Final Report

- ## What we were able to get working and what is not working

We made multiple changes to the encoding. We removed the encoded machine's blank, moved the encoded machine's leftend marker to the left of the encoded input string, and added strings of @s before each input character as a placeholder for the current state. We calculate the number of @s needed based on the maximum sized state in the encoded machines set of states. Also, at the end of the encoded input, we added the encoded machine's blank (with a corresponding set of @s).

So, our tape looks like (suppose the maximum length of states is 3)

?start_state#final_state1,final_state2,...,#transition_function1,transition_function2,…,#@@@.left_end ,@@@.input_character1,@@@.input_character2,…,@@@,blank,#

We were able to update our tape to set current state with its starting state of the given Turing machine, to compare current state and final states, and to update our tape according to the transition functions matched with the direction bit of GoRight. One major failure we have found in our machine is that it fails to move the tapehead left. We have found that when the machine needs to go left, the tapehead location gets lost the wrong bits are updated. Even when we get this part working, our machine will have the limitation that the encoding is not dynamic- given that we place the @ symbols next to each input our machine would fail in cases where the tape is expected to grow. Currently, our machine is only working for Turing machines whose starting state is a final state.

We implemented two debugging tools that we proposed. One is a function "accepts2" which is like "accepts" in TM.hs but instead of returning "true" or "false", it returns the final configuration if the input is accepted and returns "Nothing" if it is not accepted. The second debugging tool is a function "nthChecking" that takes in an input and a number and returns the list of configurations reached after n calls to newConfigs. We found nthChecking essential to making progress with the machine.

- ## Testing

We used those debugging tools that we implemented, especially "nthChecking" to see if our tape is updated as we intended to. Since we have tested part by part, we could observe that setting starting state to be the current state, checking if current state is in final states, and updating UTM's tape when its matched transition's direction bit is GoRight are working as we intended

When we have tested our utm with inputU tripletm "abc", "a", "aaabaaa" (amongst other inputs) and a simple TM which has only one transition function.

- **High-level explanation**

Initialize: write start state to first set of @ symbols
Loop: checking the current state is in final states (if it is, accepts or not continue)
     find transition function matching with [current state + input character]
     move the tape head according the transition function
     update current state and cell with the transition found or reject
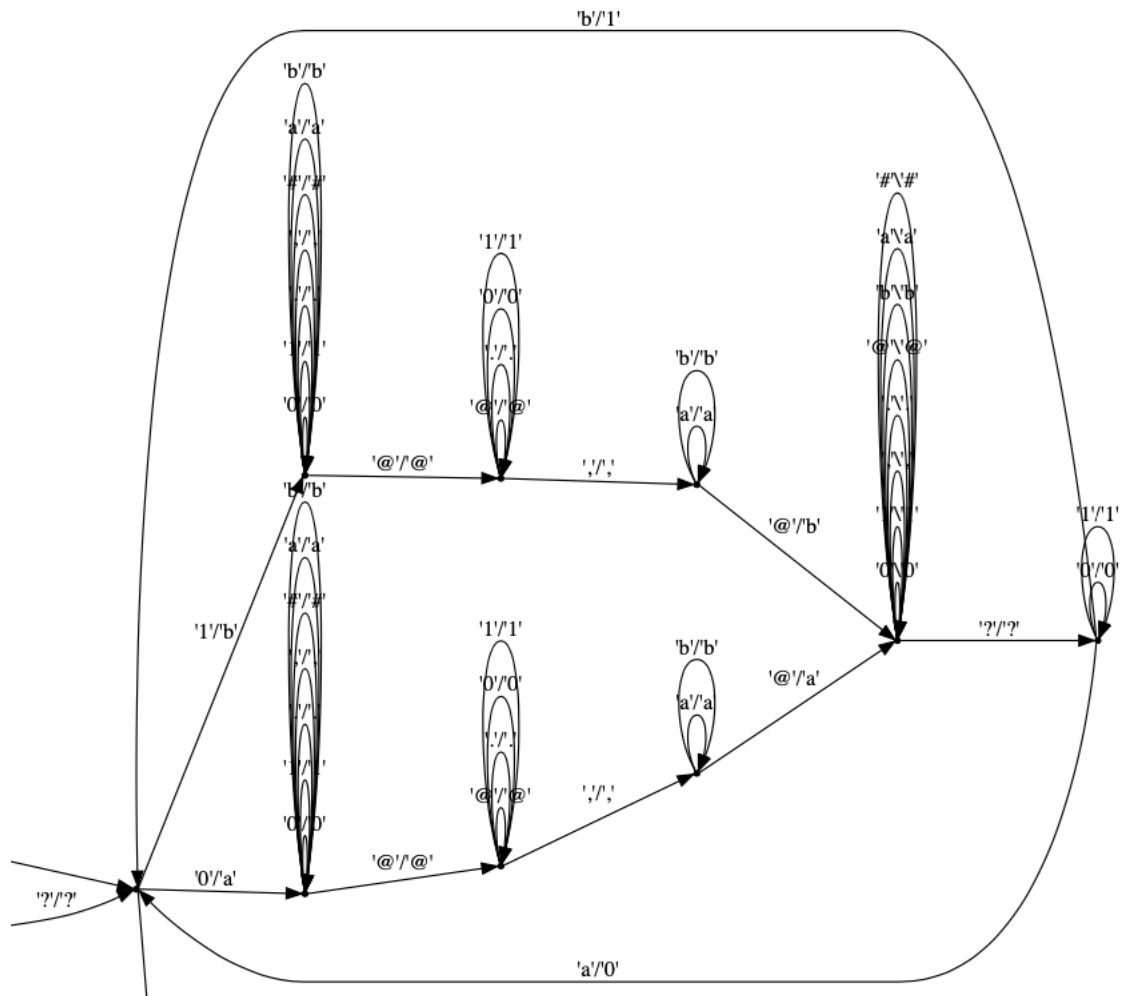
- **Course-evaluation**

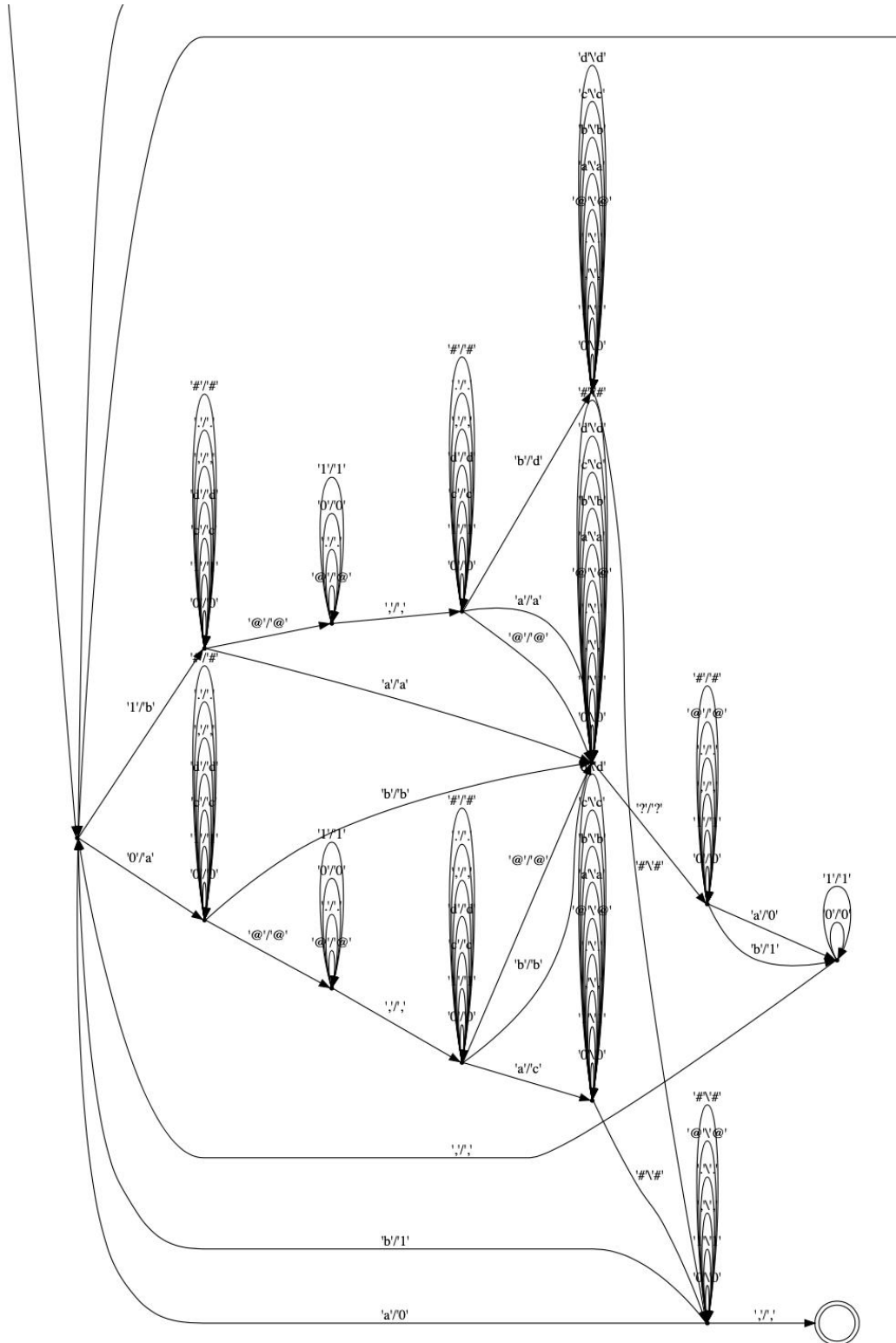Both of us did course evaluation.

