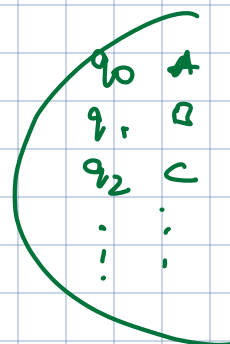
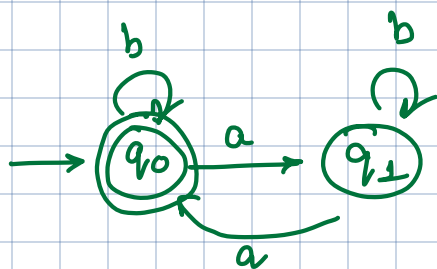


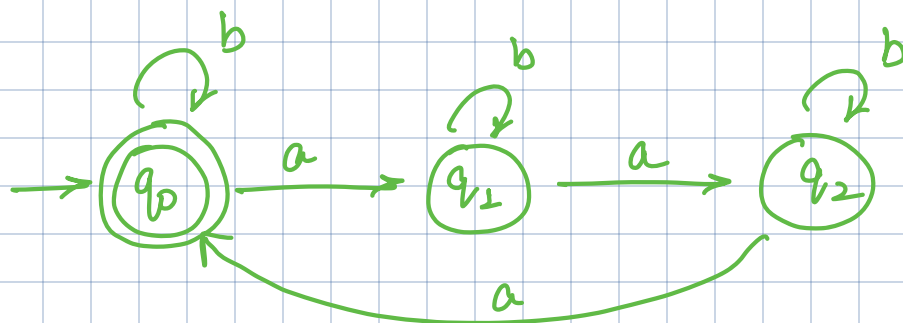
Type 4

Q: $n_a(w) \bmod 2 = 0$ no 'a's should be even $\bmod 2 \begin{cases} \rightarrow 0 \\ \rightarrow 1 \end{cases}$



Q: $n_a(w) \bmod 3 = 0$

$\bmod 3: \begin{cases} \rightarrow 0 \\ \rightarrow 1 \\ \rightarrow 2 \end{cases}$

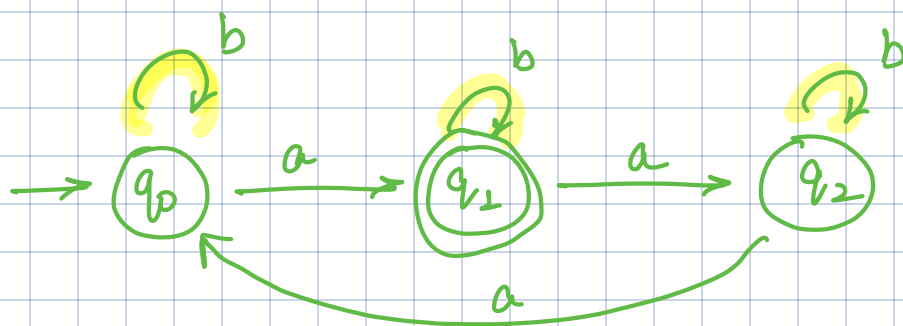


$\begin{cases} aaba \checkmark \\ aabba \checkmark \\ baaba \checkmark \\ bbaa \times \end{cases}$

DFA: accept all the strings which are present in the language.

should not accept any string which is not in the language.

