

CS/ECE 374 A ✧ Fall 2026
☞ Midterm 1 Practice 1 ☞
September 24, 2026

Name:	
NetID:	

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- *Don't panic!*
 - You have 120 minutes to answer five questions. **The questions are described in more detail in a separate handout.**
 - If you brought anything except your writing implements, your **hand-written** double-sided $8\frac{1}{2}'' \times 11''$ cheat sheet, and your university ID, please put it away for the duration of the exam. In particular, please turn off and put away *all* medically unnecessary electronic devices.
 - Please clearly print your name and your NetID in the boxes above.
 - Please also print your name at the top of every page of the answer booklet, except this cover page. We want to make sure that if a staple falls out, we can reassemble your answer booklet. (It doesn't happen often, but it does happen.)
 - Proofs or other justifications beyond those listed in the standard grading rubrics are required if and only if we explicitly ask for them, using the word ***prove*** or ***justify*** in bold italics. **In particular, DFAs need to have mnemonic state names.**
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- **Do not write outside the black boxes on each page.** These indicate the area of the page that our scanners will actually scan. If the scanner can't see your work, we can't grade it.
 - If you run out of space for an answer, feel free to use the overflow/scratch pages at the back of the answer booklet, but **clearly indicate where we should look**. If we can't find your work, we can't grade it.
 - **Only work that is written into the stapled answer booklet will be graded.** We **do not** recommend detaching pages from the answer booklet, because any work on those detached pages will not be graded (and it disrupts our process for uploading solutions to Gradescope.) Please let us know if you detach a page either on purpose or accidentally so we can reattach it.
 - We will provide additional blank scratch paper on request, but we will not grade anything written on it.
 - **Please return all paper with your answer booklet** including your question sheet, your cheat sheet, and all scratch paper. Please put this loose paper **inside** your answer booklet.
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Midterm 1 Practice 1 Problem 1

Name: _____

For each statement below, check “Yes” if the statement is always true and check “No” otherwise, and give a brief (one short sentence) explanation of your answer. Read these statements very carefully—small details matter!

(a) Every infinite language is regular.

☐ Yes

☐ No

(b) The language $(0 + 1(01^*0)^*1)^*$ is not context-free.

☐ Yes

☐ No

(c) Every subset of an irregular language is irregular.

☐ Yes

☐ No

(d) The language $\{0^a 1^b \mid a - b \text{ is divisible by } 374\}$ is regular.

☐ Yes

☐ No

(e) If language L is not regular, then L has a finite fooling set.

☐ Yes

☐ No

(f) If there is a DFA that rejects every string in language L , then L is regular.

☐ Yes

☐ No

(g) If language L is accepted by an DFA with n states, then its complement $\Sigma^* \setminus L$ is also accepted by a DFA with n states.

☐ Yes

☐ No

(h) 1^*0^* is a fooling set for the language $\{1^i 0^{i+j} 1^j \mid i, j \geq 0\}$.

☐ Yes

☐ No

(i) Every regular language is accepted by a DFA with an odd number of accepting states.

☐ Yes

☐ No

(j) The context-free grammar

$$S \rightarrow \varepsilon \mid 0A \mid 1S$$

$$A \rightarrow 0S \mid 1A$$

generates all binary strings with an even number of 0s.

☐ Yes

☐ No

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For any non-empty string $w \in \{0, 1\}^*$, let $\text{Delete1st}(w)$ denote the string obtained by deleting the first run in w . Let L be an arbitrary regular language over the alphabet $\Sigma = \{0, 1\}$. **Prove** that the following languages are also regular.

(a) $\text{INSERTED1ST}(L) = \{w \in \Sigma^* \mid w \neq \varepsilon \text{ and } \text{Delete1st}(w) \in L\}$

(b) $\text{DELETED1ST}(L) = \{\text{Delete1st}(w) \mid w \neq \varepsilon \text{ and } w \in L\}$

CS/ECE 374 A ✧ Fall 2026 Midterm 1 Practice 1 Problem 3	Name:
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For any string $w \in \{0, 1\}^*$, let $\text{squish}(w)$ denote the string obtained by dividing w into pairs of symbols, replacing each pair with 0 if the symbols are equal and 1 otherwise, and keeping the last symbol if w has odd length. (See the question handout for a formal recursive definition.)

- (a) **Prove** that $\#(1, \text{squish}(w)) \leq \#(1, w)$ for every string w .
- (b) **Prove** that $\#(1, \text{squish}(w))$ is even if and only if $\#(1, w)$ is even, for every string w .
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CS/ECE 374 A ✧ Fall 2026 Midterm 1 Practice 1 Problem 4	Name:
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Let L be the set of all strings in $\{0, 1\}^*$ in which every run of 0s is followed immediately by a *shorter* run of 1s.

- (a) **Prove** that L is *not* a regular language.
 - (b) Describe a context-free grammar for L .
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For each of the following languages L over the alphabet $\Sigma = \{0, 1\}$, describe a DFA that accepts L **and** give a regular expression that represents L . You do **not** need to prove that your answers are correct, but you should give your DFA states mnemonic names.

- (a) Strings that do not contain the subsequence 010 .
- (b) Strings that contain at least two even-length runs of 1 s.

(scratch paper)

(scratch paper)

(scratch paper)