- **Summary**

We were able to successfully check individual groups of transitions for their expected behaviors but didn't get the pieces to work together.
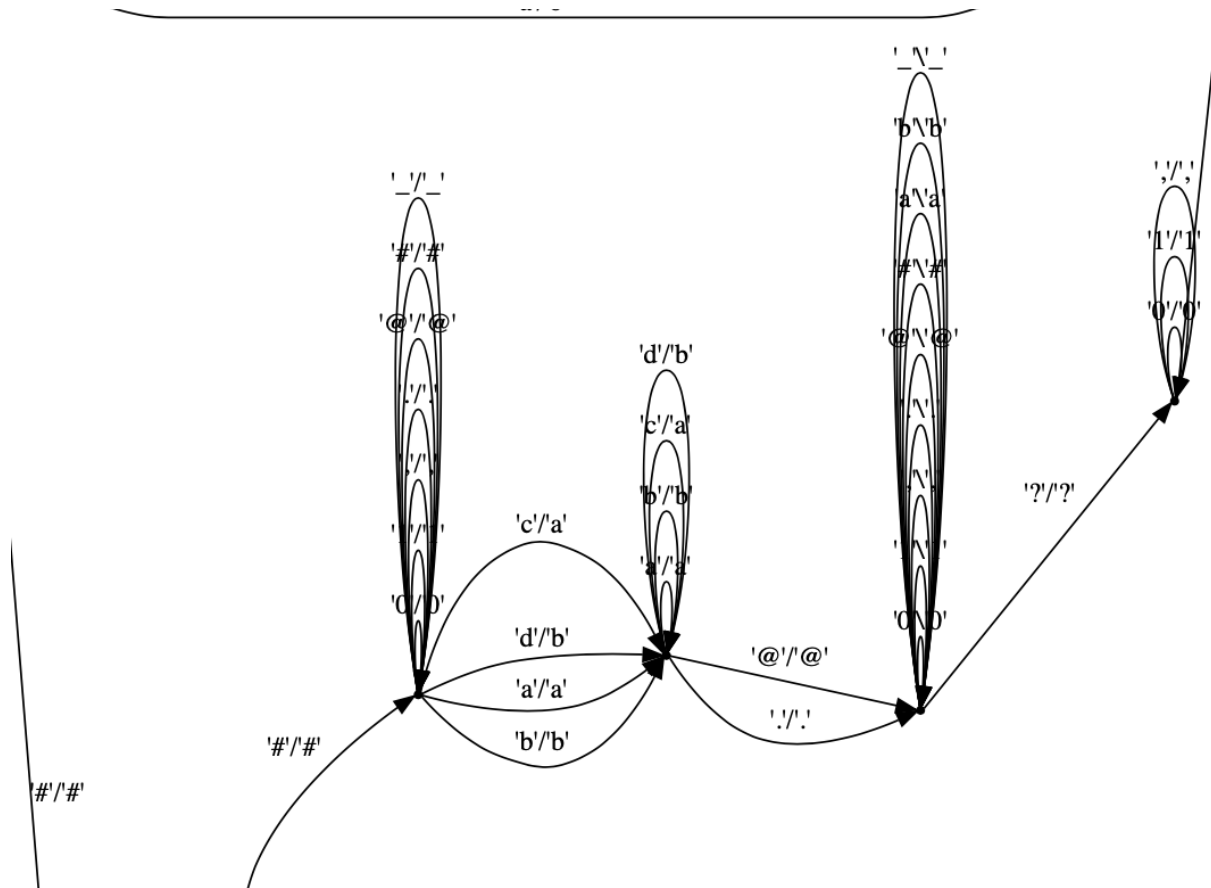
- **Diagrams**

1) Setting the starting state

'b'/'1'

'b'/'b'
'a'/'a'
'#'/'#'
'1'/'1'
'0'/'0'
'@'/'@'
'@'/'@'
'1'/'1'
'0'/'0'
'@'/'@'
'@'/'@'
','/','
'b'/'b'
'a'/'a'
'@'/'b'
'#'\'#'
'a'\'a'
'b'\'b'
'@'\'@'
'@'/'b'
'1'/'1'
'0'/'0'
'b'/'b'
'a'/'a'
'#'/'#'
'1'/'1'
'0'/'0'
'@'/'@'
'@'/'@'
'1'/'1'
'0'/'0'
'@'/'@'
'@'/'@'
','/','
'b'/'b'
'a'/'a'
'@'/'a'
'?'/'?'
'1'/'b'
'?'/'?'
'0'/'a'
'@'/'@'
'a'/'0'

3) Putting back c and d that we used during processing transitions function back to a and b

4) For the rest of them, please refer utm.pdf file.