COSC 341 – Tutorial 10 (Solution)

1. Design context-free grammars for following languages on the alphabet $\{a, b\}$:

(a)
$$a^*b^+ = \{a^nb^k | n \in \mathbb{N}, k \in \mathbb{N}, k > 0\}$$

$$S \to aS, S \to bT, T \to bT, T \to \lambda$$

(b) The language Palindrome consisting of all strings that can read the same forwards as backwards

$$S \to aSa, S \to bSb, S \to a, S \to b, S \to \lambda$$

(c) The language of strings that contain at least one occurrence of aa as a substring

$$S \to TaaT, T \to aT, T \to bT, T \to \lambda$$

- 2. If possible, design Pushdown Automata and context-free grammars for following languages:
 - (a) $L=\{a^nb^nc^m\mid n,m\geq 0\}$ Context free grammar: $S\to Sc,\ S\to aTb,\ S\to \lambda,\ T\to bT,\ T\to \lambda$ PDA:

- (b) $L = \{a^n b^n c^m | m \ge n\}$ This language is not context free.
- (c) $L=\{a^ib^jc^k|i+j=k\}$ Context-free grammar: $S\to aSc,\ S\to bTc,\ S\to \lambda,\ T\to bTc,\ T\to \lambda$ PDA:

Homework

1. Let G be following context-free grammar:

$$S \to abSc, S \to T, T \to cTd, T \to cd$$

Describe the language of G (for example by using the set notation) and construct a Pushdown Automaton for that language.

$$L=\{(ab)^nc^kd^kc^n|n\geq 0, k>0\}$$

PDA:

