5DV037 Fundamentals of Computer Science Fall 2010
Obligatory Exercise 1
Due date: September 10, 2010 at 5pm (1700)

1. Let $\Sigma = \{a, b, c\}$, and define $L = \{\alpha \in \Sigma^* \mid \alpha$ does not contain the substring $abc\}$. Design a DFA which accepts L. Show your solution as a transition graph and explain clearly why it is correct.

2. Let $\Sigma = \{a, b, c, d, e\}$, and define $L = \{\alpha \in \Sigma^* \mid \mathsf{Count}\langle x, \alpha \rangle \geq 2$ for each $x \in \{a, b\}\}$. Design a DFA which accepts L. Show your solution as a transition graph and explain clearly why it is correct.
Hint: Think of having one state for each possibility of the number of a's, b's, and c's which have been read so far (up to two of each). Then add appropriate starting and ending states.

3. Web sites often give annoying requirements for the form of passwords. Consider the following fairly typical requirement:

> A valid password must contain at least one uppercase letter, at least one lowercase letter, and at least two digits.

To model this situation, let $\Sigma = \{A, B, \ldots, Z, a, b, \ldots, z, 0, 1, \ldots, 9\}$, and define L to be the language over Σ consisting of strings satisfying the above password condition. Adapt your solution to Problem 2 to obtain a DFA which accepts L.

4. Let $\Sigma = \{a, b, c, d, e, f\}$, and define L to be the language over Σ consisting of those strings which contain *abcabd* as a substring. Design an NFA which accepts L. Show your solution as a transition graph and explain clearly why it is correct.

5. Using the algorithm given in the textbook and course slides, convert the NFA depicted below to a DFA. Express your solution as a transition graph, and show the main steps in the solution process.
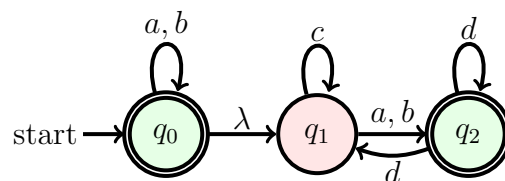
Further Notes:

1. As stipulated in the course syllabus, this exercise may be done either individually, in a group of two, or in a group of three. Remember that there are point penalties for late submission. See the course syllabus.

2. It is strongly recommended that you use a graphical tool to display your results. If you draw them by hand, they must be very neat. It is not allowed to copy the work of others. The submission must be the original work of the individual(s) in the working group. The grader reserves the right to interview members of the working group about the solution.

Updated: September 6, 2010

3. So that solutions may be discussed in a class meeting, students and/or groups that are very late in preparing a solution may be required to solve an alternate problem to receive credit for this exercise.