HW6

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1 1

Starting with

- A $\rightarrow$ BAB | B | 1 | ϵ
- B $\rightarrow$ 00 | ϵ

Add a new start state 'S'

- S $\rightarrow$ A
- A $\rightarrow$ BAB | B | 1 | ϵ
- B $\rightarrow$ 00 | ϵ

2 2

Removal of ϵ rules

2.1 a

Σ = {a,b,c} R: S $\rightarrow$ A A $\rightarrow$ AaB B $\rightarrow$ b | C | ϵ C $\rightarrow$ CC | c | ϵ

- Step 2 removing Epsilon Rules
  - Removing B $\rightarrow$ ϵ
    - S $\rightarrow$ A
    - A $\rightarrow$ AaB | Aa
    - B $\rightarrow$ b | C
    - C $\rightarrow$ CC | c | ϵ

- Removing C $\rightarrow \epsilon$
  - S $\rightarrow$ A
  - A $\rightarrow$ AaB | Aa
  - B $\rightarrow$ b | C
  - C $\rightarrow$ CC | c

2.2 b

- S $\rightarrow$ A
- A $\rightarrow$ AA | AB | B | a
- B $\rightarrow$ BB | b | ϵ

The only epsilon rule we see is B $\rightarrow \epsilon$

- S $\rightarrow$ A
- A $\rightarrow$ AA | A | AB | B | a
- B $\rightarrow$ BB | B | b

3 3

3.1 a

- S $\rightarrow$ A
- A $\rightarrow$ AA | AB | A | B | aB
- B $\rightarrow$ BB | Bb | b

Start by removing A $\rightarrow$ A

- S $\rightarrow$ A
- A $\rightarrow$ AA | AB | B | aB
- B $\rightarrow$ BB | Bb | b

Replace A $\rightarrow$ B

- S $\rightarrow$ A
- A $\rightarrow$ AA | AB | BB | Bb | b | aB

- B → BB | Bb | b

Replace S → B

- S → AA | AB | BB | Bb | b | aB
- A → AA | AB | BB | Bb | b | aB
- B → BB | Bb | b

3.2 b

Σ = {a,b,c} R:

- S → A | ϵ
- A → BC
- B → BD | bb
- C → CD | cc
- D → B | C

Step 3 Removal of unit rules (remember we can have epsilon because the empty string is in the language)

- S → **A** | ϵ
- A → BC
- B → BD | bb
- C → CD | cc
- **D → B | C**

Removing S → A

- S → BC | ϵ
- A → BC
- B → BD | bb
- C → CD | cc
- D → B | C

Removing B → D

- S → BC | ϵ
- A → BC
- B → BD | bb
- C → CD | cc
- D → BD | bb | C

Removing D → C

- S → BC | ϵ
- A → BC
- B → BD | bb
- C → CD | cc
- D → BD | bb | CD | cc

A is now redundent

4 4

- S → AAB | aBb | ABB | Ab
- A → AAB | aBb | ABB | Ab
- B → BB | Bb | b

Start by identifying rules not in CNF (bold)

- S → **AAB** | **aBb** | **ABB** | **Ab**
- A → **AAB** | **aBb** | **ABB** | **Ab**
- B → BB | **Bb** | b

Create A_1 which produces AA

- S → A_1B | **aBb** | **ABB** | **Ab**
- A → A_1B | **aBb** | **ABB** | **Ab**

- $B \rightarrow BB \mid \mathbf{Bb} \mid b$
- $A_1 \rightarrow AA$

Create B_1 which produces BB

- $S \rightarrow A_1B \mid \mathbf{aBb} \mid AB_1 \mid \mathbf{Ab}$
- $A \rightarrow A_1B \mid \mathbf{aBb} \mid AB_1 \mid \mathbf{Ab}$
- $B \rightarrow BB \mid \mathbf{Bb} \mid b$
- $A_1 \rightarrow AA$
- $B_1 \rightarrow BB$

