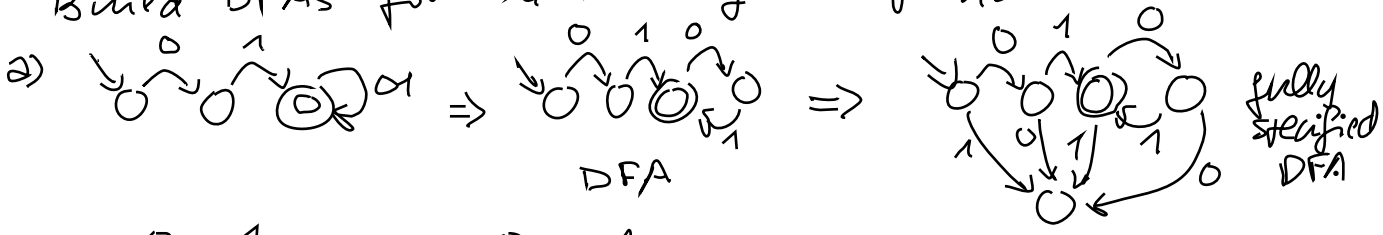
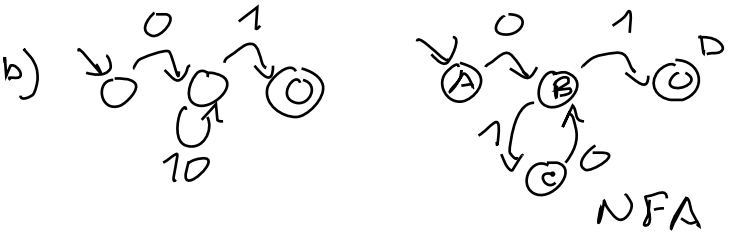
Formal Languages and Compilers Theory test September 16, 2022

1. (9 points) Verify the equivalence of the following two regular expressions:
   01 (01)* 0 (10)* 1

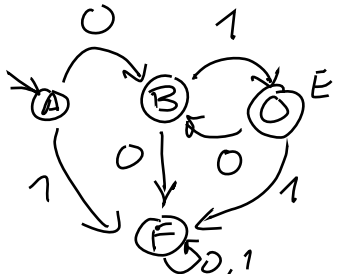
Build DFAs for the two regular expressions:

a) 

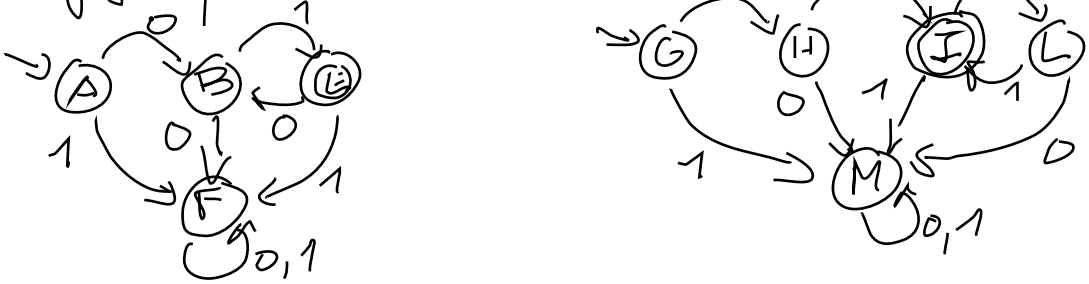
b) 

Build DFA

	0	1
→A	B	–
B	–	C,D
*C,D	B	–
E	–	–
F		



Verify equivalence:



Π_0 : {E, I}, {A, B, F, G, H, L, M}
Π_1 : {E, I}, {A, F, G, M}, {B, H, L}
Π_2 : {E, I}, {A, G}, {F, M}, {B, H, L}
Π_3 : {E, I}, {A, G}, {F, M}, {B, H, L}

The two regular expressions are equivalent because their DFAs are equivalent (their initial states are in the same equivalence class)

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2. (8 points) Find a PDA that accepts the context-free language that is made of all the strings that are composed of n occurrences of the X symbol followed by n repetitions of the + symbol or n repetitions of the - symbol, with n>0.
For example, XXX+++ and XXXX---- are strings belonging to this language, with n=3 and n=4 respectively.

context-free grammar for the language:

$S \rightarrow A \mid B$

$A \rightarrow xA+ \mid x+$

$B \rightarrow xB- \mid x-$

PDA: $(\{q\}, \{x,+,-\}, \{x,+,-,S,A,B\}, \delta, q, S, \Phi)$

δ:

$\delta(q,\varepsilon,S) = \{(q,A),(q,B)\}$

$\delta(q,\varepsilon,A) = \{(q,xA+),(q,x+)\}$

$\delta(q,\varepsilon,B) = \{(q,xB-),(q,x-)\}$

$\delta(q,x,x) = \delta(q,+,+) = \delta(q,-,-) = \{(q,\varepsilon)\}$

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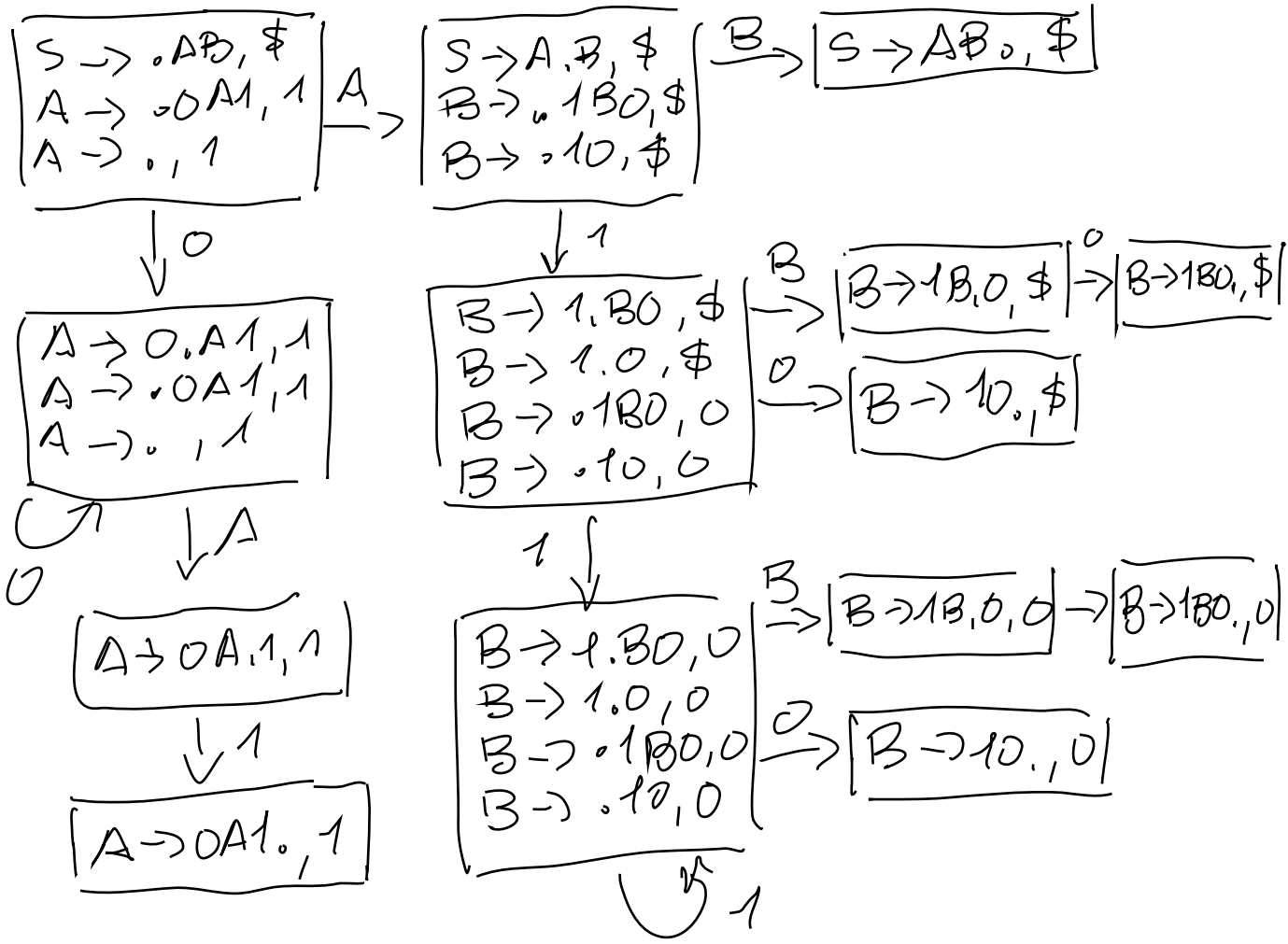
3. (9 points) Given the following grammar, whose set of terminal symbols is { 0, 1 } and whose start symbol is S, tell if the grammar is LR(1) or not and motivate your answer.

S → A B
A → 0 A 1 | ε
B → 1 B 0 | 1 0

	nullable	FIRST	FOLLOW
S	N	0, 1	$
A	Y	0	1
B	N	1	0, $

Build LR(1) DFA



From the DFA it is clear that the LR(1) parsing table will not contain conflicts. Then, the grammar is LR(1)

4. (6 points) What is the relation between the languages generated by linear grammars and the languages generated by regular grammars?

The languages generated by regular grammars are a subset of the languages generated by linear grammars.