

Boolean Expressions

$E \rightarrow E \text{ or } E \mid E \text{ and } E \mid \text{not } E \mid (E) \mid \text{id rel op id} \mid$
true | false

Translated in 2 ways,

- numerical representation
- control flow representation.

Numerical representation

$1 \rightarrow \text{true}$, $0 \rightarrow \text{false}$. Expressions will be evaluated from left to right.

$a \text{ or } b \text{ and not } c$

} three-address code

$t_1 = \text{not } c$

$t_2 = b \text{ and } t_1$

$t_3 = a \text{ or } t_2$

relational expression - if $a < b$ then 1 else 0.

100: if $a < b$ goto 103

101: $t := 0$

102: goto 104

103: $t := 1$

104:

} three-address code

Translation scheme using numerical representation for booleans.

$E \rightarrow E_1 \text{ or } E_2$

$\{ E.place := newtemp;$
 $emit(E.place := 'E_1.place \text{ or } E_2.place');$

$E \rightarrow E_1 \text{ and } E_2$

$E \rightarrow \text{not } E_1$

$\{ E.place := newtemp;$
 $emit(E.place := 'not' E_1.place);$

$E \rightarrow (E_1)$

$\{ E.place := E_1.place \}$

$E \rightarrow id_1 \text{ relop } id_2$

$\{ E.place := newtemp;$
 $emit('if' id_1.place \text{ relop } id_2.place \text{ goto } nextstat+3);$
 $emit(E.place := '0');$
 $emit('goto' nextstat+2);$
 $emit(E.place := '1');$

$E \rightarrow \text{true}$

$\{ E.place := newtemp;$
 $emit(E.place := '1');$

control flow representation

$S \rightarrow \text{if } E \text{ then } S_1$

$\text{if } E \text{ then } S_1 \text{ else } S_2$

$\text{while } E \text{ do } S_1$

Syntax-directed definition for how to control statements.

production

$S \rightarrow \text{if } E \text{ then } S_1$

semantic rules

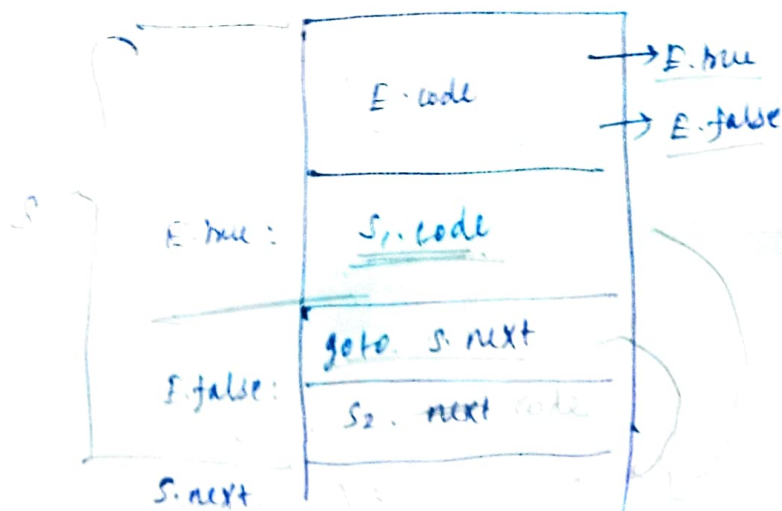
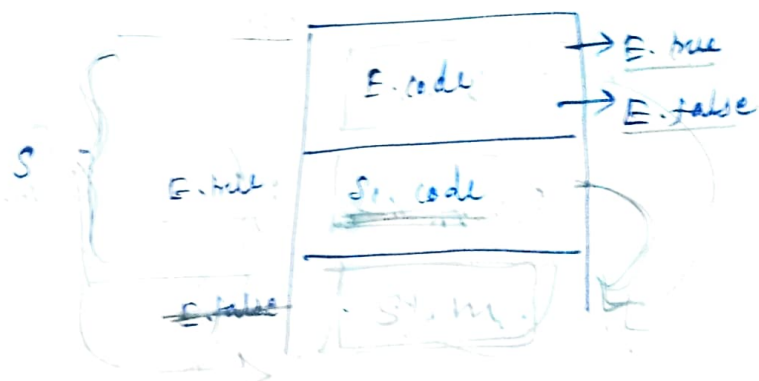
$E.\text{true} := \text{nextlabel};$

$E.\text{false} := S.\text{next};$

$S_1.\text{next} := S.\text{next};$

$S.\text{code} := E.\text{code} ||$

$\text{gen}(E.\text{true} :) || S_1.\text{code}$



$S \rightarrow \text{if } E \text{ then } S_1 \text{ else } S_2$

$E.\text{true} := \text{newlabel};$

$E.\text{false} := \text{newlabel};$

$S_1.\text{next} := S.\text{next};$

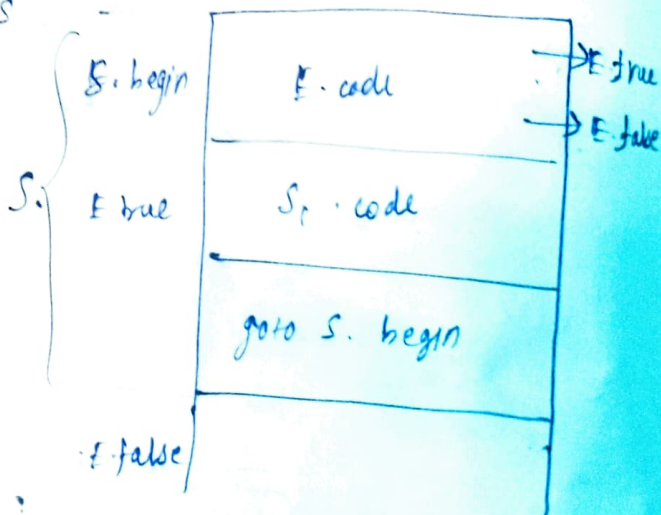
$S_2.\text{next} := S.\text{next};$

$S.\text{code} := E.\text{code} \parallel \text{gen}(E.\text{true})$

$S_1.\text{code} \parallel \text{gen}(\text{'goto' } S.\text{next})$

$\parallel \text{gen}(E.\text{false}) \parallel S_2.\text{code}$

$S \rightarrow \text{while } E \text{ do } S$



$S.\text{begin} := \text{newlabel};$

$E.\text{true} := \text{newlabel};$

$E.\text{false} := S.\text{next};$

$S_1.\text{next} := S.\text{begin};$

$S.\text{code} := \text{gen}(S.\text{begin} ':') \parallel E.\text{true}$

$\text{gen}(E.\text{false} ':') \parallel S_1.\text{code}$

$\text{gen}(\text{'goto' } S.\text{begin})$

Control Flow Translation of Boolean Expression:

SDD to produce three-address code for booleans.

$E \rightarrow E_1 \text{ or } E_2$

0	0	0
0	1	1
1	0	1
1	1	1

$E_1.\text{true} := E.\text{true}$

$E_1.\text{false} := \text{newlabel}$

$E_2.\text{true} := E.\text{true}$

$E_2.\text{false} := E.\text{false};$

$E.\text{code} := E_1.\text{code} \parallel \text{gen}(E_1.\text{false});$
 $\parallel E_2.\text{code};$

$E \rightarrow E_1 \text{ and } E_2$

0	0	0
0	1	0
1	0	0
1	1	1

$E.\text{true} := \text{newlabel};$

$E_1.\text{false} := E.\text{false};$

$E_2.\text{true} := E.\text{true};$

$E_2.\text{false} := E.\text{false};$

$E.\text{code} := E_1.\text{code} \parallel \text{gen}(E_1.\text{true});$
 $\parallel E_2.\text{code};$

$E \rightarrow \text{not } E_1$

$E_1.\text{true} := E.\text{false}$

$E_1.\text{false} := E.\text{true};$

$E.\text{code} := E_1.\text{code};$

$E \rightarrow (E_1)$

$E_1.\text{true} := E.\text{true};$

$E_1.\text{false} := E.\text{false};$

$E.\text{code} := E_1.\text{code}$

$E \rightarrow id_1 \text{ relop } id_2$

$E.\text{code} := \text{gen}('id' id_1.\text{place}$
 $\text{relop.op } id_2.\text{place}$
 $'goto' E.\text{true}) \parallel \text{gen}$
 $('goto' E.\text{false})$

$E \rightarrow \text{true}$

$E.\text{code} := \text{gen}('goto' E.\text{true})$

$E \rightarrow \text{false}$

$E.\text{code} := \text{gen}('goto' E.\text{false})$