

CSE 340 Spring 2021

HOMEWORK 1

Assigned 3/2/2021

Due 3/8/2021 by 11:59:59 pm on Canvas.

All submissions must be PDF and should be typed. Exception can only be made for drawing parse trees, which can be handwritten and scanned in the submitted document.

Note. Some of these problems are taken from the Dragon book.

Problem 1. Consider the following regular expressions (we omit the dot operator)

$$\begin{aligned}
 R_0 &= 1|2|3|4|5|6|7|8|9 \\
 R_1 &= 0|1|2|3|4|5|6|7|8|9 \\
 R_2 &= (0|1)^* R_0 (0|1) \\
 R_3 &= 00 R_0 (0|1)^* \\
 R_4 &= R_3^* R_2^* 000
 \end{aligned}$$

Assume that the longest prefix-matching rule is used. Assume that ties are broken in favor of the regular expression listed first in the list.

1. Give an example of input for which getToken() returns $R_0 : 1$ // $1 \sim 9$
2. Give an example of input for which getToken() returns $R_1 : 0$ // $0 \sim 9$
3. Give an example of input for which getToken() returns $R_2 : 00141$ // ends with $(1\sim 9)(0|1)$
4. Give an example of input for which getToken() returns $R_3 : 008711$ // start with 00
5. Give an example of input for which getToken() returns $R_4 : 008081000$
// $R_3(008) R_2(081) R_4(000)$
6. If getToken() is called repeatedly on the following input, what is the sequence of tokens returned?

99001101678100010101030123457000010	match	potential	longest	longest match
9	R_0	R_2	R_0	1
99	—	—	R_0	1
9	R_0	R_2	R_0	1
90	R_2	—	R_2	2

0	R1	R2,R3,R4	R1	1
01	R2	R2,R4	R1	1
011	R2	R2,R4	R2	3
0110	R2	R2,R4	R2	4
01101	—	—	R2	4
1	R0	R2	R0	1
16	—	R2	R0	1
167	—	—	R0	1
6	R0	R2	R0	1
67	—	—	R0	1
7	R0	R2	R0	1
78	—	—	R0	1
8	R0	R2	R0	1
81	R2	—	R2	2
0	R1	R2,R3,R4	R1	1
00	R3	R2,R3,R4	R3	2
000	R3	R2,R3,R4	R3	3
0001	R3	R2,R3,R4	R3	4
00010	R2	R2,R3,R4	R2	5
000101	R3	R2,R3,R4	R3	6
0001010	R2	R2,R3,R4	R2	7
00010101	R3	R2,R3,R4	R3	8
000101010	R2	R2,R3,R4	R2	9
0001010103	R2	R2,R4	R2	9

00010101030	R2	R2,R4	R2	11
000101010301	–	–	R2	11
1	R0	R2	R0	1
12	–	R2	R0	1
123	–	–	R0	1
2	R0	R2	R0	1
23	–	–	R0	1
3	R0	R2	R0	1
34	–	–	R0	1
4	R0	R2	R0	1
45	–	–	R0	1
5	R0	R2	R0	1
57	–	–	R0	1
7	R0	R2	R0	1
70	R2	–	R2	2
0	R1	R2,R3,R4	R1	1
00	R3	R2,R3,R4	R3	2
000	R3	R2,R3,R4	R3	3
0001	R3	R2,R3,R4	R3	4
00010	R2	R2,R3,R4	R2	5

