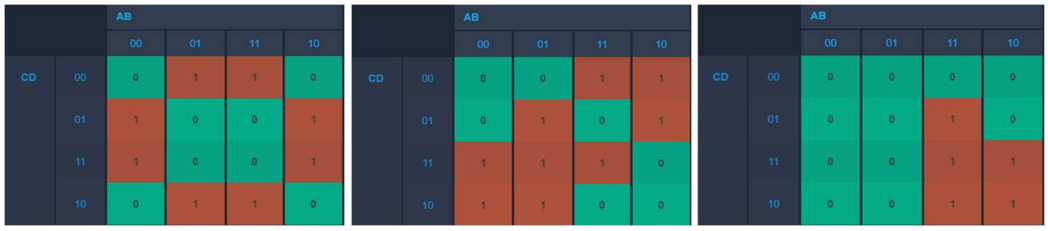
This was an extension of an example done in class. We already have the truth table for adding two 2-bit unsigned integers, which is the following:

A1	A0	B1	B0	C3	C2	C1	C0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	0
0	0	1	1	0	0	1	1
0	1	0	0	0	0	0	1
0	1	0	1	0	0	1	0
0	1	1	0	0	0	1	1
0	1	1	1	0	1	0	0
1	0	0	0	0	0	1	0
1	0	0	1	0	0	1	1
1	0	1	0	0	1	0	0
1	0	1	1	0	1	0	1
1	1	0	0	0	0	1	1
1	1	0	1	0	1	0	0
1	1	1	0	0	1	0	1
1	1	1	1	0	1	1	0

From this truth table, we get the following Kmaps for C0, C1 and C2 respectively:



From these Kmaps, we get the following equations:

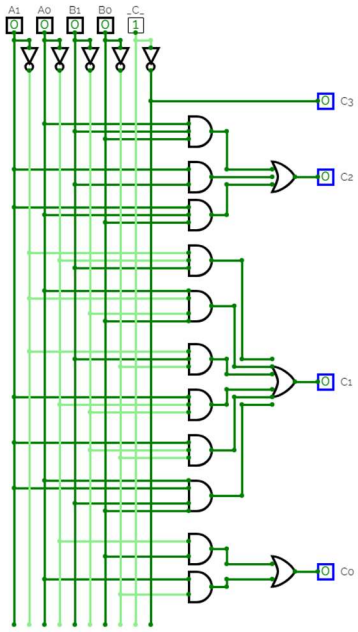
C2 = A0B1B0 + A1B1 + A1A0B0

C1 = A1'A0'B1 + A1'A0B1'B0 + A1'B1B0' + A1A0'B1' + A1B1'B0' + A1A0B1B0

C0 = A0'B0 + A0B0'

C3 does not have a kmap or an equation because it is always 0 as the largest number when adding two 2-bit unsigned integers is 6, which you only need three bits to represent.

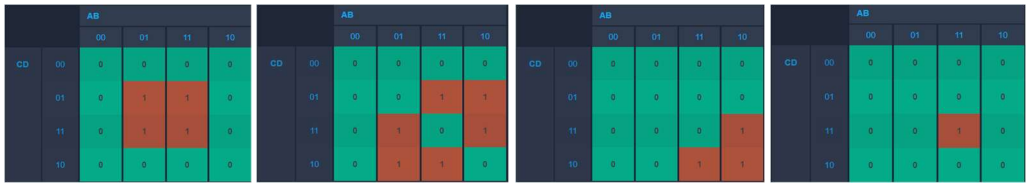
These equations result in the following circuit:



For the multiplication of the integers, we have the following truth table:

A1	A0	B1	B0	C3	C2	C1	C0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	1	0	0	0	0	0
0	0	1	1	0	0	0	0
0	1	0	0	0	0	0	0
0	1	0	1	0	0	0	1
0	1	1	0	0	0	1	0
0	1	1	1	0	0	1	1
1	0	0	0	0	0	0	0
1	0	0	1	0	0	1	0
1	0	1	0	0	1	0	0
1	0	1	1	0	1	1	0
1	1	0	0	0	0	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	1	1	0
1	1	1	1	1	0	0	1

From this truth table, we get the following kmaps for C0, C1, C2 and C3 respectively:



C3 has a kmap here because we are now multiplying the integers, which means the largest number we can get is 9, which needs four bits to be represented. (1001)

From these kmaps, we can get the following equations:

