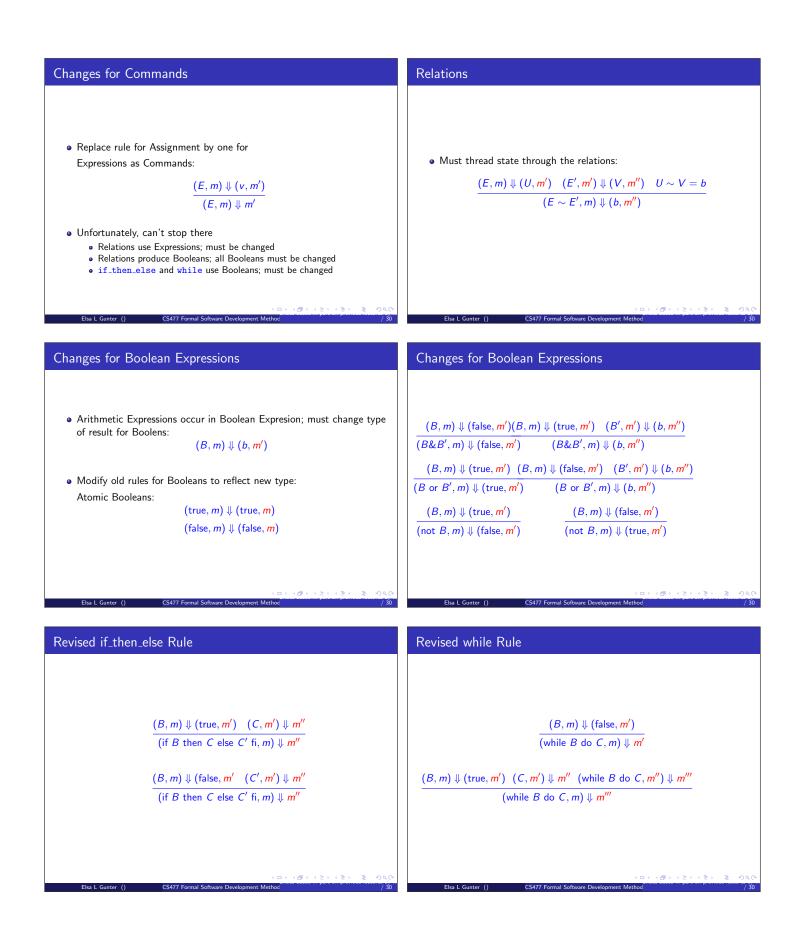


 $(E \oplus E', m) \Downarrow (N, m'')$ 

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Termination and Errors in SOS	Transition Semantics
<ul> <li>(C,m), (E,m), (B,m) called configurations</li> <li>A configuration <i>c</i> evaluates to a result <i>r</i> if <i>c</i> ↓ <i>r</i>.</li> <li>If a configuration <i>c</i> evaluates to a result <i>r</i>, then <i>c</i> terminates without error</li> <li>Problem: Can not distinguish between untermination (<i>e.g.</i> a while loop that runs forever), versus and error (<i>e.g.</i> referencing an unassigned value</li> <li>Can be (partially) remedied by adding error result</li> </ul>	<ul> <li>Aka "small step structured operational semantics"</li> <li>Defingstarmation and for stepping from the semantics of complete evaluation</li> <li>Typically have two kinds of "result": configurations and final values</li> <li>Written (C, m) → (C', m') or (C, m) → m'</li> </ul>
Elsa L Gunter () CS477 Formal Software Development Method () Simple Imperative Programming Language #1 (SIMPL1)	Elsa L Gunter () CS477 Formal Software Development Method /30
$I \in Identifiers$ $N \in Numerals$ $E ::= N   I   E + E   E * E   E - E$ $B ::= true   false   B \& B   B \text{ or } B   \text{ not } B$ $  E < E   E = E$ $C ::= skip   C; C   \{C\}   I ::= E$ $  if B \text{ then } C \text{ else } C \text{ fi}$ $  while B \text{ do } C$	Identifiers: $(I, m) \longrightarrow m(I)$ Numerals are values: $(N, m) \longrightarrow N$ Booleans: $(true, m) \longrightarrow true$ $(false, m) \longrightarrow false$
Elsa L Gunter () CS477 Formal Software Development Method /3	ে (০০০৫০০০০০০০০০০০০০০০০০০০০০০০০০০০০০০০০০

- Values = {true, false}
- Operators: (short-circuit)

$$\begin{array}{ll} (\mathsf{false}\&B,m) \longrightarrow \mathsf{false} & (B,m) \longrightarrow (B'',m) \\ (\mathsf{true}\&B,m) \longrightarrow (B,m) & \overline{(B\&B',m)} \longrightarrow (B''\&B,m) \end{array}$$

$$(\mathsf{true}\&B,m) \longrightarrow (B,m) \qquad \overline{(B\&a)}$$

(true or 
$$B, m$$
)  $\longrightarrow$  true  
(false or  $B, m$ )  $\longrightarrow$  ( $B, m$ )

$$(\text{not true}, m) \longrightarrow \text{false}$$
$$(\text{not false}, m) \longrightarrow \text{true}$$

