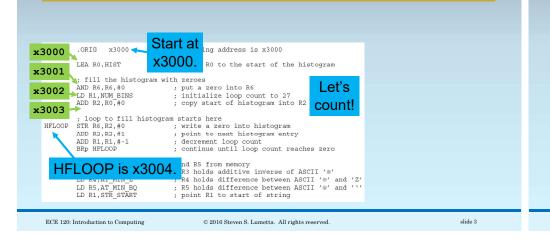


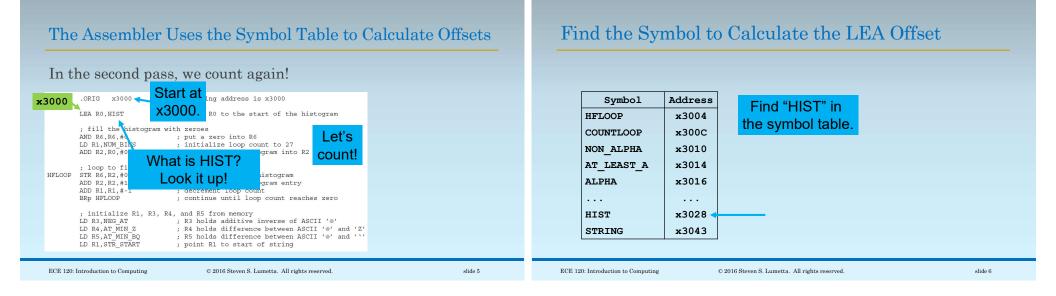
## The Assembler Counts to Find Label Values (Addresses)



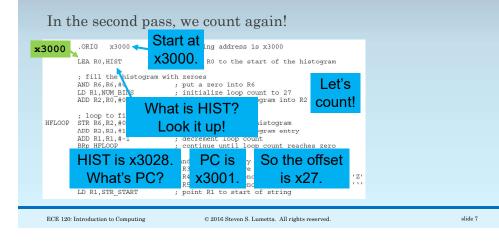
## The Assembler Counts to Find Label Values (Addresses)

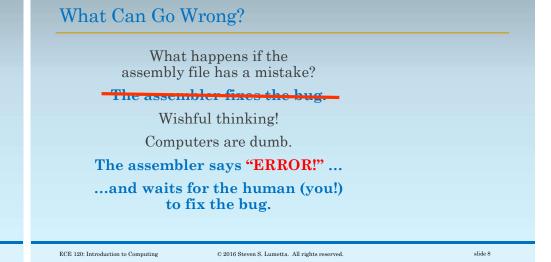
The first pass produces a **symbol table**.

Symbol	Address	
HFLOOP	x3004	
COUNTLOOP	x300C	This table is
NON_ALPHA	x3010	generated for the
AT_LEAST_A	x3014	assembly version
ALPHA	x3016	of the letter
		frequency program.
HIST	x3028	
STRING	x3043	



## The Assembler Uses the Symbol Table to Calculate Offsets





What Can Happen in the First Pass?		What Can Happen in the First Pass?		
What kinds of errors can the assembler detect in the first pass?		What about labels? Is this code ok?		
Things like <b>bad mnemonics</b> MULT R1,R2,R3		BRp NO_LABEL_YET		
and <b>bad operands</b>		ADD R1,R2,R3 NO_LABEL_YET ; here it is! The assembler reads the file in order.		
ADD R42,R0,#-3 ADD R1,R2,#1000				
		A symbol in the file may not be found in the symbol table in the first pass, but that's ok.		
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What Can Happen in the First Pass? What about this code BRp NO_LABEL_YET	What Can Happen in the Second Pass? What kinds of errors can the assembler find in the second pass?
ADD R1,R2,R3	We saw one already
NO_LABEL_YET ; here it is!	
ADD R2,R1,R5	
NO_LABEL_YET ; here, too!	
The symbol <b>cannot be added twice</b> !	
If a symbol is already in the table, the <b>label is multiply-defined</b> (first pass).	
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What's Wrong with This Code?	Errors Found by the LC-3 Assembler		
LEA R0, MY_SPACE         BRnzp STOP         MY_SPACE       .BLKW x4200         STOP       HALT         Data interleaved with code!         Bad style, but not an error.         What's the offset for BRnzp? More than 9 bits         (Error: Address/offset out of range.)	<ul> <li>Found in the first pass</li> <li>bad opcode mnemonic</li> <li>bad operand (of any kind, such as the wrong number, wrong type, or out of range)</li> <li>multiply-defined label</li> <li>Found in the second pass</li> <li>undefined label</li> <li>target address too far away</li> </ul>		
(Error. Address/onset out of range.)			

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