

## Homework I

### 1. [15 points]

Taking  $\Sigma = \{0,1\}$  and start = S in the BNF

$S ::= 0B \mid 1A$

$A ::= 0 \mid 0S \mid 1AA$

$B ::= 1 \mid 1S \mid 0BB$

show derivation trees for each of the following

(a) 001011

(b) 10111001

(c) 10011100

### 2. [10 points]

Taking  $\Sigma = \{a,b\}$  and start = S in the BNF below, show two distinct derivation trees for the string aab.

$S ::= aSB \mid \epsilon$

$B ::= bB \mid \epsilon$

### 3. [10 points]

Consider the two grammars  $G_1$  (start=W) and  $G_2$  (start=Y) below with  $\Sigma = \{a,b,c\}$ . Determine whether or not they are equivalent (i.e.,  $L(G_1) = L(G_2)$ ) and prove your answer.

$G_1$	$G_2$
$W ::= Wc \mid X$	$Y ::= aY \mid Z$
$X ::= aXb \mid \epsilon$	$Z ::= bZc \mid \epsilon$

### 4. [20 points]

Determine whether each of the following identities is true for all languages  $L_1, L_2 \subseteq \Sigma^*$ , and justify your answers.

(a)  $(L_1 \cup L_2)^* = L_1^* \cup L_2^*$

(b)  $(L_1 \cdot L_2)^* = L_1^* \cdot L_2^*$

(c)  $\emptyset^* = \emptyset$

(d)  $(L_1 \cap L_2)^* = L_1^* \cap L_2^*$