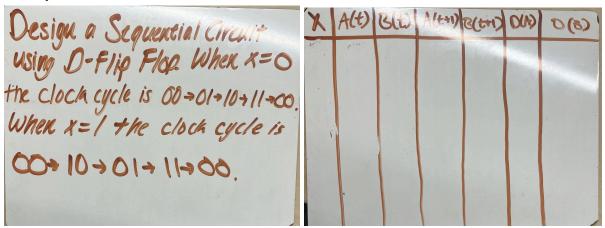# CS 231
T-Flip Flop / D-Flip Flop with a Switch
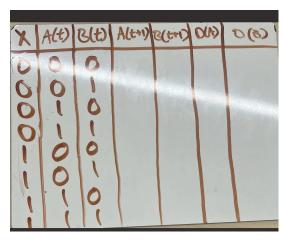
Why use a switch with Flip Flops?
- Without a switch, we can only work with one clock cycle
- A switch allows us to run different clock cycles depending on if the switch is on or off
- For example when the switch is off the cycle can go 00->01->10->11->00 but we can make the cycle change to 00->11->10->01->00 if the switch is on

FOR BASICS ON FILLING OUT TRUTH TABLES FIND D OR T FLIP FLOP WS

Example

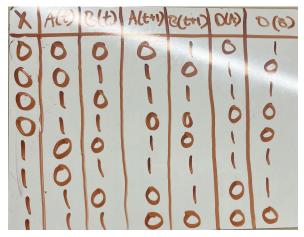- Setup is the same but we need an additional column for our switch

- Even though x is a switch, it is still an input
- This means that our three input slots include x, A(t), B(t)

- This calls for a 3 bit formation, therefore we fill out every possible 3 bit formation
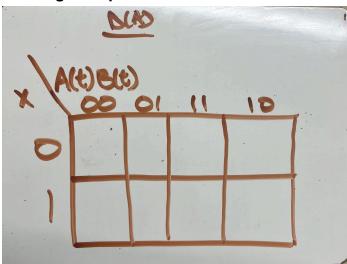
X	A(t)	B(t)	A(t+1)	B(t+1)	D(A)	D(B)
0	0	0	0	1	0	1
0	0	1	1	0	1	0
0	1	0	1	1	1	0
0	1	1	0	0	0	0
1	0	0	1	0	1	0
1	0	1	1	1	1	1
1	1	0	0	1	0	1
1	1	1	0	0	0	0

- Then we fill out the (t+1) rows based on the x values
- Remember the cycle changes based on when x=0 or x=1
- When x=0 cycle: 00->01->10->11->00
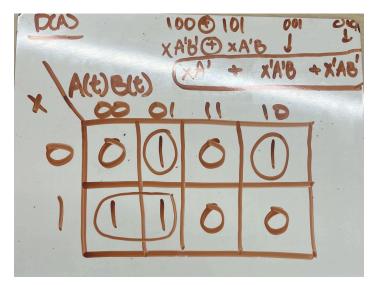- When x=1 cycle: 00->10->01->11->00

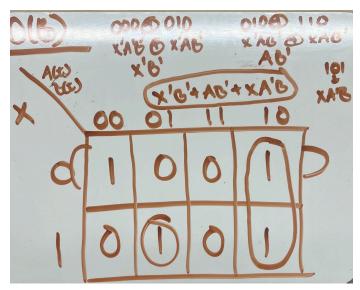## Creating K-Maps with A Switch

- Because we have 3 inputs we set up a 3 input k-map
- Because the right half of the setup is A(t) B(t) we need a two bit formation for this side
- This is why we have 00,01,11,10 instead of just 0 and 1
- 00,01,11,10 is always the order when making a k-map with 3 or more inputs
- We keep it 0 and 1 on the left side because there is only one input of x

D(A)

$100 \oplus 101$ 001   000

$XA'B' \oplus XA'B$

$(XA' + X'A'B + X'AB')$

x \ A(t)B(t)	00	01	11	10
0	0	1	0	1
1	1	1	0	0

- Group and keep whats common

D(B)

$000 \oplus 010$ $010 \oplus 110$

$X'A'B \oplus X'AB$ $X'AB' \oplus XAB'$

$X'B'$ AB'

$X'B' + AB' + XA'B$ 101 $XA'B$

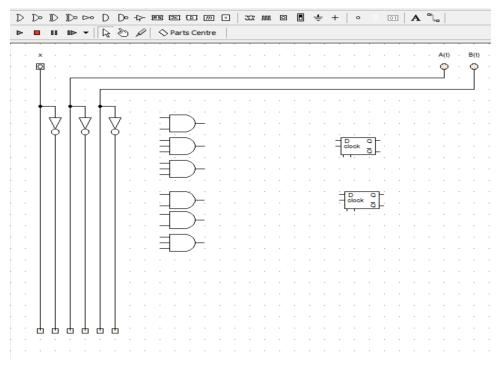| x \ A(t)B(t)	00	01	11	10
0	1	0	0	1
1	0	1	0	1

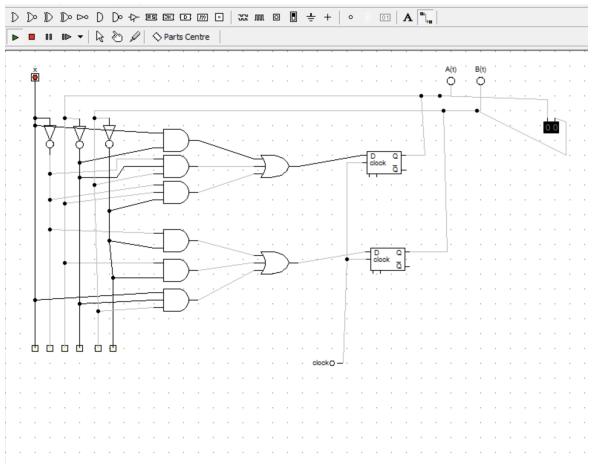- Group and keep whats in common

Digital Works

- Set up your switch and set up your A and B
- Also make sure to include the necessary gates based on your equation from the k-maps
- Lay out your two d-flip flops
- Because we are using three letter equations, use right click or control click on the gates to change the inputs for necessary connections

- Make your connections based on equation
- Then connect your equations to or gates and to their respective flip flops
- Connect the q of your flip flop to their input of a and b
- Connect your clock cycles to the clock part of each flip flop
- Connect a binary converter to show cycle
- RUN THE PROGRAM WITH IWTCH ON AND OFF
- Make sure cycle is correct for when x=0 and x=1, remember they should be different refer to prompt