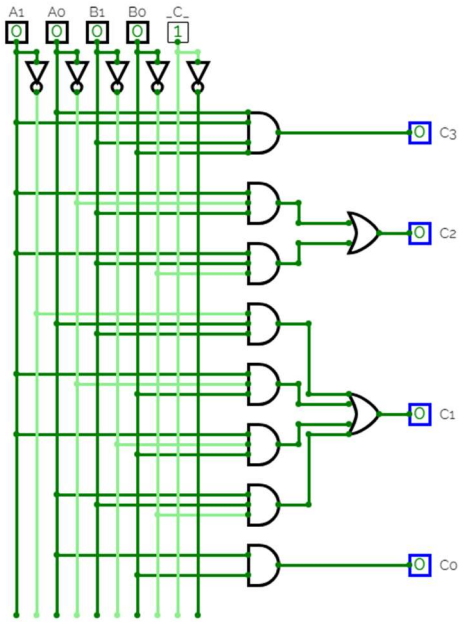
C3 = A1A0B1B0

C2 = A1A0'B1 + A1B1B0'

C1 = A1'A0B1 + A1A0'B0 + A1B1'B0 + A0B1B0'

C0 = A0B0

The equations result in the following circuit:



Finally, we have a 2-1 Multiplexer, which has the following truth table:

S	A	B	C
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

From this truth table, we get the following kmap:

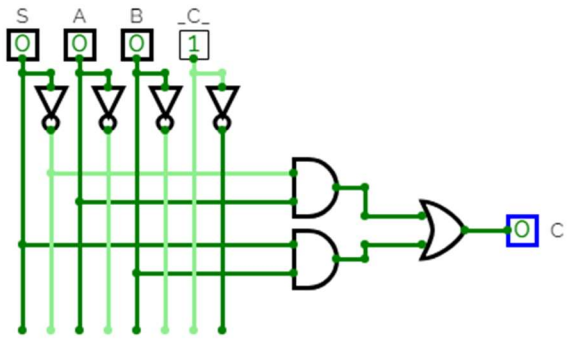
		AB			
		00	01	11	10
C	0	0	0	1	1
	1	0	1	1	0

In this kmap, C refers to S, and was put in the truth table last (ABC or ABS)

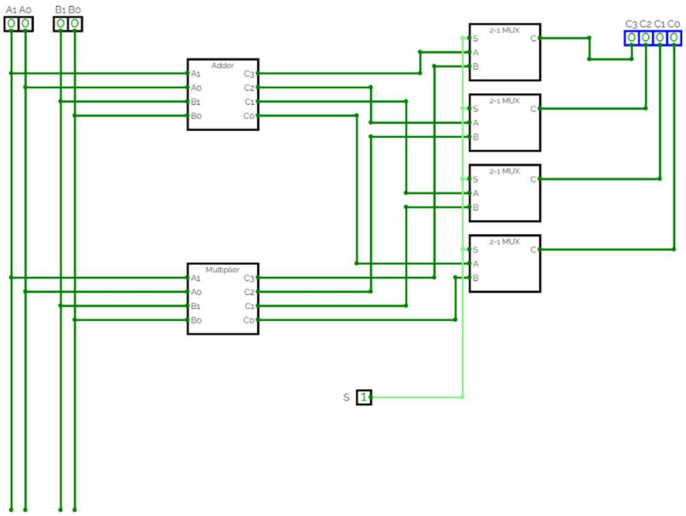
This Kmap gives us the following equation:

C = S'A + SB

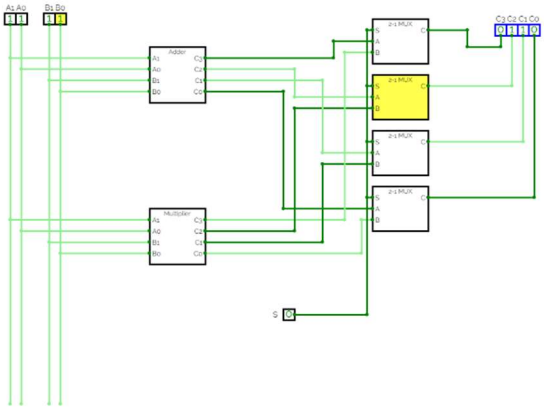
That equation becomes the following circuit:

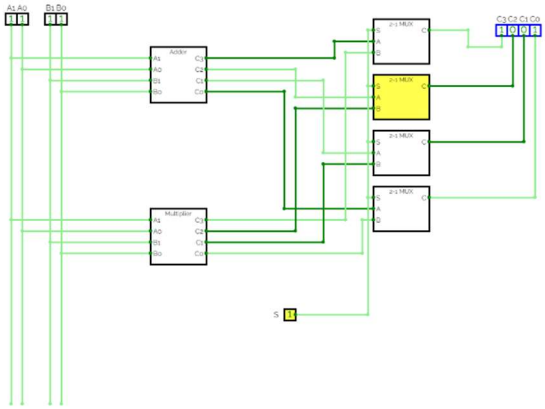


Now, we can put all of these together to create the entire circuit:



Below are examples of when both inputs are equal to 3, and S is either 0 (addition) or 1 (multiplication):





As we can see, the outputs are equal to 6 on the left (addition) and 9 on the right. (multiplication)