# CSE355 Fall 2016–Recitation Quiz 5 (Solutions)

Name: ______________________________ ASU ID: ____________________

| Monday 9:40AM | Monday 10:45AM | Tuesday 7:30AM | Tuesday 4:35PM | Wednesday 9:40AM |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

| Wednesday 10:45AM | Thursday 7:30AM | Thursday 4:35PM | Friday 9:40AM | Friday 10:45AM |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

1. Let $L = \{0^n 1^{n+355} \mid n \geq 0\}$. Show that $L$ is not regular.

   (The proof of this is very similar to that of $\{0^n 1^n \mid n \geq 0\}$).

   Suppose (to the contrary) that $L$ were regular. Then by the Pumping Lemma for Regular Languages, there exists a "pumping constant" $p$ for $L$. We choose a string $w = 0^p 1^{p+355}$. Clearly, $w \in L$ and $|w| \geq p$. We want to show that no matter how we split $w$ into $uvx$ (with $|uv| \leq p$ and $|v| \geq 1$) that $uv^i x \notin L$ for some $i$.

   Since $|uv| \leq p$, we have that $u, v$ consist entirely of 0's. Then write $u = 0^\alpha, v = 0^\beta, x = 0^{p-\alpha-\beta}1^{p+355}$. Observe the string $uv^2x = 0^\alpha 0^{2\beta} 0^{p-\alpha-\beta} 1^{p+355} = 0^{p+\beta} 1^{p+355}$. The only way $uv^2x$ can be in $L$ is if $\beta = 0$, implying $|v| = 0$, a contradiction.

   Therefore, $L$ is not regular.

2. State True or False for each. If you say True, then give a short explanation/proof for your answer; if you say False, give a counterexample.

   (a) If $A$ is a finite language, then $A$ is regular. This is true. It is the union of singleton sets (with 1 string each): design an NFA for each of these singleton sets, and then take the union construction for all of them. There are only finitely many unions, so we just made an NFA for $A$.

   (b) If $A \subseteq B \subseteq C$ with both $A$ and $C$ regular, then $B$ is regular also. This is false. Choose $A = \emptyset, C = \Sigma^\star$, and $B$ any non-regular language.

   (c) If $A$ is a subset of any regular language $L$, and $A$ has all but only a finite number of strings from $L$, then $A$ is regular. This is true. By the first question, all finite languages are regular. So we can write $A = L \setminus F$ for some finite set $F$. We have $L \setminus F = L \cap \overline{F}$. Since regular languages are closed under intersection and complement, $A = L \cap \overline{F}$ is regular.

---

TA use only! Quiz has been recorded: ☐