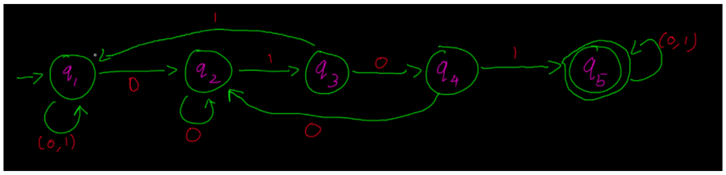
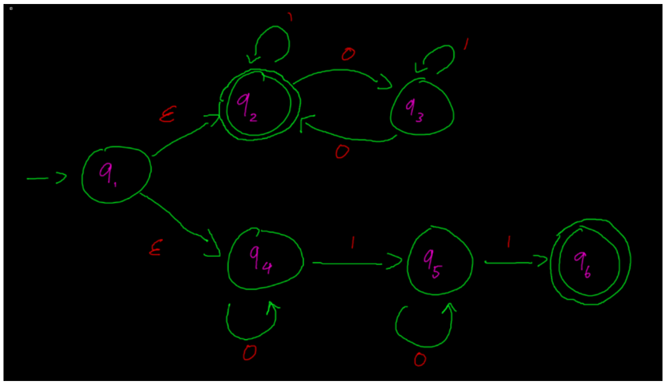
Problem 1.7

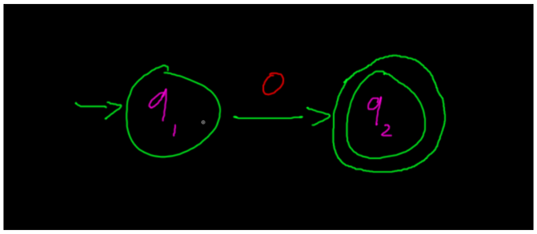
b. 1.6c with five states



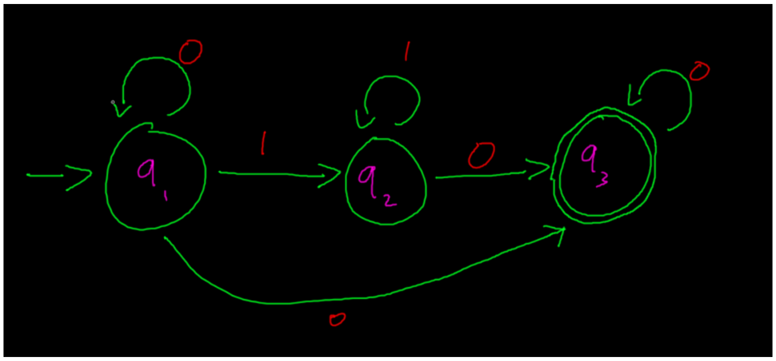
c. 1.6l with six states



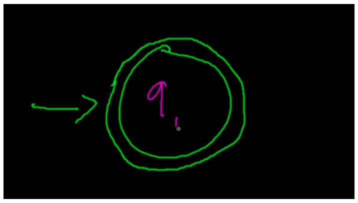
d. The language {0} with two states



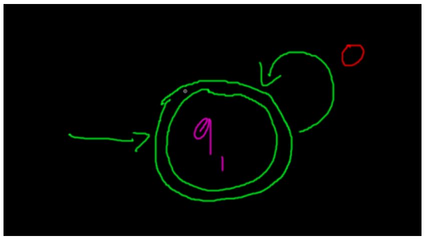
e. The language $0^*1^*0^+$ with three states



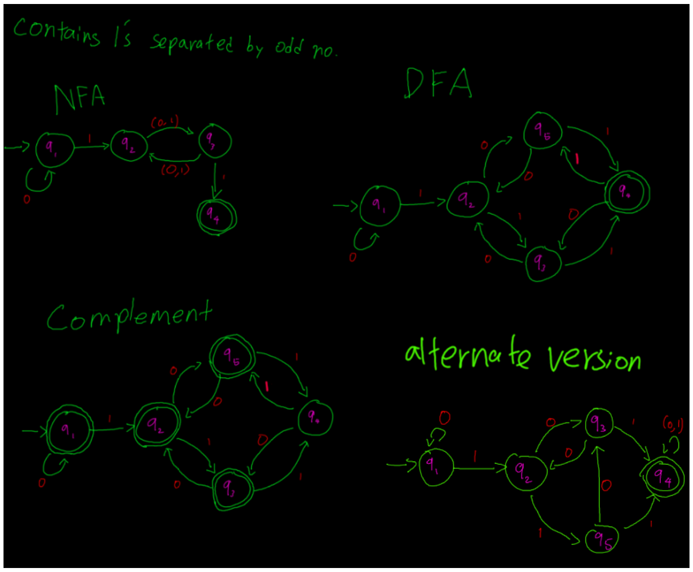
g. The language $\{\epsilon\}$ with one state



