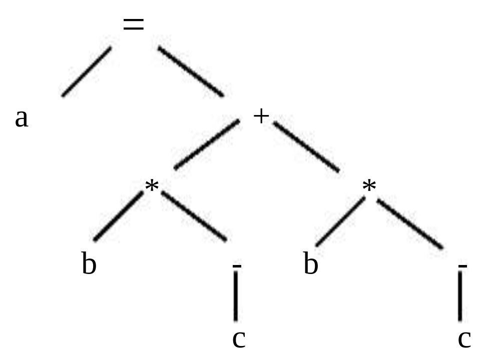
Intermediate Code Generation (IR)

IR is an internal form of a program created by the compiler while translating the program from a *H.L.L* to *L.L.L.*(*assembly* or *machine code*),from IR the back end of compiler generates *target code*.
Although a source program can be translated directly into the target language, some benefits of using a machine independent IR are:

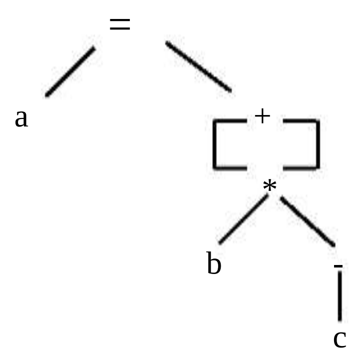
1. A compiler for different machine can be created by attaching a back end for a new machine into an existing front end.
2. Certain optimization strategies can be more easily performed on IR than on either original program or L.L.L.
3. An IR represents a more attractive form of target code.

Intermediate Languages:-

1. Syntax Tree and Postfix Notation are tow kinds of intermediate representations, for example **a=b*-c+b*-c**

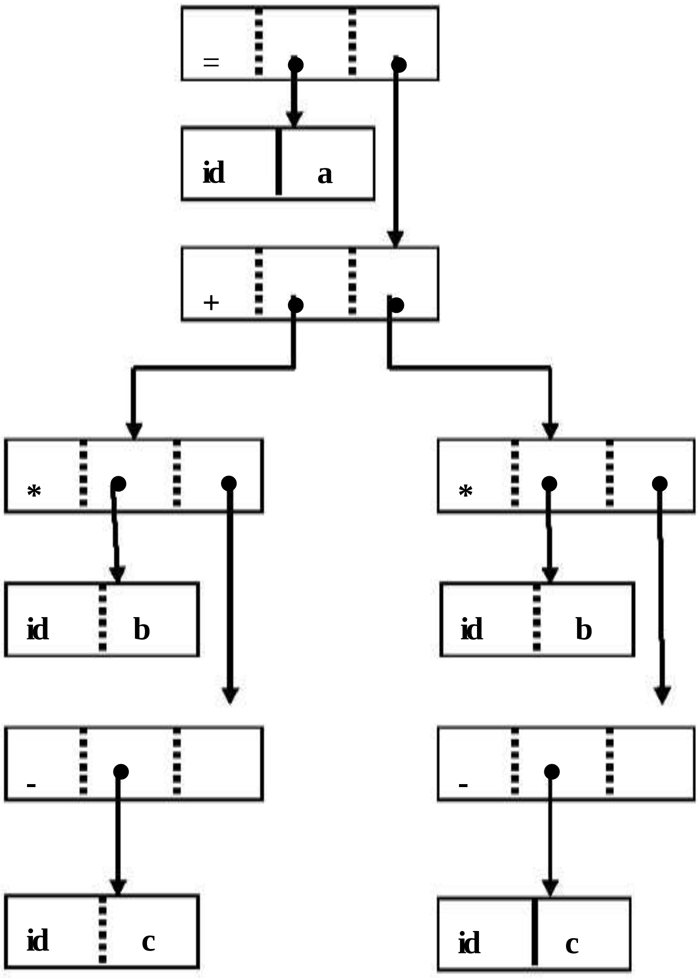


Syntax Tree



DAG

- A *DAG* give the same information in syntax tree but in compact way because common subexpressions are identified.
- *Postfix notation* is a linearized representation of a syntax tree, for example: **a b c - * b c - * + =**
- Two representation of above syntax tree are:



1

0	id	b	
1	id	c	
2	-	1	
3	*	0	2
4	id	b	
5	id	c	
6	-	5	
7	*	4	6
8	+	3	7
9	id	a	
10	=	9	8
	….	…..	…..
	…..	…..	…..

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2. Three-Address Code is a sequence of statements of the general form :

X= Yop Z // op is binary arithmetic operation

For example : *x + y * z*

*t1 = y * z*
t2 = x + t1

where t1 ,t2 are compiler generated temporary.

Types of three address code statement:-

1. Assignment statements of the form *X= Yop Z* (where op is a binary arithmetic or logical operator).
2. Assignment instructions of the form *X= op Y* (op is a unary operator).
3. Copy statements of the form *X= Y*. **4.** Unconditional jump (*Goto L*).
5. Conditional jump (*if X relop Ygoto L*).
6. *Param X* & *Call P,N* for procedure call and and return *Y*, for example :

Param	x1x2
Param	
……..	xn
Param	P,n
Call	

7. Index assignments of the form X=Y[i] & X[i]=Y.
8. Address & Pointer Assignments

X= &Y
*X= * Y*
**X= Y*

Example : a= b * -c + b * -c

t1 = - c
t2 = b * t1
t3 = - c
t4 = b * t3
t5 = t2 + t4
a = t5

Three address code
For syntax tree

t1 = - c
t2 = b * t1 t5
= t2 + t2
a = t5

Three address code
For DAG

Note: Three-address statements are a kin to assembly code statements can have symbolic labels and there are statements for flow of control.

Implementation of Three Address Code :-

In compiler , three-address code can be implement as records, with fields for operator and operands.

1. **Quadruples :-** It is a record structure with four fields:
    - **OP** // operator
    - **arg1 , arg2** // operands
    - **result**

2. **Triples :-** To avoid entering temporary into *ST* , we might refer to a temporary value by position of the statement that compute it . So three address can be represent by record with only three fields:

    - **OP** // operator
    - **arg1 , arg2** // operands

Example: a = b * -c + b * -c

i. By Quadruples

Position	OP	arg1	arg2	result
0	-	c		t1
1	*	b	t1	t2
2	-	c		t3
3	*	b	t3	t4
4	+	t2	t4	t5
5	=	t5		a

ii. By Triples

Position	OP	arg1	arg2
0	-	c	
1	*	b	(0)
2	-3	c	
	*	b	(2)
4		(1)	(3)
	+	a	(4)
5	=		