University of Nevada, Las Vegas Computer Science 456/656 Fall 2018

Assignment 5: Due October 31, 2018

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. But the handwriting on this document must be your own. You may attach extra sheets using a stapler, not a paper clip.

You will find a link to the definitions of the two pumping lemmas on the assignment page. I had to correct an error in my definition of the pumping lemma for conext-free languages. The definitions can also be found on Wikipedia, with very slightly different notation. I have used the term **the** pumping length, but more correctly, I should have said **a** pumping length. If p is a pumping length for a regular language L, then $p+1$ is also a pumping length for L. Thus, there is a *minimum* pumping length of any regular language. For example, the minimum pumping length of the language L whose regular expression is $c(ab)^*$ is 3, since if $w \in L$ and $|w| \geq 3$, then $w = c(ab)^n$ for some $n \geq 1$. We can let $x = c$, $y = ab$, and $z = (ab)^{n-1}$.

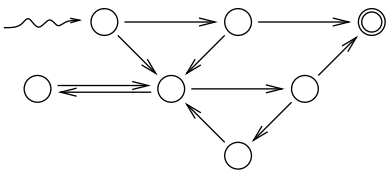
The same holds for the pumping lengths of context-free languages.

In these problems, "pumping length" means a p given by the pumping lemma for regular languages.

1. Let $L = \{a^n : n \geq 0\}$, the language of all strings over the unary alphabet $\{a\}$. What is the minimum pumping length of L?

2. What is the minimum pumping length of the language whose regular expression is $(a + \varepsilon)(ab + aba)^*$.

3. Let L be the language accepted by the DFA illustrated below. What is the minumum pumping length of L? (Unfortunately, I was so rushed getting this homework ready that I forgot the labels on the arrows.) (Hint: look at the proof of the pumping lemma.)



4. Let L be the language of all binary numerals for multiples of 3, where leading zeros are allowed. Prove that 4 is a pumping length for L. (Hint: draw a DFA for L.)

5. Every finite language is regular. What is the minimum pumping length of a finite language? (Hint: "vacuous implication.")