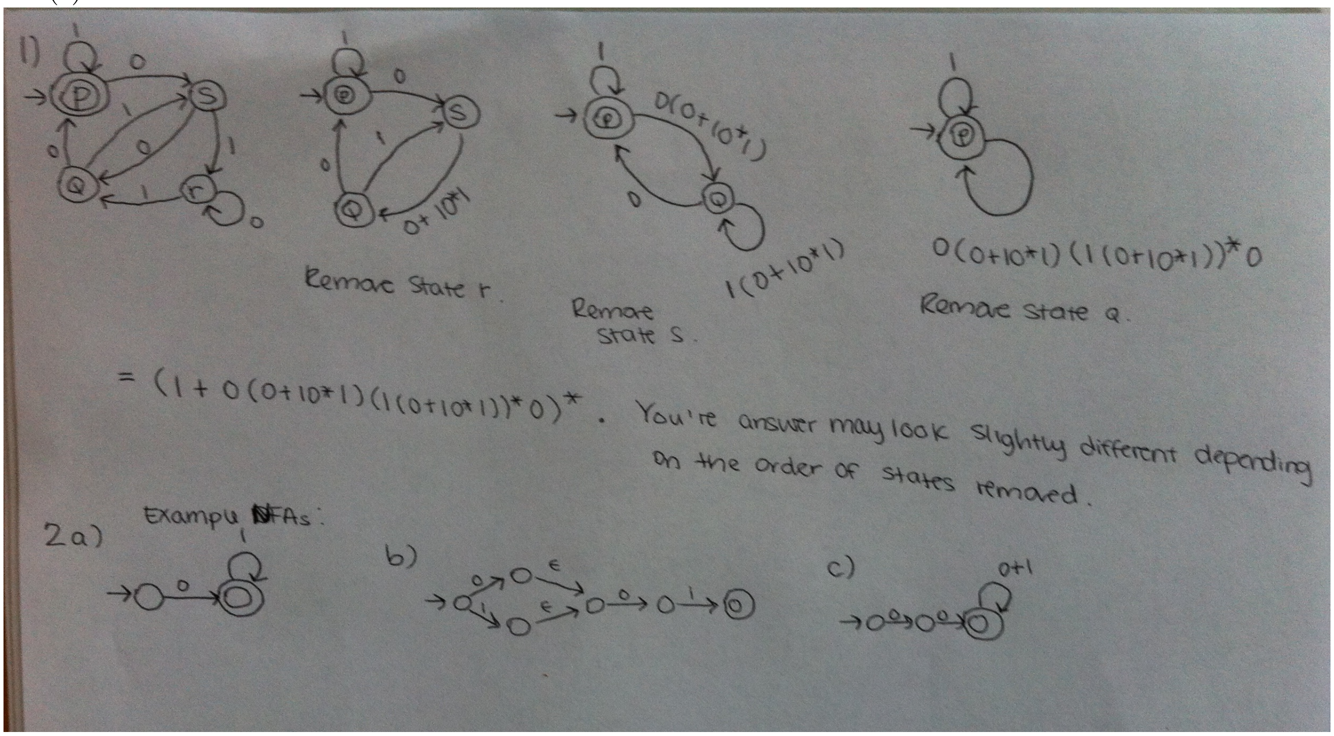
DISCLAIMER: The solutions presented below are incomplete and might be insufficient to get full grade on the homework. They do not model acceptable solutions, but rather present an idea of how a certain problem can be approached. A diligent student should be able to work out complete solutions. Please report any mistakes that you find to the instructor and TA(s).



3. All subparts of problem 3 can be solved using the pumping lemma.

   Let n be given by the pumping lemma. Choose string $w \in L$ s.t. $|w| \geq n$. Then by the pumping lemma, w can be broken into three strings $w = xyz$ s.t. $y \neq \epsilon$, $|xy| \leq n$ and $\forall k \geq 0$, $xy^k z \in L$.

   Below, see an example choice of w that will give the desired contradiction, namely that $xy^k z \notin L$ for some k.

   (a) $w = 0^n 1^n, k = 0$
   (b) $w = (^n)^n, k = 0$
   (c) $w = 0^n 1 0^n, k = 0$
   (d) $w = 0^n 1^n 2^n, k = 0$
   (e) $w = 0^n 1^n, k = 2$
   (f) $w = 0^n 1^{2n}, k = 0$

4. All subparts of problem 4 can be solved using the pumping lemma. There are multiple possible choices of strings.

   Let n be given by the pumping lemma. Choose string $w \in L$ s.t. $|w| \geq n$. Then by the pumping lemma, w can be broken into three strings $w = xyz$ s.t. $y \neq \epsilon$, $|xy| \leq n$ and $\forall k \geq 0$, $xy^k z \in L$.

   (a) $w = 0^{n^2}$. If $k = 2$, then $|w' = xy^2 z| = n^2 + |y| \leq n^2 + n$. Since $n^2 < n^2 + n < (n+1)^2$, then $|w'|$ is not a perfect square and $w' \notin L$.

(b) $w = 0^{n^3}$. If $k = 2$, then $|w' = xy^2z| = n^3 + |y| \leq n^3 + n$. Since $n^3 < n^3 + n < (n+1)^3$, then $|w'|$ is not a perfect cube and $w' \notin L$.

(c) $w = 0^{2^n}$. If $k = 2$, then $|w' = xy^2z| = 2^n + |y| \leq 2^n + n$. Since $2^n < 2^n + n < 2^(n+1)$, then $|w'|$ is not a power of two and $w' \notin L$.

(d) $w = 0^{n^2}$ is an example of this and was shown in part a not to be regular.

(e) $w = 0^n1$, so string $w' = ww = 0^n10^n1 \in L$. Consider $k = 0$.

(f) $w = 0^n1$, so string $w' = ww^R = 0^n110^n \in L$. Consider $k = 0$.

(g) $w = 0^n$, so string $w' = w\bar{w} = 0^n1^n \in L$, which is known to be not regular.

(h) $w = 0^n$ gives us $w1^n = 0^n1^n \in L$, but this known to be not regular.

5. Use the formula definition of a DFA to construct a DFA for the language of each of the following operations.

   (a) Modify δ to remove all transitions leaving an accepting state.

   (b) Remove all accepting states with a transition leaving the state non-accepting.

   (c) Make all states leading to an accepting state an accepting state and make all accepting states without transitions non-accepting.