Q: $n_a(w) \bmod 3 = 1$



Q: *

$\Sigma = \{a, b\}$

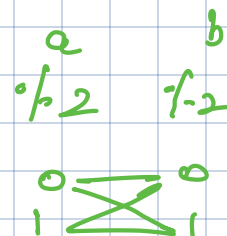
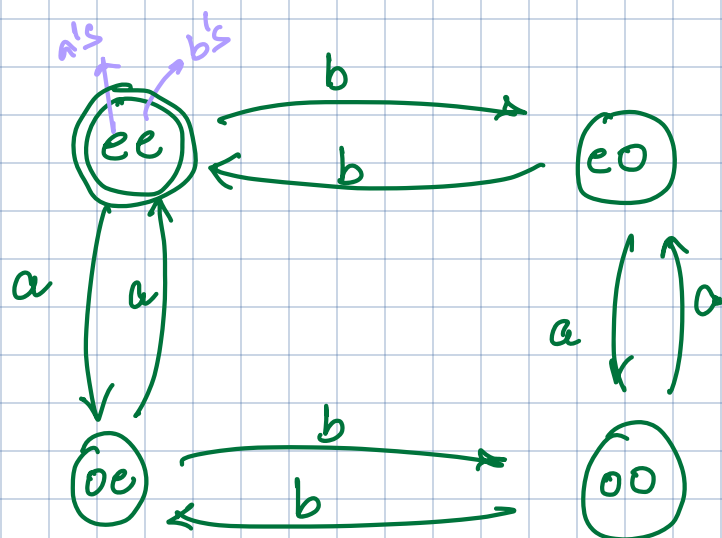
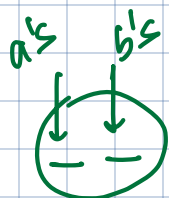
$$n_a(w) \equiv 0 \pmod{2} \rightarrow n_a(w) \pmod{2} = 0 \rightarrow n_a(w) \text{ even}$$

and

$$n_b(w) \equiv 0 \pmod{2} \rightarrow n_b(w) \pmod{2} = 0 \rightarrow n_b(w) \text{ even}$$

Way 1:

$n_a(w)$	$n_b(w)$	eg
e	e	$\epsilon, aa, bb, aabb, \dots$
e	o	$aab, aabbbbaa, \dots$
o	e	bab, \dots
o	o	$ab, abbb, \dots$

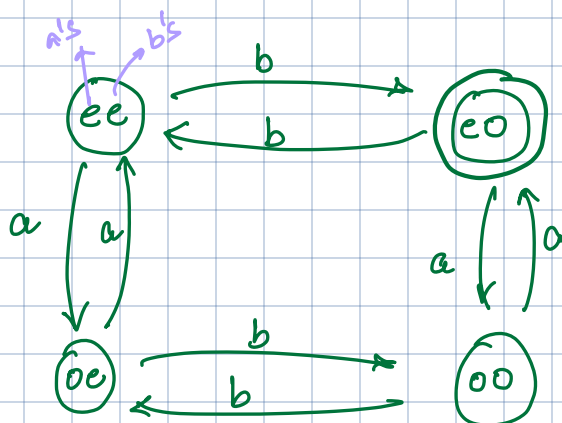


Q:

$$n_a(w) \equiv 0 \pmod{2}$$

and

$$n_b(w) \equiv 1 \pmod{2}$$

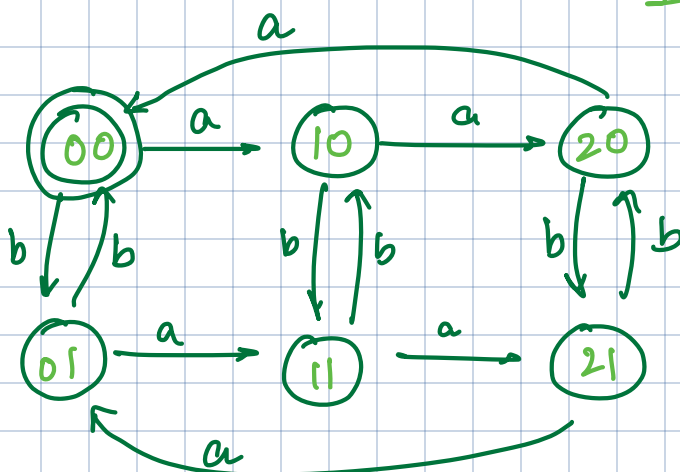
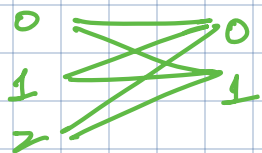


Q: DFA $\Sigma = \{a, b\}$

a's divisible by 3 $\rightarrow n_a(w) \equiv 0 \pmod 3 \rightarrow n_a(w) \% 3 = 0$

b's divisible by 2 $\rightarrow n_b(w) \equiv 0 \pmod 2 \rightarrow n_b(w) \% 2 = 0$

