

Quiz: 3

Q1 Regular Expression $\rightarrow (ab)^* a + a^*$

CFG for $(ab)^*$

$A \rightarrow abA \mid \Lambda$

CFG for a

$B \rightarrow a$

CFG for a^*

$C \rightarrow BC \mid \Lambda$

CFG for $(ab)^* a$

$D \rightarrow AB$

CFG for $(ab)^* a + a^*$

$E \rightarrow D \mid C$

CFG for $(ab)^* a + a^*$

$E \rightarrow D \mid C$

$D \rightarrow AB$

$C \rightarrow BC \mid \Lambda$

$B \rightarrow a$

$A \rightarrow abA \mid \Lambda$

Q2

$\Sigma = \{a, b\}$

double letter combination (aa or bb)

Recursive definition -

R1. aa, bb \in double

R2. For any $S \in \text{double}$, aaS, Saa, aaSaa, bbS, Sbb, bbSbb, aaSbb, bbSaa are in double.

R3. No other strings are in double.

CFG,

~~$S \rightarrow AXB \mid BXA \mid AXA \mid BXB \mid A \mid B$~~

~~$A \rightarrow aa$~~

~~$B \rightarrow bb$~~

$S \rightarrow AXB \mid BXA \mid AXA \mid BXB \mid A \mid B$

$A \rightarrow aa$

$B \rightarrow bb$

$X \rightarrow S \mid \Lambda$

Q3 Convert CFG to CNF.

$S \rightarrow ZaY \mid ax \mid Yb$
 $X \rightarrow aZ \mid c$
 $Y \rightarrow XS \mid ZZ$
 $Z \rightarrow XXa \mid bY \mid \Lambda$

Step 1) Z is nullable.

$S \rightarrow aY \mid ax \mid Yb$

$X \rightarrow a \mid c$

$Y \rightarrow XS \mid \Lambda$

$Z \rightarrow XXa \mid bY$

Y is nullable.

$S \rightarrow a \mid ax \mid b$

$X \rightarrow a \mid c$

$Y \rightarrow XS$

$Z \rightarrow XXa \mid b$

Step 2) Introduce $A \rightarrow a, B \rightarrow b, C \rightarrow c$

$S \rightarrow A \mid AX \mid B$

$X \rightarrow A \mid C$

$Y \rightarrow XS$

$Z \rightarrow XXA \mid B$

$A \rightarrow a \quad B \rightarrow b \quad C \rightarrow c$

Step 3) Remove unit productions

$S \rightarrow a \mid AX \mid b$

$X \rightarrow a \mid c$

$Y \rightarrow XS$

$Z \rightarrow XXA \mid b$

$A \rightarrow a$

$B \rightarrow b$

~~@esgo~~

Step 4) CNF.

$$S \rightarrow a | Ax | b$$

$$X \rightarrow a | c$$

$$Y \rightarrow XS$$

$$Z \rightarrow DA | b$$

$$D \rightarrow XX \wedge | Y | AXX$$

$$A \rightarrow a$$

$$B \rightarrow b$$

~~Recall~~

Q4

PDA for

all words that contain substring "ba"

