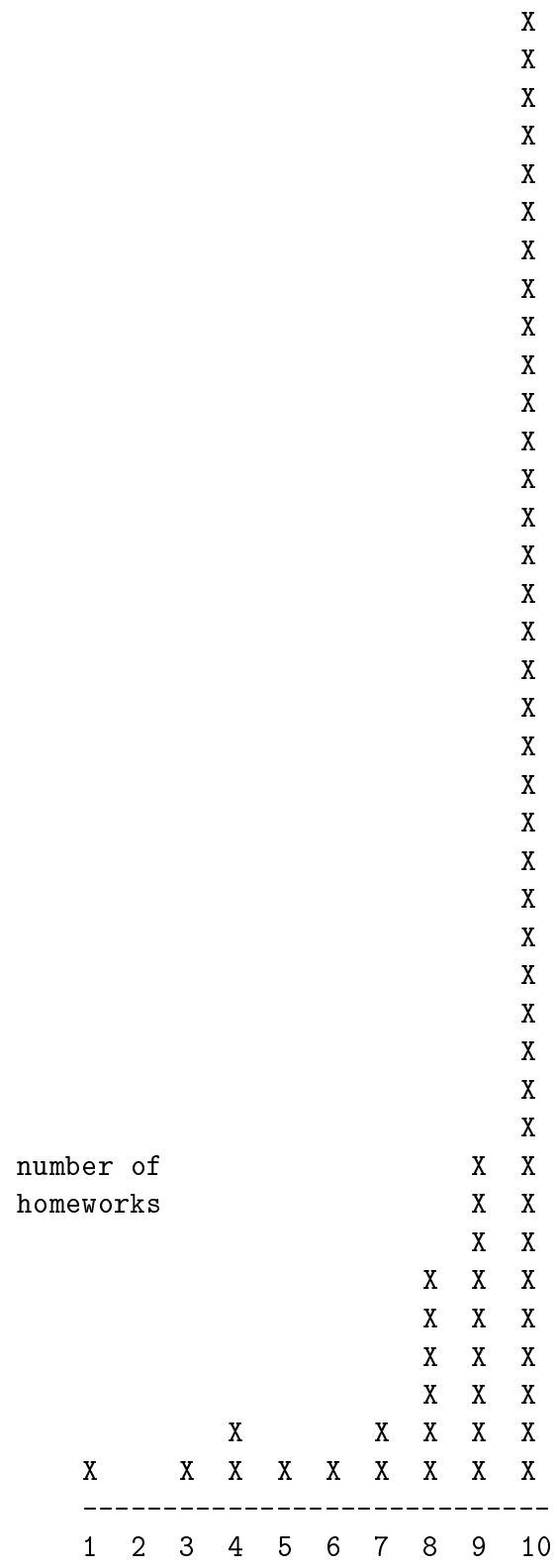
Automata Theory: Solutions 8



Consider the following grammar:

$S \to aSa \mid A \mid C$
$A \to bBb \mid bCb \mid E$
$B \to bBb \mid \lambda$
$C \to aC \mid bC$
$D \to aD \mid \lambda$
$E \to bb \mid bEb$

Problem 1
Simplify this grammar: remove all useless variables, λ-productions, and unit-productions.

The simplification gives the following result:

$S \to aSa \mid bb \mid bBb \mid bEb$
$B \to bb \mid bBb$
$E \to bb \mid bEb$

Since B and E give rise to the same strings, we may remove either of them:

$S \to aSa \mid bb \mid bBb$
$B \to bb \mid bBb$

This grammar generates the language $\{a^n b^{2m} a^n : \ n \geq 0, m \geq 1\}$.

Problem 2
Give an equivalent grammar in Chomsky normal form.

$S \to XC \mid YY \mid YD$
$C \to SX$
$D \to BY$
$X \to a$
$Y \to b$

Problem 3
Give an equivalent grammar in Greibach normal form.

$S \to aSX \mid bY \mid bBY$
$B \to bY \mid bBY$
$X \to a$
$Y \to b$