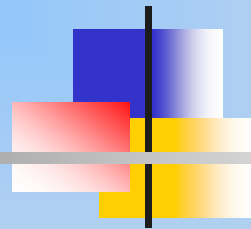


CSE302: Compiler Design



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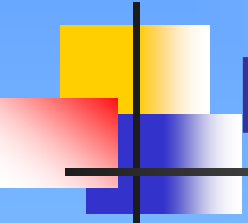
Outline

- Recap
 - Intermediate code generation
- Things related to project part II
- Summary

Translation of Boolean Expressions (1)

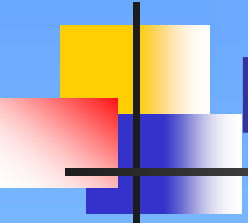
- $S \rightarrow \text{if}(B) S1$
 - $\{B.\text{true}=\text{newlabel}(); B.\text{false}=S.\text{next};\}$
 - $\{S.\text{code}=B.\text{code} \ || \ \text{label}(B.\text{true}) \ || \ S1.\text{code}\}$
 - if B goto L1
 - goto L2
 - L1: S1
 - L2:

- $B \rightarrow B1 \ || \ B2$
- $S \rightarrow \text{if}(B1 \ || \ B2) S1$
 - $\{B.\text{true}=\text{newlabel}(); B.\text{false}=S.\text{next};$
 - $B1.\text{true}=B.\text{true}; B1.\text{false}=\text{newlabel}();$
 - $B2.\text{true}=B.\text{true}; B2.\text{false}=B.\text{false};\}$
 - $\{B.\text{code}=B1.\text{code} \ || \ \text{label}(B1.\text{false}) \ || \ B2.\text{code}\}$
 - $\{S.\text{code}=B.\text{code} \ || \ \text{label}(B.\text{true}) \ || \ S1.\text{code}\}$
 - if B1 goto L1
 - goto L2
 - L2: if B2 goto L1
 - goto L3
 - L1: S1
 - L3:



Translation of Boolean Expressions (2)

- $B \rightarrow B1 \ \&\& \ B2$
- $S \rightarrow \text{if}(\quad \{ B.\text{true}=\text{newlabel}(); B.\text{false}=S.\text{next};$
 $B1.\text{true}=\text{newlabel}(); B1.\text{false}=B.\text{false};$
 $B2.\text{true}=B.\text{true}; B2.\text{false}=B.\text{false};\}$
 $B1\&\&B2) \{B.\text{code}=B1.\text{code} \ || \ \text{label}(B1.\text{true}) \ || \ B2.\text{code}\}$
 $S1 \quad \quad \{S.\text{code}=B.\text{code} \ || \ \text{label}(B.\text{true}) \ || \ S1.\text{code}$
- if B1 goto L2
- goto L3
- L2: if B2 goto L1
- goto L3
- L1: S1
- L3:



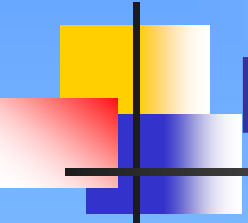
Translation of Boolean Expressions (3)

- $B \rightarrow !B1$
- $S \rightarrow$ if({B.true=newlabel(); B.false=S.next;
 B1.true=B.false; B1.false=B.true;}
 !B1) {B.code=B1.code}
 S1 {S.code=B.code || label(B.true) || S1.code}
- if B1 goto L2
- goto L1
- L1: S1
- L2:

Translation of Boolean Expressions (4)

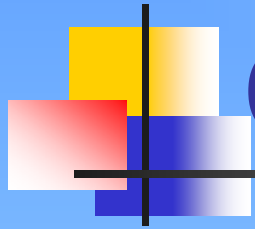
- $B \rightarrow E1 \text{ rel } E2$
 - $S \rightarrow \text{if}(E1 \text{ rel } E2)$

```
{B.true=newlabel(); B.false=S.next;}
{B.code=E1.code || E2.code ||
gen('if E1.addr rel.op E2.addr 'goto' B.true ||
gen('goto' B.false);
}
S1
{S.code=B.code || label(B.true) || S1.code}
```
- E1.code
 - E2.code
 - if E1 rel.op E2 goto L1
 - goto L2
 - L1: S1
 - L2:



Translation of Boolean Expressions (5)

- $B \rightarrow \text{true}$ `{B.code=gen('goto' B.true);}`
- $B \rightarrow \text{false}$ `{B.code=gen('goto' B.false);}`



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Support for Arbitrary Value Types

- **YYSTYPE** may be a union type

```
%union {  
    body of union ...  
}
```

- This declares the Yacc value stack, and the external variables `yylval` and `yyval`, to have type equal to this union.
- `-d`: the union declaration is copied onto the `y.tab.h`
- The union member names are associated with terminals and nonterminals
 - `%token <name> _TOKEN`
 - `%type <name> _nonterminal`



LR parsing with L-attributes

- Section 5.5.4
- Yacc implementation



SDD for While

- SDD of **while** to generate 3-address code

- $S \rightarrow \text{while} (C) S$
 - `while(i<a) i=i*2;
j=j*i;`
 - `label L5: if i<a goto L6
goto L7
label L6: i=i*2
goto L5
label L7: j=j*i`

- $S \rightarrow \text{while} (C) S$ `L1=new(); L2=new();
S1.next=L1;
C.true=L2; C.false=S.next;`

`S.code= label || L1 || C.code || label || L2 || S1.code`



Attribute Computation

- For synthesized attribute computations
 - End of the production body
- For computing inherited attributes of a nonterminal
 - Immediately before the nonterminal occurrence

```
S → while ( { L1=new(); L2=new();  
              C.true=L2; C.false=S.next;  
            }  
C) { S1.next=L1; }  
S1 { S.code= label || L1 || C.code || label || L2 || S1.code; }
```



Markers

- $M \rightarrow \varepsilon$
 - Hold the inherited attributes



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