Homework 4

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Chapter 1: 1.19 Chapter 2: 2.1, 2.4, 2.6acd, 2.8, 2.13a, 2.14

1.19 a.$(0 \cup 1)^* 000 (0 \cup 1)^*$

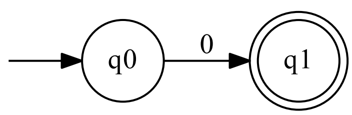


Figure 1: The NFA for 0.

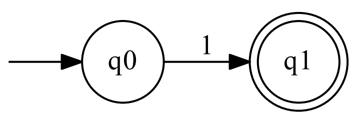


Figure 2: The NFA for 1.

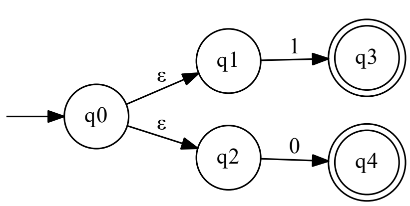


Figure 3: The NFA for $0 \cup 1$.

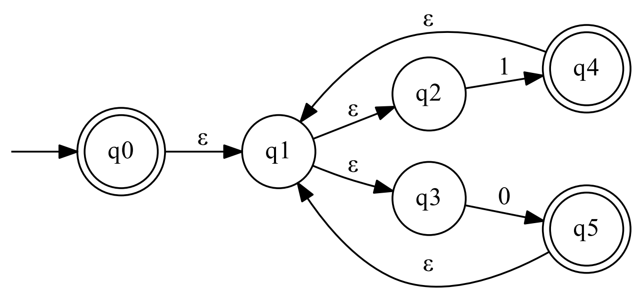


Figure 4: The NFA for $(0 \cup 1)^*$.

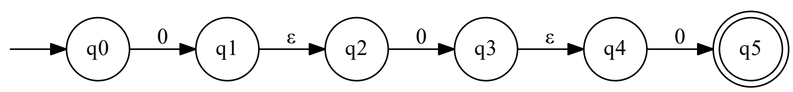


Figure 5: The NFA for 000.

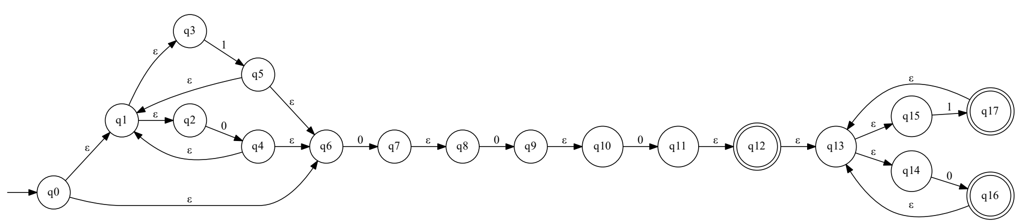


Figure 6: The NFA for $(0 \cup 1)^*000(0 \cup 1)^*$.

b.$(((00)^*(11)) \cup 01)^*$

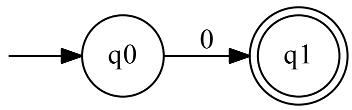


Figure 7: The NFA for 0.

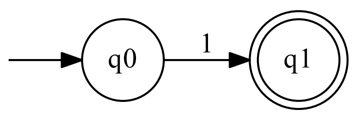


Figure 8: The NFA for 1.

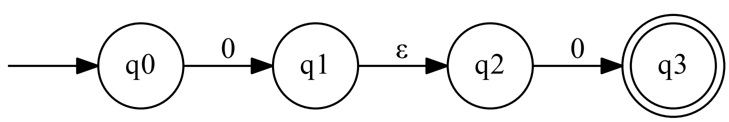


Figure 9: The NFA for 00.

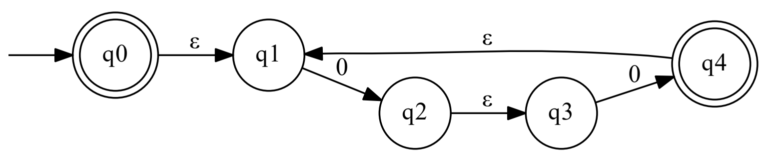


Figure 10: The NFA for (00)*.

