

**SUPPLEMENTAL MIDTERM PRACTICE, CPSC 421/501, FALL
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- (1) For each of ACCEPTANCE, NON-ACCEPTANCE, NON-PYTH-INP, HALTING, REJECTING, LOOPING of the handout “Uncomputability in CPSC 421/501:” which are decidable? Which are recognizable? Explain.
- (2) Explain how we proved in the first few weeks of classes that
$$\{p \in \Sigma_{\text{ASCII}}^* \mid p \notin \text{LanguageRecBy}(p)\}$$
is unrecognizable, by appealing to Cantor’s theorem (which states that any map $f: S \rightarrow \text{Power}(S)$ is not surjective). In particular, what values of S and f did we use?
- (3) Which of the following are true? Explain: explain why they are (always) true, or give a counterexample and explain why this is a counterexample.
 - (a) If L_1, L_2 are Duck-recognizable, then $L_1 \setminus L_2$ is Duck-recognizable.
 - (b) If L_1, L_2 are decidable, then $L_1 \setminus L_2$ is decidable.
 - (c) If L_1, L_2 are undecidable, then $L_1 \setminus L_2$ is undecidable.
 - (d) If L_1, L_2 are recognizable, then $L_1 \setminus L_2$ is recognizable.
 - (e) If L_1, L_2 are unrecognizable, then $L_1 \setminus L_2$ is unrecognizable.
- (4) Same as Question (3), where $L_1 \setminus L_2$ is replaced with $L_1 \cup L_2$.
- (5) Same as Question (3), where $L_1 \setminus L_2$ is replaced with $L_1 \cap L_2$.
- (6) Same as Question (3), where $L_1 \setminus L_2$ is replaced with L_1^* .
- (7) Which of the sets below are countable?
 - (a) \mathbb{N} ;
 - (b) Σ^* where Σ is any alphabet;

- (c) $\mathbb{N} \times \mathbb{N}$;
- (d) $\text{Power}(\Sigma^*)$; where Σ is any alphabet;
- (e) the set of functions $\Sigma^* \rightarrow \{0, 1\}$, where Σ is any alphabet;
- (f) the set of functions $\{0, 1\} \rightarrow \Sigma^*$, where Σ is any alphabet;
- (g) the set of functions $\Sigma^* \rightarrow \mathbb{N}$, where Σ is any alphabet.

(8) MORE PROBLEMS MAY BE ADDED LATER.

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