

CS/ECE 374 A ✧ Fall 2026
☞ Midterm 1 Practice 2 ☞
September 25, 2026

Name:	
NetID:	

-
- *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.**
-
- **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.
-

Is between
between is and between
or between between and is
or between and and or
or between or and between
or between between and and
or between or and and
or between or and or?

Consider the function $\text{compress}s$ defined in the question handout. Let L be an arbitrary regular language.

- (a) *Prove* that $\text{DECOMPRESSED}(L) := \{w \in \Sigma^* \mid \text{compress}s(w) \in L\}$ is regular.
- (b) *Prove* that $\text{COMPRESSED}(L) := \{\text{compress}s(w) \mid w \in L\}$ is regular.
-

Let L be the language of all strings over $\{0, 1\}$ that contain at least 374 consecutive 1s.

- (a) Give a regular expression that matches L . You may use the notation R^k to denote the concatenation of k copies of the regular expression R .
 - (b) Describe a DFA whose language is L .
 - (c) **Prove** that any DFA whose language is L must have at least 375 states.
-

Consider the recursive function Bond defined in the question handout.

- (a) *Prove* that $|\text{Bond}(w)| \geq |w|$ for all strings w .
- (b) *Prove* that $\text{Bond}(x \bullet y) = \text{Bond}(x) \bullet \text{Bond}(y)$ for all strings x and y .
-

Let L be the language $\{0^a 1^b 0^c \mid a = b \text{ or } a = c \text{ or } b = c\}$

1. **Prove** that L is *not* a regular language.
 2. Describe a context-free grammar for L . You do not need to justify your answer.
-

CS/ECE 374 A ♦ Fall 2026
Midterm 1 Practice 2 Problem 5

Name: _____

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

For any string $w \in (\{0, 1\})^*$, let w^c denote the *bitwise complement* of w , obtained by flipping every 0 in w to a 1, and vice versa. For example, $\varepsilon^c = \varepsilon$ and $000110^c = 111001$.

- (a) If $2 + 2 = 5$, then zero is odd.

☐ Yes

☐ No

- (b) $\{0^n 1 \mid n > 0\}$ is the only infinite fooling set for the language $\{0^n 1 0^n \mid n > 0\}$.

☐ Yes

☐ No

- (c) $\{0^n 1 0^n \mid n > 0\}$ is a context-free language.

☐ Yes

☐ No

- (d) The context-free grammar $S \rightarrow 00S \mid S11 \mid 01$ generates the language $\{0^n 1^n \mid n \geq 0\}$.

☐ Yes

☐ No

- (e) Every regular language is recognized by a DFA with exactly one accepting state.

☐ Yes

☐ No

- (f) Any language that can be decided by an NFA with ε -transitions can also be decided by an NFA without ε -transitions.

☐ Yes

☐ No

- (g) If L is a regular language over the alphabet $\{0, 1\}$, then $\{xy^c \mid x, y \in L\}$ is also regular.

☐ Yes

☐ No

- (h) If L is a regular language over the alphabet $\{0, 1\}$, then $\{ww^c \mid w \in L\}$ is also regular.

☐ Yes

☐ No

- (i) The regular expression $(00 + 11)^*$ represents the language of all strings over $\{0, 1\}$ of even length.

☐ Yes

☐ No

- (j) Let L_1, L_2 be two regular languages. The language $(L_1 \cup L_2)^*$ is also regular.

☐ Yes

☐ No

(scratch paper)

(scratch paper)

(scratch paper)