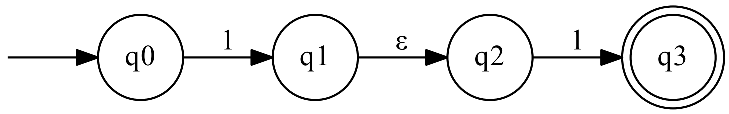


Figure 11: The NFA for 11.

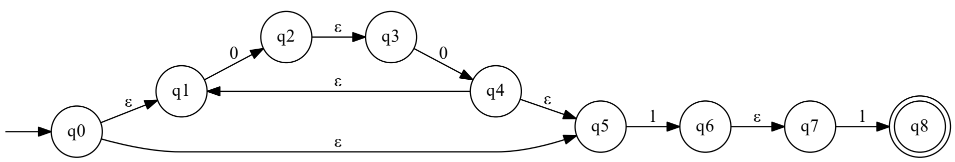


Figure 12: The NFA for (00)*11.

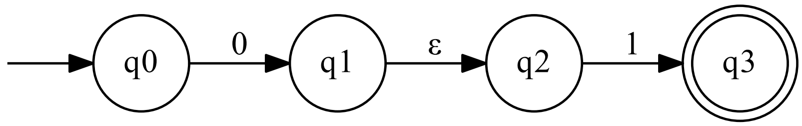


Figure 13: The NFA for 01.

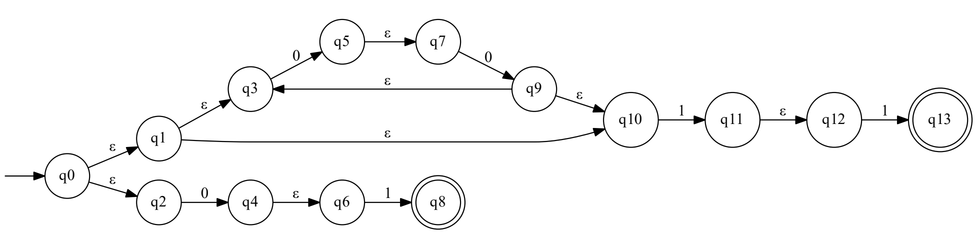


Figure 14: The NFA for (((00)*(11))∪(01)).

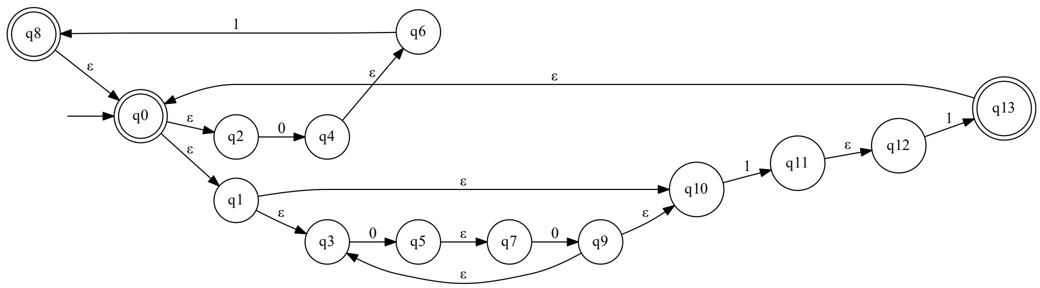


Figure 15: The NFA for (((00)*(11))∪(01))*.

c.∅*

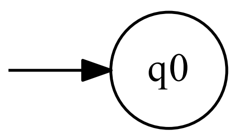


Figure 16: The NFA for ∅.

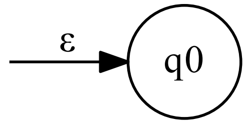
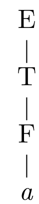
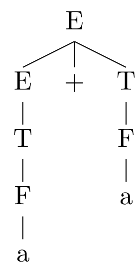


Figure 17: The NFA for ∅*.

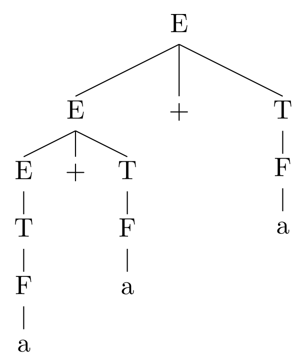
2.1 a. The derivation for a is $E \Rightarrow T \Rightarrow F \Rightarrow a$ and the parse tree is below.



