David Estrada

Homework # 7
April 2021

Problem 1

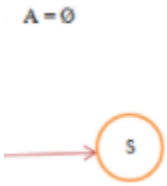
40 points

Draw the state-transition diagram for a Turing Machine M that *decides* each of the following languages. That is, M is supposed to accept all strings in the language and reject all strings not in the language (it cannot loop forever on any input).

Assume that the input alphabet is $\Sigma = \{0,1\}$ and tape alphabet is $\Gamma = \Sigma \cup \{\square\}$. Feel free to define more tape symbols if necessary.

1. $A = \emptyset$
2. $B = \{\epsilon\}$
3. $C = \{0\}$
4. $D = \{1\}^*$

1.



- The Turing machine does not contain a final state, only contains a start state. It is also an empty set, meaning that there is no more final states or transitions.

2.

- The string is empty, E refers to an empty string. It can also change to any state without reading the input.

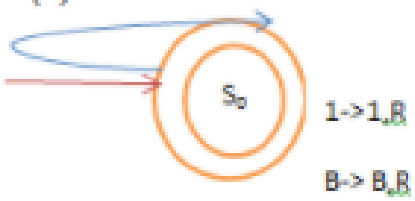
S_0 -> initial state

S_f -> final state

3.

- start state -> S_1
- final state -> S_f
- Dead state -> S_d
- it starts with S_1 when S_0 receives 0
- If B is received then S_f
- If not B then S_d

4. $D = \{1\}^*$



- S_0 -> start state
- It accepts 1 or ε
- It is also a final state.

Problem 2

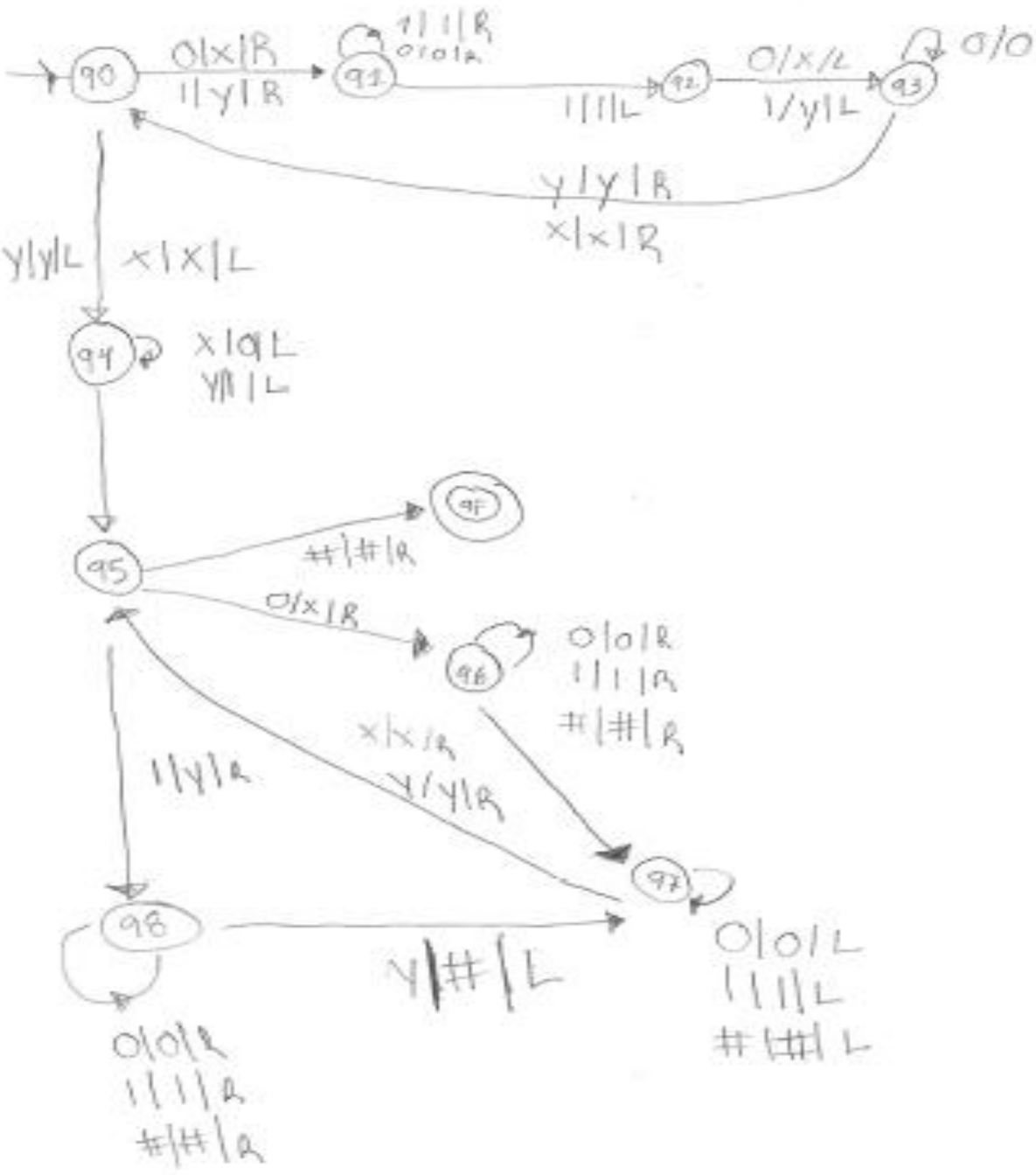
30 points

Show a Turing Machine M that decides the following language.

$$E = \{\, yy \mid y \in \{0,1\}^* \,\}$$

Please

1. Describe in English the idea how it works. **15 points**
2. Show all the transitions. **15 points**



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Turing machine for "yy" where y belongs to (0,1)*.

First decide the logic to create a Turing machine, so "yy"logic says that any how first find the mid point, now divide the task into two parts:

First mid point calculation

Second matching of symbol

Turing Machine should accept first from the starting should be matched with first from the mid point, second from the starting should be matched with the second from the mid point, similarly for other variables.

Assume, at initial state q0 0 or 1 occurs, then what we are doing? if 0 occurs, converting 0 into X and moving into right direction else converting 1 into Y and moving into right direction.

that means scanned the first symbol and moved to the next state.

At q1 stae, any number of 0 or 1 may oocur, TM skipping it till blank occurs.

When blank occurs, you moved to left i.e. move one position backward.

if 0 comes, convet it into X and move to left OR if 1 comes, move to left and convet it into Y.

Now, at q3 any number of 0 and 1 may come, skip all of them and moving into left until X or Y occur(which was initially occurs at initial state).

Now, all 0 and 1 must be converted into X and Y.

Now, from q0 to q4 all XX or YY are left together. Here, Turing machine will convert all X into 0 and Y into 1 respectively.

Convert all X and Y into 0 and 1 also move to left side till blank occurs (q4 to q5)

represents Blank

Now Matching starts:

From q5 to q6, if 0 occurs convert again it into X and move forward till X occurs and in the last if X comes "well and good" else Turing machine halt non accepting state or non final state.

represents Blank

From state q6 to q7, X conert into blank and skip all 0 and 1 till blank occurs.

Similarly, from q5 to q8, if 1 occurs convert again it into Y and move forward till Y occurs and in the last if Y comes "well and good" else Turing machine halt non accepting state or non final state.

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represents Blank