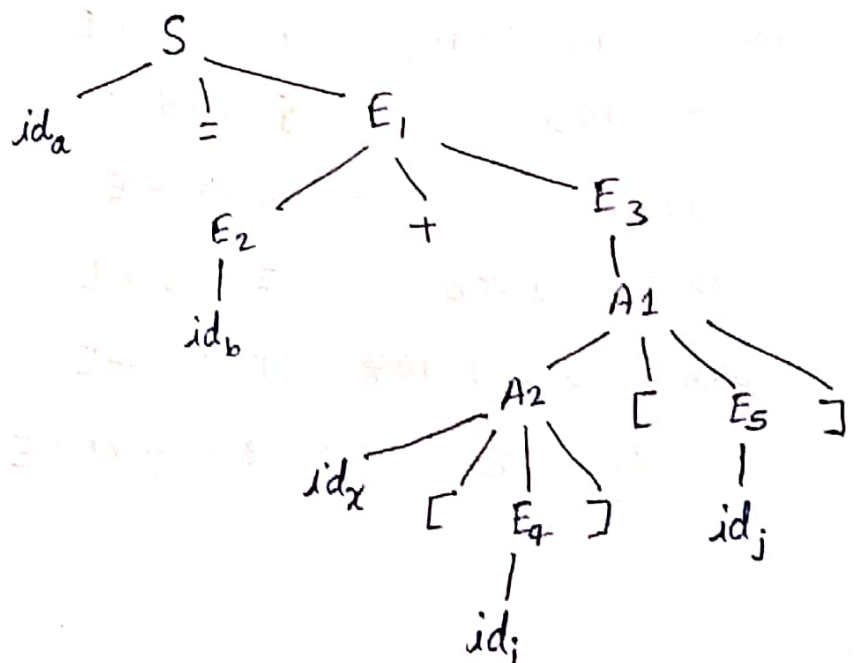
$E_3 \rightarrow A_1$

$a = t5$

$E_1 \rightarrow E_2 + E_3$

$S \rightarrow id = E_1$

Parse tree:



Ans:-2

$$L \rightarrow LS \setminus n \mid s \setminus n$$

$$S \rightarrow id = E \mid E$$

$$E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid (E) \mid -E \mid num \mid id$$

$$a = 5$$

$$b = 6$$

$$c = a + (b * (10/a))$$

$$d = -c + a * b$$

TAC

$$t00 = 5$$

$$a = t00$$

$$t01 = 6$$

$$b = t01$$

$$t02 = 10$$

$$t03 = t02/a$$

$$t04 = b * t03$$

$$t05 = a + t04$$

$$c = t05$$

$$t06 = -c$$

$$t07 = a * b$$

$$t08 = t06 + t07$$

$$d = t08$$

Reductions

$$E \rightarrow num$$

$$S \rightarrow id = E$$

$$E \rightarrow num$$

$$S \rightarrow id = E$$

$$E \rightarrow num$$

$$E \rightarrow E/E$$

$$E \rightarrow (E)$$

$$E \rightarrow E * E$$

$$E \rightarrow (E)$$

$$E \rightarrow E + E$$

$$S \rightarrow id = E$$

$$E \rightarrow -E$$

$$E \rightarrow E * E$$

$$E \rightarrow E + E$$

$$S \rightarrow id = E$$

Annotated Parse tree:-

