MAU22C00: TUTORIAL 10 PROBLEMS
FORMAL LANGUAGES AND GRAMMARS

1) Let L be the language over the alphabet $A = \{0, 1\}$ consisting of all words where the string 00 occurs as a substring.

(a) Devise a regular grammar in normal form that generates the language L. Be sure to specify the start symbol, the non-terminals, and all the production rules.

(b) Write down a regular expression that gives the language L and justify your answer.

2) Let M be the language

$$\{0101,\ 001001,\ 00010001,\ 0000100001,\ \dots\}$$

whose words consist of some positive number n of occurrences of the digit 0, followed by the digit 1, followed by n further occurrences of the digit 0, and followed by the digit 1. (In particular, the number of occurrences of 0 preceding the first 1 is equal to the number of occurrences of 0 preceding the second 1.)

(a) Use the Pumping Lemma to show this language is not regular.

(b) Write down the production rules of a context-free grammar that generates exactly M. Justify your answer.