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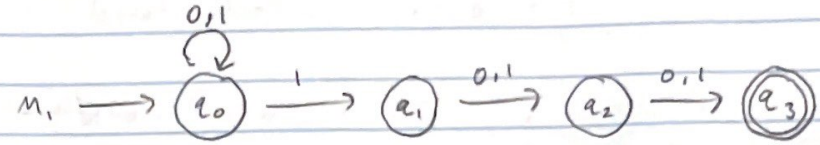
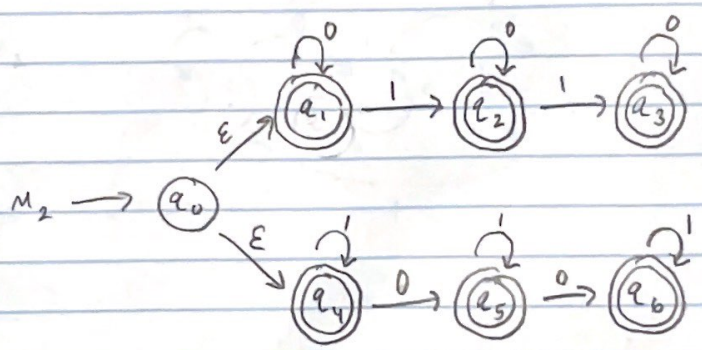
Homework 3

Problem 1

1. All binary numbers that contain a 1 in the 3rd location from the right (e.g. 100, 10111, ...)



2. All binary numbers that contain at most two 1's or contain at most two 0's (e.g. ε, 111101, 01000, ...)



3. All binary numbers that can be divided by 4.

$m = c \pmod 4$, $c \in \{0, 1, 2, 3\}$

$c = 0$, $m = 4k$
- 0: $2m = 8k \equiv 0 \pmod 4$
- 1: $2m+1 = 8k+1 \equiv 1 \pmod 4$

$c = 1$, $m = 4k+1$
- 0: $2m = 8k+2 \equiv 2 \pmod 4$
- 1: $2m+1 = 8k+3 \equiv 3 \pmod 4$

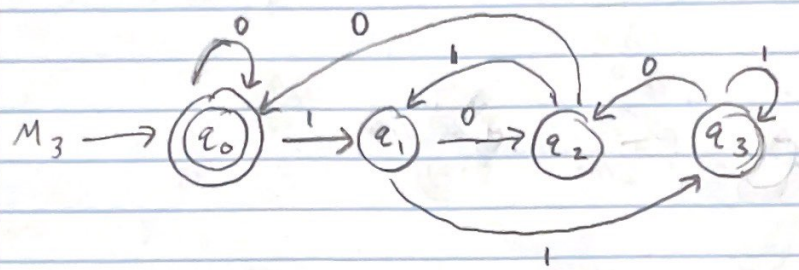
(1.3 continued)

$C = 2 \quad m = 4k+2$

- 0 → $2m = 8k+4 \equiv 0 \pmod 4$
- 1 → $2m+1 = 8k+5 \equiv 1 \pmod 4$

$C = 3 \quad m = 4k+3$

- 0 → $2m = 8k+6 \equiv 2 \pmod 4$
- 1 → $2m+1 = 8k+7 \equiv 3 \pmod 4$

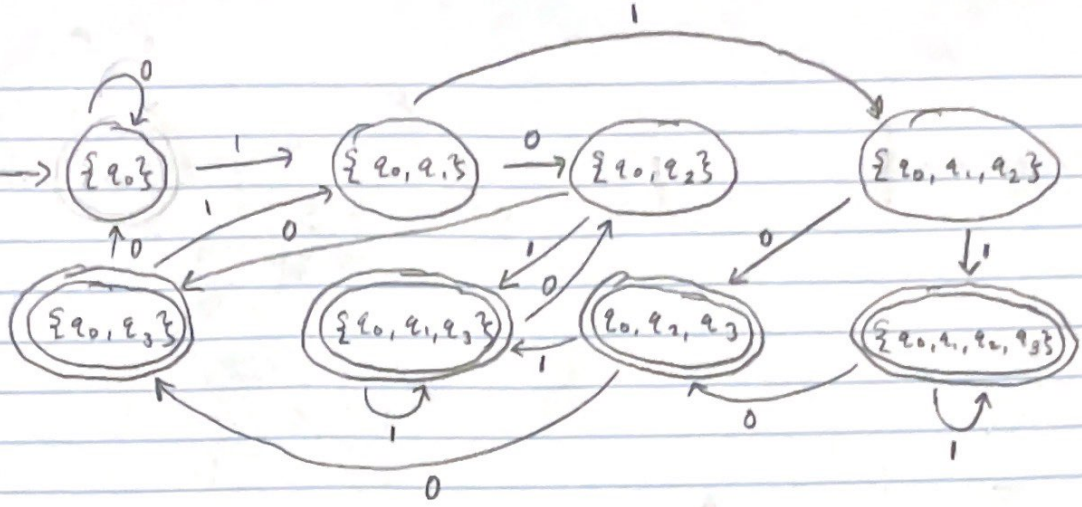


Problem 2

2.1 DFA for Problem 1.1

State	0	1
$S^* \{q_0\}$	$\{q_0\}$	$\{q_0, q_1\}$
$\{q_0, q_1\}$	$\{q_0, q_2\}$	$\{q_0, q_1, q_2\}$
$\{q_0, q_2\}$	$\{q_0, q_3\}$	$\{q_0, q_1, q_3\}$
$\{q_0, q_1, q_2\}$	$\{q_0, q_2, q_3\}$	$\{q_0, q_1, q_2, q_3\}$
$\{q_0, q_3\}$	$\{q_0\}$	$\{q_0, q_1\}$
$\{q_0, q_1, q_3\}$	$\{q_0, q_2\}$	$\{q_0, q_1, q_2\}$
$\{q_0, q_2, q_3\}$	$\{q_0, q_3\}$	$\{q_0, q_1, q_3\}$
$\{q_0, q_1, q_2, q_3\}$	$\{q_0, q_2, q_3\}$	$\{q_0, q_1, q_2, q_3\}$

