CPSC 351 — Practice Midterm Test

NAME: _____

ID: _____

Aids Allowed: One double-sized $8\frac{1}{2} \times 11$-sized page of notes. ***No other aids are allowed.***

Use of Electronic Devices: In particular, the use of camera devices, MP3 Players and headphones, or wireless access devices such as cell phones or Blackberries during the examination is ***not*** allowed. Calculators are ***not*** allowed for this examination.

Instructions:

1. Answer the question in Part A and ONE question in Part B, using the space provided. Use the blank pages at the end of this test if you need more space for your answers. ***If more than one question in Part B is started — and you do not CLEARLY say which question should be marked — then only the FIRST question, whose answer is started, will be considered.***

2. This test is out of 30.

Duration: 90 minutes.

ID Number: _____

Part A: This question must be answered.

1. *(15 marks):* Let $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$. Design (and draw a picture of) a deterministic finite automaton $M = (Q, \Sigma, \delta, q_0, F)$ for the following language $L \subseteq \Sigma^\star$, and explain (briefly) why your DFA is correct:

   $$L = \{\omega \in \Sigma^\star \mid \omega \text{ includes at least two a's and the number of a's in } \omega \text{ is even}\}.$$

   Your answer should include a *brief* description of each set

   $$S_q = \{\omega \in \Sigma^\star \mid \delta^\star(q_0, \omega) = q\}$$

   for each state $q \in Q$ in your DFA — written in clear, simple English — that can help a reader to understand why your DFA really *does* accept the above language L. It should also include a ***short*** description of how it is possible to check that this DFA really *does* accept this language.

   Note: The maximum number of marks given, for an answer that includes a DFA but not an explanation of why it is correct, will be 5 out of 15.

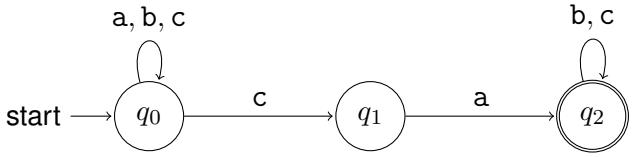
ID Number: _____

ID Number: _____

Part B: ONE question must be answered. If you start to answer more than one — and do not ***CLEARLY*** state which question should be marked —then only the answer for the ***FIRST*** question, that you started, will be considered.

(15 marks)

2. Let $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$. Consider the following ***nondeterministic finite automaton*** whose alphabet is Σ.



Give a ***deterministic finite automaton***, with alphabet Σ, ***with the same language as the language of this nondeterministic finite automaton*** and show, ***reasonably briefly***, that your answer is correct.

If you give a correct deterministic finite automaton and do not give any explanation why it is correct, at all, then at most 10 out of 15 marks will be awarded.

ID Number: _____

ID Number: _____

(15 marks)

3. Let $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$. Let $L \subseteq \Sigma^\star$ be the set of strings in $\omega \in \Sigma^\star$ such that ω includes at least one copy of "a", and such that there is a copy of "c" ***immediately*** before the ***last*** copy of "a" in ω.

   Give a ***regular expression*** over Σ ***whose language is*** L and explain why your answer is correct.

   If you give a correct regular expression without explaining why it is correct then at most 10 out of 15 marks will be awarded.

ID Number: _____

ID Number: _____

4. *(15 marks).* Let $\Sigma = \{\mathtt{a}\}$ and consider the language

$$L = \{\mathtt{a}^k \mid k = 2^\ell \text{ for an integer } \ell \geq 0\},$$

so that L is the set of strings in $\Sigma^\star$ whose length is a power of two. Prove that L is not a regular language.

ID Number: _____

ID Number: _____