CS335A: Assignment 3

Udit Prasad (201055)

Question 1

Solution:
(a) CFG is as follows:

$$S \to \alpha(P) \tag{0}$$
$$S \to \beta(P_1, P_2) \tag{1}$$
$$S \to \gamma(P_1, P_2, P_3) \tag{2}$$
$$P \to S \tag{3}$$
$$P \to x \tag{4}$$
$$P \to y \tag{5}$$

(b) Given, $type(x) = A$ and $type(y) = B$

Using this information and the CFG from part(a), following is the SDT,

Production	Semantic Rule
$S \to \alpha(P)$	{if(P.type == A) then S.type = A else print("Type error") }
$S \to \beta(P_1, P_2)$	{if(P_1.type == B and P_2.type == B) then S.type = B else print("Type error") }
$S \to \gamma(P_1, P_2, P_3)$	{if(P_1.type == P_2.type and P_2.type == P_3.type) then S.type = B else print("Type error") }
$P \to S$	{P.type = S.type}
$P \to x$	{P.type = A}
$P \to y$	{P.type = B}

(c) □
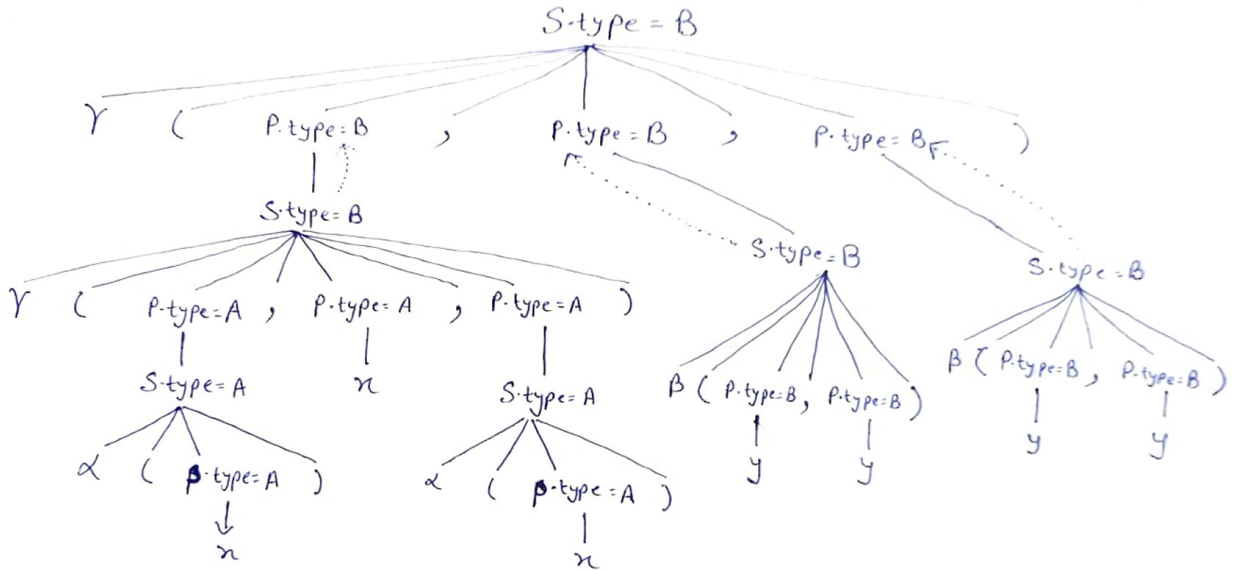
Figure 1: Annotated Parse Tree

Question 2

Solution: (a) CFG is as follows:

$$P \rightarrow S \tag{0}$$
$$P \rightarrow P; S \tag{1}$$
$$S \rightarrow x = E \tag{2}$$
$$E \rightarrow E + T \tag{3}$$
$$E \rightarrow T \tag{4}$$
$$T \rightarrow T * F \tag{5}$$
$$T \rightarrow F \tag{6}$$
$$F \rightarrow 1 \tag{7}$$
$$F \rightarrow x \tag{8}$$
$$\tag{9}$$

(b) following is the SDT,

Production	Semantic Rule
$P \rightarrow S$	{S.xval = 0; P.val=S.val;}
$P \rightarrow P_1; S$	{P_1.xval = 0; S.xval = P_1.val; P.val = S.val;}
$S \rightarrow x = E$	{S.val = E.val; E.xval = S.xval;}
$E \rightarrow E_1 + T$	{E.val = E_1.val + T.val; E_1.xval = E.xval; T.xval = E.xval; }
$E \rightarrow T$	{E.val = T.val; T.xval = E.xval;}
$T \rightarrow T_1 * F$	{T.val = T_1.val * F.val; T_1.xval = T.xval; F.xval = T.xval;}
$T \rightarrow F$	{T.val = F.val; F.xval = T.xval;}
$F \rightarrow 1$	{F.val = 1; }
$F \rightarrow x$	{F.val = F.xval; }

(c) Following table tells about all the attributes of different terminals:

Terminal	attribute	Type
S	val	synthesized
S	xval	inherited
P	val	synthesized
P	xval	inherited
E	val	synthesized
E	xval	inherited
T	val	synthesized
T	xval	inherited
F	val	synthesized
F	xval	inherited

