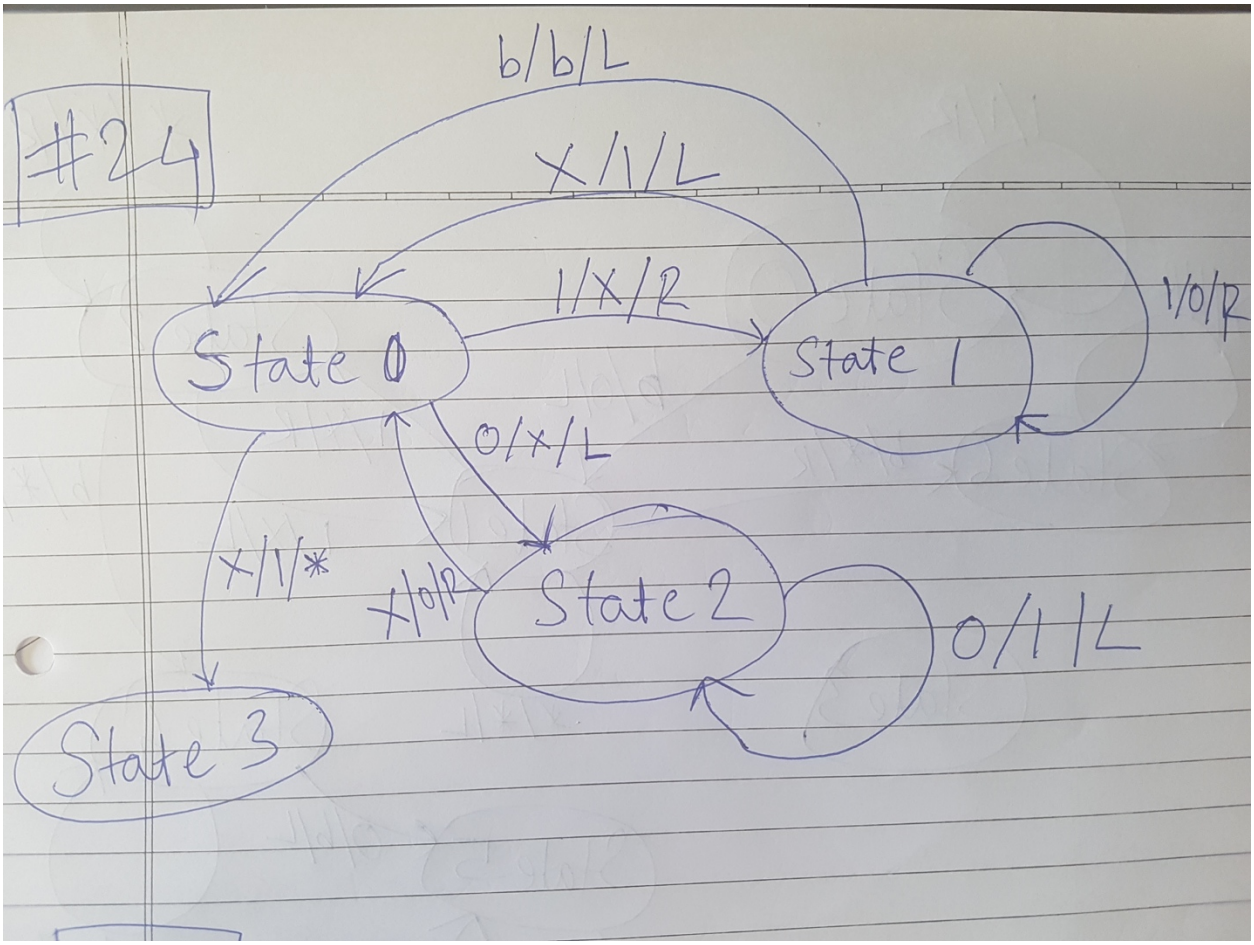
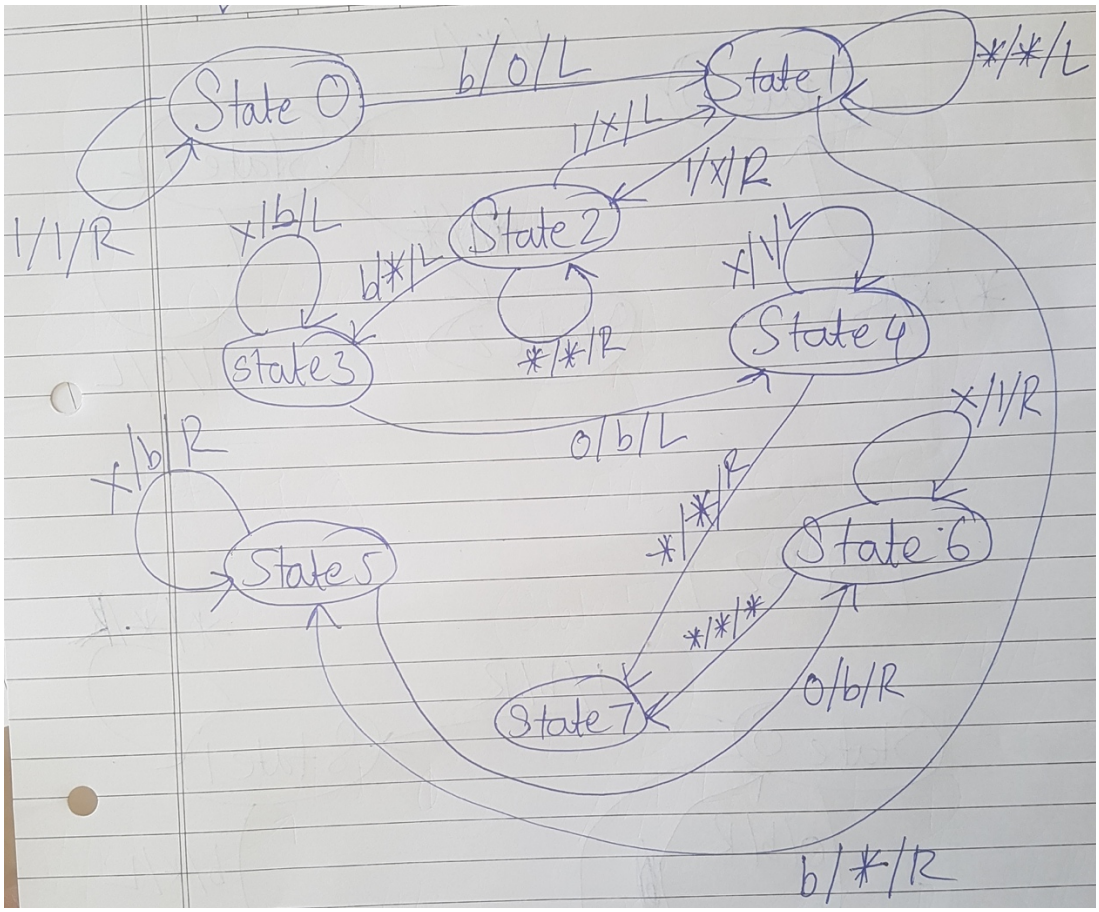
PS6: Name – Shikhar Bakhda; UNI: ssb2189

Question 24



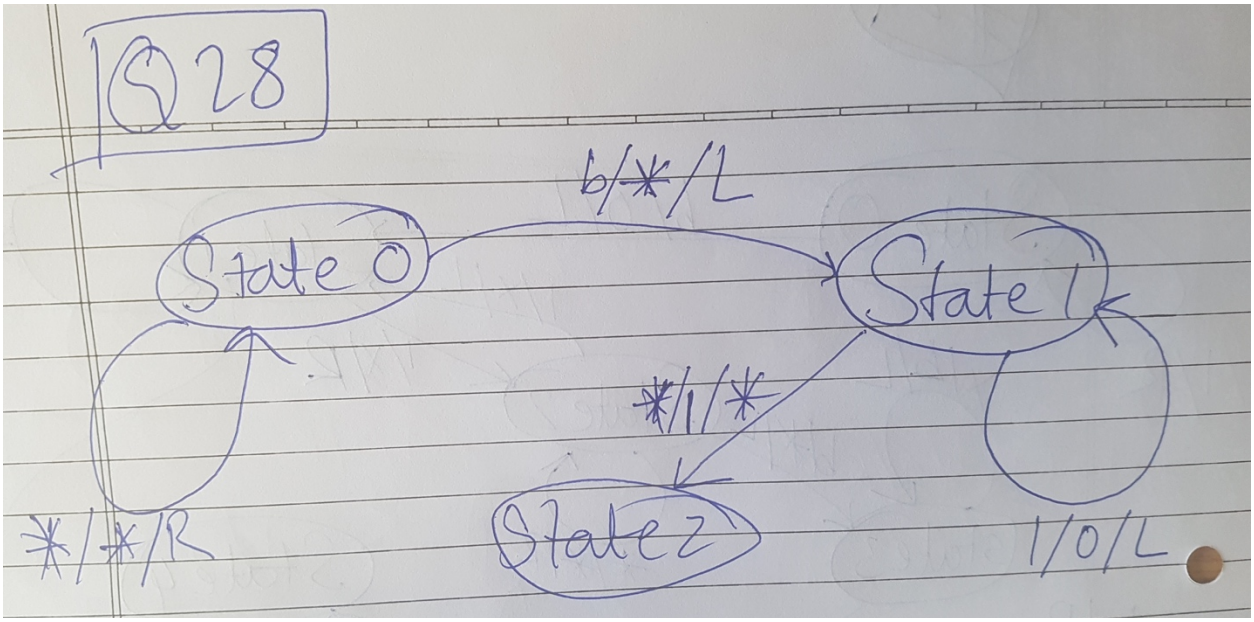

```
; adding marker/halting
0 1 X r 1
0 0 X l 2
0 X 1 * halt

; running right
1 1 0 r 1
1 X 1 l 0
1 _ _ l 0

; running left
2 0 1 l 2
2 X 0 r 0
```

