CSci 435: Formal Languages and Automata

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**Home Assignment 5: 50points + 10 points (optional)**

Q1. [20] In the given grammar G, generate the simplified equivalent grammar by eliminating the following productions through (1) – (3).

G = ( {S, A, B, C, D}, {*a, b, c, d*}, S, P ) with productions

S → *a* | *a*A | B | C , A → *aB* | *λ ,* B→ *Aa* , C → *c*CD, D → *ddd* | C*d*

1. [5] Eliminate the λ-productions

G = ( {S, A, B, C, D}, {*a, b, c, d*}, S, P1 )

S -> a | aaB | B | C, A -> aB | a, B -> aBa | a, C -> cCD, D -> ddd|Cd

1. [5] Eliminate the Unit-productions from (1)

G = ( {S, A, B, C, D}, {*a, b, c, d*}, S, P2 )

S -> a | aaB | aBa | cCD, A -> aB | a, B -> aBa | a, C -> cCD, D -> ddd | Cd

1. [5] Eliminate the useless productions (2), so that give the simplified equivalent grammar.

G = ( {S, A, B}, {*a, b*}, S, P3 )

S -> a | aaB | aBa, A -> aB, B -> aBa | a

1. [5] Give the language L that is generated by this grammar, L = L(G), in a formal expression (including a regular expression).

L(G) = a\*

Q2. [10] Convert the given grammar into Chomsky Normal Form (CNF).

S → *ba*AB , A → *b*AB | λ , B → BA*a* | A |λ.

Hint: Eliminate the λ-productions and/or any unit-production prior to their conversion into CNF.

S -> ZP | ZB | ZA | YX

A -> ZB | YB | YA | b

B -> QX | BX | AX | a

Z -> YX

P -> AB

Q -> BA

X -> a

Y -> b

Q3. [10] Convert the given grammar into Greibach normal form.

S → *a*S| *aa*S| *a*SS | *ab*

S -> aA | aaB | aC | ab

A -> aA | aaB | aC | lambda

B -> S

C -> S

Q4. [10] Using the CYK algorithm, determine whether a given string *w* is in the language generated by the

grammar below.

S → AB, A → BB | *a*, B → AB | *b*

Draw a CYK-table of the V*ij* s, *i, < j* to show S ∈V*1n*.

1. [10] *w* = *aabba*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| - |  |  |  |  |
| A | - |  |  |  |
| S, B | A | - |  |  |
| - | S, B | A | - |  |
| A | A | B | B | A |
| A | A | B | B | A |

1. The word is not supported as S is not in the top of the graph.
2. [10, optional] *w* = *abbbb*