Explain your answers

ANS: R0 R2 R2 R0 R0 R0 R2 R2 R0 R0 R0 R0 R0 R2 R2

Problem 2. Consider the grammar

$$S \rightarrow AB$$

$$A \rightarrow BaA \mid bB$$

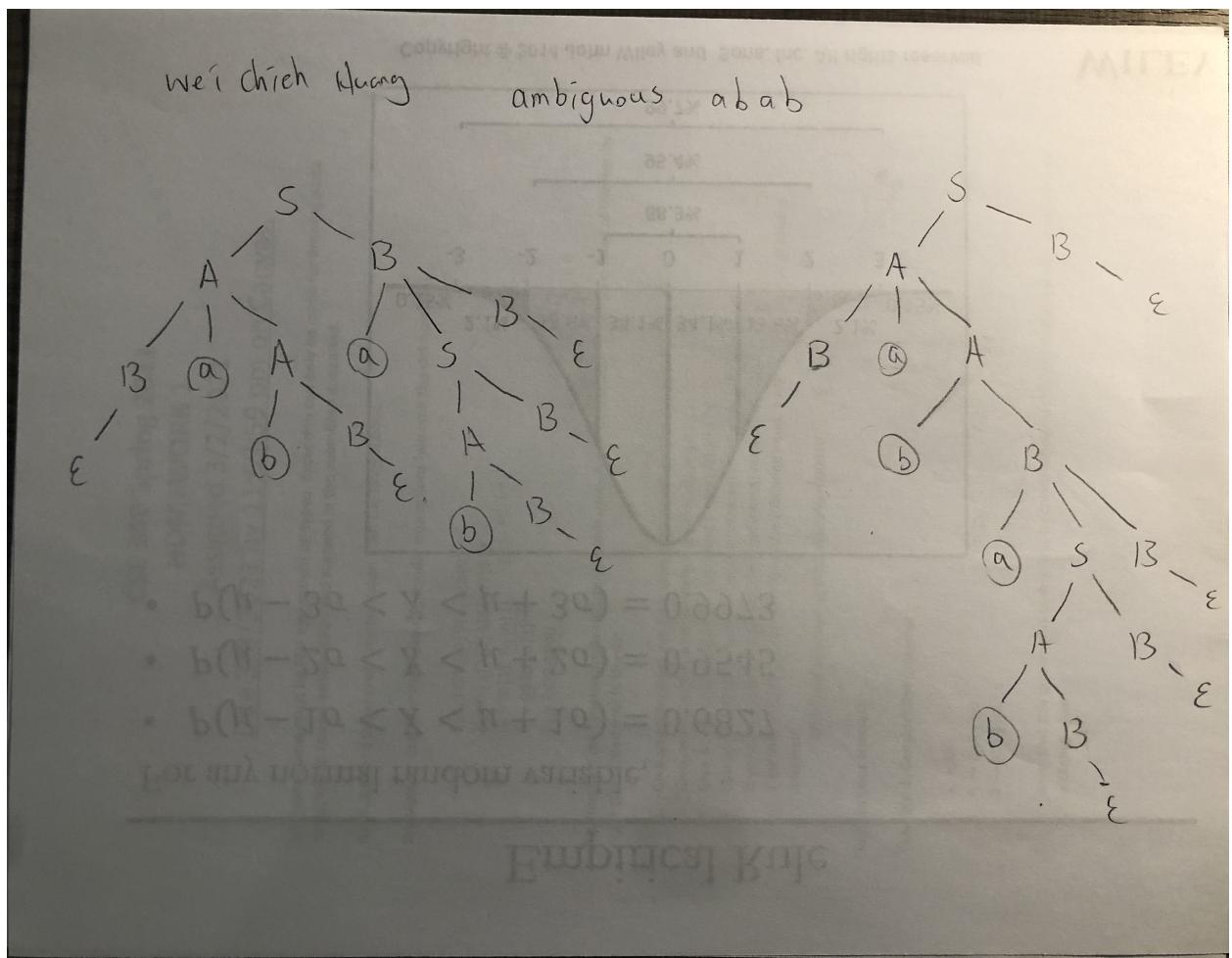
$$B \rightarrow aSB \mid AS \mid \epsilon$$

1. Show that this grammar is ambiguous by constructing two different leftmost derivations for the sentence abab

$$S \rightarrow AB \rightarrow BaAB \rightarrow aAB \rightarrow abBB \rightarrow abaSBB \rightarrow abaABBB \rightarrow ababBBBB \rightarrow abab$$

$$S \rightarrow AB \rightarrow BaAB \rightarrow abBB \rightarrow abB \rightarrow abaSB \rightarrow abaABB \rightarrow abab BBB \rightarrow abab$$

2. Show that this grammar is ambiguous by constructing two different parse trees for the string abab



Problem 3. Compute FIRST sets for the following grammar.

$$S \rightarrow aAB \mid CD$$

$A \rightarrow CD \mid SE \mid \epsilon$

$B \rightarrow aSB \mid AS$

$C \rightarrow cC \mid \epsilon$

$D \rightarrow CDd \mid \epsilon$

$E \rightarrow eFg$

$F \rightarrow Fg \mid \epsilon$

Show your work. An answer by itself does not count.

$S \rightarrow \text{First}(a) \cup \text{First}(C)$

$S \rightarrow a \cup \{c, \epsilon\}$

$S \rightarrow \{a, c, \epsilon\}$

$A \rightarrow \text{First}(C) \cup \text{First}(D) \cup \text{First}(S) \cup \text{First}(\epsilon)$

//when C = ε than D will be first

$A \rightarrow \{c, \epsilon\} \cup \{c, d, \epsilon\} \cup \{a, c, \epsilon\} \cup \epsilon$

$A \rightarrow \{a, c, \epsilon\}$

$B \rightarrow \text{First}(a) \cup \text{First}(A) \cup \text{First}(S)$

//when A = ε than S will be first

$B \rightarrow a \cup \{a, c, \epsilon\} \cup \{a, c, \epsilon\}$

$B \rightarrow \{a, c, \epsilon\}$

$C \rightarrow \text{First}(c) \cup \epsilon$

$C \rightarrow c \cup \epsilon$

$C \rightarrow \{c, \epsilon\}$

$D \rightarrow \text{First}(C) \cup \text{First}(D) \cup \text{First}(d) \cup \epsilon$

//when C|D = ε than d will be first

$D \rightarrow \{c, \epsilon\} \cup d \cup \epsilon$

$D \rightarrow \{c, d, \varepsilon\}$

$E \rightarrow \text{First}(e)$

$E \rightarrow \{e\}$

$F \rightarrow \text{First}(F) \cup \text{First}(g) \cup \varepsilon$

$F \rightarrow \{g, \varepsilon\}$