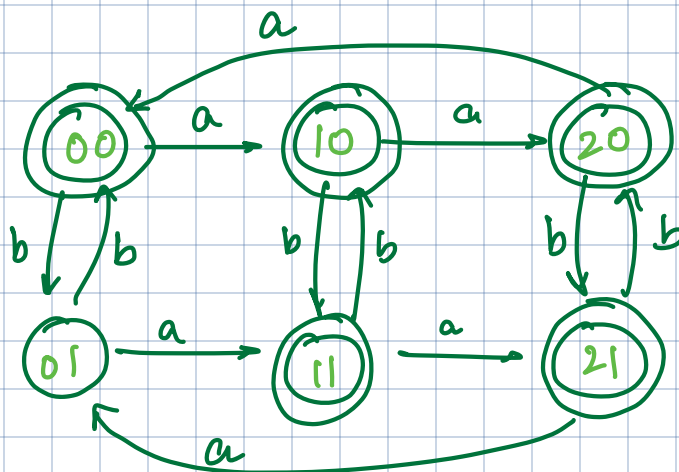
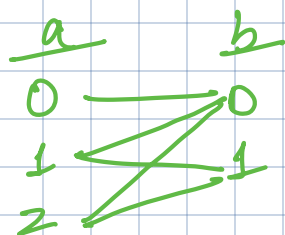
$\% 3$ $\% 2$



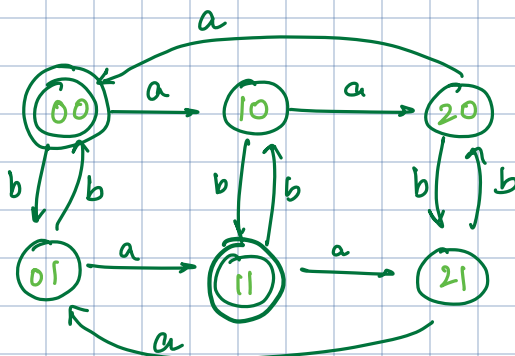
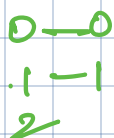
abbba

$n_a(w) \% i = 0$
 $n_b(w) \% j = 0$ } no of states = $i * j$

Q: $n_a(w) \pmod 3 \geq n_b(w) \pmod 2$



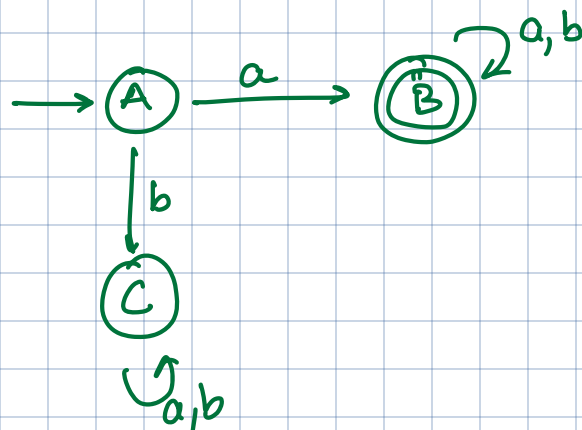
Q: $n_a(w) \pmod 3 = n_b(w) \pmod 2$



Type 5: Strings : Starts with, Ends with, Substring

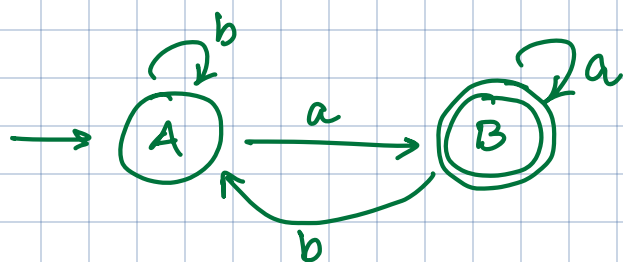
Q: minimal DFA $\Sigma = \{a, b\}$

Language accepts string that starts with 'a'.



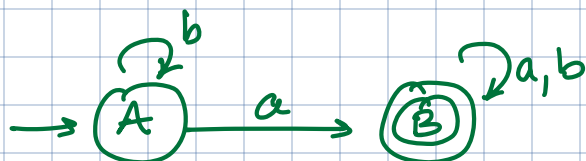
C: Dead State
↓
You can never reach final state

Q: DFA $\Sigma = \{a, b\}$
Language: String end with 'a'.



'a' 'ba'
'aaa' 'bbbbba'
'ab'

Q: Language: String contains 'a'.



'b'

Present

100	78	112	85
118	131	125	76
83	143	138	77
135	137	84	145
124	103	114	
117	95	96	
	139		