CS 360 Assignment 3

Due Date Tuesday, November 22nd, at the beginning of class.

All questions are worth the same amount. Please ensure that your name and student number appear, in ink, on each page of your assignment.

Work is to be done individually.

Assignment Questions

1. Informally, but clearly, describe a multi-tape Turing machine that accepts the language \( \{ a^n b^n c^n | n \geq 1 \} \).

2. Design a PDA, \( P \), such that \( L(P) = \{ a^i b^j c^k | i \neq j \text{ or } j \neq k \} \).

3. Convert the following grammar to a PDA. Explain your answer.
   \[
   S \rightarrow aSb \mid T \\
   T \rightarrow bTa \mid S \mid \epsilon.
   \]

4. Describe a Turing Machine that accepts the language \( \{ww^R | w \in \{0, 1\}^*\} \), where \( w^R \) is the reverse of \( w \).

5. Let \( A \) and \( B \) be two languages, subsets of \( \Sigma^* \). (i) If \( A \) and \( B \) are decidable then is the union of the two languages, \( A \cup B \), a decidable language? Explain your answer. (ii) If \( A \) and \( B \) are Turing-recognizable is \( A \cup B \) Turing-recognizable? Explain your answer.