Compilers (CS31003)

Lecture 15-16

Syntax Directed Translation

PRODUCTION	SEMANTIC RULE
E → E_1 + T	E.code=E_1.code || T.code || '+'

Syntax Directed Definition: A CFG together with attributes and rules. Attributes are associated with grammar symbols and rules are associated with productions.

Synthesized Attribute: For a non-terminal *A* at a parse tree node *N* synthesized attribute is defined by a semantic rule associated with the production at *N*.

Inherited Attribute: For a non-terminal *B* at a parse tree node *N* inherited attribute is defined by a semantic rule associated with the production at the parent of *N*.

Syntax Directed Definition

Sl No	PRODUCTION	SEMANTIC RULES
1	$L \rightarrow E\ \$$	L.val=E.val
2	$E \rightarrow E_1 + T$	$E.val=E_1.val + T.val$
3	$E \rightarrow T$	E.val=T.val
4	$T \rightarrow T_1 * F$	$T.val=T_1.val \times F.val$
5	$T \rightarrow F$	T.val=F.val
6	$F \rightarrow (E)$	F.val=E.val
7	$F \rightarrow digit$	F.val=digit.lexval

Draw an annotated parse tree for 3 * 5 + 4 $

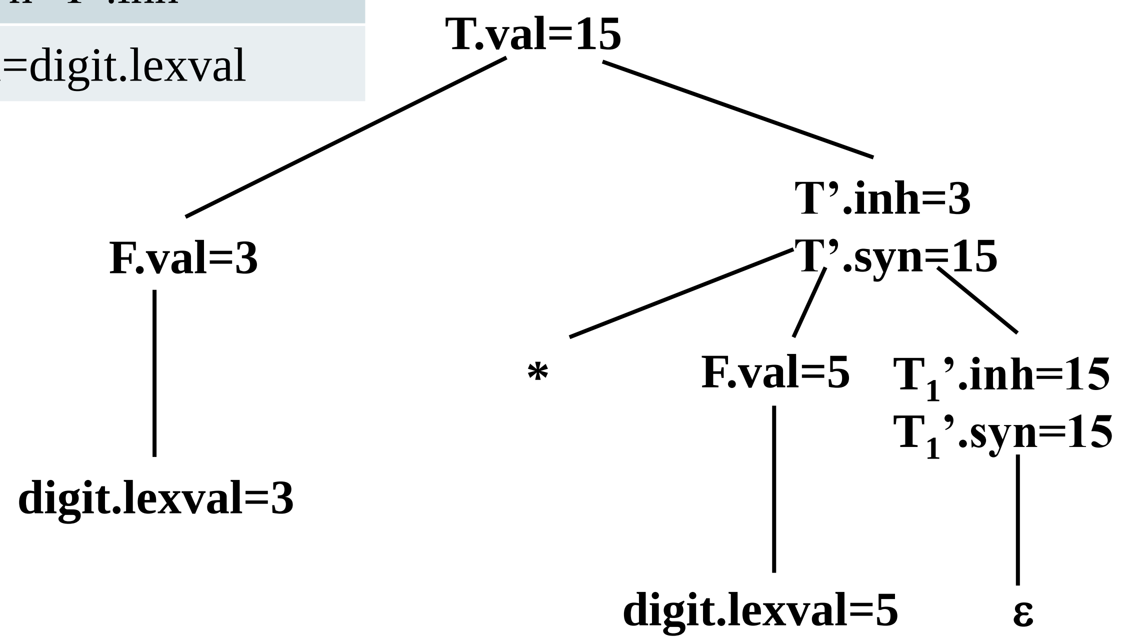
Homework

- Using previous SDD draw the annotated parse tree for

$$(3+4)*(5+6)\$$$

SDD for top-down parsing

	PRODUCTION	SEMNATIC RULE
1	T → FT’	T’.inh=F.val
		T.val=T’.syn
2	T’ → *FT$_1$’	T$_1$’.inh=T’.inh × F.val
		T’.syn=T$_1$’.syn
3	T’ → ε	T’.syn=T’.inh
4	F → digit	F.val=digit.lexval



Annotated parse tree for 3 * 5

Evaluation order for SDD

- ***Dependency Graph***

- ***S-Attributed Definitions:*** An SDD is S-attributed if every attribute is synthesized.

