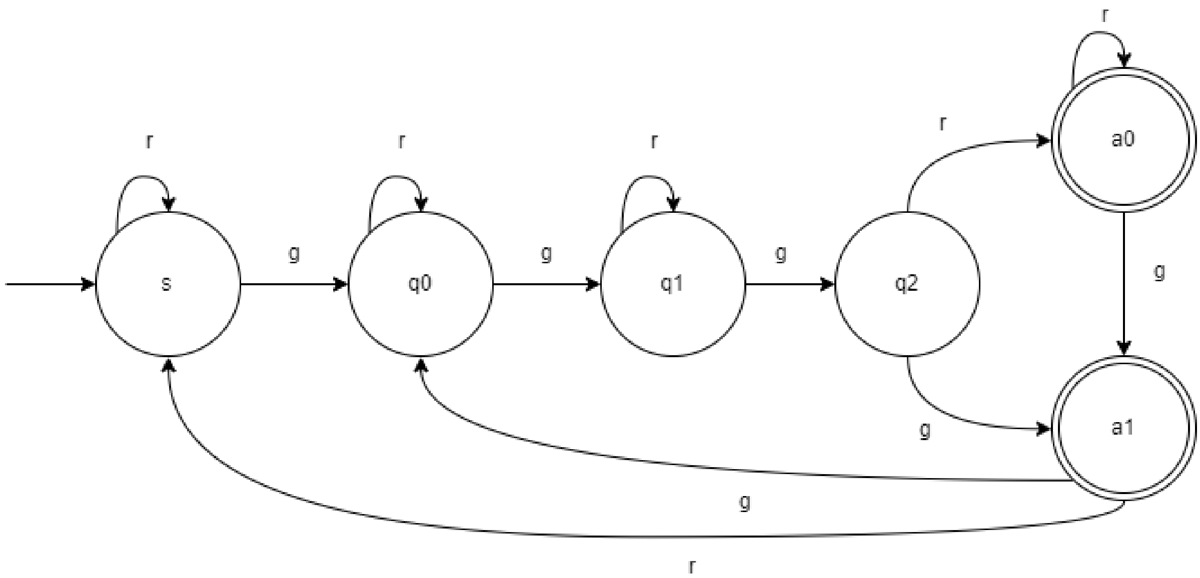
Assessment: Individual Coursework 1

1ai)

s	q0	q1	q2
Door 1 = Right	Door 1 = Left	Door 1 = Right	Door 1 = Left
Door 2 = Right	Door 2 = Right	Door 2 = Left	Door 2 = Left
A0	A1		
Door 1 = Left	Door 1 = Right		
Door 2 = Left	Door 2 = Right		



1aii)

M = (Q , ∑ , δ , q0 , F)

Q = { s , q0, q1 , q2 , a0 , a1 }

∑ = { g , r }

q0 = s

F { a0 , a1 }

δ: Q × ∑ → Q is

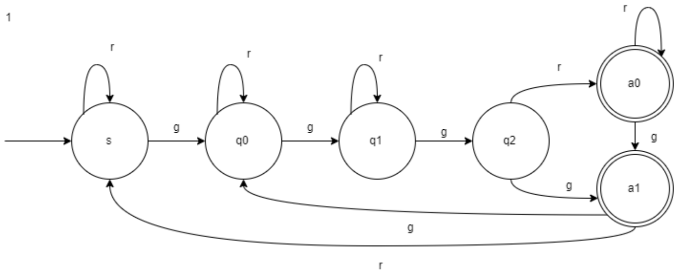
$Q \setminus \Sigma$	g	r
S	q0	s
$q0$	q1	q0
$q1$	q2	q1
$q2$	a1	a0
$a0$	a1	a0
$a1$	q0	s

