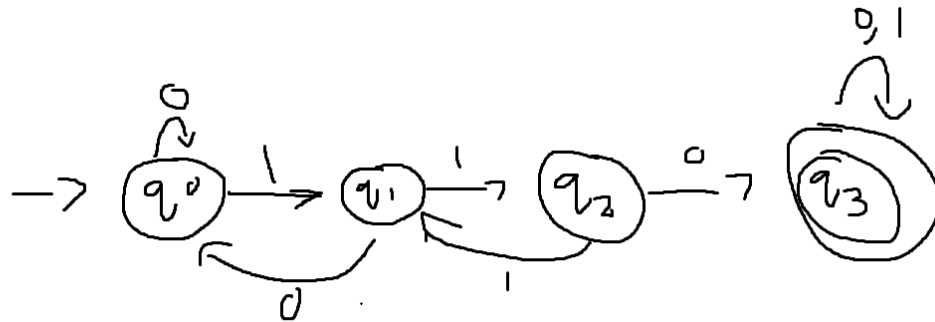1.

Start: $N(h) = 2^{h+1} - 1$

Base: $N(0) = 2^{0+1} - 1 = 1$

Inductive Step: $N(h+1) = 2^{(h+1)+1} - 1 = 2^{h+2} - 1 = 2^{h+1} + 2^{h+1} - 1 = 2 * 2^{h+1} - 1$
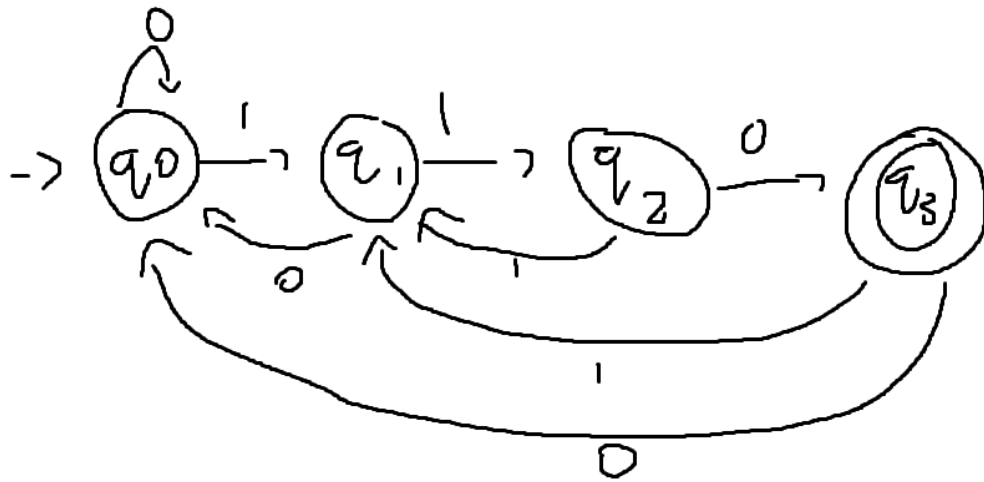$$= 2^{h+2} - 1$$

2.

a)

$Q = \{q0, q1, q2, q3\}$

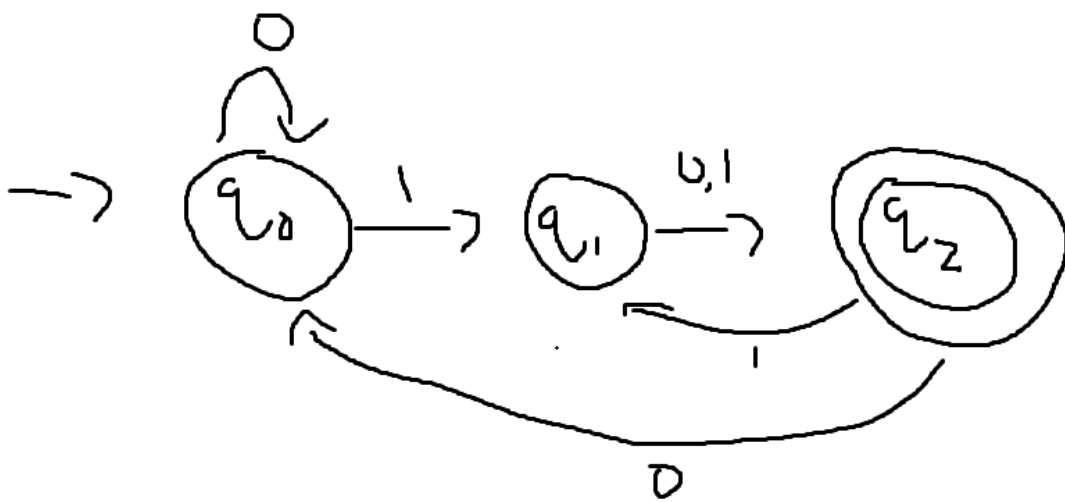$\Sigma = \{0,1\}$

Start state $= q0$

Final State $= q3$

b)

