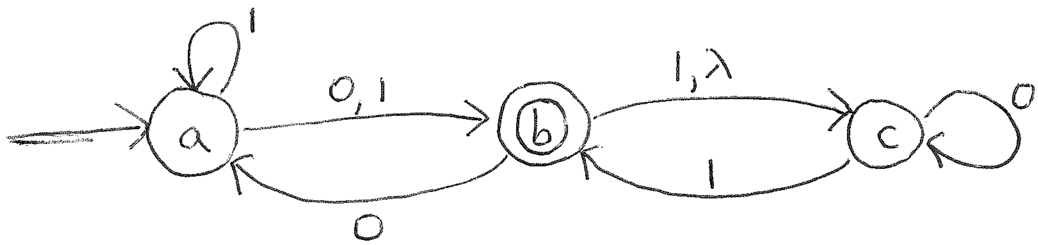
Mid-term 1

September 21, 2018

(1) (20 points) Construct a DFA that accepts precisely the strings on $\Sigma = \{a, b\}$ which do not have three consecutive identical letters. (For example, the empty string, a, and $aabbabbaa$ should be accepted, but $aabbabbbaa$ should not.)

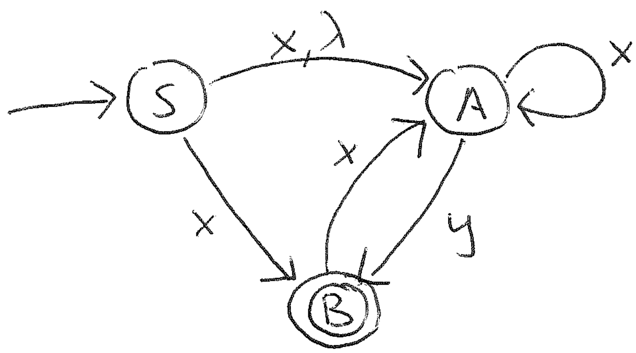
(2) (16 points) Consider the following NFA. Construct a DFA that accepts the same language.



(3) (16 points) Construct an NFA that accepts precisely the strings that match the regular expression $[aa^*b + ba]^*b + aba$.

(4) (18 points) Suppose we have a grammar $G = (V, \Sigma, S, P)$. Give the formal definition for what it means for a string $u \in \Sigma^*$ to produce the string $v \in \Sigma^*$ (using the grammar) in one step. Suppose $(A, xyAzB) \in P$ is a production. Explain why, in terms of the definition you have given, the string $yABz$ produces $yxyAzBBz$ in one step.

(5) (10 points) Give a right regular grammar (it suffices to write the production rules) that generates the language accepted by the NFA drawn below.



(6) (20 points) Given a language L on $\Sigma = \{a, b, c\}$, let $da(L)$ be the language consisting of all strings formed by deleting one a from a string in L. (For example, if $abaca \in L$, then that implies $baca$, $abca$, and $abac$ are all in $da(L)$.) Explain why, if L is regular, then $da(L)$ must also be regular. (Hint: Given an NFA M that accepts L, construct a new machine that looks like 2 copies of M connected in some way.)