1bi) Accepted

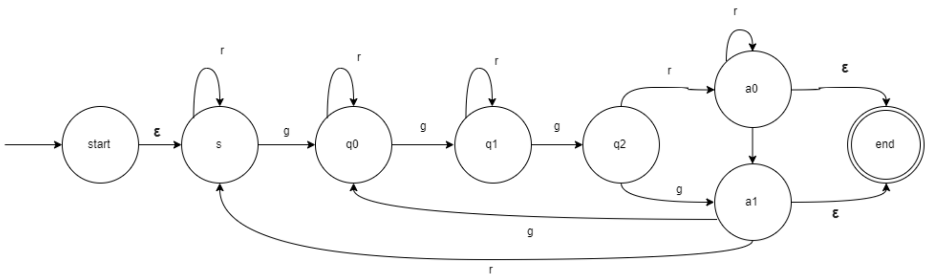
1bii) Accepted

1c)

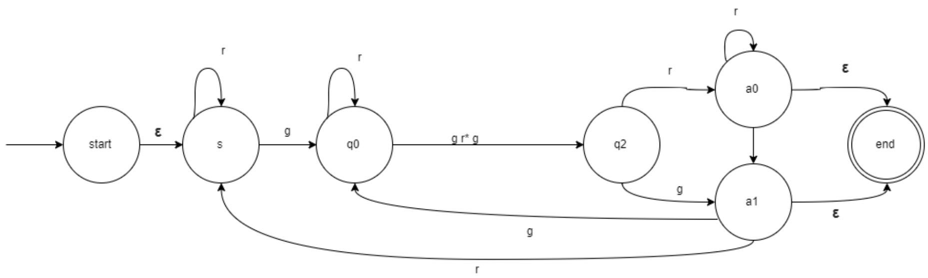
1



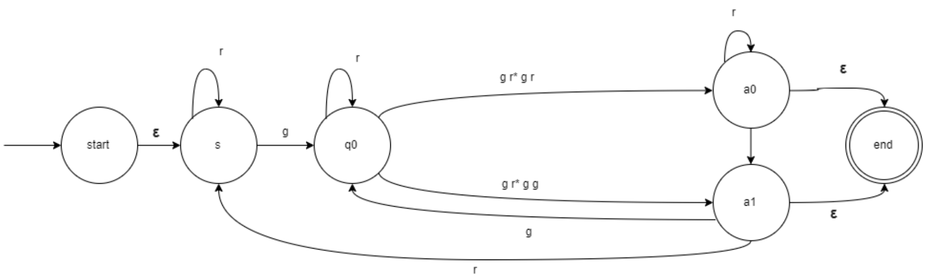
2 Add start and end states



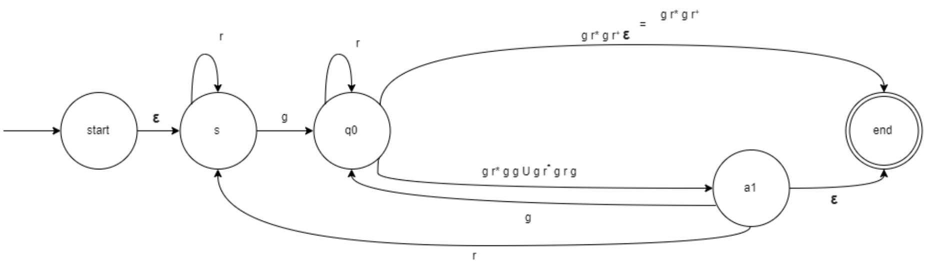
3 Remove q1



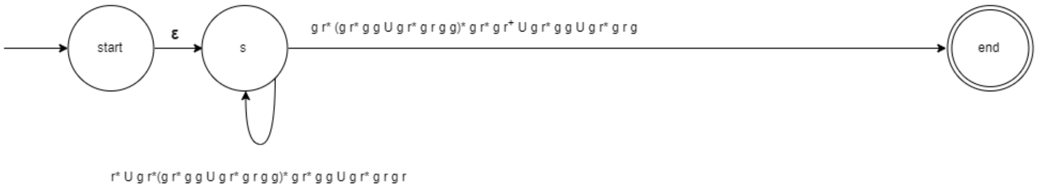
4 Remove q2



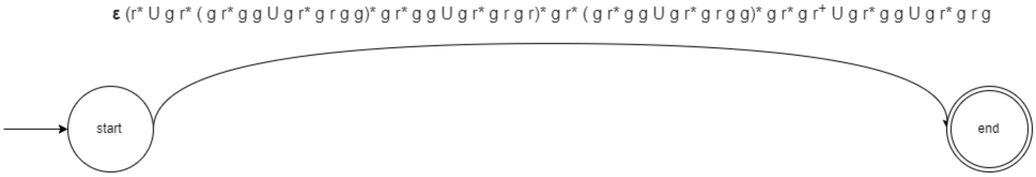
5 Remove a0



6 Remove q0



7 Remove s



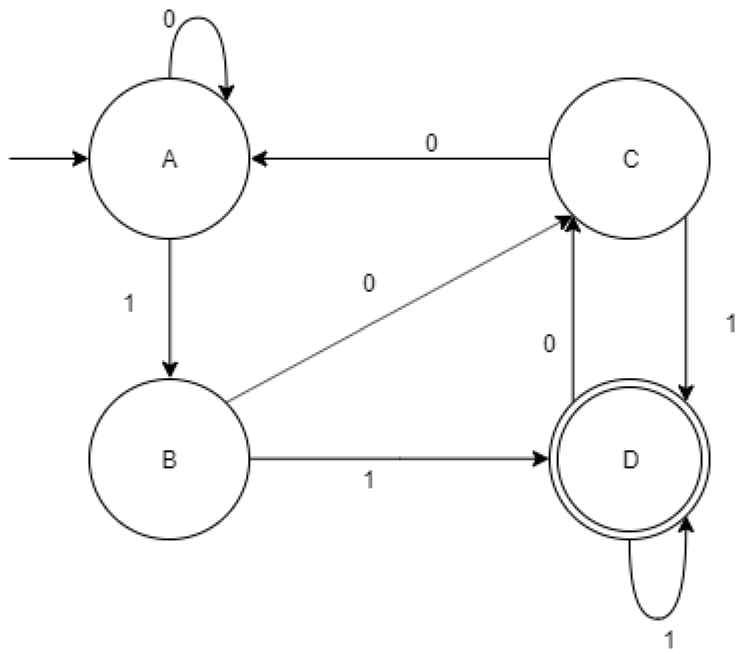
Therefore the language recognised by the automata can be described as:

(r* U g r* (g r* g g U g r* g r g g)* g r* g r g r (g r* g g U g r* g r g g)* g r* g r^+ U g r* g g U g r* g r g

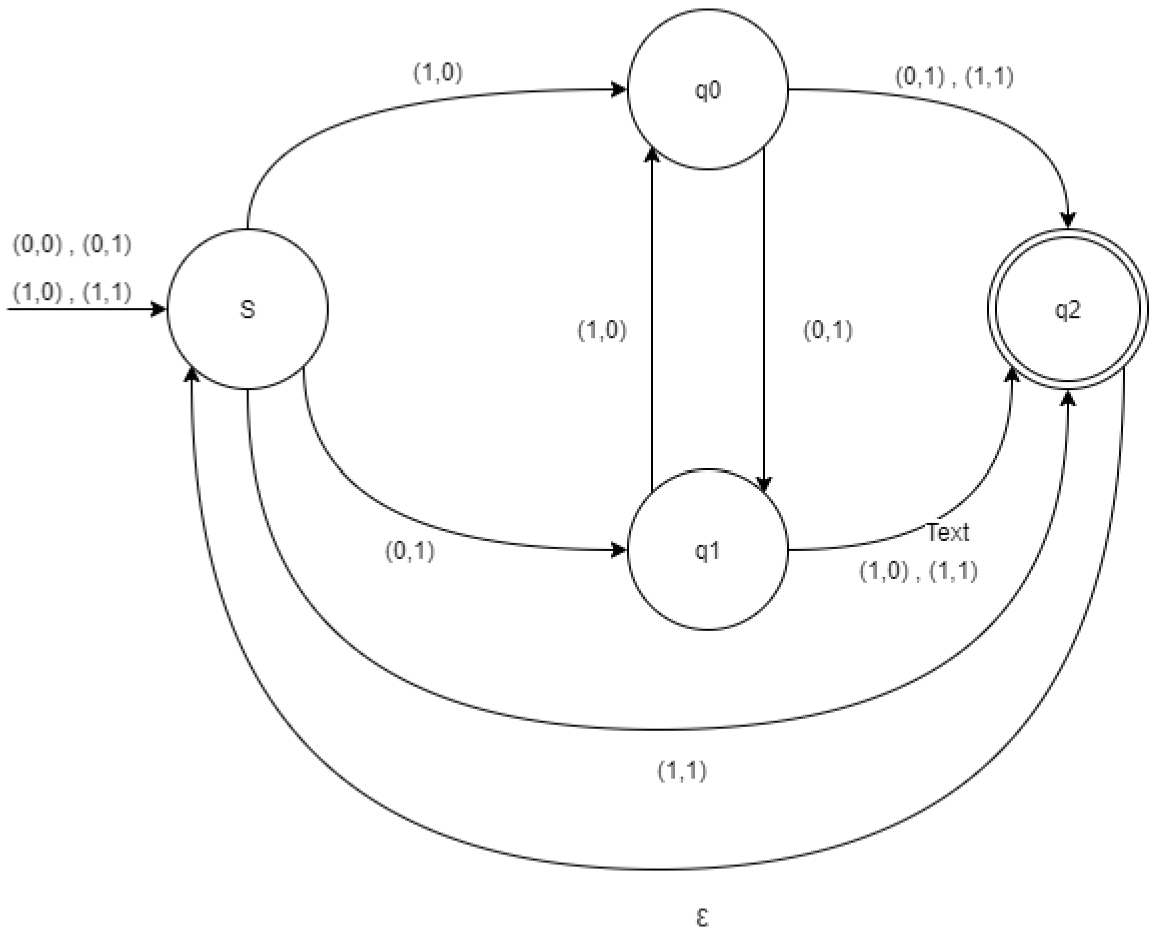
2a)

Q \ ∑	*0*	*1*	
[q0]	[q0]	[q0 q2 q5]	A
[q0 q2 q5]	[q0 q6]	[q0 q2 q5 q3]	B
[q0 q6]	[q0]	[q0 q2 q5 q3]	C
[q0 q2 q5 q3]	[q0 q6]	[q0 q2 q5 q3]	D

	0	*1*
A	A	B
B	C	D
C	A	D
D	C	D



2bi)

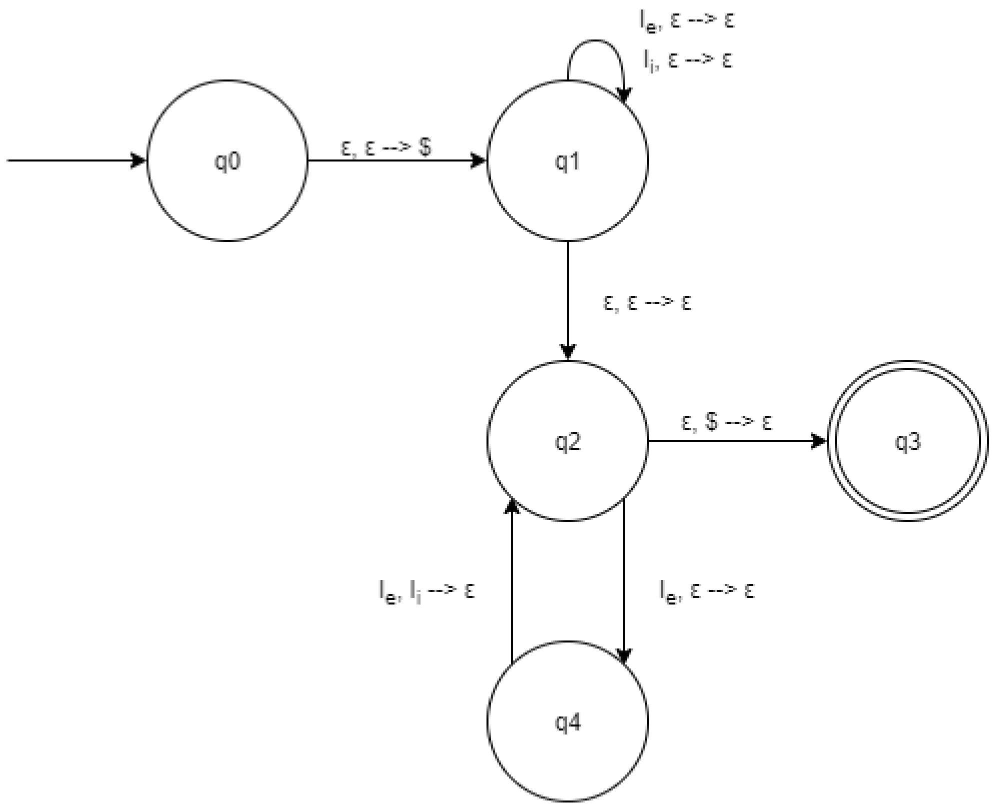


2bii)

$Q \setminus \Sigma$	(0,0)	(0,1)	(1,0)	(1,1)
S	∅	{q1}	{q0}	{q2}
q0	∅	{q1 , q2}	∅	{q2}
q1	∅	∅	{ q0 , q2}	{q2}
q2	{s}	{s}	{s}	{s}

3)

$\{(I_e{}^* I_i)^n I_e{}^{2N} \mid n > 0\}$



4)

L = $\{a^i b^j \mid I > 2j \text{ for } i, j \in \mathbb{N}\}$

Assume by way of contradiction that L ∈ REG, then L satisfies the conditions of the pumping lemma.

Let P > 0 be the pumping length

Consider the word S = $a^{2p+l} b^p$

Clearly W ∈ L and |w| > p so according to the pumping lemma there exists x,y,z ∈ ∑ such that w = x y z, I x y | ≤ p, |y| > 0 and for all i ≥ 0 it holds that $x y^i z \in L$.

Since |x y| ≤ p , then x = a^n, y = a^m and \ = $a^k b^p$ such that m + n + k = 2p +1 and m> 0

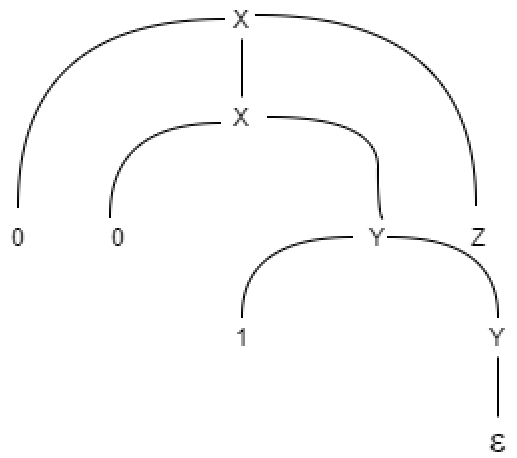
