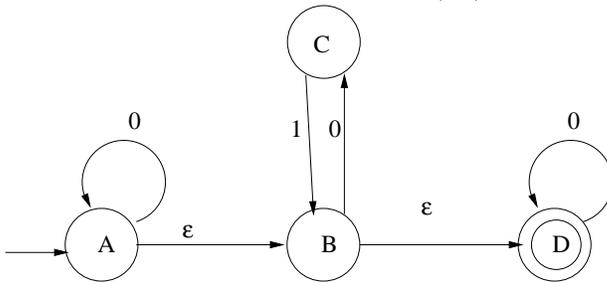


6.035 Practice Quiz 1

1. Give a Regular Expression and DFA for:
 $L = \{x \in \{0, 1\}^* \mid x \text{ ends with 1 and does not contain the substring } 00\}$
2. Give a RE for: $L = \{0^i 1^j \mid i \text{ is even and } j \text{ is odd}\}$
3. Given the NFA for below for $0^*(01)^*0^*$, construct a DFA:

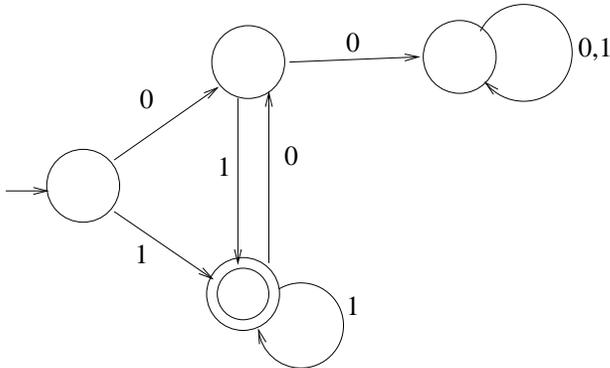


4. Give a RE and a DFA/NFA for the language of all strings over $\{0, 1\}^*$ that do not end in 01.
5. Give a RE and a CFG for:
 $L = \{x \in \{0, 1\}^* \mid x \text{ starts and ends with different symbols}\}$
6. Give a CFG for:
 $L = \{x \in \{0, 1\}^* \mid \text{symbol at position } i \text{ is same as symbol at position } i+2 \text{ and } |x| \geq 2\}$
7. Give a CFG for the language of all non-palindromes over $\{0, 1\}^*$.
8. Give a CFG for:
 $L = \{0^i 1^j 0^k \mid j > i + k\}$ So, 001111100 is in the string. Hint, the concatenation of two (or more) context-free languages is context-free.
9. Eliminate left recursion from:
 $S \rightarrow Aa \mid b$
 $A \rightarrow Ac \mid Sd \mid \epsilon$
10. Give a CFG for $L = \{a^i b^i c^i \mid i \geq 1\}$.
11. Is this grammar ambiguous? If so, prove it and construct a non-ambiguous grammar that derives the same language.
 $S \rightarrow aS \mid aSbS \mid c$

12. Assume that we have added a pointer type to decaf that can point to integers and booleans. We want to extend our type system (our attributed grammar) to handle these types. We have added a *pointer*(*t*) type to the type system to denote a pointer of type *t*. Complete the semantic action that propagates the type attribute for a pointer dereference expression: $E \rightarrow *E_1 \quad \{ : E.type = \text{????} : \}$

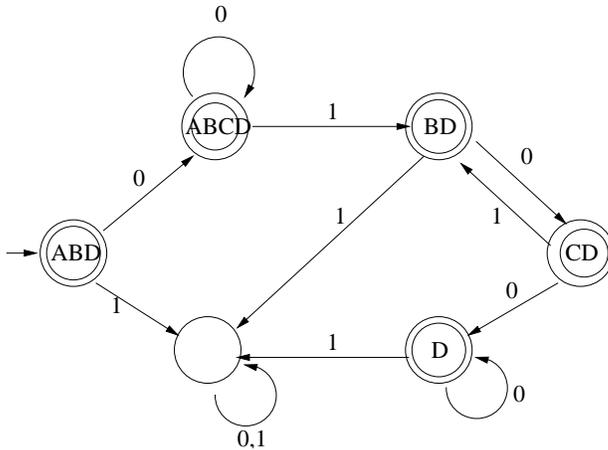
Answers

1. $(1 \mid 01)^+$

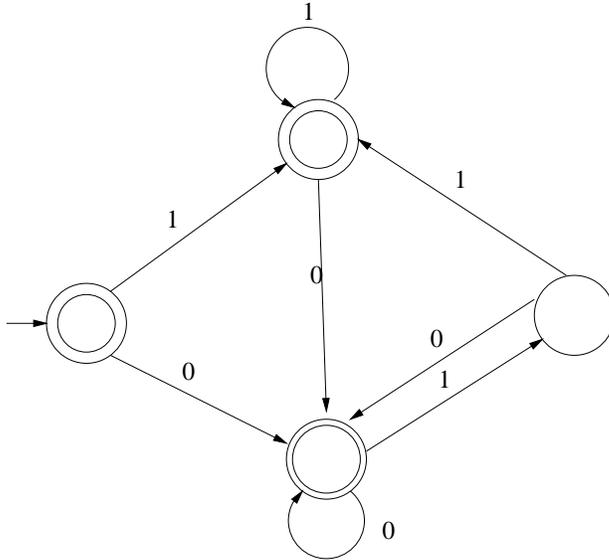


2. $(00)^*1(11)^*$

3. DFA:



4. $\varepsilon \mid 0 \mid 1 \mid (0 \mid 1)^*(11 \mid 00 \mid 10)$



5. $[a(a | b)^*b][b(a | b)^*a]$
 $S \rightarrow aAb | bAa$
 $A \rightarrow aA | bA | \varepsilon$

6. $S \rightarrow A | B | C | D$
 $A \rightarrow 00A | 00$
 $B \rightarrow 11B | 11$
 $C \rightarrow 10C | 10$
 $D \rightarrow 01D | 01$

7. $S \rightarrow 0S0 | 1S1 | D$
 $D \rightarrow 1A0 | 0A1$
 $A \rightarrow \varepsilon | 0A | 1A$

8. $S \rightarrow ABC$
 $A \rightarrow 0A1 | \varepsilon$
 $B \rightarrow 1B | 1$
 $C \rightarrow 1C0 | \varepsilon$

L is a concatenation of $L_1L_2L_3$ where $L_1 = \{0^i1^i | i \geq 0\}$, $L_2 = \{1^m | m > 0\}$, and $L_3 = \{1^k0^k | k \geq 0\}$.

9. $S \rightarrow Aa | b$
 $A \rightarrow bdA^1 | A^1$
 $A^1 \rightarrow cA^1 | adA^1 | \varepsilon$

10. Trick question, the language is not context-free. Sorry!

11. It is ambiguous! aacbc has two parse trees (not pictured, but you have to show the two parse trees to prove it is ambiguous).

Unambiguous grammar:

$$S \rightarrow T \mid U$$
$$T \rightarrow aTbT \mid c$$
$$U \rightarrow aS \mid aTbU$$

12. $E \rightarrow *E_1 \{E.type := \mathbf{if} E_1.type = pointer(t) \mathbf{then} t \mathbf{else} type_error;\}$

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