CS/ECE 374 A ✧ Fall 2021 **Fake Midterm 1 Problem 1**	Name:

For each statement below, check "Yes" if the statement is ***ALWAYS*** true and "No" otherwise, and give a ***brief*** explanation of your answer.

(a) Every integer in the empty set is prime.

Yes | No

(b) The language $\{0^m 1^n \mid m + n \leq 374\}$ is regular.

Yes | No

(c) The language $\{0^m 1^n \mid m - n \leq 374\}$ is regular.

Yes | No

(d) For all languages L, the language L^* is regular.

Yes | No

(e) For all languages L, the language L^* is infinite.

Yes | No

(f) For all languages $L \subset \Sigma^*$, if L can be represented by a regular expression, then $\Sigma^* \setminus L$ is recognized by a DFA.

Yes | No

(g) For all languages L and L', if $L \cap L' = \varnothing$ and L' is not regular, then L is regular.

Yes | No

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

Yes | No

(i) Every regular language is recognized by an NFA with exactly one accepting state.

Yes | No

(j) Every language is either regular or context-free.

Yes | No

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For each of the following languages over the alphabet $\Sigma = \{0, 1\}$, either ***prove*** that the language is regular or ***prove*** that the language is not regular. ***Exactly one of these two languages is regular.*** Both of these languages contain the string 00110100000110100.

1. $\left\{ 0^n w 0^n \;\middle|\; w \in \Sigma^+ \text{ and } n > 0 \right\}$

2. $\left\{ w 0^n w \;\middle|\; w \in \Sigma^+ \text{ and } n > 0 \right\}$

The *parity* of a bit-string w is 0 if w has an even number of 1s, and 1 if w has an odd number of 1s. For example:

$$parity(\varepsilon) = 0 \qquad parity(0010100) = 0 \qquad parity(00101110100) = 1$$

(a) Give a *self-contained*, formal, recursive definition of the *parity* function. (In particular, do ***not*** refer to # or other functions defined in class.)

(b) Let L be an arbitrary regular language. Prove that the language $OddParity(L) := \{w \in L \mid parity(w) = 1\}$ is also regular.

(c) Let L be an arbitrary regular language. Prove that the language $AddParity(L) := \{parity(w) \cdot w \mid w \in L\}$ is also regular.

[Hint: Yes, you have enough room.]

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For each of the following languages L, give a regular expression that represents L ***and*** describe a DFA that recognizes L. You do ***not*** need to prove that your answers are correct.

(a) All strings in $(0+1)^*$ that do not contain the substring 0110.

(b) All strings in 0^*10^* whose length is a multiple of 3.

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Fake Midterm 1 Problem 5	

For any string $w \in \{0, 1\}^*$, let $obliviate(w)$ denote the string obtained from w by removing every 1. For example:

$$obliviate(\varepsilon) = \varepsilon$$
$$obliviate(000000) = 000000$$
$$obliviate(111111) = \varepsilon$$
$$obliviate(010001101) = 00000$$

Let L be an arbitrary regular language.

1. ***Prove*** that the language $\text{OBLIVIATE}(L) = \{obliviate(w) \mid w \in L\}$ is regular.

2. ***Prove*** that the language $\text{UNOBLIVIATE}(L) = \{w \in \{0, 1\}^* \mid obliviate(w) \in L\}$ is regular.