We pump with i = 0 and get the word x z = $a^n z = a^n a^k b^p$.

Since m + n + k = 2p + 1 and m > 0 then n + k ≤ 2p + 1

Thus x z ∑ ∈ L in contradiction to the pumping lemma

Therefore L is not regular.

5a)



5b)

5c)

X → OX2 | 0Y

Y → 1Y | ε

1: Create new start variable and 'map' it to the original start variable

S → X

A → 0X2 | 0Y

Y → 1Y | ε

2: Remove ε rules

S → X

A → 0X2 | 0Y

Y → 1Y | 1

3: Remove unit rules

S → 0X2 | 0Y | 0

A → 0X2 | 0Y | 0

Y → 1Y | 1

4: "Break chains" of length > 2

S → 0X2	X → 0X2
S → 0Z_0	X → 0Z_0
Z_0 → X2	

S → T_0 Z_0 \|T_0 Y \| T_0

X → T_0 Z_0 \|T_0 Y \| T_0

Y → T_1 Y\|T_1

Z_0 → X2

T_0 → 0

T_1 → 1

References

18-Pumping lemma example to prove a language not regular by Deeba Kannan. (n.d.). Retrieved from https://www.youtube.com/watch?v=SLG-LvaA6Hc

Using pumping lemma to prove {a^ib^j | i > j} non-regular. (2018, November 3). Retrieved December 5, 2019, from https://cs.stackexchange.com/questions/99546/using-pumping-lemma-to-prove-aibj-i-j-non-regular