Converting binary to Binary Coded Decimal (BCD)

This is helpful when wishing to store a decimal number in binary using a nibble for each decimal digit. The operation uses left-shifting of binary digits, filling a fully shifting register of nibbles (initially set to all 0s). Each time a binary digit (bit) is shifted left, the nibbles are evaluated. If bits remain to be added and any nibble represents 5 or more, 3 is added to the nibble to ensure proper positional number value. For instance, 1010_2 is equal to 10_{10}. To represent 1010_2 in BCD, we do the following:

Step 1: Set up a two nibbles (4 bits) register.

Step 2: Shift the left most 1 (representing the 8s position) from the binary number.

Step 3: If there are bits waiting to be shifted, evaluate the binary number to see if any of the nibbles represent 5 (0101) or more. This won't happen for the first two checks of any number, but you need to get in the habit of checking regularly.

Step 4: Shift the left most 0 (representing the 4s position) from the remaining binary number.

Step 5: See Step 3.

Step 6: Shift the left most 1 (representing the 2s position) from the remaining binary number.

Step 7: See Step 3.

Step 8: 0101 in binary is 5 in decimal. 5 is 5 or more, so we need to add 3 to this nibble. 3 in binary is 0011. Adding 0101 and 0011, we get 1000.

Step 9: Shift the final 0 to the left and observe the results: the 10s nibble holds 0001 and the 1s nibble holds 0000. This represents the decimal number 10.

10s nibble				1s nibble					binary number			
0	0	0	0	0	0	0	0		1	0	1	0
0	0	0	0	0	0	0	1	<-	0	1	0	
0	0	0	0	0	0	1	0	<-	1	0		
0	0	0	0	0	1	0	1	<-	0			
0	0	0	0	0	0	1	1	+				
0	0	0	0	1	0	0	0	=				
0	0	0	1	0	0	0	0	<-				
			1				0					

For a slightly longer example, we use the binary number 11110011:

100s Nibble				10s Nibble				1s Nibble					**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**
0	0	0	0	0	0	0	0	0	0	0	0									
0	0	0	0	0	0	0	0	0	0	0	**1**	<-	1	1	1	0	0	1	1	
0	0	0	0	0	0	0	0	0	0	1	**1**	<-	1	1	0	0	1	1		
0	0	0	0	0	0	0	0	0	1	1	**1**	<-	1	0	0	1	1			
0	0	0	0	0	0	0	0	0	0	1	1	+								
0	0	0	0	0	0	0	0	1	0	1	0	=								
0	0	0	0	0	0	0	1	0	1	0	**1**	<-	0	0	1	1				
0	0	0	0	0	0	0	0	0	0	1	1	+								
0	0	0	0	0	0	0	1	1	0	0	0	=								

0	0	0	0	0	0	1	1	0	0	0	**0**	<-	0	1	1
0	0	0	0	0	1	1	0	0	0	0	**0**	<-	1	1	
0	0	0	0	0	0	1	1	0	0	0	0	+			
0	0	0	0	1	0	0	1	0	0	0	0	=			
0	0	0	1	0	0	1	0	0	0	0	**1**	<-	1		
0	0	1	0	0	1	0	0	0	0	1	**1**	<-			
		2				4				3					

BCD

https://www.youtube.com/watch?v=eXIfZ1yKFlA

https://www.youtube.com/watch?v=RDoYo3yOL_E

https://www.youtube.com/watch?v=-YeMlP3O34g

Signed Magnitude

https://www.youtube.com/watch?v=lKTsv6iVxV4