Momina Atif Dar
P18-0030 Section B

Question 1:

① $L1 = \{a^n b^n a^m \mid n, m \geq 0\}$

words = {^, ab, a, aba, aabba, abaa, aabbaa, abaaa, aaabbbba, abaaaa...

$S \rightarrow aSbB \mid B \mid \wedge$
$B \rightarrow aB \mid \wedge$

② $L2 = \{w \in \Sigma^* \mid w \text{ is a palindrome}\}$

words = {^, aa, bb, a, b, aba, bab, abba, baab, aaaa, bbbb, aaa, bbb...}

$S \rightarrow aSa \mid bSb \mid bB \mid aB \mid \wedge$
$B \rightarrow bB \mid aB \mid a \mid b \mid \wedge$

③ $L3 = \{a^i b^j a^k \mid j = i + k\}$

words = {^, ab, ba, abba, aabbba, abbbaa, aabbbbaa, aabb, bbaa ...}

$S \rightarrow aSa \mid B$
$B \rightarrow aBb \mid bBa \mid bbB \mid \wedge$

Question 2

PDA

$S \rightarrow S1 \mid S2$

$S1 \rightarrow aS1a \mid bS1b \mid a \mid b \mid \wedge$

$S2 \rightarrow aS2b \mid \wedge$

First change it into CNF.

1. Remove $\wedge$-production.

$S1 \rightarrow aS1a \mid bS1b \mid a \mid b \mid \wedge$

$S1 \rightarrow aS1a \mid bS1b \mid a \mid b \mid aa \mid bb$

$S2 \rightarrow aS2b \mid \wedge$

$S2 \rightarrow aS2b \mid ab$

2. Remove unit-production

$S_0 \rightarrow S$

$S \rightarrow S1 \mid S2$

$S1 \rightarrow aS1a \mid bS1b \mid a \mid b \mid aa \mid bb$

$S2 \rightarrow aS2b \mid ab$

$S_0 \rightarrow S$

$S \rightarrow aS1a \mid bS1b \mid a \mid b \mid aa \mid bb \mid aS2b \mid ab$

$S1 \rightarrow aS1a \mid bS1b \mid a \mid b \mid aa \mid bb$

$S2 \rightarrow aS2b \mid ab$

$S_0 \rightarrow aS_1a \mid bS_1b \mid a \mid b \mid aa \mid bb \mid aS_2b \mid ab$

$S_1 \rightarrow aS_1a \mid bS_1b \mid a \mid b \mid aa \mid bb \mid aS_2b \mid ab$

$S_1 \rightarrow aS_1a \mid bS_1b \mid a \mid b \mid aa \mid bb$

$S_2 \rightarrow aS_2b \mid ab$

↓

$S_0 \rightarrow S_3S_1S_3 \mid S_4S_1S_4 \mid a \mid b \mid S_3S_3 \mid S_4S_4 \mid S_3S_2S_4 \mid S_3S_4$

$S \rightarrow S_3S_1S_3 \mid S_4S_1S_4 \mid a \mid b \mid S_3S_3 \mid S_4S_4 \mid S_3S_2S_4 \mid S_3S_4$

~~$S_1 \rightarrow aS_1a \mid bS_1b \mid a \mid b \mid aa \mid bb$~~

~~$S_2 \rightarrow aS_2b \mid ab$~~

$S_1 \rightarrow S_3S_1S_3 \mid S_4S_1S_4 \mid a \mid b \mid S_3S_3 \mid S_4S_4$

$S_2 \rightarrow S_3S_2S_4 \mid S_3S_4$

$S_3 \rightarrow a$

$S_4 \rightarrow b$

↓

$S_0 \rightarrow S_5S_3 \mid S_6S_4 \mid a \mid b \mid S_3S_3 \mid S_4S_4 \mid S_7S_4 \mid S_3S_4$

$S \rightarrow S_5S_3 \mid S_6S_4 \mid a \mid b \mid S_3S_3 \mid S_4S_4 \mid S_7S_4 \mid S_3S_4$

