CS 390 – Introduction to Theory of Computation

The ODU honor code is in effect for the duration of this examination. You are not to communicate with anyone else about the content of the exam. If someone contacts you, you are required to notify the instructor immediately.

For questions 1 and 2 write out regular expressions for the following, the alphabet for both is {a, b}

1. The set of all strings that EITHER begin with aaa and end with bbb
   OR
   Strings that begin with bbb and end with aaa.

2. The set of all strings that begin with at least one 1 substring ab, followed by a single instance of aa at which time it will either terminate OR will be followed by at least one instance of the substring ba.

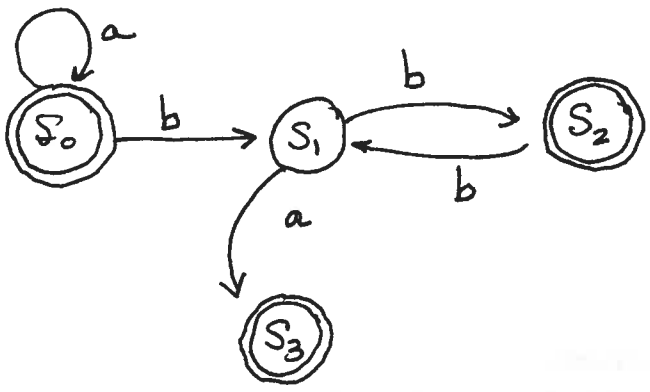
3. Describe in words the following expression.

$$[(aa)^* + (bb)^*][(a+b)^*](b^+)$$

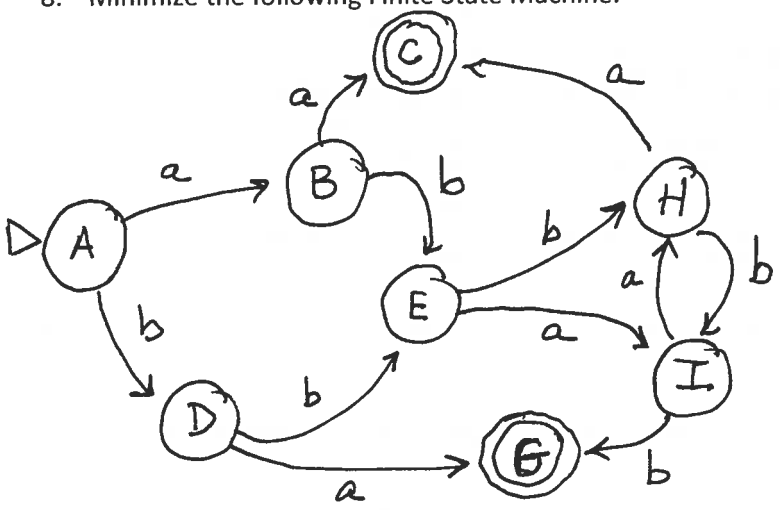
4. Generate a F.A from this expression:

$$(ab^{+} + a^{+}b)(aa+ bbb)^{*}$$

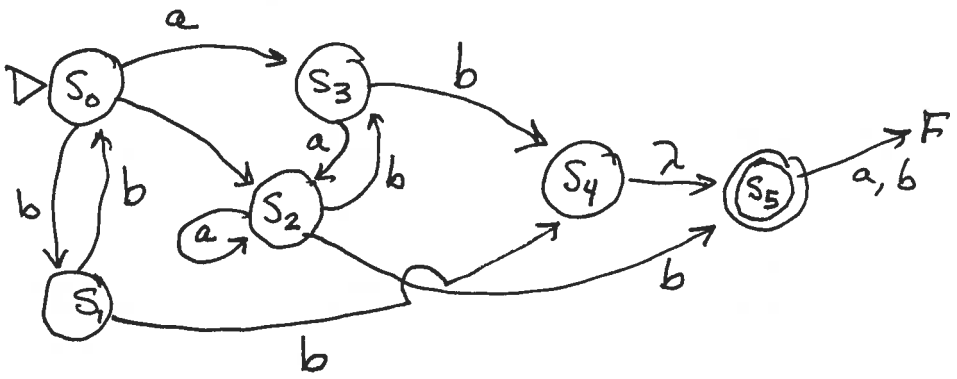
5. What regular expression is described by the following finite automata?



8. Minimize the following Finite State Machine.



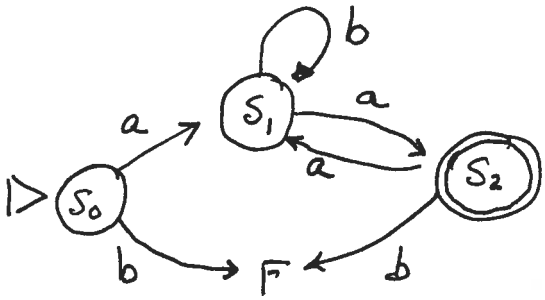
9. Reduce the following NFA-lamba to a standard F.A.

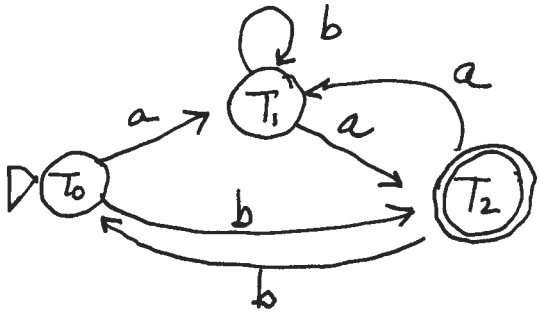


6. Write out the smallest NFA-Lamba you can for the following expression.

$$(((ab) + (abb))^*b)^+$$

7. Given there are two machines S and T, compute the intersection and union of the languages they describe.





Prove by induction the following two problems, show every step.

10.

$$\sum_{i=1}^{k+1}(-1)^i\, i^2 = \frac{(-1)^n n(n+1)}{2}$$

$$\sum_{i=1}^{n}(2i-1) < n^2 + 1$$

Extra Credit.

In class and in our textbook and in many others it is said that Finite state machines must have exactly ONE initial state. Can you come up with a special case where a NFA-Lamba CAN have more than one initial state? If so show an example, if not say why you cannot.