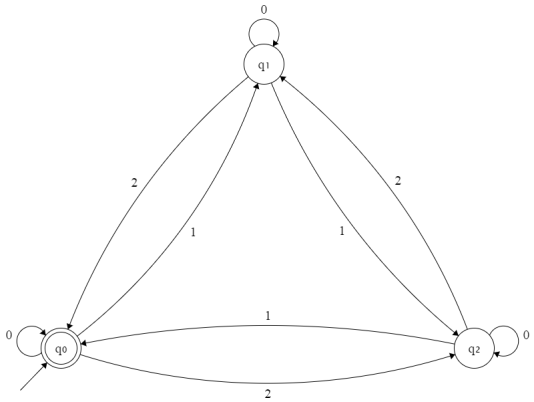
Homework 1
Com S 331, Spring 2017
Due date: **Monday, January 23, 2017**
Please submit the homework via BlackBoard **before the class that day**.

Note: all submissions should be .pdf or .doc(x) format. However, state diagrams can be drawn with hand and presented in the final manuscript as images. We recommend to use Latex for typing homeworks. Please note that in this homework we **do not** require from you to formally prove the correctness of the finite state automata that you present.

Total points available: 100

0. Read the class-book (Sipser, 3rd edition) up to page 40.

1. **(30 points)** On lectures you have seen a finite state automaton over an alphabet $\Sigma_3 = \{0, 1, 2\}$ that given a word $w = w_1 w_2 ... w_k \in \Sigma_3^*$ accepts it if and only if $\sum_{i=1}^{k} w_i \equiv 0 \mod 3$. That is, the sum of symbols in w is 0 modulo 3. This automaton is given in the figure below.



Let $\Sigma_r = \{0, 1, ..., r\}$, and let

$$L_{r,t} = \{w = w_1 \dots w_k \in \Sigma_r^* | \sum_{i=1}^{k} w_i \equiv 0 \mod t\}$$

for some $r \geq 2$ and $t \geq 3$. Here we ask you to construct a finite state automaton $M_{r,t} = (Q, \Sigma_r, \delta, q_0, F)$ that recognizes (accepts) the language $L_{r,t}$ for some fixed r and t.

Note: you **should not** draw the state diagram, but instead formally state what are the components Q, δ, q_0 and F of the FSA $M_{r,t}$ that you construct.

2. **(50 points)** Solve items **(a), (b), (d), (f), (g), (n)** of the problem **1.6** in the class-book. Please, do not forget to indicate the initial states in your solutions.

   We encourage you to solve all the items from this problem, as it gives a very valuable training that will help through the rest of the course.

3. **(20 points)** Solve problem **1.24** from the class-book.