ANKARA UNIVERSITY COMPUTER ENGINEERING
2019-2020 COM364 AUTOMATA THEORY
RESIT EXAMINATION

23.06.2020

Important Note: Please write your answers clearly and explain your reasoning. Points will be deducted if your final result is correct but how you obtained it is not clear.

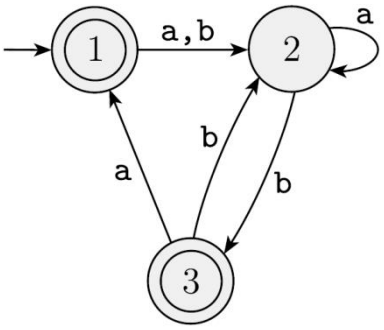
1. [30 points] Let $G = (V, \Sigma, R, S)$ be the following grammar. $V = \{S, A, B\}$; $\Sigma = \{x, \$\}$; and R is the set of rules:

$$S \rightarrow AA \mid B$$
$$A \rightarrow xA \mid Ax \mid \$$$
$$B \rightarrow xBxx \mid \$$$

a. [10 points] Describe $L(G)$ mathematically or in English.
b. [20 points] Prove that $L(G)$ is not regular.

2. [25 points] Consider a language that contains strings of a's and b's in which there is no pair of a's with odd number of symbols in between. For example, the following strings are not in this language: aaa (there is 1 symbol between first and last a), aba, aabbba. On the other hand, the following are example strings in this language: any string with b's and at most 1 a, abba, aa, bbbabbbbbba. Design a deterministic finite automaton (DFA) that recognizes this language. A 5-state DFA will get full points. More than 5 states will get 15 points at most.

3. [25 points] Give the regular expression for the language accepted by the automaton shown below.



4. [20 points] Describe (Design) how a Turing machine that decides the following language over the alphabet {a,b} will work. (No drawing, only algorithmic, implementation-level descriptions.)

$$\{s \mid \text{the number of } a'\text{s is twice the number of } b'\text{s in } s\}$$