

MIDTERM EXAM SHEET

Name:

StudentID:

Instructions

You have 90 minutes to complete the exam. Answer Parts A and B.

Part A: The multiple selection questions are worth 40% in total and each question is worth the same amount. The score of part A is calculated using the following formula:

$$\text{Max} \left(\frac{\# \text{selected correct answers} - \# \text{selected incorrect answers}}{\text{total } \# \text{ of correct answers}} \times \text{total } \# \text{ of points}, 0 \right)$$

Use the special answer sheet for Part A.

Part B: Part B contains FOUR questions. Answer any THREE. Each is worth 20%. You may use the back of the exam sheets if you need extra space.

The exam will be closed-book. You are not allowed to use phones and laptops too. However, you are allowed to bring a hard copy of my slides with review notes (without multiple choice questions and multiple selection questions).

PART A: MULTIPLE SELECTION QUESTIONS

Question 1: What of the following strings match the regular expression $a^+(a+b)^*$

- A. babab
- B. abbbb
- C. aaaaaa
- D. ab

Question 2: Identify the language generated by the following grammar:

$$\begin{aligned} S &\rightarrow XY \\ X &\rightarrow aX \mid \varepsilon \\ Y &\rightarrow aYb \mid \varepsilon \end{aligned}$$

- A. $\{a^m b^n \mid m \geq n, n > 0\}$
- B. $\{a^m b^n \mid m \geq n, n \geq 0\}$
- C. $\{a^m b^n \mid m > n, n \geq 0\}$
- D. $\{a^m b^n \mid m > n, n > 0\}$

Question 3: Which of the following is true for the language $L = \{a^n b^n c^n \mid n \geq 1\}$?

- A. It is Regular
- B. It is not Regular but Context Free
- C. It is neither Regular nor Context Free
- D. It is Recursively Enumerable

Question 4: Transition function of a Deterministic Finite Automaton $D = (Q, \Sigma, \delta, q_0, F)$ maps

- A. $\Sigma \times Q \rightarrow \Sigma$
- B. $\Sigma \times \Sigma \rightarrow Q$
- C. $Q \times Q \rightarrow \Sigma$
- D. $Q \times \Sigma \rightarrow Q$

Question 5 In a context-free grammar $G = (V, \Sigma, R, S)$, V is the set of

- A. Non-terminal symbols
- B. Terminal symbols
- C. Variables
- D. Nullable variables

Question 6: Which of the following components are not in formal definition of a Nondeterministic Pushdown Automaton?

- A. Transition function
- B. Blank symbol
- C. Set of states
- D. Stack alphabet
- E. Configuration

Question 7: Which of the following are correct about finite automata?

- A. Finite automata cannot remember arbitrary large amount of information
- B. Finite automata sometimes recognize languages that are not regular
- C. There is no finite automata that can recognize set of binary strings of equal 0's and 1's.
- D. Some finite automata fail to recognize regular languages
- E. There is a finite automaton that recognizes the set of strings over “(” and “)” and have balanced parenthesis

Question 8: Consider the CFG G

$$\begin{aligned} S &\rightarrow A \mid B \\ A &\rightarrow aaA \mid \varepsilon \\ B &\rightarrow bB \mid \varepsilon \end{aligned}$$

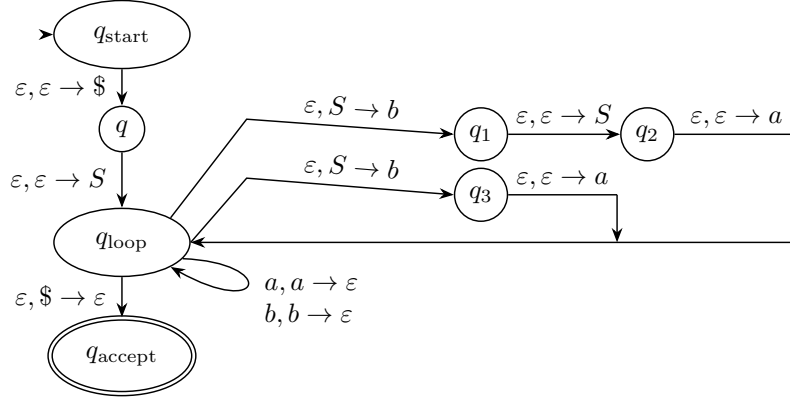
What is correct about G ?

- A. All strings in G have at least one a's
- B. G is in CNF
- C. G is ambiguous

D. S is nullable

E. $aabb \in L(G)$

Question 9: Given the Push Down Automaton P



Which of the following is the order of configuration (q_1, ab, bS) in the computation of P with string $aaabbb$. It is known that the first configuration is $(q_{start}, ab, \varepsilon)$

A. 2

B. 3

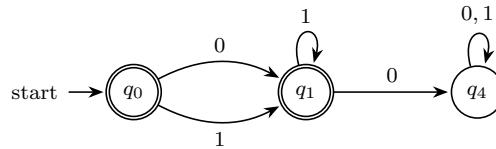
C. 4

D. 5

E. 6

Question 10:

Consider the following DFA D



Which of the following regular expressions denote the language accepted by D ?

A. $\varepsilon + 01^* + 1^*$

B. $\varepsilon + 01^* + 1^+$

C. $01^* + 1^*$

D. $01^* + 1^+$

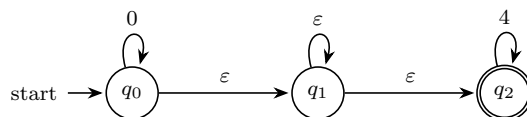
E. $1(0 + 1)^* + 0(0 + 1)^*$

ANSWER SHEET FOR PART A

QUESTION NUMBER	CORRECT ANSWERS
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

PART B: ANSWER QUESTIONS

1/Let N be the following nondeterministic finite automaton.



- a) Write the formal definition of N
- b) Convert N to the equivalent DFA: D

2/ Given the regular expression over alphabet $\{1, 2, 3\}$

$$123(1 + 2 + 3)^*$$

- a) Use proper English to describe the language defined by the regular expression
- b) Convert the regular expression to its equivalent NFA

3/ Convert the following grammar to Chomsky Normal Form

$$S \rightarrow ABa$$

$$A \rightarrow aabA \mid a$$

$$B \rightarrow Ac$$

4/ Prove that language $L = \{ww^R \mid w \in \{0,1\}^*\}$ is not context free.