School of Computer Science, University of Nottingham

G52MAL Machines and their Languages, Spring 2012

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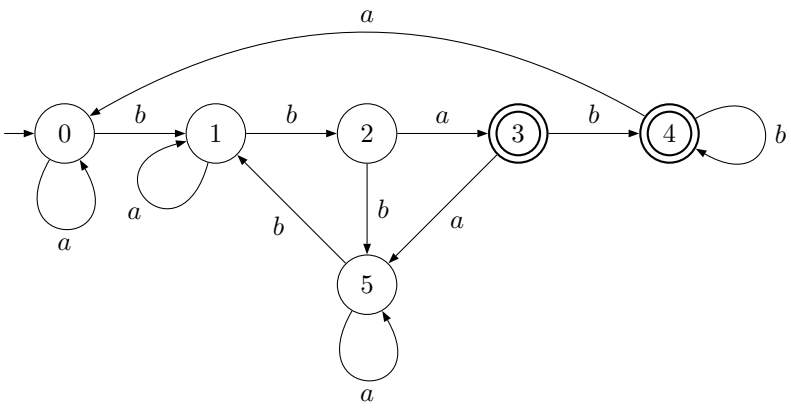
Exercises, Set 4

Friday 9th March 2012

Deadline: Wednesday 21th March 2012, in your tutorial

1. Minimise the following DFA using the Table-Filling Algorithm. You should show the major steps of your derivation, and draw the transition diagram of the final minimal DFA.



2. Given $\Sigma = \{a, b\}$ show that the regular expressions a^*abb^* and aa^*b^*b generate the same language by constructing the minimal DFAs for both expressions.
   First translate the regular expressions into NFAs, then turn those into DFAs and minimize the DFAs.

3. Which of the following languages over $\Sigma = \{0, 1\}$ are regular?

   (a) $\{ww \mid w \in \{0\}^*\}$

   (b) $\{ww \mid w \in \{0, 1\}^*\}$

   (c) $\{0^n 1^m \mid n \equiv m \mod 2\}$
   where $n \equiv m \mod 2$ means that m,n have the same remainder when divided by 2.

   (d) $\{0^n 1^m \mid n = m\}$

   (e) $\{1^{2n+3m} \mid n, m \in \mathbb{N}\}$

   Either show that the language is regular by exhibiting a DFA, NFA or a regular expression, or show that the language is not regular by using the pumping lemma.

4. **Bonus Exercise**

   Using the pumping lemma show that the language $\{0^n 1^m \mid n \neq m\}$ over $\Sigma = \{0, 1\}$ is not regular.

   Hint: If you think this is easy you haven't understood the pumping lemme.