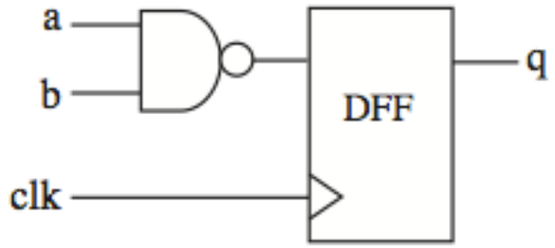
Practice Exercises

Topic #03 - c) Introduction to Aldec Active HDL development environment

Exercise #1- NAND + DFF

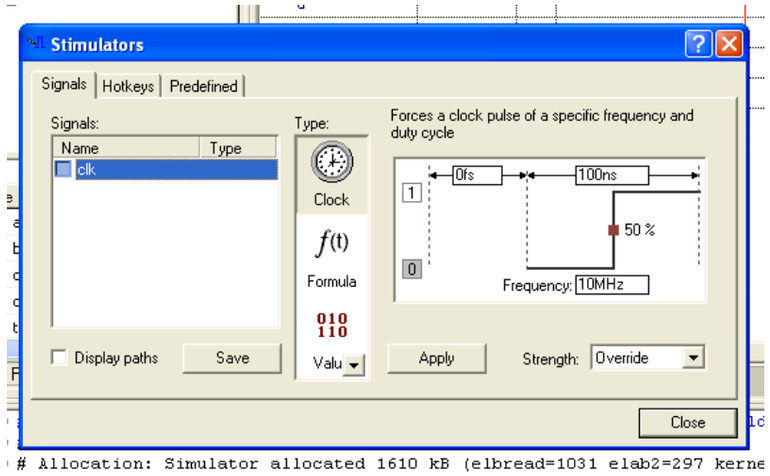



```
entity example is
    port (a,b,clk : in bit;
    q: out bit);
end example;


architecture example of example is
signal temp : bit;

begin
  temp <= a NAND b;
  process (clk)
    begin
    if (clk'event and clk='1') then q<=temp;
    end if;
  end process;
end example;
```

- Re-implement this code but find a way to remove *q<=temp*

- Display the wave-form. Use the "*Clock function*" as a stimulus for the clock signal and "hotkey" for the other inputs

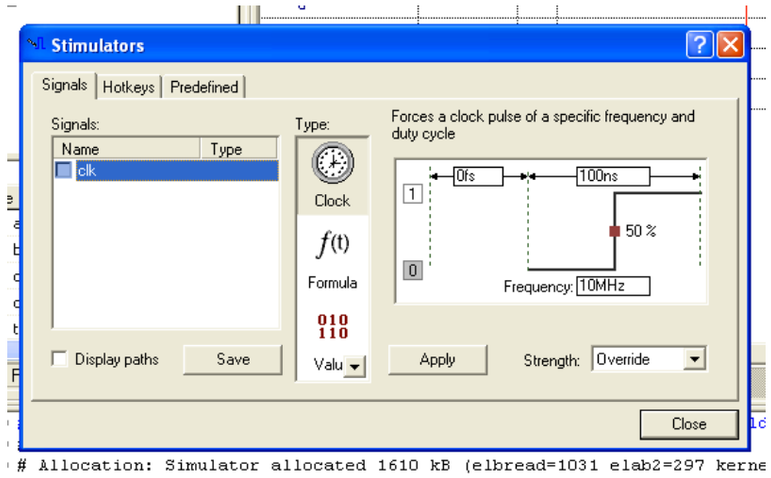
- Set the clock period to 20ns



Solution #1- NAND + DFF (1/3)

```
entity example is
    port (a,b,clk : in bit;
    q: out bit);
end example;

architecture example of example is

begin
  temp <= a NAND b;
  process (clk)
    begin
    if (clk'event and clk='1') then q<= a NAND b;
    end if;
  end process;
end example;
```

- The code is straight forward



- Setting the stimulus to have a period of 20ns is also easy. You can always try different frequency values and see what is the resulting period (not a very good approach) or ...

