HW4

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I Question 1

$C = \{w \mid w \text{ has an equal number of 0s and 1}\}$

Assume C is a regular language, and let p be the pumping length of C. Choose $s = 0^p1^p \in C$. Clearly $|0^p1^p| > p$. According to the pumping lemma, s can be paritioned into $s = xyz \in C$ such that for all $i \geq 0$, we have the following $xy^iz \in C$. By condition 3 of the pumping lemma, we must also have $|xy| \leq p$. Therefore y must consist only of 0's and subsequently $xyyz = xy^2z \notin F$ since the string s would now contain a greater number of 0s than 1s. Subsequently if we pumped down, resulting in a string of xz, the string would now contain fewer 0s than 1s. Hence, s cannot be pumped and that is a violation of our assumption that C is regular. By this contradiction we can conclude that the language C is not regular.#

II Question 2

$F = \{ww \mid w \text{ is a string from } \{0,1\}^*\}$

Assume F is a regular language and let p be the pumping length of F. Choose $s = 0^p10^p1 \in F$, when $w = 0^p1$. Clearly $|0^p10^p1| > p$. According to the puming lemma, s can be partitioned into $s = xyz \in F$ such that for all $i \geq 0$, we have the following $xy^iz \in F$. By condition 3 of the pumping lemma, we must also have $|xy| \leq p$. Therefore, y must consist only of 0s and subsequenttly $xyyz = xy^2z \notin F$ since the first part of the strings (substring w) does not equal the second part of the string s. Hence, S cannot be pumped and that is a violation of our assumption that F is regular. By this contradiction we can conclude that the language F is not regular.#

III Question 3

$A = \{www \mid w \text{ is a string from } \{a,b\}^*\}$

Assume A is a regular language and let p by the pumping length of A. Choose s to be $= a^pba^pba^pb \in A$. Clearly $|a^pba^pba^pb| > p$. According to the pumping lemma, s can be partitioned into $s = xyz \in A$ such that for all $i \geq 0$, we have the following $xy^iz \in A$. By condition 3 of the pumping lemma, we must also have $|xy| \leq p$. Therefore, y must consist only of a's, and subsequently $xyyz = xy^2z \notin A$ since the first substring w would now contain more a's than the second and third parts of the string s. Hence, s cannot be pumped and that is a violation of our assumption that A is regular. By this contradiction we can conclude that the language A is not regular.#

IV Question 4

L = $\{0^n 1^m 0^n \mid m,n >= 0\}$

Assume L is a regular language and let p be the pumping length of L. Choose s to be = $0^p 1 0^p$ $\in$ L. Clearly $|0^p 1 0^p| > p$. According to the pumping lemma, s can be partitioned into s = xyz $\in$ L such that for all i $\geq$ 0, we have the following $xy^iz \in L$. By condition 3 of the pumping lemma, we must also have $|xy| \leq p$. Therefore y must consist of only 0's and subsequently xyyz = xy^2z $\notin$ L since the string s would now contain $0^{p+|y|}10^p$, which is $\notin$ L. Hence, s cannot be pumped and that is a violation of our assumption that L is regular. By this contradiction we can conclue that the language L is not regular.#