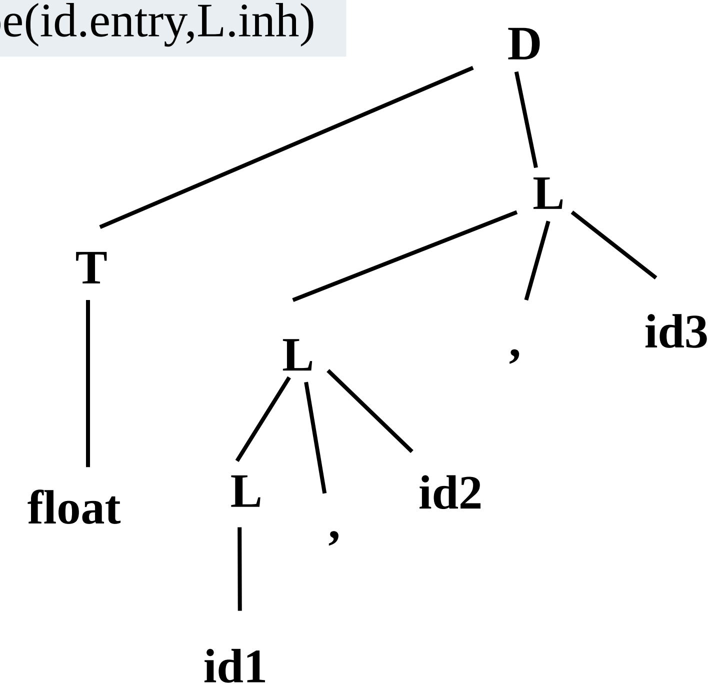
- ***L-Attributed Definitions:*** Each attribute must be either (i) Synthesized or (ii) Inherited with the limited rules.

	PRODUCTION	SEMNATIC RULE
1	$T \rightarrow FT'$	$T'.inh=F.val$
		$T.val=T'syn$
2	$T' \rightarrow *FT_1'$	$T_1'.inh=T'.inh \times F.val$
		$T'.syn=T_1'.syn$
3	$T' \rightarrow \varepsilon$	$T'.syn=T'.inh$
4	$F \rightarrow digit$	$F.val=digit.lexval$

Semantic Rules with controlled side effects

	PRODUCTION	SEMANTIC RULES
1	D → T L	L.inh=T.type
2	T → int	T.type=integer
3	T → float	T.type=float
4	L → L_1, id	L_1.inh=L.inh
		addtype(id.entry,L.inh)
5	L → id	addtype(id.entry,L.inh)

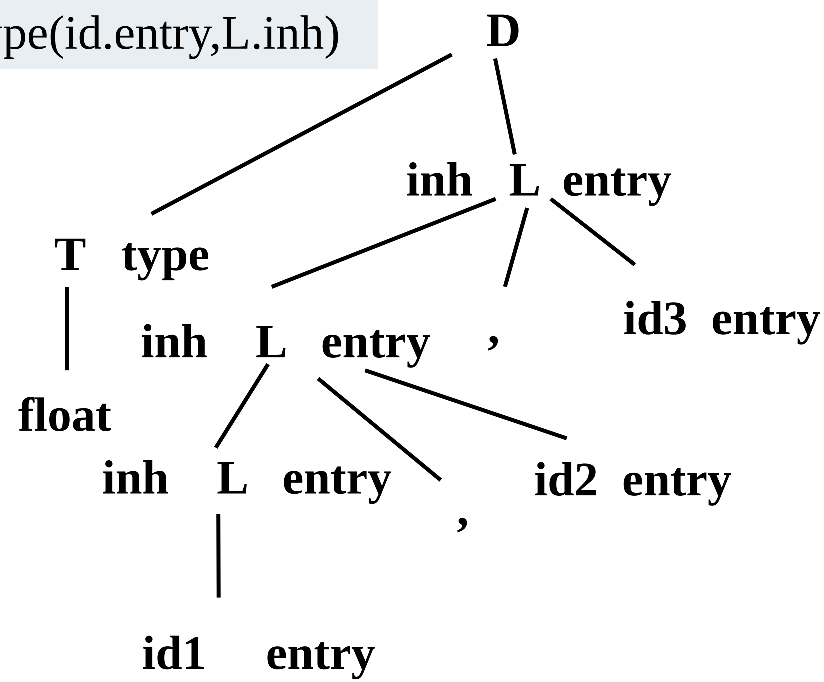
float id1, id2, id3



Semantic Rules with controlled side effects

	PRODUCTION	SEMANTIC RULES
1	D → T L	L.inh=T.type
2	T → int	T.type=integer
3	T → float	T.type=float
4	L → L_1, id	L_1.inh=L.inh
		addtype(id.entry,L.inh)
5	L → id	addtype(id.entry,L.inh)

float id1, id2, id3



AST???

Syntax Directed Translation

	PRODUCTION	SEMANTIC RULES
1	E → E_1 + T	E.node=new Node('+',E_1.node,T.node)
2	E → E_1 – T	E.node=new Node('-',E_1.node,T.node)
3	E → T	E.node=T.node
4	T → (E)	T.node=E.node
5	T → id	T.node= new Leaf(id, id.entry)
6	T → num	T.node= new Leaf(num, num.val)

Syntax tree construction for a-4+c

1. p1=new Leaf(id, entry-a);
2. p2=new Leaf(num,4);
3. p3=new Node('-',p1,p2);
4. p4=new Leaf(id,entry-c);
5. p5=new Node('+',p3,p4);

