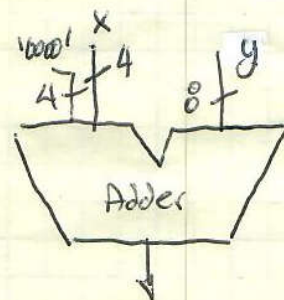


Wire Logic

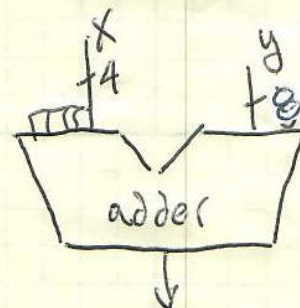
Often we need to change the number of bits used to represent a value, or change the position of the bits in a value. Often this can be accomplished without logic gates, just by rearranging the wires holding the value.

Pad w/ zeros

You have a 4-bit unsigned value  $x$  that needs to be added to an 8-bit value  $y$ . Solution: add 0s to upper 4 bits - pad w/ 0s.  
Does not change value of  $x$ .

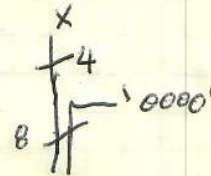
Sign Extension

You have a 4-bit 2's complement value  $x$  that needs to be added to an 8-bit value  $y$ . Solution: add MSB of  $x$  to upper 4 bits - sign extend.  
Does not change value of  $x$ .



Shifting

You have a 4-bit unsigned value  $x$  that you want to multiply by 16. Solution is to add 0s to the 4 least significant bits.



Signals are just wires that you can rearrange or pad as needed.

Combinations of building blocks

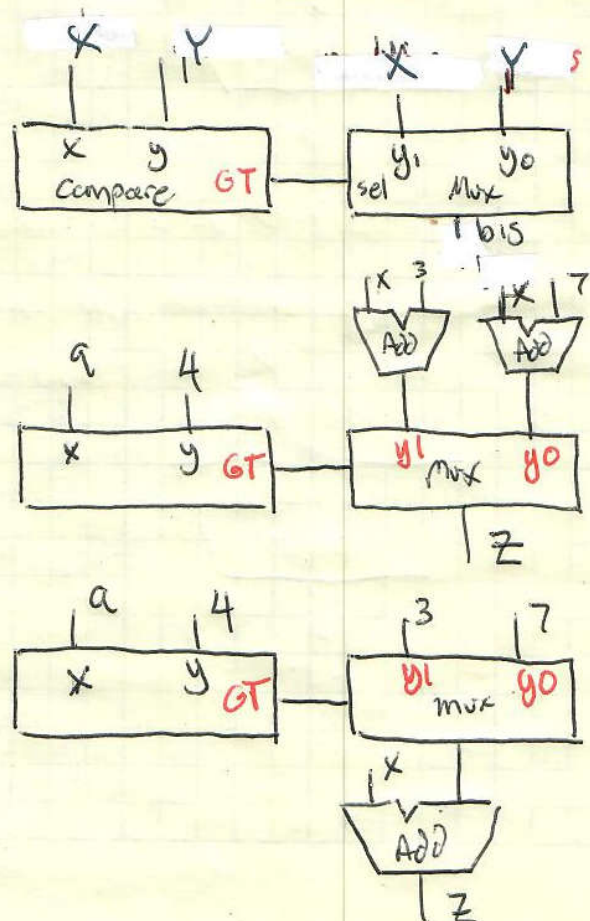
Use Mux, Compare & Address to realize if/then/else algorithmic statements

Algorithm

Find Max of  $X$  &  $Y$   
 if ( $X > Y$ )  
      $big = X$   
 else  
      $big = Y$

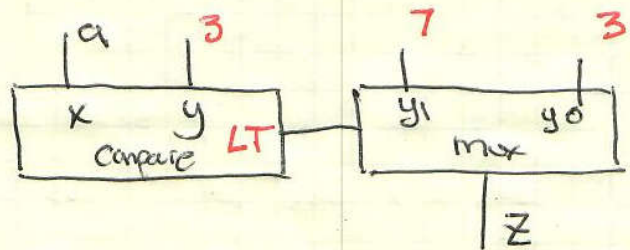
if ( $a > 4$ )  $z = x + 3$   
 else  $z = x + 7$

minimize hardware  
when possible

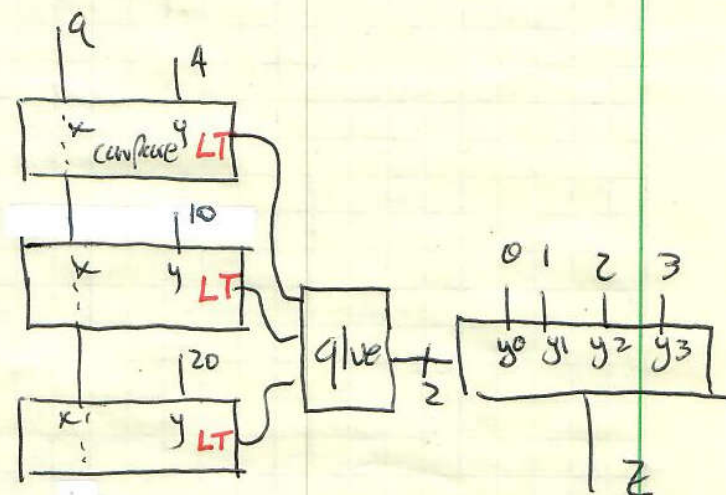
Hardware



if ( $a \geq 4$ )  $z = 3$   
 else  $z = 7$



if ( $a < 4$ )  $z = 0$   
 else if ( $a < 10$ )  $z = 1$   
 else if ( $a < 20$ )  $z = 2$   
 else  $z = 3$



LT4	LT10	LT20	S
1	1	1	00
0	1	1	01
0	0	1	10
0	0	0	11