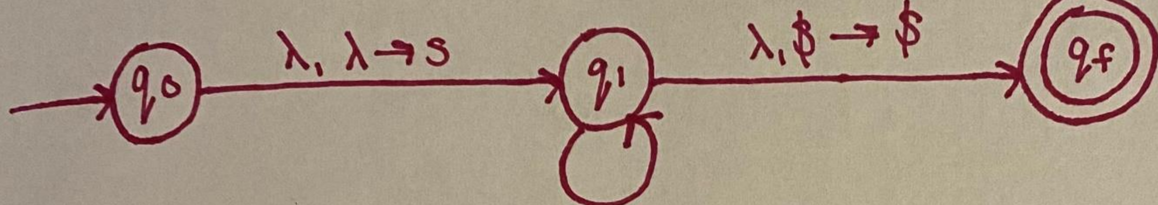
Morgan Baccus
CptS 317
Homework #9

1) $S \to aaB \mid bbA \mid AB \mid aabb$

$A \to BA \mid aB \mid a$

$B \to AB \mid bA \mid b$



$\lambda, S \to aaB$
$\lambda, S \to bbA$
$\lambda, S \to AB$
$\lambda, S \to aabb$

$\lambda, A \to BA$
$\lambda, A \to aB$
$\lambda, A \to a$

$\lambda, B \to AB$
$\lambda, B \to bA$
$\lambda, B \to b$

$\lambda, a \to \lambda$

$\lambda, b \to b$

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2) The PDA of grammar G can be expressed as (V, T, P, S). Let V contain the initial symbol of G, being the symbol S. Also let V contain the symbols X, T and S which correlate to every combination of the stack symbol X, with the states T and S. It then follows that the set V can be expressed as

$V = \{ S, [q_{00}, q_0], [q_0, q_{evn}], [q_0, q_{odd}], \ldots \}$, onward for all state combination stack symbols for both $T = \{0, 1\}$ and $S = \{S\}$.

The productions of grammar G, denoted as P, has 2 forms:

For all P: $S \rightarrow q_0 Z_0 q_0 \mid q_0 Z_0 q_2 \mid \ldots$

For all P swapped for S: $S \rightarrow 0 Z_0 0 \mid 1 Z_0 1$, $Z_0 \rightarrow 0 Z_0 0 \mid 1 Z_0 1 \mid e \mid 0 \mid 1$

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3) By the closure property of regular language, If language L is regular then the language L^r (the reverse of strings in the language L) is also regular.

Another closure property of regular language is that concatenation of 2 regular languages is regular.

Since language L_2 is regular, by the closure property L_2^r is also regular.

Then by closure property of concatenation of regular language, $L_1L_2^r$ (the concatenation of 2 strings x and y in L_1 and L_2^r respectively) is also regular.

We can see that L_3 is concatenation of L_1 and L_2^r, hence L_3 is also a regular language.

Since every regular language is also a context-free language, L_3 is context-free since it is a regular language.

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4) We can prove that L is not a context-free language with the help of pumping Lemma:

① take a contradiction

② take a string W divide into 5 parts

$W = uvxyz$

③ $W = u v^i x y^i z$ where i is integer

④ for every i

$W \in L$ then it is a context-free language

otherwise it is not.

Given the language $L = \{ a^{2m} b^{3m} c^{4m} : m \geq 0 \}$

① L is a context-free language.

② string $W =$ aa bbb cccc

$W = \underset{u}{\underline{aa}}\ \underset{v}{\underline{bb}}\ \underset{x}{\underline{bc}}\ \underset{y}{\underline{cc}}\ \underset{z}{\underline{c}}$

③ $W = u v^i x y^i z$

if $i = 2$

$=$ aa bbbbb cccccc

$W \neq L$

$\boxed{\text{So that the given language L is not a context-free language.}}$