DEPARTEMENT OF COMPUTER SCIENCE & ENGENEERING

Theory of Computation (CS1534)

CSE-C SEM-III

CNF

1. S->a|aA|B|C, A->aB|ϵ, B->aA|ϵ, C->cCD, D->ddd

Sol: Eliminating ϵ-productions:

V_n= {A}

P_1 {S->a|aA|B|C , A-> aB, B->aA|a, C->cCD, D->ddd }

G_1 ={{A,B,C,D} , {a,c,d}, P_1, S}

Eliminating unit productions:

(S,S) S->a|aA|B|C

(S,B) S->aA|a

(S,C) S->cCD

(A,A) A->aB

(B,B) B->a|aA

(C,C) C->cCD

(D,D) D->ddd

P_2 {S->a|aA|cCD, A->aB, B-> a|aA, C->cCD, D->ddd}

G_2 ={{A,B,C,D}, {a,c,d}, P_2, S}

Useful symbols:

C is not generating.

P_3 {S->a|aA, A->aB, B-> a|aA, D->ddd}

D is not reachable

P_4 {S->a|aA, A->aB, B->a|aA}

G_3={{A,B}, {a}, P_4, S}

CNF:

Let C_1->a

P_5 {S-> a|C_1A, A->C_1B, B->a|C_1A}

G_4={{A,B,C_1}, {a}, P_5, S}

2. S->ABC|BaB, A->aA|BaC|aaa, B->bBb|a|D, C->CA|AC, D->ϵ

Sol: Eliminating ϵ-productions:

V_n= {D,B}

P_1 {S->ABC|AC|BaB|Ba|aB|a , A-> aA|BaC|aC|aaa, B->bBb|bb|a|D, C->CA|AC }

G_1 ={{A,B,C} , {a,b}, P_1, S}

Eliminating unit productions:

(S,S) S->ABC|BaB|AC|Ba|aB|a

(A,A) A->aA|BaC|aaa|aC

(B,B) B->bBb|bb|a|D

(C,C) C->CA|AC

(B,D)

P_2 { S->ABC|BaB|AC|Ba|aB|a, A->aA|BaC|aaa|aC, B->bBb|bb|a, C->CA|AC }

G_2 ={{A,B,C}, {a, b}, P_2, S}

Useful symbols:

C is not generating.

P_3 { S->BaB|Ba|aB|a, A->aA|aaa, B->bBb|bb|a }

A is not reachable

P_4 { S->BaB|Ba|aB|a, B->bBb|bb|a|D }

G_3={{B}, {a,b}, P_4, S}

CNF:

Let C_1->a, C_2->B, C_3->BC_1, C_4->BC_2

P_5 {S-> C_3B|BC_1|C_1B|a, B->C_2C_4|C_2C_2|a}

G_4={{B,C_1 ,C_2,C_3}, {a}, P_5, S}

3. S->0A0|1B1|BB, A->C, B->S|A, C->S|ϵ

Sol: Eliminating ϵ-productions:

V_n= {C,A,B,S}

P_1 { S->0A0|00|1B1|11|BB|B, A->C, B->S|A, C->S }

G_1 ={{A,B,C} , {0,1}, P_1, S}

Eliminating unit productions:

(S,S) S->0A0|00|1B1|11|BB|B

(S,B) S->S|A

(S,A) S->C

(S,C) S->S

(A,A) A->C

(A,C) A->S

(A,S) A->0A0|00|1B1|11|BB|B

(A,B) A->S|A

(B,B) B->S|A

(B,A) B->C

(B,C) B->S

(B,S) B->0A0|00|1B1|11|BB|B

(C,C) C->S

(C,S) C->0A0|00|1B1|11|BB|B

(C,B) C->S|A

(C,A) C->C

P_2 { S->0A0|00|1B1|11|BB, A->0A0|00|1B1|11|BB, B->0A0|00|1B1|11|BB,

C->0A0|00|1B1|11|BB }

G_2 ={{A,B,C}, {0,1}, P_2, S}

Useful symbols:

All are generating.

C is not reachable

P_3 { S->0A0|00|1B1|11|BB, A->0A0|00|1B1|11|BB, B->0A0|00|1B1|11|BB }

G_3={{A,B}, {0,1}, P_3, S}

CNF:

Let C_1->0, C_2->1, C_3->C_1A, C_4->C_2B

P_4 {S-> C_3C_1|C_1 C_1|C_4C_2|C_2C_2|BB, A-> C_3C_1|C_1 C_1|C_4C_2|C_2C_2|BB, B-> C_3C_1|C_1 C_1|C_4C_2|C_2C_2|BB }

G_4={{A,B,C_1 ,C_2,C_3, C_4 }, {0,1}, P_4, S}

4. S->AAA|B, A->aA|B, B->ϵ

Sol: Eliminating ϵ-productions:

V_n= {A,B,S}

P_1 {S->AAA|AA|A|B , A-> aA|B|a}

G_1 ={{A,B} , {a}, P_1, S}

Eliminating unit productions:

(S,S) S->AAA|AA|A|B

(S,A) S->aA|B|a

(S,B)

(A,A) S->aA|B|a

(A,B)

P_2 { S-> AAA|AA|aA|a, A->aA|a}

G_2 ={{A}, {a}, P_2, S}

Useful symbols:

All are generating and reachable

P_3 { S-> AAA|AA|aA|a, A->aA|a}

G_3 ={{A}, {a}, P_2, S}

CNF:

Let C_1->a, C_2->AA

P_4 {S-> C_2A|AA|C_1A|a, A->C_1A|a}

G_4={{A,C_1 ,C_2}, {a}, P_4, S}

5. S->aAa|bBb|ϵ, A->C|a, B->C|b, C->CDE|ϵ, D->A|B|ab

Sol: Eliminating ϵ-productions:

V_n= {C,D,B,A,S}

P_1 { S->aAa|aa|bBb|bb, A->C|a, B->C|b, C->CDE|CE|DE, D->A|B|ab }

G_1 ={{A,B,C,D} , {a,b}, P_1, S}

Eliminating unit productions:

(S,S) S-> aAa|aa|bBb|bb

(A,A) A->C|a

(A,C) A-> CDE|CE|DE

(B,B) B->C|b

(B,C) B-> CDE|CE|DE

(C,C) C-> CDE|CE|DE

(D,D) D->A|B|ab

(D,A) D->A|a

(D,C) D-> CDE|CE|DE

(D,B) D->C|b

P_2 {S->aAa|aa|bBb|bb, A-> CDE|CE|DE|a, B-> CDE|CE|DE|b, C-> CDE|CE|DE, D-> CDE|CE|DE |b|ab}

G_2 ={{A,B,C,D}, {a,b}, P_2, S}

Useful symbols:

C is not generating.

P_3 { S->aAa|aa|bBb|bb, A-> DE|a, B-> DE|b, D-> DE |b|ab }

D is not reachable

P_4 {S->aAa|aa|bBb|bb, A->a, B->b}

G_3={{A,B}, {a,b}, P_4, S}

CNF:

Let C_1->a, C_2->b, C_3->C_1A, C_4->C_2B

P_4 {S-> C_3C_1|C_1 C_1|C_4C_2|C_2C_2, A->a, B-> b }

G_4={{A,B,C_1 ,C_2,C_3, C_4 }, {a,b}, P_4, S}

6. S->aA|a|B|C, A->aB|ϵ, B->aA, C->cC, D->abd

Sol: Eliminating ϵ-productions:

V_n= {A}

P_1 { S->aA|a|B|C, A->ab, B->aA|a, C->cC, D->abd}

G_1 ={{A,B,C,D} , {a,b,c}, P_1, S}

Eliminating unit productions:

(S,S) S->aA|a|B|C

(S,B) S->aA|a

(S,C) S->cC

(A,A) A->aB

(B,B) B->aA|a

(C,C) C-> cC

(D,D) D->abd

P_2 {S->aA|a|cC, A->aB, B->aA|a, C-> cC, D->abd}

G_2 ={{A,B,C,D}, {a,b,c}, P_2, S}

Useful symbols:

C is not generating.

P_3 { S->aA|a, A->aB, B->aA|a, D->abd }

D is not reachable

P_4 { S->aA|a, A->aB, B->aA|a}

G_3={{A,B}, {a,b}, P_4, S}

CNF:

Let C_1->a

P_4 {S-> C_1A|a, A-> C_1B, B-> C_1A|a}

G_4={{A,B,C_1 }, {a}, P_4, S}

7. S->BAAB, A->0A2|2A0|ϵ, B->AB|1B|ϵ

Sol: Eliminating ϵ-productions:

V_n= {A,B,S}

P_1 { S->BAAB|B|A|BA|AB|AA|BB|BAA|BAB|AAB, A->0A2|02|2A0|20, B->AB|A|B|1B|1}

G_1 ={{A,B} , {0,1,2}, P_1, S}

Eliminating unit productions:

(S,S) S-> BAAB|B|A|BA|AB|AA|BB|BAA|BAB|AAB

(S,A) S->0A2|02|2A0|20

(S,B) S-> AB|A|B|1B|1

(A,A) A->0A2|02|2A0|20

(B,B) B->AB|A|B|1B|1

(B,A) B->0A2|02|2A0|20

P_2 { S->BAAB|BA|AB|AA|BB|BAA|BAB|AAB|0A2|02|2A0|20|AB|1B|1, A->0A2|02|2A0|20,

B->AB|0A2|02|2A0|20|1B|1}

G_2 ={{A,B}, {0,1,2}, P_2, S}

Useful symbols:

All are generating and reachable.

P_3 { S->BAAB|BA|AB|AA|BB|BAA|BAB|AAB|0A2|02|2A0|20|AB|1B|1, A->0A2|02|2A0|20,

B->AB|0A2|02|2A0|20|1B|1}

G_3={{A,B}, {0,1,2}, P_3, S}

CNF:

Let C_1->1, C_2->0, C_3->2, C_4->C_2A, C_5->C_3A, C_6->BA, C_7->AB

P_4 {S-> C_4A|C_2 C_3|C_5C_2|C_3C_2|AB|C_1B|1|BA|AB|AA|BB|C_6A|C_6B|AC_7|C_6C_7 ,

A-> C_4C_3|C_2C_3|C_5C_2|C_3C_2 , B-> C_4C_3|C_2C_3|C_5C_2|C_3C_2|C_1B|AB|1 }

G_4={{A,B,C_1 ,C_2,C_3, C_4 ,C_5,C_6, C_7}, {0,1,2}, P_4, S}