Solution #1- NAND + DFF (2/3)

Prefix	Symbol	1000^m	10^n	Decimal
yotta	Y	1000^8	10^{24}	1 000 000 000 000 000 000 000 000
zetta	Z	1000^7	10^{21}	1 000 000 000 000 000 000 000
exa	E	1000^6	10^{18}	1 000 000 000 000 000 000
peta	P	1000^5	10^{15}	1 000 000 000 000 000
tera	T	1000^4	10^{12}	1 000 000 000 000
giga	G	1000^3	10^9	1 000 000 000
mega	M	1000^2	10^6	1 000 000
kilo	k	1000^1	10^3	1 000
hecto	h	$1000^{2/3}$	10^2	100
deca	da	$1000^{1/3}$	10^1	10
		1000^0	10^0	1
deci	d	$1000^{-1/3}$	10^{-1}	0.1
centi	c	$1000^{-2/3}$	10^{-2}	0.01
milli	m	1000^{-1}	10^{-3}	0.001
micro	µ	1000^{-2}	10^{-6}	0.000 001
nano	n	1000^{-3}	10^{-9}	0.000 000 001
pico	p	1000^{-4}	10^{-12}	0.000 000 000 001
femto	f	1000^{-5}	10^{-15}	0.000 000 000 000 001

- Remember that:
- (frequency) = 1 / (period)
- So a period of 20ns is equivalent to

$$\frac{1}{20 * 10^{-9}} = \frac{1}{2 * 10^{-8}}$$

$$= \frac{1}{2} * \frac{10^0}{10^{-8}}$$

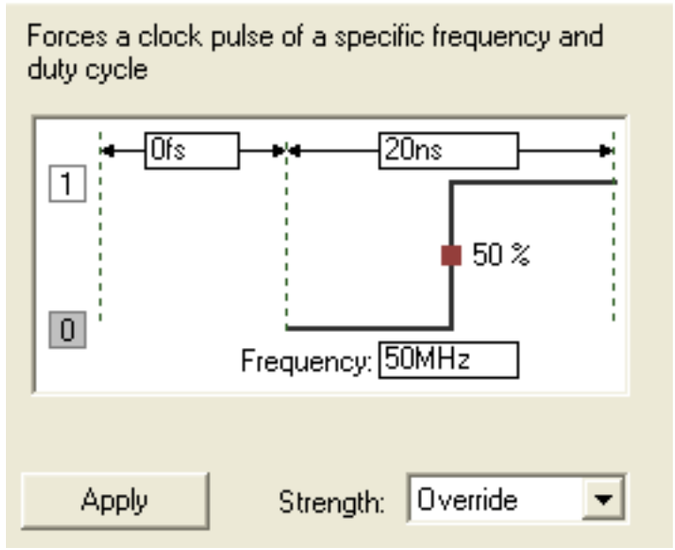
$$= \frac{1}{2} * 10^8$$

$$= 0.5 * 10^8$$

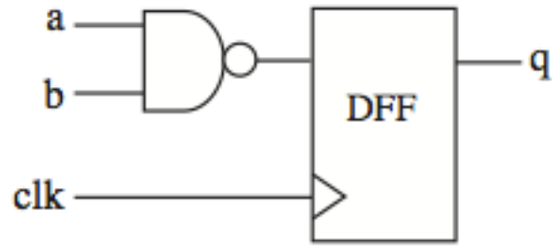
$$= 5 * 10^7$$

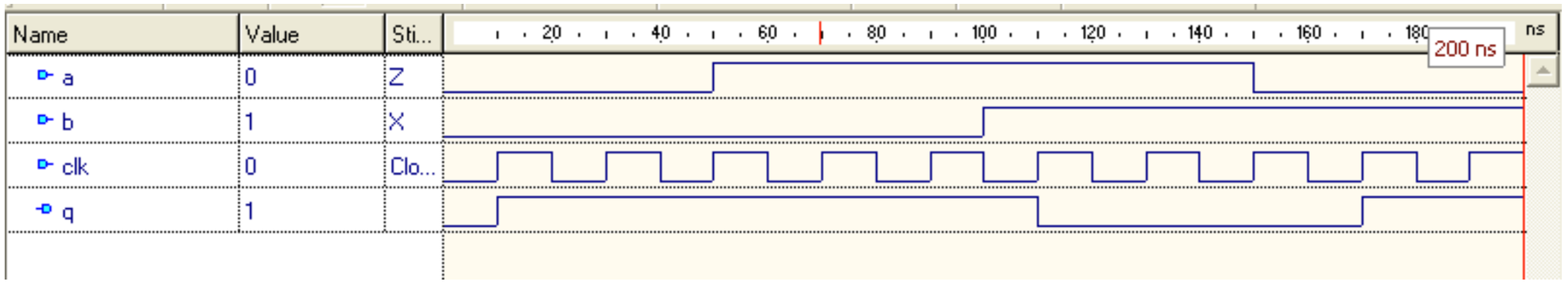
$$= 50 * 10^6$$

$$= 50\ \text{MHz}$$

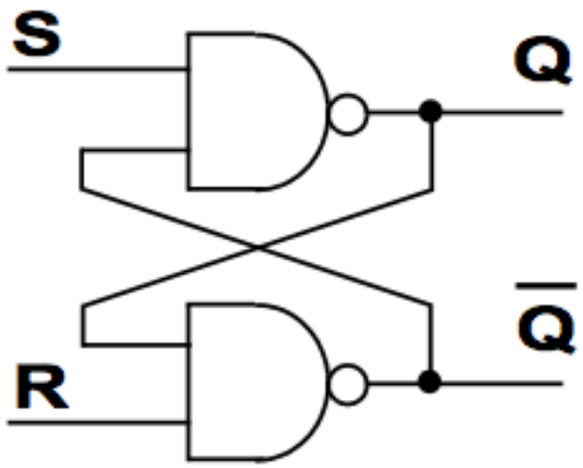


Solution #1- NAND + DFF (3/3)





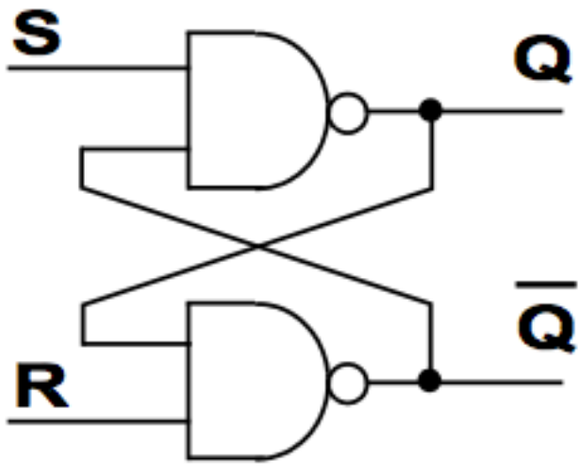
Exercise #2- Set Reset (SR) latch



S	R	Q	$\overline{Q}$	Function
0	0	1-?	1-?	Indeterminate State
0	1	1	0	Set
1	0	0	1	Reset
1	1	Q^+	$\overline{Q}^+$	Storage State

- Implement this SR latch
- Hint: Make sure you appropriately configure the signal modes
- Simulate the circuit and make sure it works as expected

Solution #2- Set Reset (SR) latch



S	R	Q	$\overline{Q}$	Function
0	0	1-?	1-?	Indeterminate State
0	1	1	0	Set
1	0	0	1	Reset
1	1	Q^+	$\overline{Q}^+$	Storage State

```
entity latch is
     port (s,r : in bit;
     q,qb : inout bit);
end entity;

architecture myarch of latch is
begin
     q  <= s NAND qb;
     qb <= r NAND q;
end architecture;
```