Lab 7 - Register

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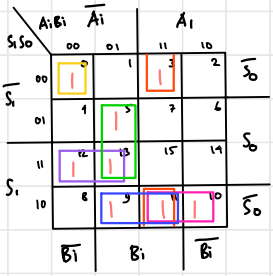
•) State table

control input		Present State	Input	next State
S_1	S_0	$A_i(t)$	$B_i(t)$	$A_i(t+1)$
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

•) optimization



$$A_i(t+1) = S_1\overline{S_0}A_i + S_1\overline{S_0}B_i + S_1S_0\overline{A_i} + S_0\overline{A_i}B_i + \overline{S_0}A_iB_i + \overline{S_1}\,\overline{S_0}\,\overline{A_i}\,\overline{B_i}$$

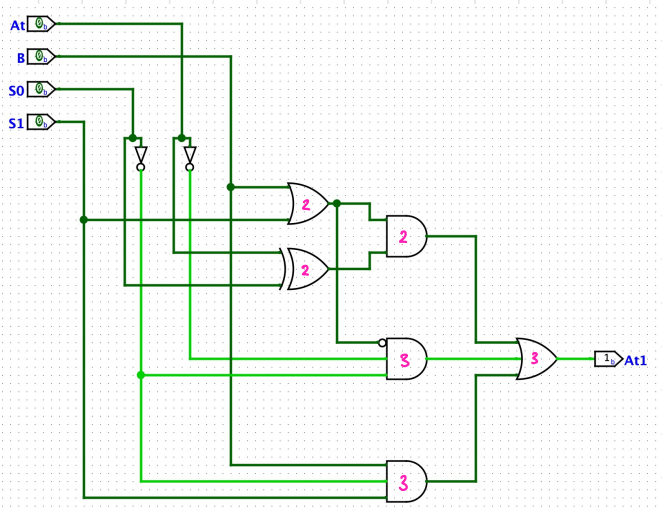
$$= S_1\left(\overline{S_0}A_i + S_0\overline{A_i}\right) + B_i\left(S_0\overline{A_i} + \overline{S_0}A_i\right) + \left(\overline{S_1}\,\overline{B_i}\right)\left(\overline{S_0}\,\overline{A_i}\right) + S_1\overline{S_0}B_i$$

$$= S_1\left(S_0 \oplus A_i\right) + B_i\left(S_0 \oplus A_i\right) + \overline{(S_1 + B_i)}\left(\overline{S_0}\,\overline{A_i}\right) + S_1\overline{S_0}B_i$$

$$= \left(S_1 + B_i\right)\left(S_0 \oplus A_i\right) + \overline{(S_1 + B_i)}\left(\overline{S_0}\,\overline{A_i}\right) + S_1\overline{S_0}B_i$$

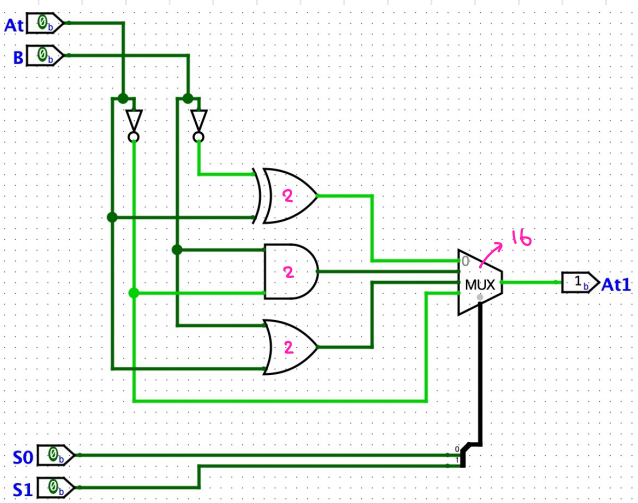
•) Combinational (without MUX)

Gate cost = 2+2+2 + 3+3+3 = 15



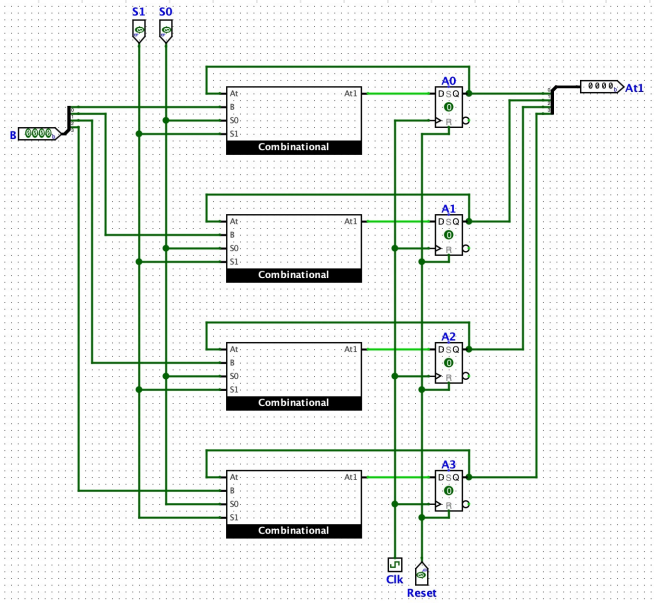
•) Combinational with MUX

Gate cost = 2+2+2 + 16 = 22



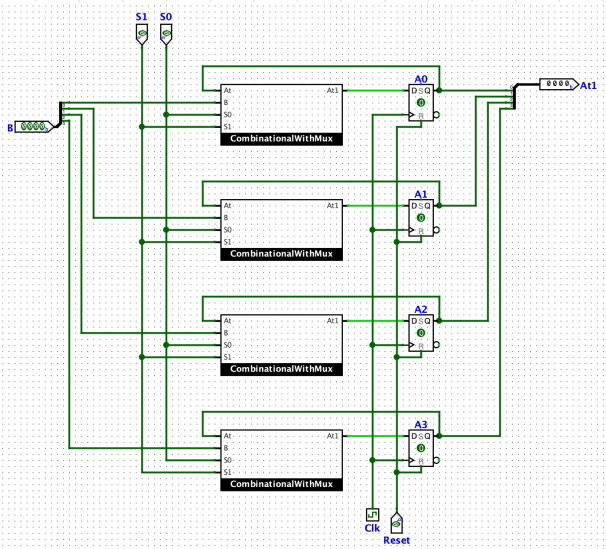
- 4-bit register without MUX

Gate cost = 15 x 4 = 60



- 4-bit register with MUX

Gate cost = 22 x 4 = 88



- Answer to Trivia: Based on the gate cost calculations above, we can conclude that the circuit that uses MUX has a larger gate cost than the circuit that does not use MUX. Therefore, it is more expensive to make a circuit that uses a MUX as opposed to no MUX.