Name	CORRECT SOLUTION
Group	

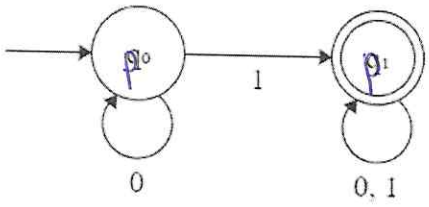
Course Name: Theoretical Computer Science
Midterm exam
Instructor: Manuel Mazzara

Year: 2021-2022 (Spring Semester)
Time allowed: 80 minutes
Max grade: 20 points

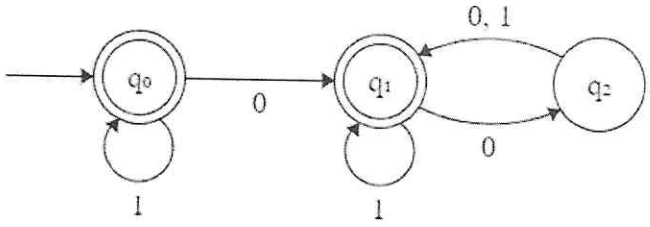
Task 1 (4 points). Construct in a graphical form a DFSA which corresponds to $M_1 \cup M_2$:

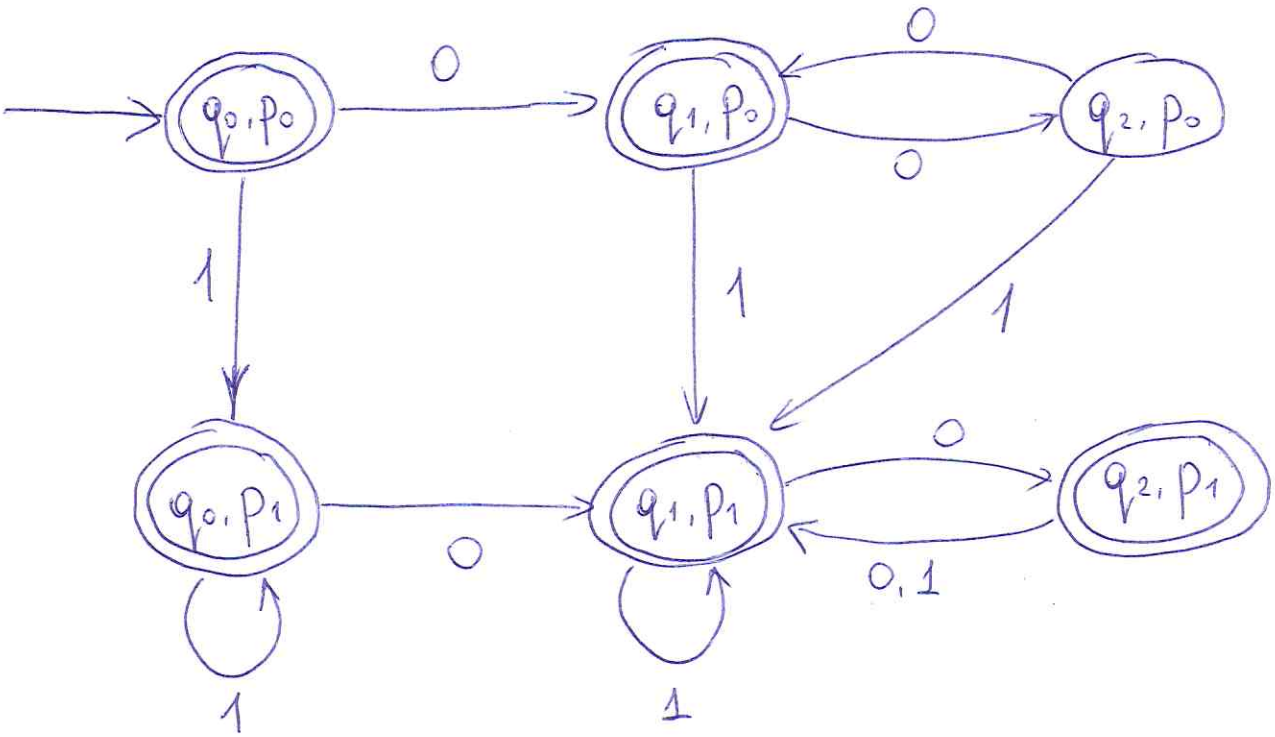
(NDFSA solutions will get 0 points)

M_1



M_2





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Task 2 (3 points). Complete the Pumping Lemma (multiple options are correct in (3)):

Let L be a regular language. Then (1)_____ integer $m \geq 1$ such that (2)_____ string w in L of length at least m can be written as $w = xyz$, satisfying the following conditions: (3)_____