h. The language 0^* with one state



Problem 1.13



The complement that I created would not work with "1101". So I created an alternate version. However, that version does not work with the string "1001001". I not think that it is possible to create a working DFA with only 5 states.

Problem 1.32

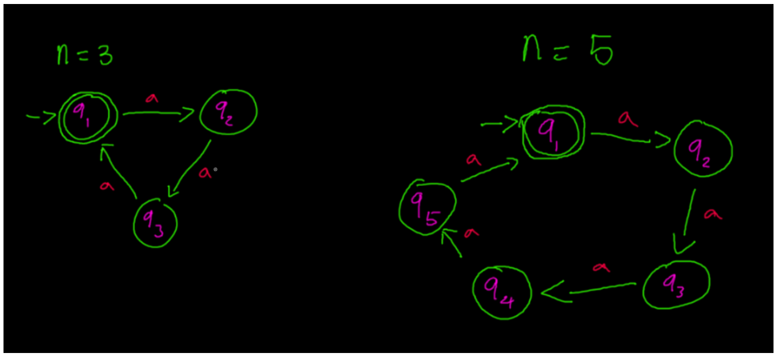
We can create a DFA called M_B that will look at the "carry" of the additions. There will be 2 states q_0 and q_1 for the binary carry. This can be denoted as q_i such that $i = \{0, 1\}$
M_B definition:
$Q : \{q_0, q_1, q_2\}$
$\Sigma : \Sigma_3$
δ can be shown as:

$$\delta(q_i, [a, b, c]) = \begin{cases} q_{(a+b+i)/2} & \text{if } i \in \{0, 1\} \text{ and } c = (a + b + i) \mod 2 \\ q_2 & \text{if } n \text{ else} \end{cases}$$

q_0 is the start state
$F : \{q_2\}$

Problem 1.36

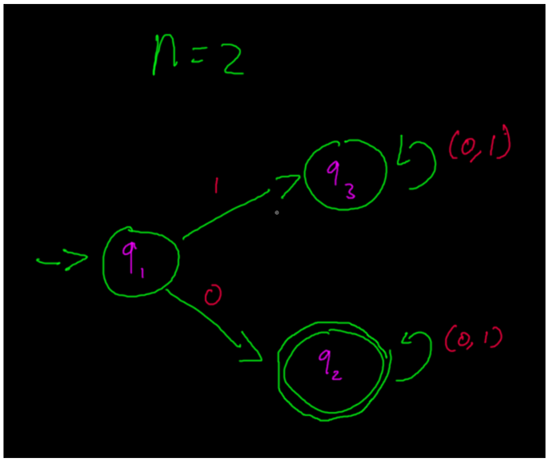
DFA's can easily be constructed for the different cases of n. two example are if n = 3 and n = 5



This pattern can be created for any such $n \geq 1$. Which means that the language B_n can be considered as regular.

Problem 1.37

To show that C_n is a regular language, we can show that it is possible to create a DFA for C_2.



Problem 1.41

We can assume that the states that hold the language A and B are regular. We can denote these two languages as M_A and M_B We can define the DFA of the perfectShuffle language as M. The formal defenition of M can be shown as:
$Q : Q_A \cdot Q_B \cdot \{A, B\}$
$\Sigma : \Sigma_A \cup \Sigma_B$
$F : F_A \cdot F_B \cdot \{A\}$
$\delta((x, y, A), a) = (\delta_A(x, a), y, B)$
This shows that if the language M_A is at x, then the language M_B is at y and M_A contains the character that has been read next. Once the next character has been read, we can then change the language M_A to $\delta_A(x, a)$ showing that the next character to be read will be in M_B