So, words can start with a

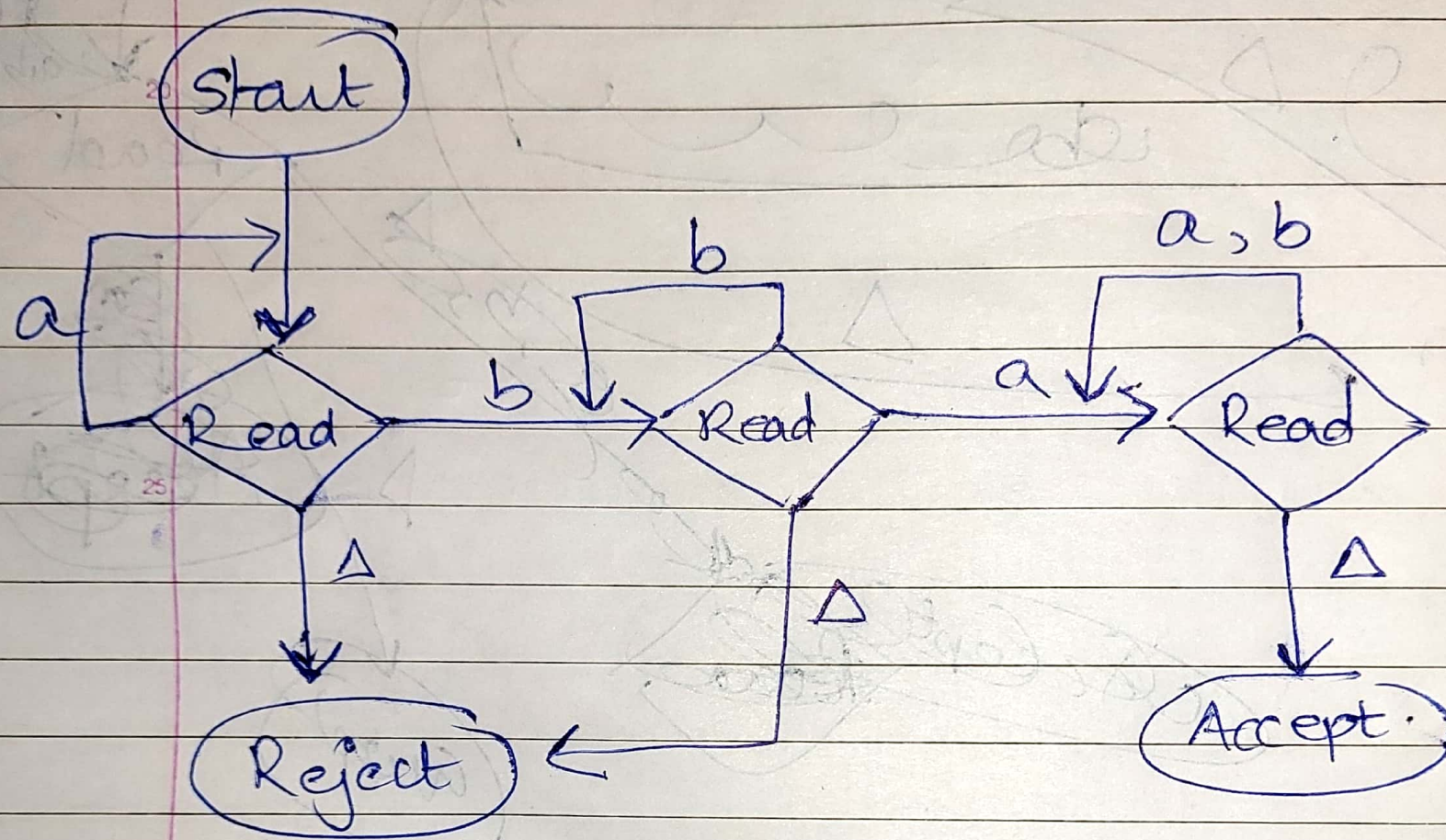
start with b

end with a

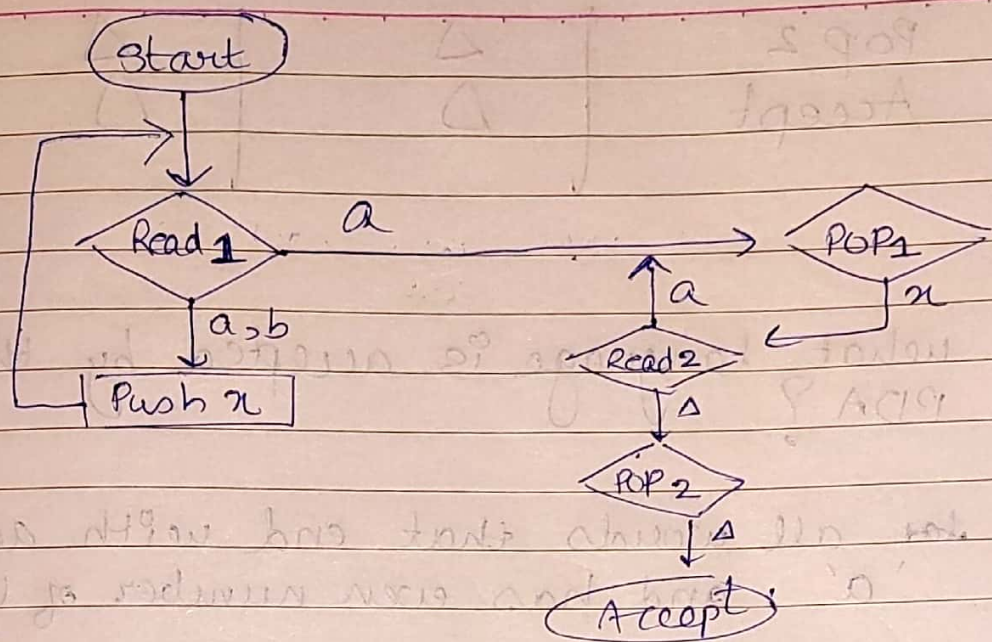
end with b.

but needs to have at least one (ba).

PDA



Q5



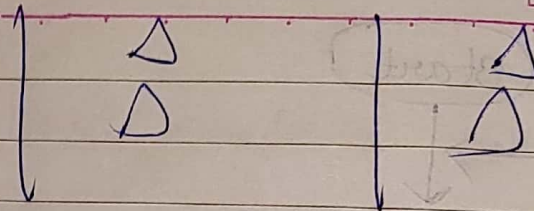
(a)

	state	Stack	Tape
	Start	Δ	aa
a	Read 1	Δ	a
	Push x	x	a
a	Read 1	x	Δ
	Pop 1	Δ	Δ
x	Read 2	Δ	Δ
	Pop 2	Δ	Δ
	Accept	Δ	Δ

(b)

	state	Stack	Tape
	Start	Δ	baaa
b	Read 1	Δ	aaa
	Push x	x	aaa
a	Read 1	x	aa
	Push x	xx	aa
a	Read 1	xx	a
	Pop 1	x	a
a	Read 2	x	Δ
	Pop 1	Δ	Δ
	Read 2	Δ	Δ

Pop 2
Accept



(c) what language is accepted by the PDA?

all words that end with an 'a' and has even number of letters