Question 25



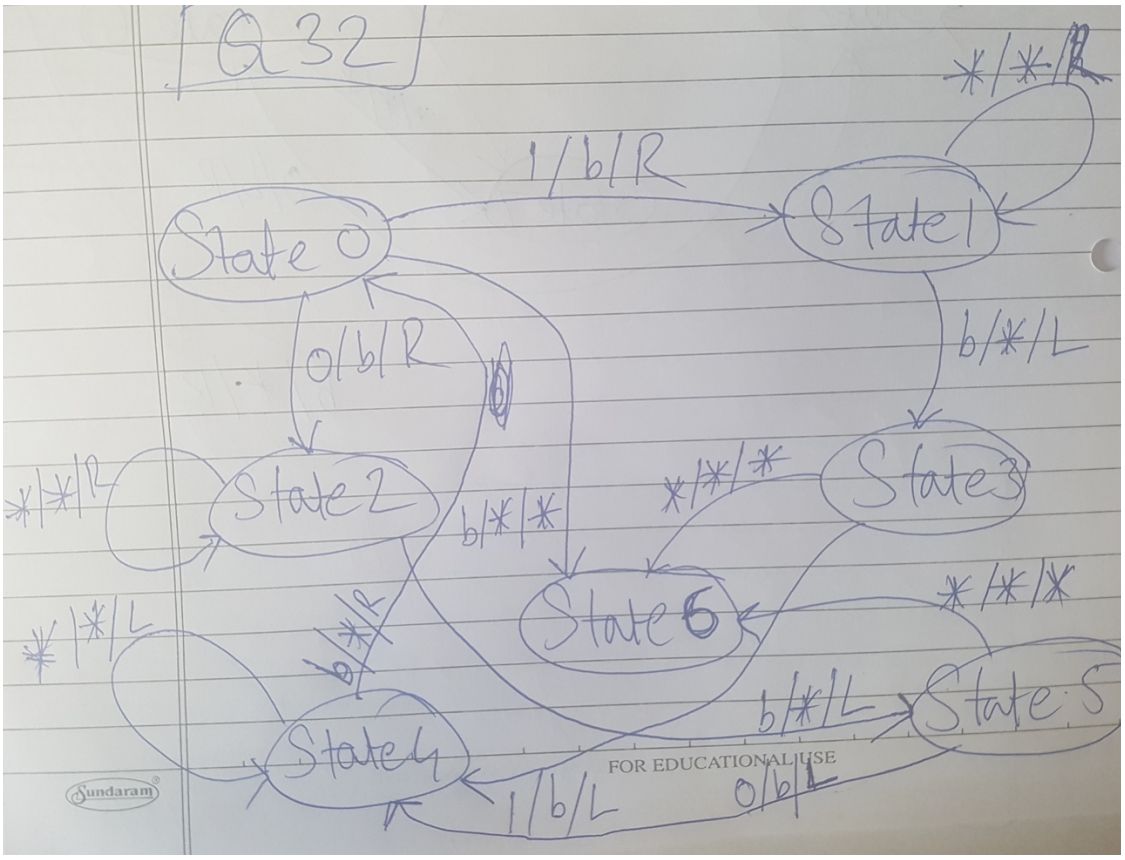

```
; move unlimited till you reach the center
0 1 1 r 0
0 _ 0 l 1

; move left unlimited till you reach 1, convert first 1 to X
1 * * l 1
1 1 X r 2
1 _ * r 5

; move right unlimited till you reach 1, convert first 1 to X
2 * * r 2
2 1 X l 1
2 _ * l 3

; Left is bigger
3 X _ l 3
3 0 _ l 4
4 X 1 l 4
4 * * r halt

; Right is bigger
5 X _ r 5
5 0 _ r 6
6 X 1 r 6
6 * * * halt
```

Question 28




```
; going unlimited till you reach the right end
0 * * r 0
0 _ * l 1

; change all 1s to 0s, halt if anything else
1 1 0 l 1
1 * 1 * halt
```

Question 32



```
; check first character
0 1 _ r 1
0 0 _ r 2
0 _ * * halt

; if 1, go to right end
1 * * r 1
1 _ * l 3

; if 0, go to right end
2 * * r 2
2 _ * l 5

; if not same, halt.
3 1 _ l 4
3 * * * halt

; if same, go to left end
4 * * l 4
4 _ * r 0

; if not same, halt.
5 0 _ l 4
5 * * * halt
```

Question 40

There can only be one possible path for a specific initial tape and a Turing machine instructions. This is because of the rule that there can only be one unique instruction in the set that has the same state and current symbol. For example, it is not possible to have 2 1 0 r 3 and 2 1 1 l 5 in the same set of instructions. This only allows one possible path for the machine, given a fixed set of instructions and initial tape contents.

The number of steps to be measured is a finite quantity, and thus, given the instructions and the tape contents, we can test whether the Turing machine will decidedly take exactly 10 steps by running it one time and checking whether the path routed by the instructions is 10 steps long.

However, this only works one way. If the Turing machine stops within 10 steps, we know that it works. However, if it doesn't stop within 10 steps, we won't know whether it works as it may not necessarily terminate.

Nevertheless, the 10-step halting problem is computable since it has a fixed, finite set of instructions and initial tape contents, and because 10 is a finite number of steps to compute.