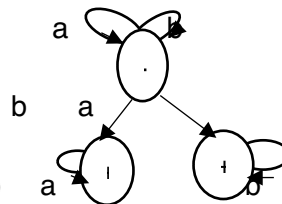


Assignment No. 3 (70 points.) Different forms of CFG, Regular and non-regular languages, regular and non-regular CFG, Deterministic and non-deterministic FAs, converting NDFA to DFA)

(10 points) Given the language $L = (a + b)^*(ba^* + ab^*)$



- Construct an FA for L (FA is already given)
- Convert the non-deterministic FA (NDFA) to a deterministic FA (DFA)
- Use the DFA to write a deterministic CFG for L

1. (10 points) Given the following non-deterministic CFG :

S \rightarrow aA | aB | bB | λ
 B \rightarrow bB | λ
 A \rightarrow aA | aB

Convert the grammar to a deterministic CFG (hint Use the CFG to construct a non-deterministic FA, convert NDFA to DFA, and then write a new DCFG)

2. (10 points) Write a regular and non-regular CFG for languages: (i) $L = a^*b(a+b)^*$ (ii) $L = a^*b^*$

3. (20 points) Given the following EBNF grammars. (i) draw their syntax diagram (ii) write each grammar in form of BNF

- $S \rightarrow [a]\{b\}d$
- $S \rightarrow \{alb\}\{c\}$
- $S \rightarrow \{a\}\{b\}[c]\{d\}$

K-mart
 23andMe
 456
 Tax 2018
 While
 switch
 do_it
 _Fall_20
 _Jan 19

Programming (10 points each)

- Write a program to read one token at a time from the given text file and determine whether the token is
 - A number
 - An identifier (must start with underscore or a letter, followed by more letters, more digits, or more underscores)
 - A reserved word. List of reserved words: string reserved[5]={"while", "for", "switch", "do", "return"};

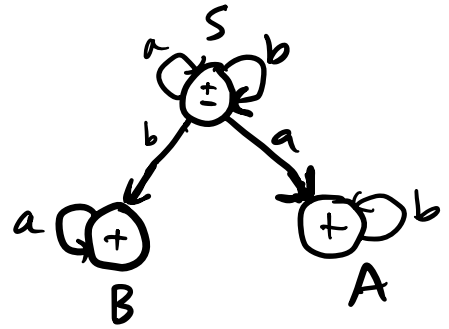
Sample output for #1

Token	number	identifier	reserved word
K-mart	no	no	no
23andMe	no	no	no
456	yes	no	no
.....			

- Given CFG: $S \rightarrow aS | bB | cC$ Write a program to determine whether an input string is accepted or rejected by the grammar.
 $B \rightarrow bB | aC | cD | \lambda$
 $C \rightarrow aS | bD | cD | \lambda$
 $D \rightarrow bD | aB | cC$

Try input strings: w1=abbbcaaa\$, w2=ccccbbb\$, w3=aabbcbbbb\$

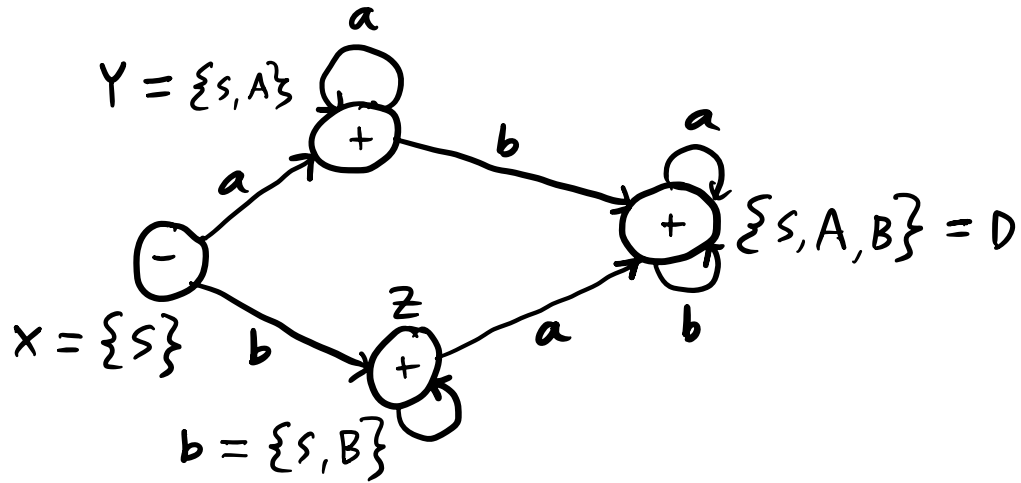
a.) $L = (a+b)^*(ba^* + ab^*)$



b.)

Input state	a	b
$\{A\}$	$\{ \}$	$\{A\}$
$\{B\}$	$\{B\}$	$\{ \}$
$\{S\}$	$\{S, A\}$	$\{S, B\}$
$\{S, A\}$	$\{S, A\}$	$\{S, B, A\}$
$\{S, B\}$	$\{S, A, B\}$	$\{S, B\}$
$\{S, A, B\}$	$\{S, A, B\}$	$\{S, A, B\}$

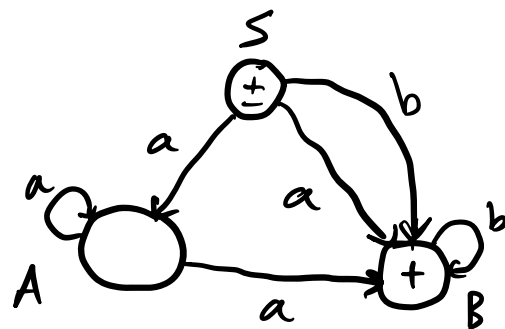
Final Final Initial Initial/Final Initial/Final Initial/Final
 $\{A\}, \{B\}, \{S\}, \{S, A\}, \{S, B\}, \{S, A, B\}$