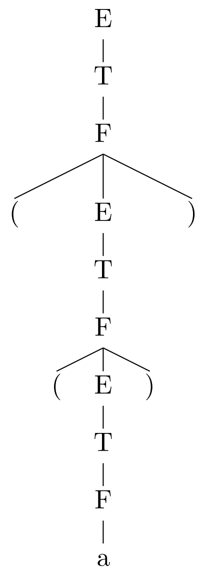
b.The derivation for a+a is $E \Rightarrow E + T \Rightarrow T + T \Rightarrow T + F \Rightarrow F + a \Rightarrow a + a$ and the parse tree is below.



c.The derivation for a+a is $E \Rightarrow E + T \Rightarrow E + T + T \Rightarrow T + T + T \Rightarrow F + T + T \Rightarrow F + F + T \Rightarrow F + F + F \Rightarrow a + F + F \Rightarrow a + a + F \Rightarrow a + a + a$ and the parse tree is below.



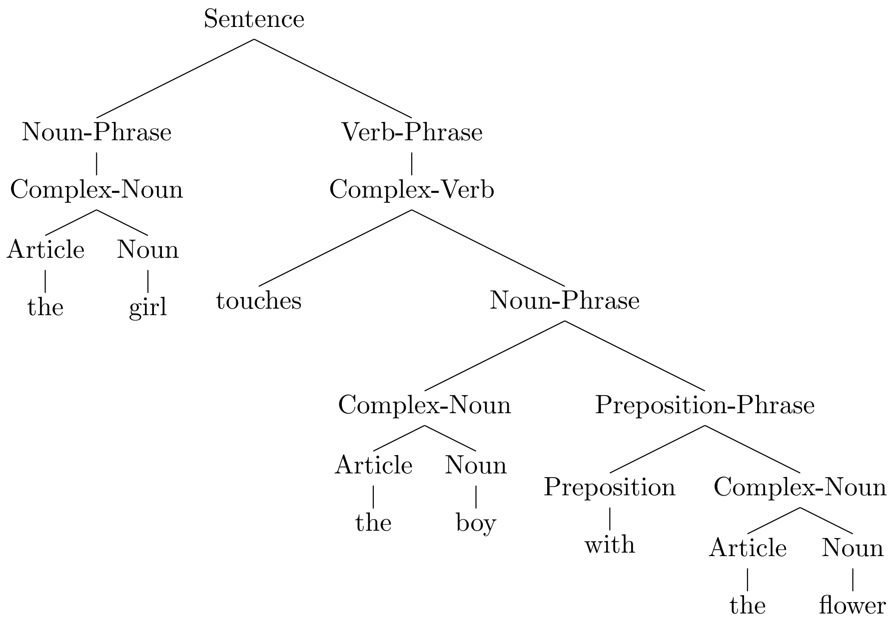
d..The derivation for ((a)) is $E \Rightarrow T \Rightarrow F \Rightarrow (E) \Rightarrow (T) \Rightarrow (F) \Rightarrow ((E)) \Rightarrow ((T)) \Rightarrow ((F)) \Rightarrow ((a))$ and the parse tree is below.

