

# Formal Languages Homework 2

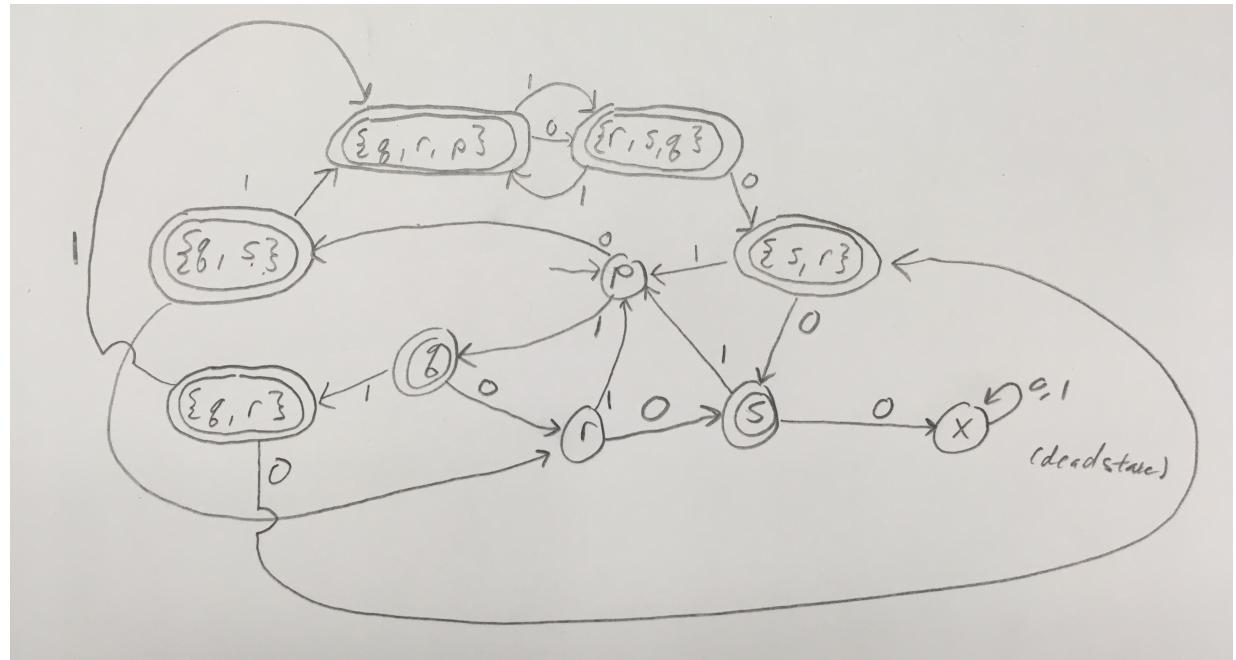
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## 1 Problem 2.3.2

Convert to a DFA the following NFA:

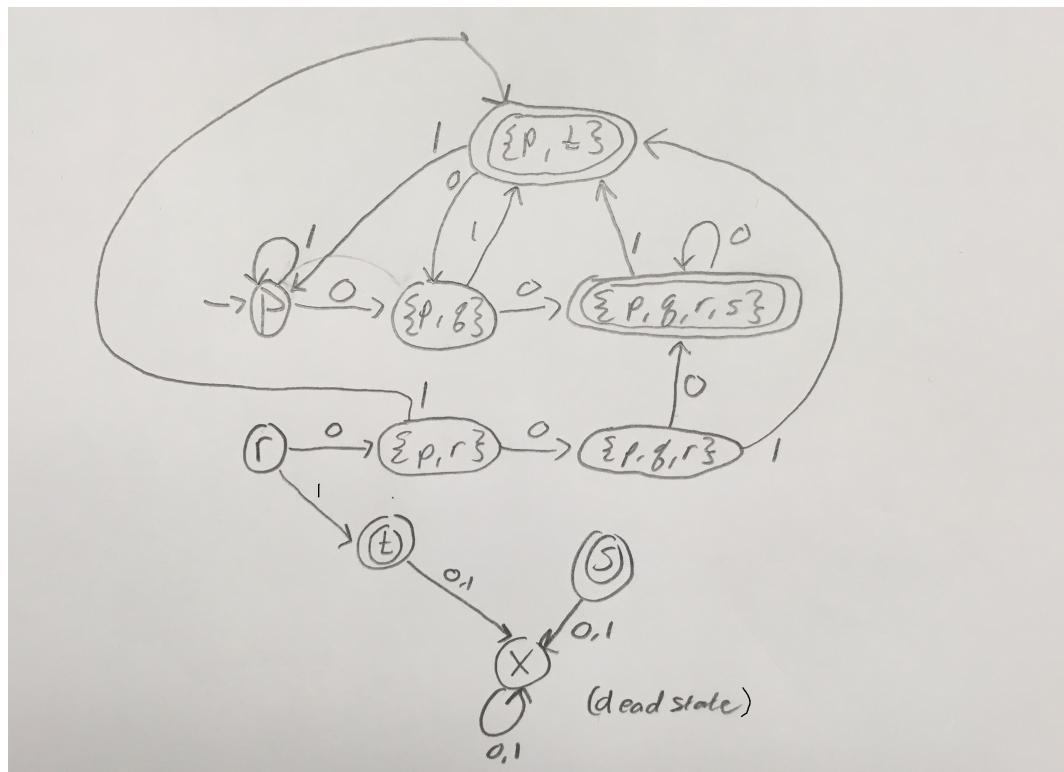
|                 | 0           | 1          |
|-----------------|-------------|------------|
| $\rightarrow p$ | $\{q, s\}$  | $\{q\}$    |
| $*q$            | $\{r\}$     | $\{q, r\}$ |
| $r$             | $\{s\}$     | $\{p\}$    |
| $*s$            | $\emptyset$ | $\{p\}$    |



## 2 Problem 2.3.3

Convert the following NFA to a DFA and informally describe the language it accepts.

|                 | 0           | 1           |
|-----------------|-------------|-------------|
| $\rightarrow p$ | $\{p, q\}$  | $\{p\}$     |
| $q$             | $\{r, s\}$  | $\{t\}$     |
| $r$             | $\{p, r\}$  | $\{t\}$     |
| $s, s$          | $\emptyset$ | $\emptyset$ |
| $s, t$          | $\emptyset$ | $\emptyset$ |

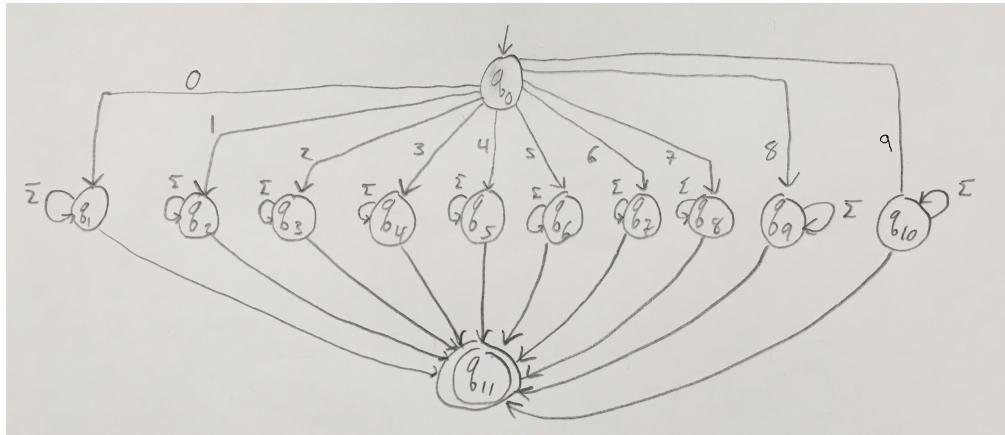


The language accepted by the NFA/DFA is all strings ending in 00, or 01.

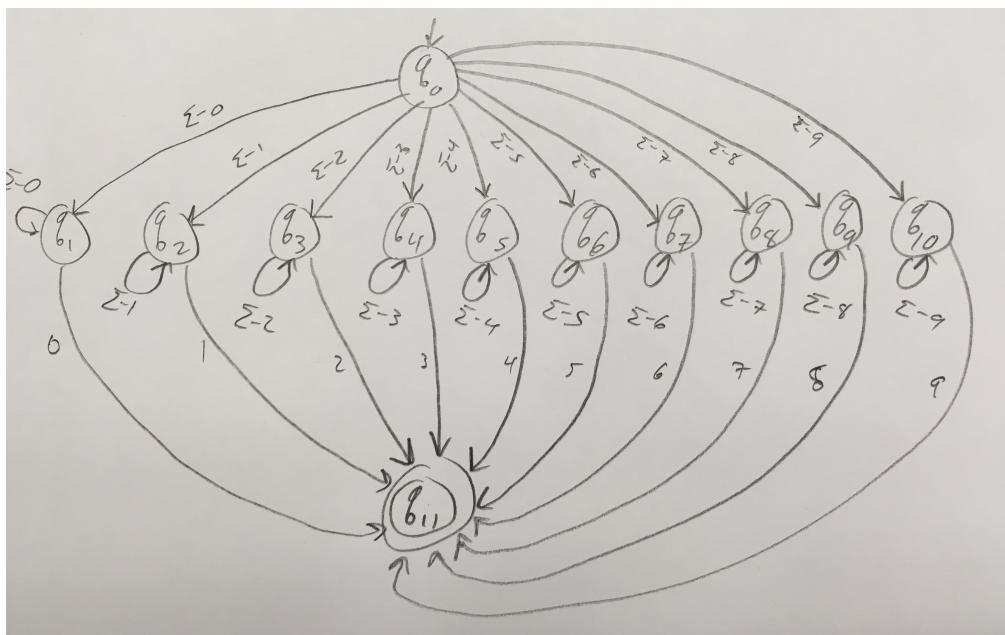
### 3 Problem 2.3.4

Give nondeterministic finite automata to accept the following languages. Try to take advantage of nondeterminism as much as possible

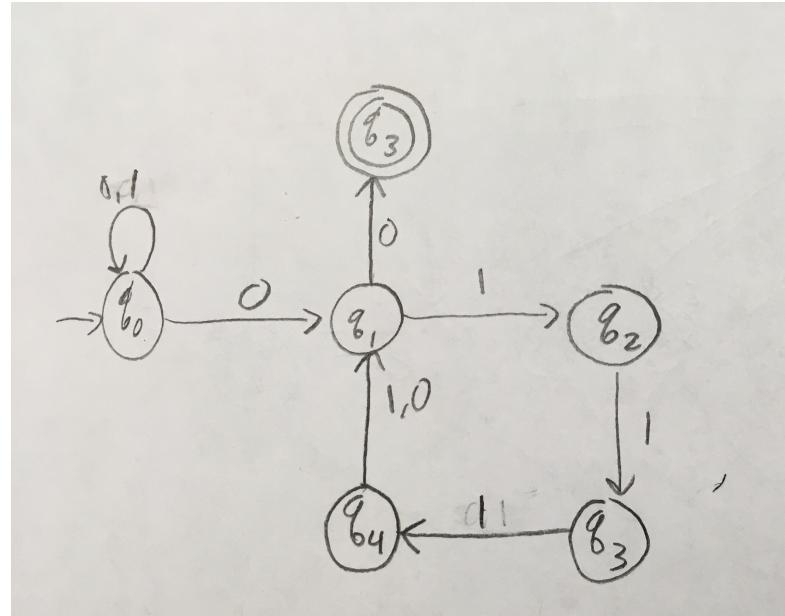
- 3.1 a). The set of strings over alphabet  $\{0, 1, \dots, 9\}$  such that the final digit has appeared before



