CPSC 351 — Practice Term Test #1

Name: _____

Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional code of conduct and promote academic integrity in upholding the University of Calgary's reputation of excellence.

Aids Allowed: Students are asked to prepare a double-sided letter-sized page of notes in advance, and refer to this during the test. No other aids are allowed and no communication about the test, with anyone except the instructor, is allowed while the test is in progress.

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.

Part A: This question must be answered.

1. *(15 marks):* Let $\Sigma = \{a, b, c\}$. 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:

   $L = \{\omega \in \Sigma^\star \mid \omega$ includes at least two a's and the number of a's in ω 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.
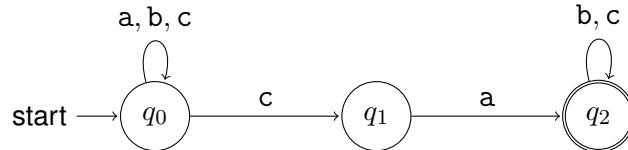
ID Number:

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 $\Sigma = \{a, b, c\}$. 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:

(15 marks)

3. Let $\Sigma = \{a, b, c\}$. 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:

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

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

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: