Rice's Theorem. Let $L$ be any set of languages that satisfies the following conditions:

- There is a Turing machine $Y$ such that $\text{ACCEPT}(Y) \in L$.
- There is a Turing machine $N$ such that $\text{ACCEPT}(N) \notin L$.

The language $\text{ACCEPTIN}(L) := \{ \langle M \rangle \mid \text{ACCEPT}(M) \in L \}$ is undecidable.

Prove that the following languages are undecidable **using Rice's Theorem**:

1. $\text{ACCEPTRegular} := \{ \langle M \rangle \mid \text{ACCEPT}(M) \text{ is regular} \}$
2. $\text{ACCEPTILLINI} := \{ \langle M \rangle \mid M \text{ accepts the string ILLINI} \}$
3. $\text{ACCEPTPalindrome} := \{ \langle M \rangle \mid M \text{ accepts at least one palindrome} \}$
4. $\text{ACCEPTThree} := \{ \langle M \rangle \mid M \text{ accepts exactly three strings} \}$
5. $\text{ACCEPTUndecidable} := \{ \langle M \rangle \mid \text{ACCEPT}(M) \text{ is undecidable} \}$

To think about later. Which of the following are undecidable? How would you prove that?

1. $\text{ACCEPT}\{\epsilon\} := \{ \langle M \rangle \mid M \text{ accepts only the string } \epsilon; \text{ that is, } \text{ACCEPT}(M) = \{\epsilon\} \}$
2. $\text{ACCEPT}\emptyset := \{ \langle M \rangle \mid M \text{ does not accept any strings}; \text{ that is, } \text{ACCEPT}(M) = \emptyset \}$
3. $\text{ACCEPT}\emptyset := \{ \langle M \rangle \mid \text{ACCEPT}(M) \text{ is not an acceptable language} \}$
4. $\text{ACCEPT}=\text{REJECT} := \{ \langle M \rangle \mid \text{ACCEPT}(M) = \text{REJECT}(M) \}$
5. $\text{ACCEPT} \neq \text{REJECT} := \{ \langle M \rangle \mid \text{ACCEPT}(M) \neq \text{REJECT}(M) \}$
6. $\text{ACCEPT} \cup \text{REJECT} := \{ \langle M \rangle \mid \text{ACCEPT}(M) \cup \text{REJECT}(M) = \Sigma^* \}$