Homework 3

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Problem. 1

(a) The states number in total is

$$N = 99^2 * 4^2 * 99^2 * 4^2 * 50 * 51 * 2 * 900 = 1.129 \times 10^{17}$$

The minimum number of bits we need to use to store the states is

$$b = \lceil \log N \rceil = 57$$

(b) Let b_i be the number of bits we need to build the circuit of element i, then

$$\begin{aligned} b_1 &= \lceil \log 99^2 \rceil = 14 \\ b_2 &= \lceil \log 4^2 \rceil = 4 \\ b_3 &= \lceil \log 99^2 \rceil = 14 \\ b_4 &= \lceil \log 4^2 \rceil = 4 \\ b_5 &= \lceil \log(50 * 51) \rceil = 12 \\ b_6 &= \lceil \log 2 \rceil = 1 \\ b_7 &= \lceil \log 900 \rceil = 10 \end{aligned}$$

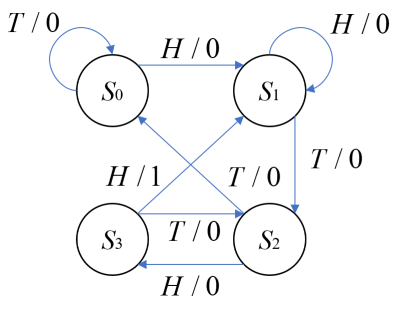
The total is

$$b' = \sum b_i = 59$$

(c) Although part b has 2 more bits to use, it separates the functions of each bit, making the whole state clearer in practical application.

Problem. 2

(a) The complete finite state mechine diagram is as follows. $H/0$ means the input is H and the following output is 0.



(b) 2, define $S = Q_1 Q_0$.

Problem. 3

Let N be the number of bytes of memory the computer have. It should be the address space times the addressibility, using byte as unit.

$$N = 2^8 \times 8 = 2048$$

Problem. 4

(a) $A[1:0] = 10, WE = 0$.

(b) $N = \lceil \log 60 \rceil = 6$. Because the number of bits of each location is unchanged, the addressability remains unchanged after the change was made.

(c) $n = 2^N - 60 = 4$.

Problem. 5

(a) 2.

(b) 16 bit.

(c) $n = 2^2 * 16/8 = 8$ bytes.

(d) The complement is as follows.

WE	A[1:0]	Di[15:0]	D[15:0]	Read/Write
0	01	xFADE	x4567	Read
1	10	xDEAD	xDEAD	Write
0	00	xBEEF	x0123	Read
1	11	xFEED	xFEED	Write

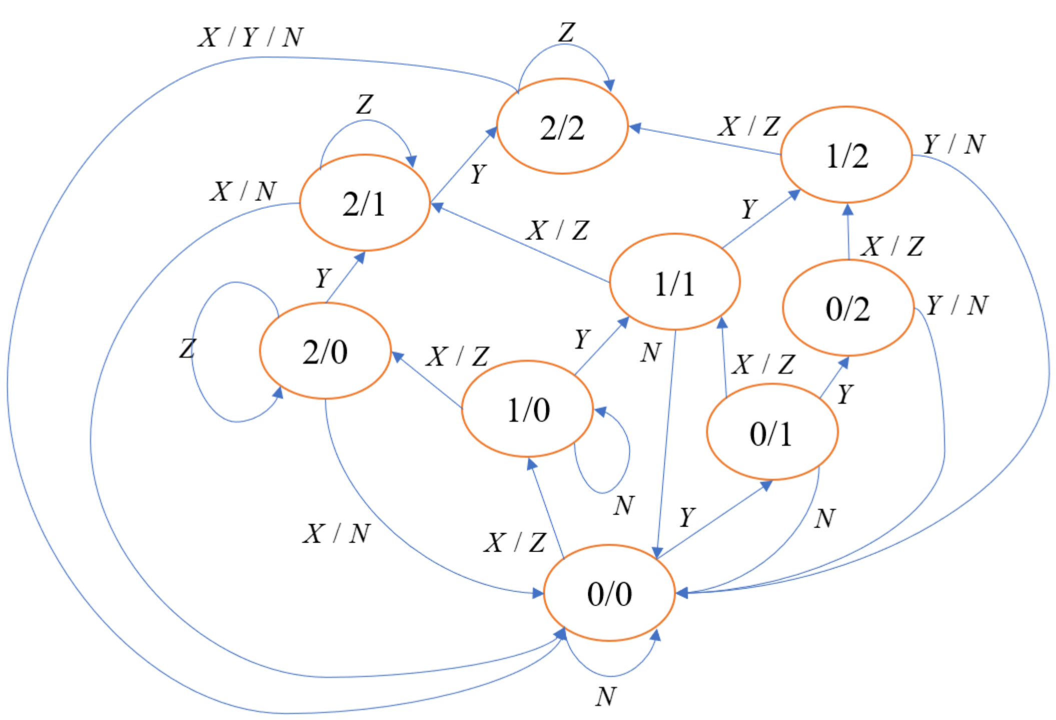
Problem. 6

(a) $n_{op} = \lceil \log 255 \rceil = 8$.

(b) $n_{dr} = \lceil \log 120 \rceil = 7$.

(c) $n_{un} = 32 - 8 - 3 \times 7 = 3$.

Problem. 7



Problem. 8

	cycle0	cycle1	cycle2	cycle3	cycle4	cycle5	cycle6	cycle7
D2	0	1	1	1	1	0	0	0
D1	0	1	1	0	0	1	1	0
D0	0	1	0	1	0	1	0	1

Function : 3 bit's subtraction counter.