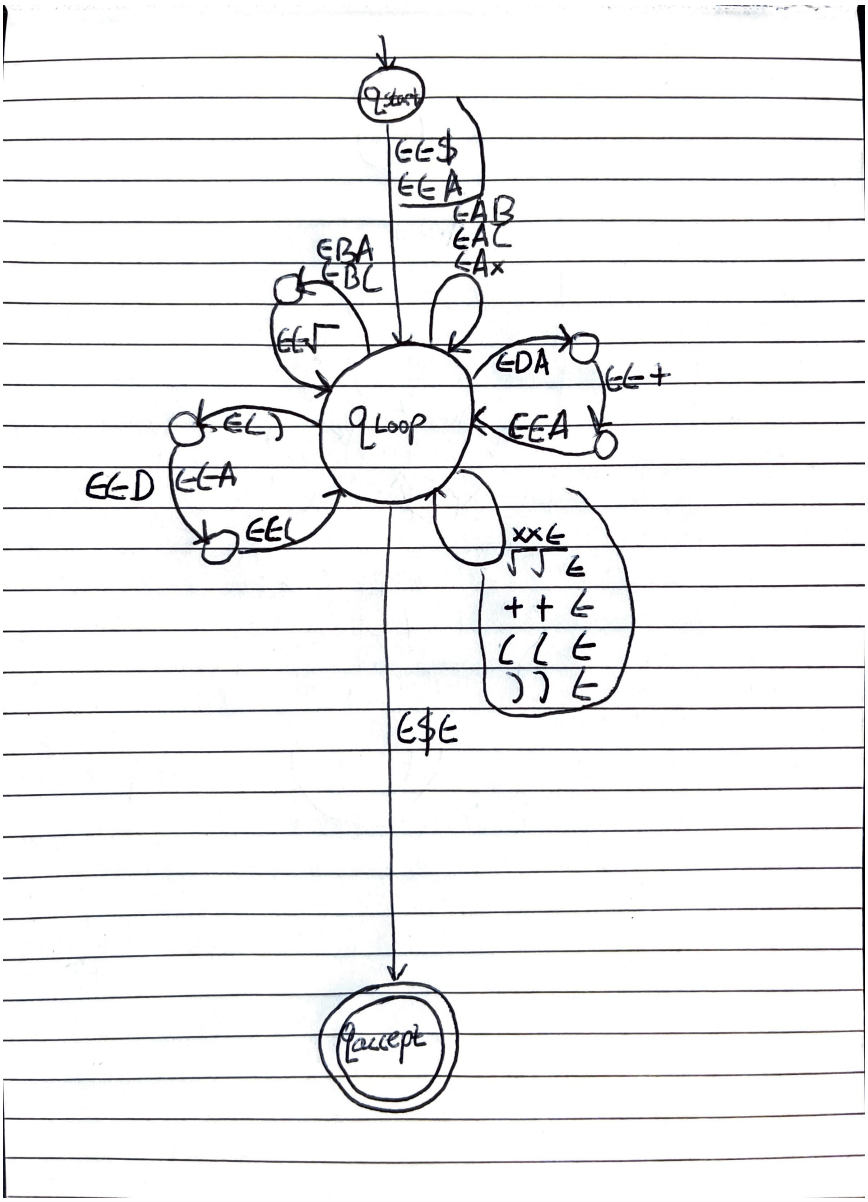
Create B_2 which produces b

- $S \rightarrow A_1B \mid \mathbf{aBb} \mid AB_1 \mid AB_2$
- $A \rightarrow A_1B \mid \mathbf{aBb} \mid AB_1 \mid AB_2$
- $B \rightarrow BB \mid BB_2 \mid b$
- $A_1 \rightarrow AA$
- $B_1 \rightarrow BB$
- $B_2 \rightarrow b$

Create A_2 which produces a && C_1 which produces A_2B

- $S \rightarrow A_1B \mid C_1B_2 \mid AB_1 \mid AB_2$
- $A \rightarrow A_1B \mid C_1B_2 \mid AB_1 \mid AB_2$
- $B \rightarrow BB \mid BB_2 \mid b$
- $A_1 \rightarrow AA$
- $A_2 \rightarrow a$
- $B_1 \rightarrow BB$
- $B_2 \rightarrow b$
- $C_1 \rightarrow A_2B$

5 5


q_start
q_Loop
q_accept
ϵϵ$
ϵϵA
ϵAB
ϵAC
ϵAx
ϵBA
ϵBC
ϵϵ√
ϵDA
ϵϵ+
ϵϵA
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xxϵ
√√ϵ
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((ϵ
))ϵ
ϵ$ϵ