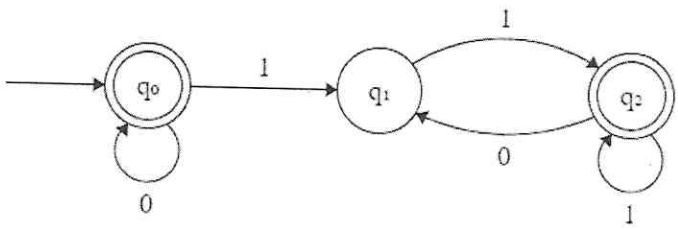
(1) a) there exists
b) for every

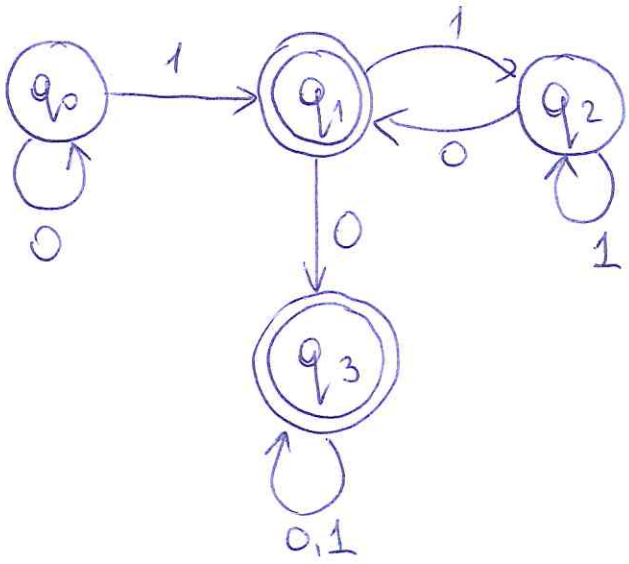
(2) a) there exists
b) every

(3) a) $|y| \geq 0$
b) $|y| \geq 1$
c) $|xyz| \leq m$
d) $|xy| \leq m$
e) $\exists i \geq 0\ xyiz \notin L$
f) $\forall i \geq 0\ xyiz \notin L$
g) $\exists i \geq 0\ xyiz \in L$
h) $\forall i \geq 0\ xyiz \in L$

Task 3 (2 points). Construct a complement of M_1 over the alphabet {0, 1}:

M_1





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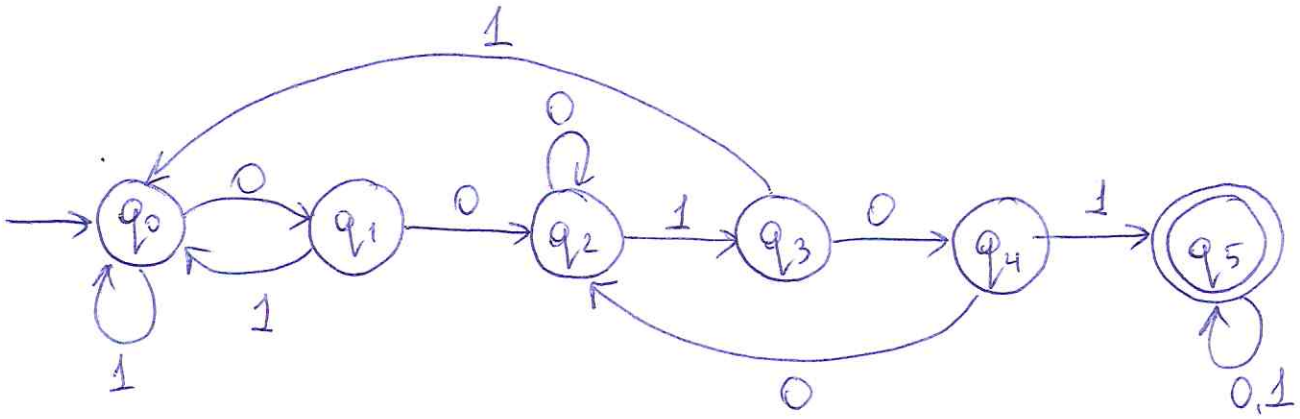
Task 4 (4 points). Construct a complete DFSA over the alphabet {0,1} that accepts the words including a substring 00101.



Task 5 (1 point). Which of the following statements are true about PDA:

(a) It has an external memory with an initial start symbol
b) It has an external memory that follows First in First Out Policy (FIFO)
(c) It can manipulate the external memory as part of performing a transition
(d) It uses the external memory to decide which transition has to be made
(e) It can be used for parsing programming languages
(f) Regular languages are recognized by PDAs

Task 6 (1 point). Is $L = \{a^m b^n |\ n > 0, m > 0\}$ a regular language?

a) Yes, which can be proved using pumping lemma
(b) Yes, but we cannot prove it using pumping lemma
c) No, but we cannot prove it using pumping lemma
d) No, which can be proved using pumping lemma

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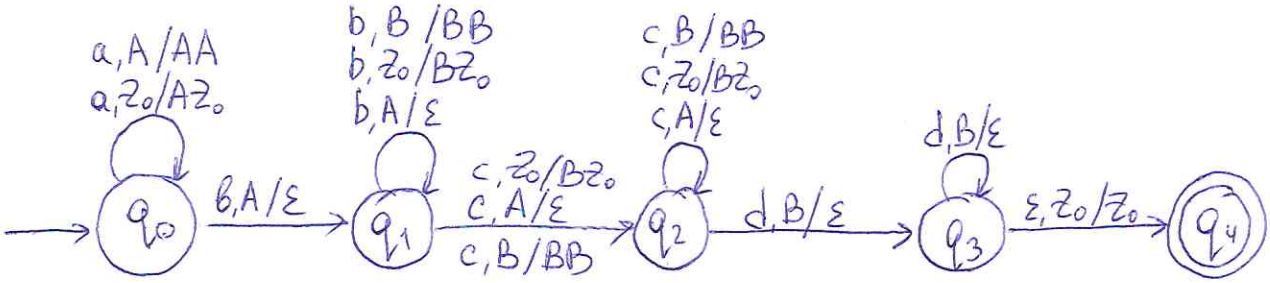
Task 7 (5 points). Solve **ONE** of the exercises:

a) Construct a DPDA that recognizes the language:
$L = \{a^m b^n c^p d^q | (m, n, p, q \geq 1) \wedge (m + q = n + p)\}$



b) Construct a DPDA that recognizes the language:
$L = \{a^m b^n a^m | (m \geq 0) \wedge (n \geq 0)\}$