CpSc 3500 — Goddard — Fall24

Assignment 4

(Please work in groups of two or three and submit one answer sheet for the group.)

1. Let P_m be the set of all binary strings with a 1 in the mth to last symbol (and at least m symbols). For example, P_1 is the set of all strings ending with a 1. Describe an NFA that accepts P_m and uses $m+1$ states.

2. Let M be the language of all binary strings that contain the substring `11` and whose number of `0`'s is even. (For example, `0101100` is in M.) Answer the following with justification:

   (a) Give a collection of strings such that your strings are pairwise distinguishable with respect to M and your collection is as big as possible.

   (b) Give a collection of strings such that your strings are pairwise indistinguishable with respect to M and your collection is as big as possible.

3. Give CFGs for all strings of the form:

   (a) $\mathtt{1}\mathtt{0}^n\mathtt{1}\mathtt{0}^n\mathtt{1}$

   (b) $\mathtt{0}^n\mathtt{1}^m\mathtt{2}^k$ with $n = m + k$

   (c) $\mathtt{0}^n\mathtt{1}^m\mathtt{0}^m\mathtt{1}^n$

   (d) $\mathtt{0}^i\mathtt{1}^j\mathtt{2}^k$ with $i = j$ or $i = k$

4. Give a CFG for each of the following:

   (a) All binary palindromes with exactly three `1`'s (such as `001010100`).

   (b) All binary strings that are NOT palindromes.

5. Consider the following CFG with start state S:

   $S \to A \mid BS \mid SS$
   $A \to \mathtt{x} \mid BB$
   $B \to \mathtt{y} \mid SS$

   Determine the language generated by S. Justify your answer.

Due: Wednesday September 25