

## 错题归纳

① All annotations must be locally consistent  
但不一定都能 reach.

② reach: true false 不能 reach

\* int y=7; // update

OCaml 比较大小用  ~~$=$~~  和  $>$  用  $=$  和  $<$   
invariant found  $\neq$  <sup>must</sup> terminate

"We define a relation  $e \Rightarrow v$   
between expressions & values  $\Rightarrow$   
big step operational semantics"

the relation is defined by means  
of axioms and rules.

iff 当且仅当

If  $f$  and  $g$  terminates then  $f=g$

当且仅当  $\forall e$   $fe, ge$ .

(否则关于“无限”无法论断)

★ let  $x = 3$  in  $x + x$

$x + x \Rightarrow 6$  当且仅当

$x \Rightarrow 3 \quad x + x [3/x] \Rightarrow 6$

let rec  $f = \text{fun } x \rightarrow \text{match } x \text{ with}$

| 0  $\rightarrow$  1

|  $k \rightarrow k * f(k-1)$

"via BigStep Semantics" termination"

$\Rightarrow$  若  $x=5 \quad k=2 \quad f 4$  无法匹配  
除非  $x=0 \checkmark$

$x=k$  但  $k-1=0 \Rightarrow x=k=1 \checkmark$

In Allgemein:

$\forall e, \exists v. \text{ if } e = v$

Substitution lemma

$e_1 = e_2$

$e[e/x]$  terminate

$$v \quad e[e_1/x] = e[e_2/x] \Rightarrow \text{true}$$

内容:  $e_1, e_2$  value 相等时  
 $e_1$  can be replaced by  $e_2$