$\{S\} = X$
 $\{S, A\} = Y$
 $\{S, B\} = Z$
 $\{S, A, B\} = D$

$X \rightarrow aY \mid bZ \mid$
 $Y \rightarrow aY \mid bD \mid \lambda$
 $Z \rightarrow bZ \mid aD \mid \lambda$

1.) $S \rightarrow aA | aB | bB | \lambda$
 $B \rightarrow bB | \lambda$
 $A \rightarrow aA | aB$



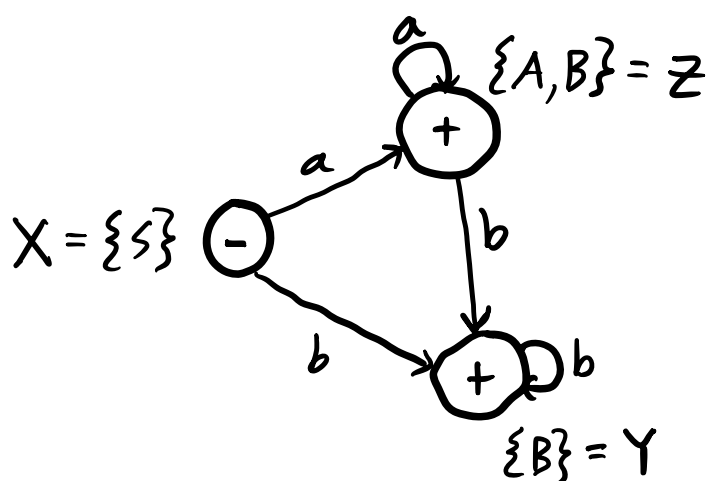
Input States	a	b
$\{S\}$	$\{A, B\}$	$\{B\}$
$\{A\}$	$\{A, B\}$	$\{ \}$
$\{B\}$	$\{ \}$	$\{B\}$
$\{A, B\}$	$\{A, B\}$	$\{B\}$

$\{S\} = X$

$\{B\} = Y$

$\{A, B\} = Z$

$\{A\}, \{B\}, \{S\}, \{A, B\}$

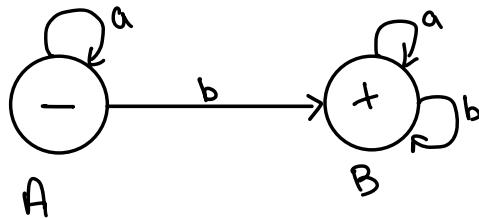


$X \rightarrow aZ | bY | \lambda$

$Y \rightarrow bY | \lambda$

$Z \rightarrow aZ | bY | \lambda$

(2i) $L = \underbrace{a^*}_A \underbrace{b}_B \underbrace{(a+b)^*}_X$



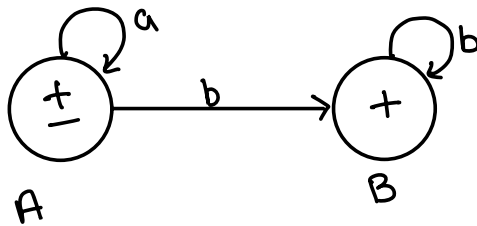
Reg

$A \rightarrow aA$
 $A \rightarrow bB$
 $A \rightarrow \lambda$
 $B \rightarrow aB$
 $B \rightarrow bB$
 $B \rightarrow \lambda$

non-reg

$S \rightarrow ABX$
 $A \rightarrow aA | \lambda$
 $B \rightarrow aB | bB | \lambda$
 $X \rightarrow aX | bX | \lambda$

(2ii) $L = \underbrace{a^*}_A \underbrace{b^*}_B$



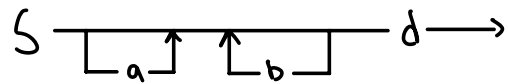
reg

$A \rightarrow aA$
 $A \rightarrow bB$
 $A \rightarrow \lambda$
 $B \rightarrow bB$
 $B \rightarrow \lambda$

non-reg

$S \rightarrow AB$
 $A \rightarrow aA | \lambda$
 $B \rightarrow bB | \lambda$

$$(3a) S \rightarrow [a] \{b\} d$$



$$L = (\lambda + a) b^* d$$

BNF

$$A \rightarrow aB$$

$$A \rightarrow \lambda$$

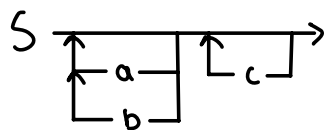
$$B \rightarrow bB$$

$$B \rightarrow dD$$

$$B \rightarrow \lambda$$

$$D \rightarrow \lambda$$

$$(3b) S \rightarrow \{a|b\} \{c\}$$



$$L = (a+b)^* c^*$$

BNF

$$A \rightarrow aA$$

$$A \rightarrow bA$$

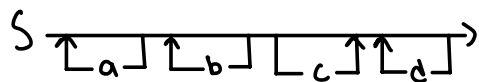
$$A \rightarrow cB$$

$$A \rightarrow \lambda$$

$$B \rightarrow cB$$

$$B \rightarrow \lambda$$

$$(3c) S \rightarrow \{a\} \{b\} [c] \{d\}$$



$$L = a^* b^* (\lambda + c) d^*$$

BNF

$$A \rightarrow aA$$

$$A \rightarrow bB$$

$$A \rightarrow \lambda$$

$$B \rightarrow bB$$

$$B \rightarrow cC$$

$$B \rightarrow \lambda$$

$$C \rightarrow dC$$

$$C \rightarrow \lambda$$