$S_1 \rightarrow S_5S_3 \mid S_6S_4 \mid a \mid b \mid S_3S_3 \mid S_4S_4$

$S_2 \rightarrow S_7S_4 \mid S_3S_4$

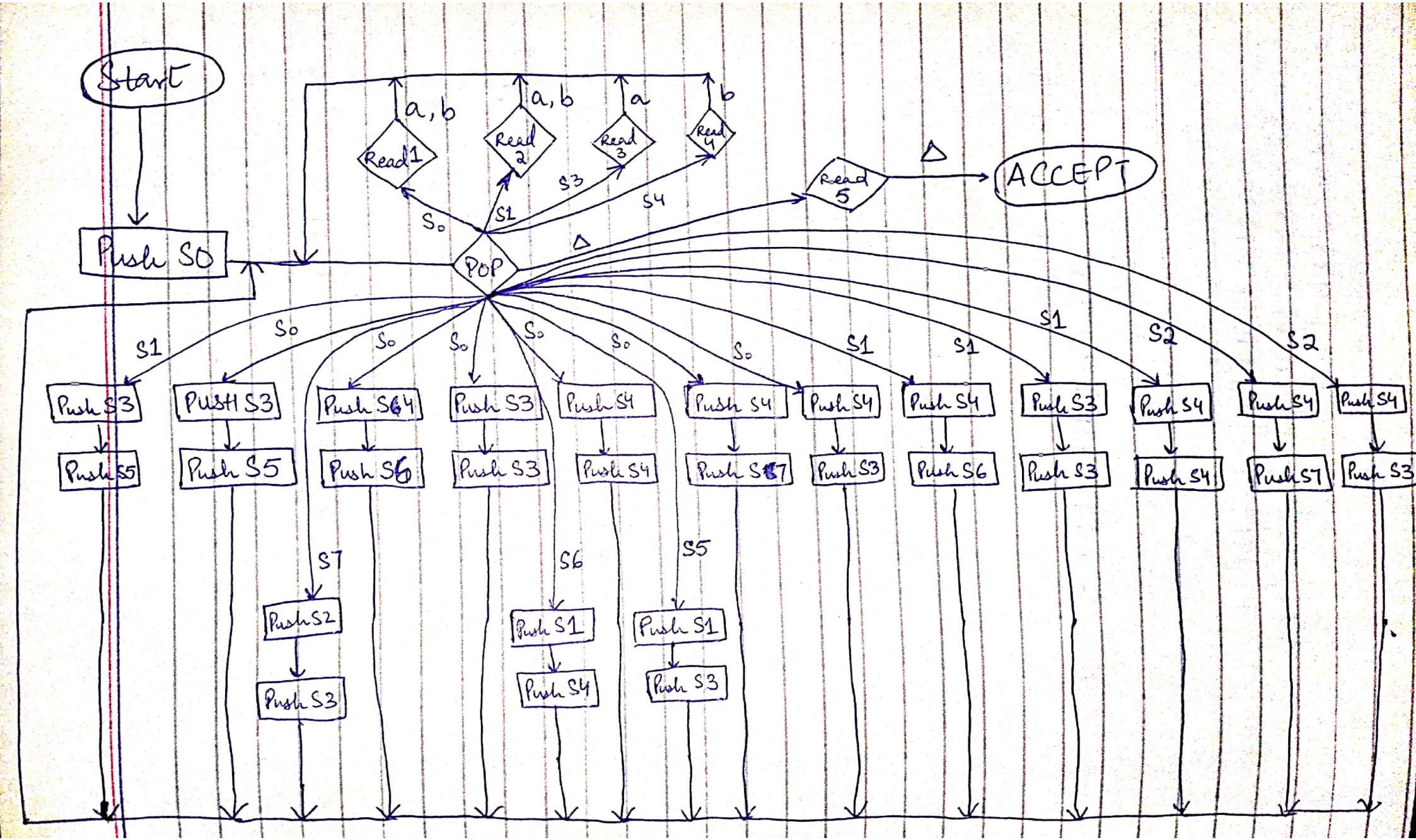
$S_3 \rightarrow a$

$S_4 \rightarrow b$

$S_5 \rightarrow S_3S_1$

$S_6 \rightarrow S_4S_1$

$S_7 \rightarrow S_3S_2$



2. CFG to PDA

equal a's and b's

$S \rightarrow aSb \mid \wedge$

change to CNF by removing $\wedge$-production

$S \rightarrow aSb \mid \wedge$

↓

$S \rightarrow aSb \mid ab$

Remove unit productions

$S_0 \rightarrow aSb \mid ab$

$S \rightarrow aSb \mid ab$

↓

$S_0 \rightarrow S1\,S\,S2 \mid S1\,S2$

$S \rightarrow S1\,S\,S2 \mid S1\,S2$

$S1 \rightarrow a$

$S2 \rightarrow b$

↓

$S_0 \rightarrow S1\,S\,S2 \mid S1\,S2$

$S \rightarrow S1\,S\,S2 \mid S1\,S2$

$S1 \rightarrow a$

$S2 \rightarrow b$

$S3 \rightarrow S1\,S$

↓

$S_0 \rightarrow S1\,S2 \mid S3\,S2$

$S \rightarrow S1\,S2 \mid S3\,S2$

$S1 \rightarrow a$

$S2 \rightarrow b$

$S3 \rightarrow S1\,S$