Q = {q0, q1, q2, q3}
∑ = {0,1}
Start state = q0
Final State = q3

c)

Q = {q0, q1, q2}
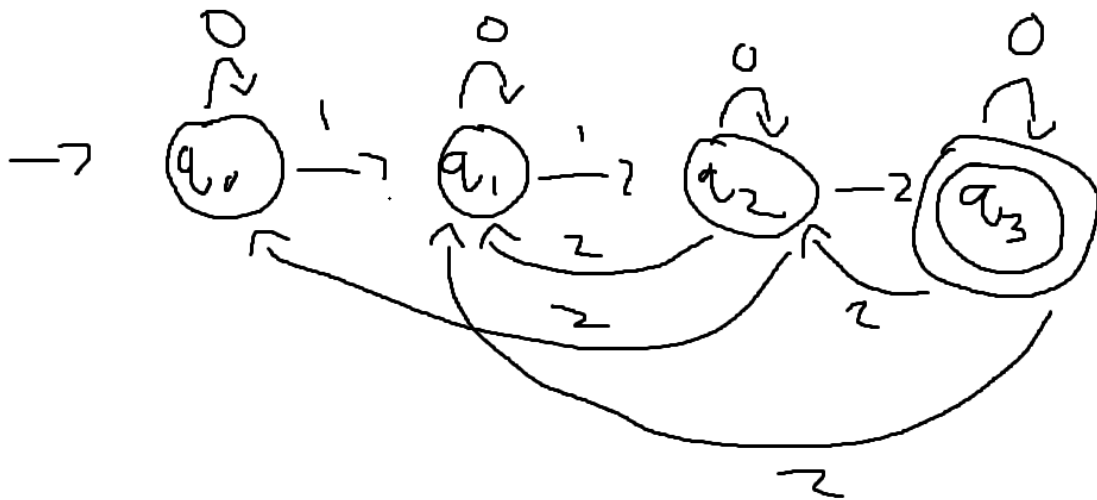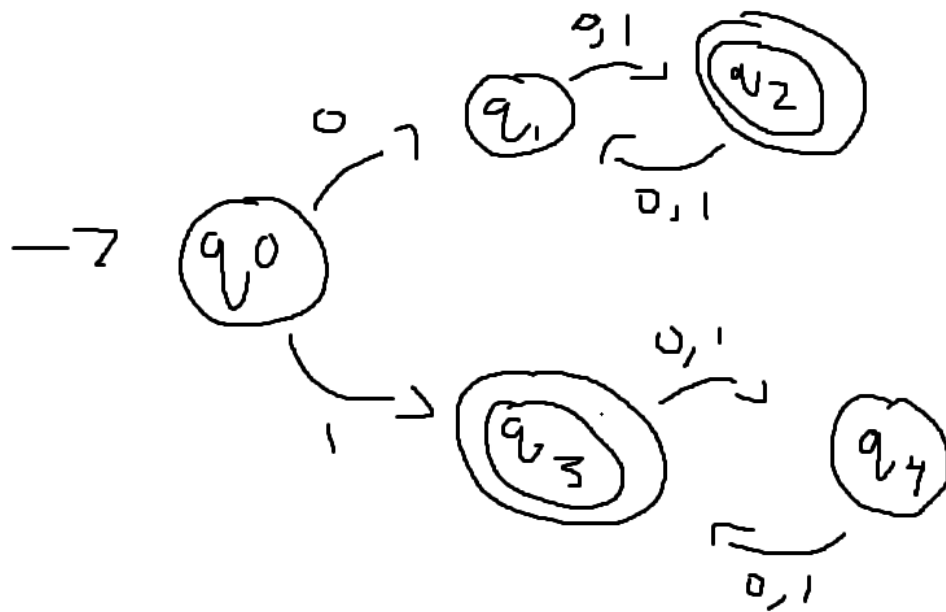∑ = {0,1}
Start state = q0
Final State = q2

3.

Q = {q0, q1, q2, q3}
∑ = {0,1, 2}
Start state = q0
Final State = q3

4.

Q = {q0, q1, q2, q3, q4}
∑ = {0,1}
Start state = q0
Final State = q2, q3