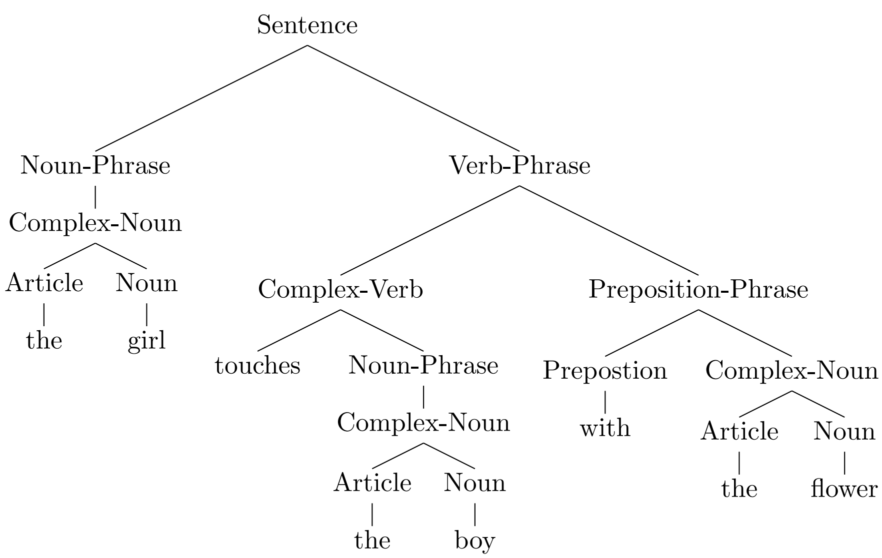


2.4 a.$S \to Q1Q1Q1Q$
$Q \to 0Q \mid 1Q \mid \varepsilon$
b.$S \to 0Q0 \mid 1Q1 \mid 0 \mid 1$
$Q \to 0Q \mid 1Q \mid \varepsilon$
c.$S \to 0 \mid 1 \mid 00S \mid 01S \mid 10S \mid 11S$
d.$S \to 0 \mid 0S0 \mid 0S1 \mid 1S0 \mid 1S1$
e.$S \to 0 \mid 1 \mid 0S0 \mid 1S1 \mid \varepsilon$
f.$S \to S$

2.6 a.$S \to YaY$
$Y \to YY \mid aYb \mid bYa \mid a \mid \varepsilon$
c.$S \to QR$
$Q \to 0Q0 \mid 1Q1 \mid \#R$
$R \to 0R \mid 1R \mid \varepsilon$
d.$S \to Q \mid Y\#Q\#Y \mid Y\#Q \mid Q\#Y$
$Q \to aQa \mid bQb \mid \# \mid \#Y\#$
$Y \to aY \mid bY \mid \#Y \mid \varepsilon$

2.8 In the first derivation the sentence means that the girl used the flower to touch the boy. In the second derivation, the boy is holding the flower when the boy touches her.





2.13 a.The language generated by $L = L(G)$ is the set of strings such that either they are composed by the concatenation of 3 or more arbitrary-length strings of zeros (delimited by the # symbol) or strings of the form $0^k\#0^{2k}$ for $k \geq 0$.

2.14 First add a new start variable S_0 and the rule $S_0 \to A$. Now the grammar is.
$S_0 \to A$
$A \to BAB \mid B \mid \varepsilon$
$B \to 00 \mid \varepsilon$
Remove all rules that have ε. Removing $A \to \varepsilon$ and $B \to \varepsilon$ gives.
$S_0 \to A \mid \varepsilon$
$A \to BAB \mid BA \mid AB \mid A \mid B \mid BB$

$B \to 00$.
Removing all unit rules. First remove $A \to A$ gives us.
$S_0 \to A \mid \varepsilon$
$A \to BAB \mid BA \mid AB \mid B \mid BB$
$B \to 00$
Now Remove $S \to B$ gives us.
$S_0 \to A \mid \varepsilon$
$A \to BAB \mid BA \mid AB \mid 00 \mid BB$
$B \to 00$
Now Remove $S_0 \to S$ gives us.
$S_0 \to BAB \mid BA \mid AB \mid 00 \mid BB \mid \varepsilon$
$A \to BAB \mid BA \mid AB \mid 00 \mid BB$
$B \to 00$
Now replace ill placed terminals 0 by the variable U that gives us.
$S_0 \to BAB \mid BA \mid AB \mid UU \mid BB \mid \varepsilon$
$A \to BAB \mid BA \mid AB \mid UU \mid BB$
$B \to UU$
$U \to 0$
Now we shorten the right-hand side of rules with only 2 variables each. To do this replace $S_0 \to BAB$ with two rules $S_0 \to BA_1$ and $A_1 \to AB$. The rule $A \to BAB$ is replaced by the two rules $A \to BA_2$ and $A_2 \to AB$. Now we get the final CFG.
$S_0 \to BA_1 \mid BA \mid SB \mid UU \mid BB \mid \varepsilon$
$A \to BA_2 \mid BA \mid SB \mid UU \mid BB$
$B \to UU$
$U \to 0$
$A_1 \to AB$
$A_2 \to AB$