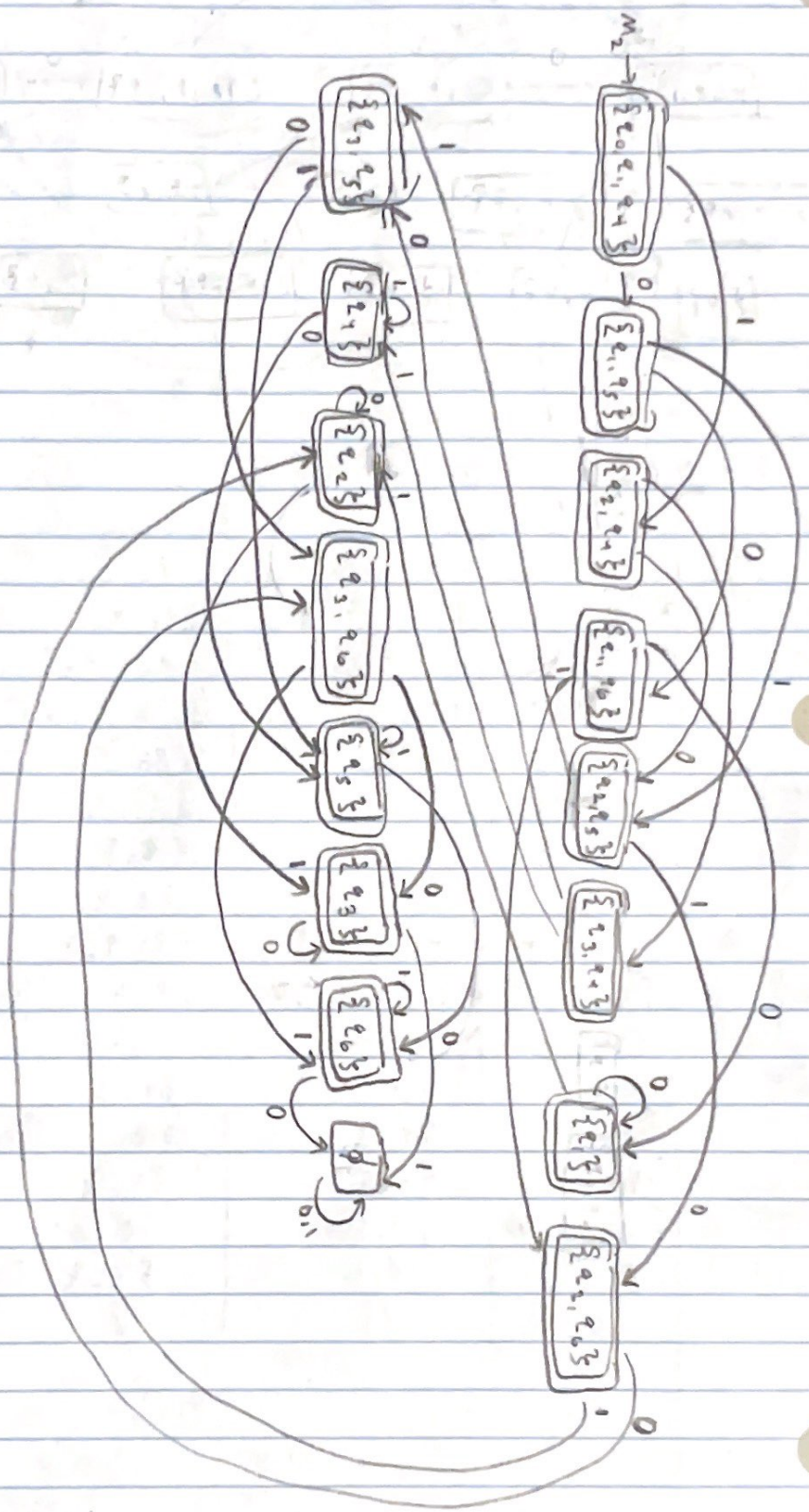
(2.1 continued) M_1 →



2.2 DFA for Problem 1.2

State	0	1
$S^*\{q_0, q_1, q_4\}$	$\{q_1, q_5\}$	$\{q_2, q_4\}$
$\{q_1, q_5\}$	$\{q_1, q_6\}$	$\{q_2, q_5\}$
$\{q_2, q_4\}$	$\{q_2, q_5\}$	$\{q_3, q_4\}$
$\{q_1, q_6\}$	$\{q_1\}$	$\{q_2, q_6\}$
$\{q_2, q_5\}$	$\{q_2, q_6\}$	$\{q_3, q_5\}$
$\{q_3, q_4\}$	$\{q_3, q_5\}$	$\{q_4\}$
$\{q_1\}$	$\{q_1\}$	$\{q_2\}$
$\{q_2, q_6\}$	$\{q_2\}$	$\{q_3, q_6\}$
$\{q_3, q_5\}$	$\{q_3, q_6\}$	$\{q_5\}$
$\{q_4\}$	$\{q_5\}$	$\{q_4\}$
$\{q_2\}$	$\{q_2\}$	$\{q_3\}$
$\{q_3, q_6\}$	$\{q_3\}$	$\{q_6\}$
$\{q_5\}$	$\{q_6\}$	$\{q_5\}$
$\{q_3\}$	$\{q_3\}$	ϕ
$\{q_6\}$	ϕ	$\{q_6\}$
ϕ	ϕ	ϕ

(2.2 (continued)



2.3 DFA for Problem 1.3

State	0	1
S^* $\{q_0\}$	$\{q_0\}$	$\{q_1\}$
$\{q_1\}$	$\{q_2\}$	$\{q_3\}$
$\{q_2\}$	$\{q_0\}$	$\{q_1\}$
$\{q_3\}$	$\{q_2\}$	$\{q_3\}$