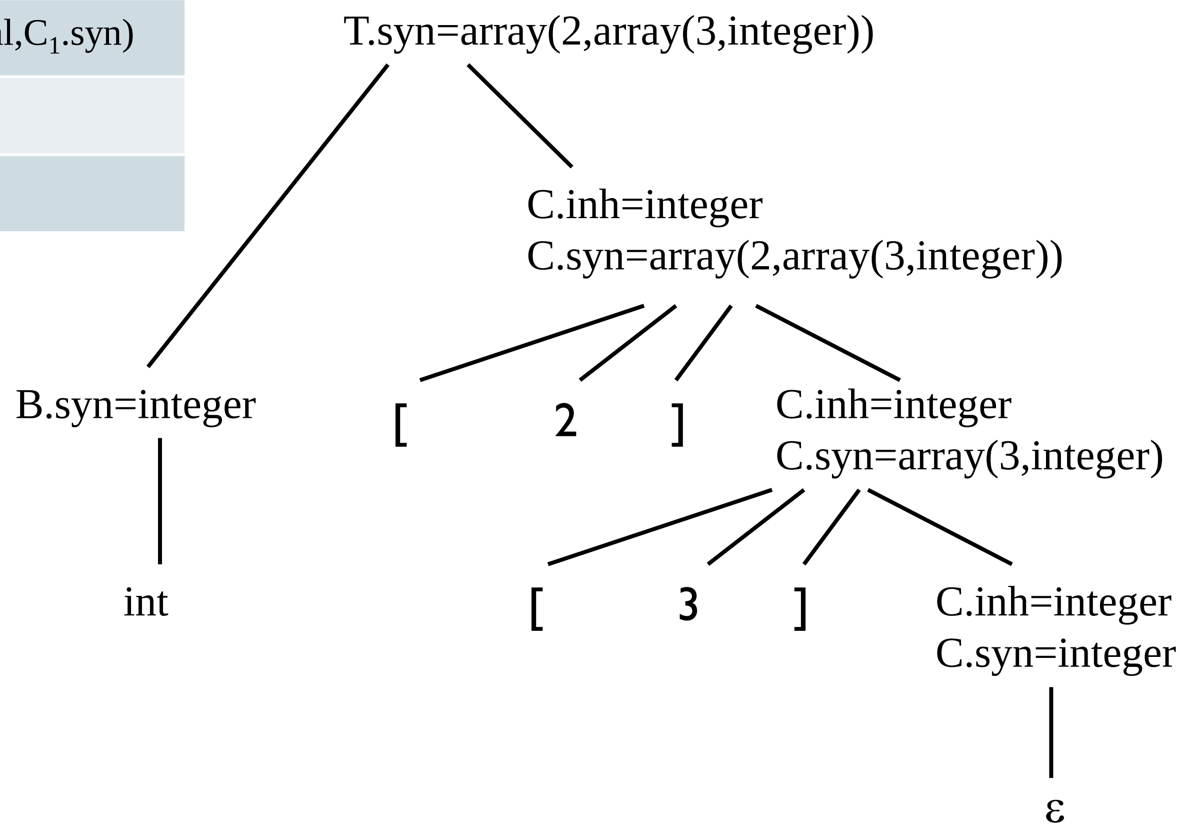
Homework

Draw the dependency graph and report if there is a cycle.

An example

	PRODUCTION	SEMANTIC RULES
1	T $\rightarrow$ B C	T.syn=C.syn
		C.inh=B.syn
2	B $\rightarrow$ int	B.syn=integer
3	B $\rightarrow$ float	B.syn=float
4	C $\rightarrow$ [num] C_1	C.syn=array(num.val,C_1.syn)
		C_1.inh=C.inh
5	C $\rightarrow$ ε	C_1.syn=C.inh

int [2][3]



Homework

Give an SDD to translate infix expression with + and $\times$ into equivalent expression without redundant parentheses.

$((a\times(b+(c)))\times(d)) \rightarrow a\times(b+c)\times d$

Encode that $\times$ is with higher precedence than +.

Syntax Directed Translation

$L \rightarrow E\ \$$	{ print (E.val);}
$E \rightarrow E_1 + T$	{ $E.val=E_1.val+T.val;$}
$E \rightarrow T$	{ E.val=T.val;}
$T \rightarrow T_1 * F$	{ $T.val=T_1.val \times F.val;$}
$T \rightarrow F$	{ T.val=F.val;}
$F \rightarrow (E)$	{ F.val=E.val;}
$F \rightarrow digit$	{ F.val=digit.lexval;}

PRODUCTION	**ACTIONS**
$L \rightarrow E\ \$$	{ print(stack[top-1].val); top=top-1; }
$E \rightarrow E_1 + T$	{ stack[top-2].val=stack[top-2].val + stack[top].val; top=top-2; }
$E \rightarrow T$	
$T \rightarrow T_1 * F$	{ stack[top-2].val=stack[top-2].val × stack[top].val; top=top-2; }
$T \rightarrow F$	
$F \rightarrow (E)$	{ stack[top-2].val=stack[top-1].val; top=top-2; }
$F \rightarrow digit$	

while statement

SDD

$S \rightarrow$ while (C) S_1

L1=new();
L2=new();
S_1.next=L1;
C.false=S.next;
C.true=L2;
S.code=label || L1 || C.code || label || L2 || S_1.code

SDT

$S \rightarrow$ while ({ L1=new(); L2=new(); C.false=S.next; C.true=L2; }
C) { S_1.next=L1; }
S_1 { S.code=label || L1 || C.code || label || L2 || S_1.code; }