- 3.2 b). The set of strings over alphabet  $\{0, 1, \dots, 9\}$  such that the final digit has not appeared before



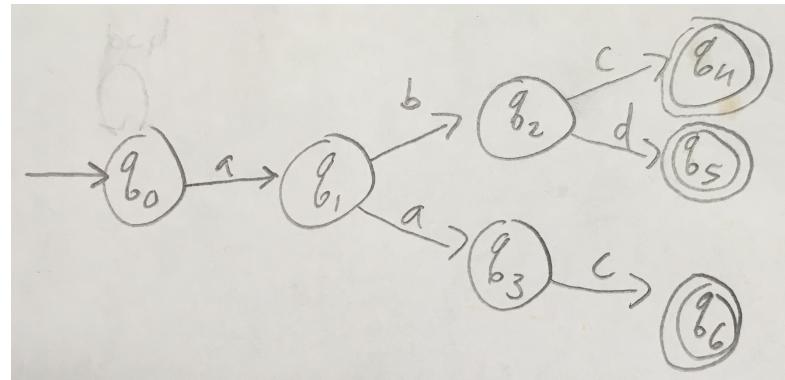
- 3.3 c). The set of strings of 0's and 1's such that there are two 0's separated by a number of positions that is a multiple of 4. Note that 0 is an allowable multiple of 4



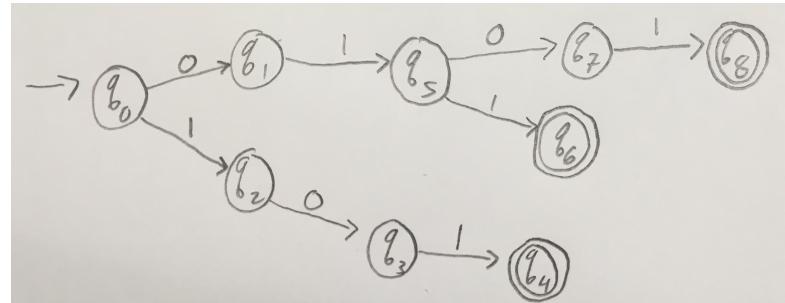
#### 4 Problem 2.4.1

Design NFA's to recognize the following sets of strings:

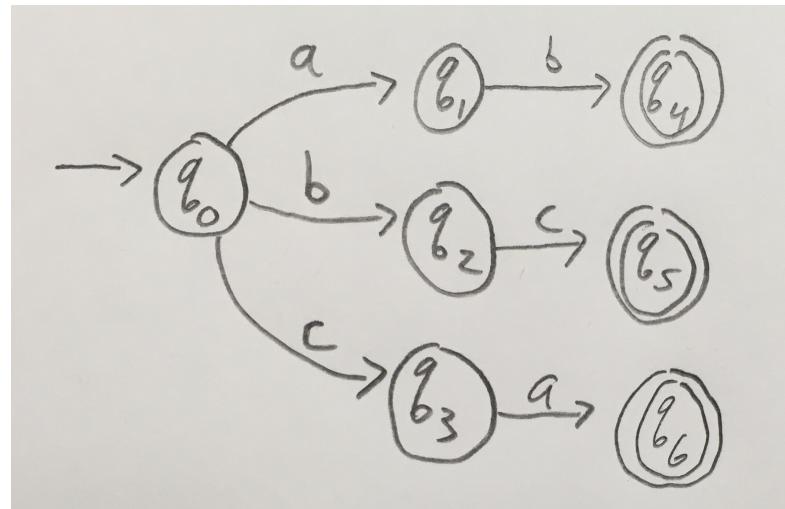
- 4.1 a).  $abc, abd$ , and  $aacd$ , Assume the alphabet is  $\{a, b, c, d\}$ .



4.2 b). 0101, 101, and 011.



4.3 c). ab, bc, and ca. Assume the alphabet is  $\{a, b, c\}$ .



## 5 Problem 2.4.2b

Convert each of your NFA's from Problem 2.4.1 to DFA's (We only complete part b here).

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