CS 321: Assignment 2

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1. Answer:
   $Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6\}$
   $F = \{q_5, q_6\}$

   Transition table

State	a	b
$\{q_0\}$	$\{q_0, q_1\}$	$\{q_0, q_2\}$
$\{q_1\}$	$\{q_1, q_3\}$	$\{q_1\}$
$\{q_2\}$	$\{q_2\}$	$\{q_2, q_4\}$
$\{q_3\}$	$\{q_3, q_5\}$	$\{q_3\}$
$\{q_4\}$	$\{q_4\}$	$\{q_4, q_6\}$
$\{q_5\}$	$\{q_5\}$	$\{q_5\}$
$\{q_6\}$	$\{q_6\}$	$\{q_6\}$

2. Answer: $Q = \{\{1\}, \{1,2\}, \{1,2,3\}, \{1,2,3,4\}\}$ $F = \{q_5, q_6\}$

   Transition table

State	a	b
$\{1\}$	$\{1,2,3,4\}$	$\emptyset$
$\{1,2\}$	$\{1,2,3,4\}$	$\{1,2\}$
$\{1,2,3\}$	$\{1,2,3,4\}$	$\{1,2\}$
$\{1,2,3,4\}$	$\{1,2,3,4\}$	$\{1,2,3\}$

3. Answer

   (a) define M_5 such that $L(M_5)$ accepts all strings in either $L(M_2)$ or $L(M_1)$ but not both: $L(M_5) = L(M_1) \cup L(M_2) \setminus L(M_1) \cap L(M_2)$

   (b) Let $M_3 = M_1 \cup M_2$:
   $Q_{M3} = \{AD, AE, AF, BD, BE, BF, CD, CE, CF\}$ $F_{M3} = \{AD, AE, AF, BD, BE, BF, CF\}$
   Transition table

State	a	b
AD	AE	BD
AE	AF	BD
AF	AF	BD
BD	AE	CD
BE	AF	CD
BF	AF	CD
BD	AE	CD
BE	AF	CD
BF	AF	CD

(c) Let $M_4 = M_1 \cap M_2$:
$Q_{M4} = \{AD, AE, AF, BD, BE, BF, CD, CE, CF\}$ $F_{M4} = \{AF, BF\}$
Transition table

State	a	b
AD	AE	BD
AE	AF	BD
AF	AF	BD
BD	AE	CD
BE	AF	CD
BF	AF	CD
BD	AE	CD
BE	AF	CD
BF	AF	CD

(d) $M_5 = M_3 \setminus M_2$ $Q_{M5} = \{AD, AE, AF, BD, BE, BF, CD, CE, CF\}$
$F_{M5} = F_{M3} \cap F_{M4} = \{AD, AE, BD, BE, CF\}$
Transition table

State	a	b
AD	AE	BD
AE	AF	BD
AF	AF	BD
BD	AE	CD
BE	AF	CD
BF	AF	CD
BD	AE	CD
BE	AF	CD
BF	AF	CD

4. Answer:

(a) Let A be the set of all strings with '011' inserted only once: $\Sigma_A = \{0, 1\}$
$Q_A = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6\}$
$F_A = \{q_3, q_4, q_5\}$

A Transition Table:

State	0	1
q_0	q_1	q_0
q_1	q_0	q_2
q_2	q_0	q_3
q_3	q_4	q_3
q_4	q_3	q_5
q_5	q_3	q_6
q_6	q_6	q_6

(b) Let B be the set of all strings divisible by 3. $\Sigma_B = \{0, 1\}$
$Q_B = \{q_0, q_1, q_2\}$
$F_B = \{q_0\}$
B Transition Table:

State	0	1
q_0	q_0	q_1
q_1	q_2	q_0
q_2	q_1	q_2

(c) Then, the final answer $C = A \cap B$

(d) Intersection is closed under the set of regular languages so C is regular.