Question 3

Solution:
following is the SDT,

Production	Semantic Rule
$stmt \rightarrow var = expr$	{if(stmt.indefs ∩ expr.refd == stmt.indefs) then stmt.outdefs = stmt.indefs ∪ var.name else print("undefined variable") }
$stmt \rightarrow stmt_1 \; ; \; stmt_2$	{$stmt_1$.indefs = stmt.indefs ; $stmt_2$.indefs = $stmt_1$.outdefs; stmt.outdefs = $stmt_2$.outdefs; }

$stmt \rightarrow$ if expr then $stmt_1$ else $stmt_2$ fi	{if(stmt.indefs ∩ expr.refd == stmt.indefs)
	 then { $stmt_1$.indefs = stmt.indefs;
	       $stmt_1$.indefs = stmt.indefs;
	       stmt.outdefs = $stmt_1$.outdefs ∩ $stmt_2$.outdefs
	    }
	 else print("undefined variable")}

$expr \rightarrow expr_1 + expr_2$	{expr.refd = $expr_1$.refd ∪ $expr_2$.refd ;}
$expr \rightarrow expr_1 < expr_2$	{expr.refd = $expr_1$.refd ∪ $expr_2$.refd ;}
$expr \rightarrow var$	{expr.refd = {var.name} ;}
$expr \rightarrow int\_const$	{}

□

Question 4

Solution: Following is the IR generated:

$$t_1 = k * 28$$
$$t_2 = j * 4$$
$$t_3 = t_1 + t_2$$
$$t_4 = B[t_3]$$
$$t_5 = i * 20$$
$$t_6 = k * 4$$
$$t_7 = t_4 + t_5$$
$$t_8 = A[t_7]$$
$$t_9 = t_4 * t_8$$
$$t_{10} = i * 28$$
$$t_{11} = j * 4$$
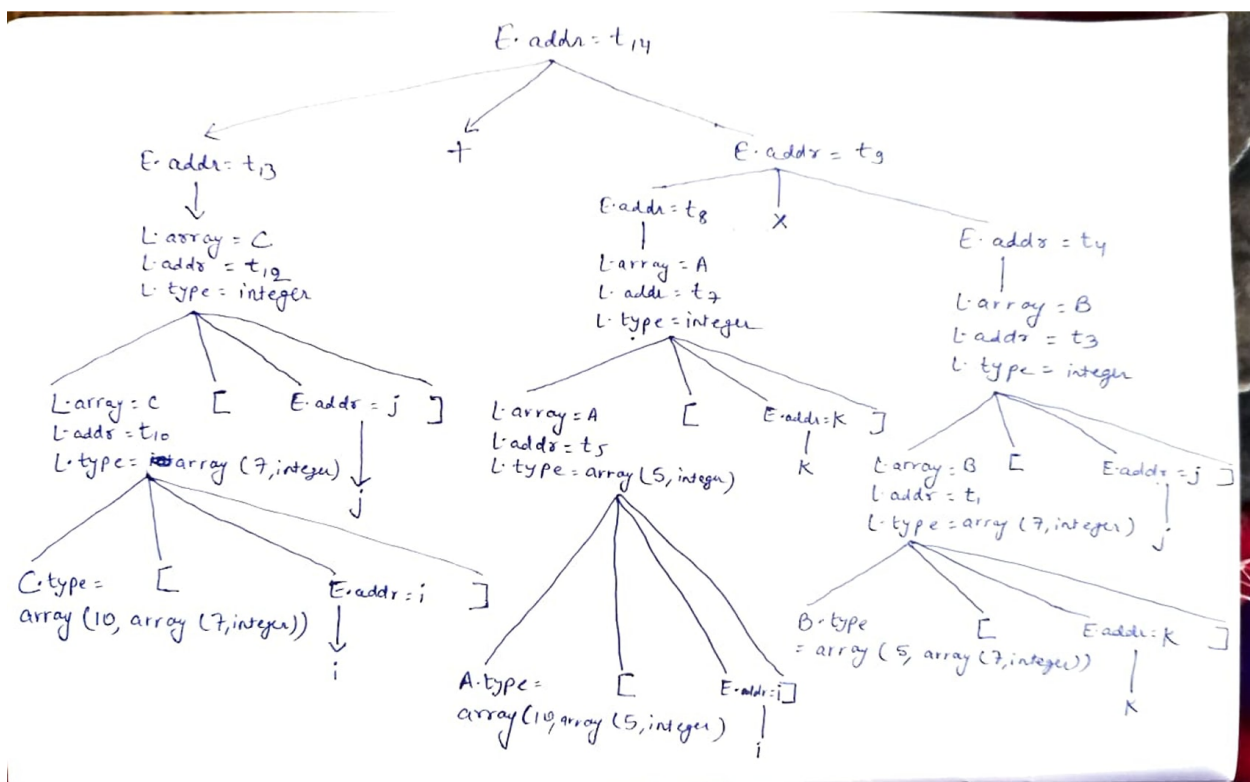$$t_{12} = t_{10} + t_{11}$$
$$t_{13} = C[t_{12}]$$
$$t_{14} = t_{13} + t_9$$

□

Figure 2: Annotated Parse Tree