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$$\frac{(B,m) \longrightarrow (B'',m)}{(B \text{ or } B',m) \longrightarrow (B'' \text{ or } B,m)}$$
$$\frac{(B,m) \longrightarrow (B'' \text{ or } B,m)}{(\text{not } B,m) \longrightarrow (\text{not } B',m)}$$

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• Let U, V be arithmetic values

$$\frac{(E,m)\longrightarrow (E'',m)}{(E\sim E',m)\longrightarrow (E''\sim E',m)}$$

$$\frac{(E,m)\longrightarrow (E',m)}{(V\sim E,m)\longrightarrow (V\sim E',m)}$$

are Development Met

 $(U \sim V, m) \longrightarrow b$ 

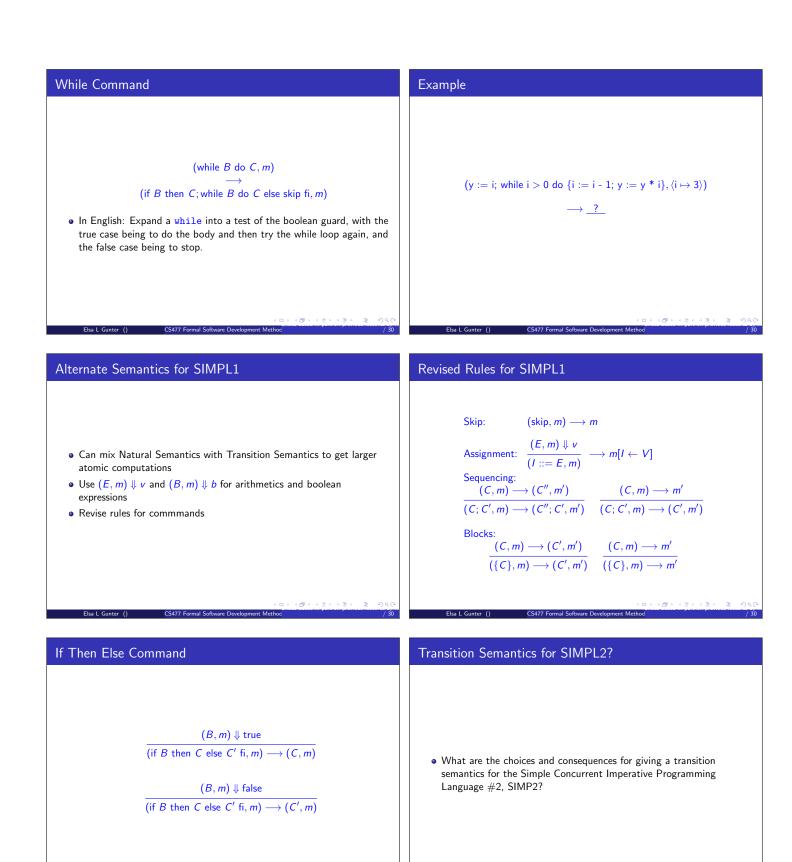
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where  $U \sim V = b$ 

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Arithmetic ExpressionsCommands - in English
$$(E, m) \rightarrow (E', m)$$
  
 $(E \in E', m) \rightarrow (E', m)$   
 $(V \in E, m) \rightarrow (V \in E', m)$   
 $(V \in E, m) \rightarrow (V \in E', m)$   
 $(U \in V, m) \rightarrow N$   
where N is the specified values for  $U \oplus V$ • all p means done evaluating an assignment, coaluate expression first  
• If the organized size actuar, update the memory with  
the new value for the distribution.  
• When evaluating a sequence, work on the first command in the  
sequence with new memory  
• When evaluating a sequence, work on the first command in the  
sequence with new memoryCommandsStip:  
 $(E = V, m) \rightarrow m$   
 $(E = E, m) \rightarrow (E', m)$   
 $(E = E, m) \rightarrow (E', m) \rightarrow (C', m)$   
 $(E = E, m) \rightarrow (E', m) \rightarrow (C', m)$   
 $(E = E, m) \rightarrow (E', m) \rightarrow (C', m)$   
 $(E = E, m) \rightarrow (E', m) \rightarrow (C', m)$   
 $(E = E, m) \rightarrow (E', m) \rightarrow (C', m)$   
 $(E = E = Command - in EnglishIf Then Else Command - in EnglishIf the boolean guard in an if, sheat, all as is true, then evaluate thefirst banch.If the boolean guard is not a value, then start by coaluate thefirst banch.If the boolean guard is not a value, then start by coaluate thefirst banch.If the boolean guard is not a value, then start by coaluate thefirst banch and is the start by coaluate the start  $E'$  the first banch and  $E'$  the coaluate the start  $E'$  the start by coaluate the start during the start  $E'$  the start by coaluate the start by coaluate the start$ 



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