CSC445, Quiz #1 on Languages
Instructor: Dr. Hasmik Gharibyan

Name___________________________________________Score________

Total points 16.

Fill in the answers.

1. (2.5 points: 0.5 point for each) Given the alphabet $\Sigma = \{11, 2, 33\}$.
   Can we say that $1112222333$ is a string over $\Sigma$? (yes/no)________
   Can we say that $112233$ is a string over $\Sigma$? (yes/no)________
   Can we say that $\lambda$ is a string over $\Sigma$? (yes/no)________
   Can we say that $\{\lambda\}$ is a language over $\Sigma$? (yes/no)________
   Can we say that $\emptyset$ is a language? (yes/no)________

2. (1.5 points: 0.5 point for each) Given strings $u$ and $v$ over the alphabet $\Sigma$.
   Can we say that $(uv)^R = u^Rv^R$? (yes/no).________
   Can we say that $uv = vu$? (yes/no).________
   Can we say that for any $i > 0$ natural number $(uv)^i = u^i v^i$? (yes/no).________

3. (1 point) Given the recursive definition of a language $L$ over the alphabet $\{a, b\}$
   Basis: $b \in L$
   Recursive step: if $u \in L$ then $au \in L$ and $bu \in L$.
   Closure: a string is in $L$ if it can be obtained from the basic element by finite number of applications of the recursive step.

   Check all the strings that are strings of $L$ (one wrong answer will cost you the point)
   _____aaa, _____abbb, ____ababab, ____abababa, _____bbbaaa, ____aaabbb, ____

4. (1 point) Given the following regular expressions over the alphabet $\{a, b\}$
   1) $(a \cup b)^*$  2) $(a^*b^*)^*$  3) $(a^*b^* \cup b^*a^*)^*$
   Which regular expressions are equivalent? Check the correct answer.
   _____ 1) and 2) are equivalent, but they are not equivalent to 3).
   _____ 1) and 3) are equivalent, but they are not equivalent to 2).
   _____ 2) and 3) are equivalent, but they are not equivalent to 1).
   _____ there are no equivalent regular expressions among those listed.
   _____ all listed regular expressions are equivalent to each other.

5. (1 point) Given a language over the alphabet $\{a, b, c\}$ defined with the help of a regular expression
   $a^*b^* \cup c^+$
   Check all the strings that are strings of $L$ (one wrong answer will cost you the point)
   _____aaa, _____aaabbbcccc, ____ababab, ____babababa, _____bbbaaa, ____aaabbb, ____

6. (1 point) Given set $X = \{a, b, c\}$.
   How many elements has the set $X^5$, (give a number)_____
7. (1 point) Fill in the answer: $\emptyset^* = ______$

8. (1 point) Given $X$ and $X^*$ sets.
   How can $X^*$ be obtained with the help of these two sets?
   Give the formula: $X^* = ______$

9. (1 point) Given the alphabet $\Sigma = \{a, b, c\}$. Is $\Sigma^*$ countable (yes/no)?_____

10. (1 point) Given the alphabet $\Sigma = \{a, b, c\}$.
    Is the set of all possible languages over $\Sigma$ countable (yes/no)?_____

11. (1 point) Given languages $X = \{aaa, bbb, ccc\}$, $Y = \{a, b, c, aaa\}$ over the alphabet $\Sigma = \{a, b, c\}$.
    Is the language $L = X \cap Y$ a regular set over $\Sigma$? (yes/no)_____

12. (1 point) Given alphabet $\Sigma = \{a, b\}$. Is $(a \cup b)^* bb (a \cup b)^* \cap a (a \cup b)^* a$ a regular expression over the alphabet $\Sigma$? (yes/no)_____

13. (1 point) List the basic regular sets over the given alphabet $\Sigma$ (the sets mentioned in the basis of the recursive definition of a regular set over alphabet $\Sigma$).

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14. (1 point) List the set operations that are used in the recursive step of the recursive definition of a regular set over the alphabet $\Sigma$ (the set operations that are used to build new regular sets from the known ones).

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