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Compiler Design.

1. (a) The FIRST of a sentential form is the set of terminals symbols that lead any sentential form derived from the very first sentential form. In this case A and B only derive the empty string and as a result the empty string is the FIRST set of both non-terminal symbols A and B. The FIRST of S, includes 'a' as in the first production once can derive a sentential form that starts with an 'a' given that A can be replaced by the empty string. A similar reasoning concludes 'b' in the FIRST(S).
∴ FIRST(A) = {ε} FIRST(B) = {ε}, FIRST(S) = {a, b}.

(b) The FOLLOW set of a non-terminal is the set of terminals that can appear after the non-terminal symbol in any sentential form derived from the grammar's start symbol. In this case, by looking at the productions of S one can determine right away that FOLLOW(A) includes terminals 'a' and 'b' and FOLLOW (B) includes terminal 'b'. Given that the non-terminal S does not appear in any production, FOLLOW(S) = \$.
∴ FOLLOW(A) = {a, b}, FOLLOW(B) = {b}, FOLLOW(S) = {\$}.

(c) Yes, because the intersection of the FIRST for every non-terminal symbol is empty. This leads to the parsing table for this LL method as indicated below. As there is no conflict in this entry then grammar is LL(1).

	a	b	\$
S	S → AaAb	S → Bb	
A	A → ε	A → ε	
B		B → ε	

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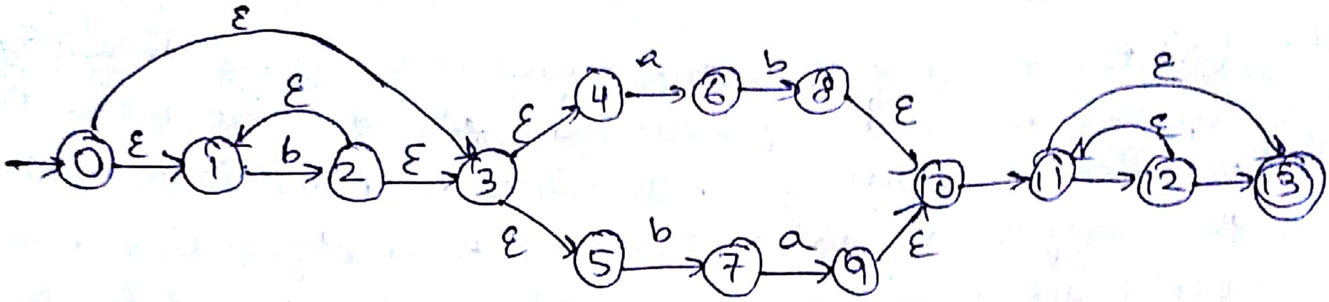
2. Considering a simplification of the combination of the NFA during the Thompson construction a possible NFA is shown below and where the start state is labeled 0.



The word w = "abbb" belongs to the language generated by this RE because there is a path from the start state 0 to the accepting state 13 that spells out the word, respectively.

0, 3, 4, 6, 8, 10, 11, 12, 13.

3. Using the ε-closure and DFA edge computation, we have the following mappings.

$I0 = \varepsilon\text{-closure}(0) = \{0, 1, 3, 4, 5\}$

$I1 = \text{DFA edge}(I0, a) = \varepsilon\text{-closure}(\{0,1,3,4,5\}) = \{6\}$

$I2 = \varepsilon\text{-closure}(\{0,1,3,4,5\}, b) = \{1,2,3,4,5,7\}$

$I3 = \varepsilon\text{-closure}(\{6\}, a) = I_{err}$

$I4 = \varepsilon\text{-closure}(\{6\}, b) = \{8, 10, 11, 13\}$.

$I5 = \varepsilon\text{-closure}(\{1,2,3,4,5,7\}, a) = \{6, 9, 10, 11, 13\}$

$I6 = \varepsilon\text{-closure}(\{1,2,3,4,5,7\}, b) = \{1,2,3,5,7\}$

$I7 = \varepsilon\text{-closure}(\{8,10,11,13\}, a) = I_{err}$

$I8 = \varepsilon\text{-closure}(\{8,10,11,13\}, b) = \{11, 12, 13\}$

$I9 = \varepsilon\text{-closure}(\{6,9,10,11,13\}, a) = I_{err}$

$I10 = \varepsilon\text{-closure}(\{6,9,10,11,13\}, b) = \{8,10,11,12,13\}$

$I11 = \varepsilon\text{-closure}(\{11,12,13\}, a) = I_{err}$

$I12 = \varepsilon\text{-closure}(\{11,12,13\}, b) = \{11, 12, 13\}$

$I13 = \varepsilon\text{-closure}(\{8,10,11,12,13\}, a) = I_{err}$

$I14 = \varepsilon\text{-closure}(\{8,10,11,12,13\}, b) = I8$.