CSA 2201
Formal Languages and Compilers
Assignment 3

This assignment is worth 20% of the final mark of the Formal Languages and Automata course. The documentation explaining your results are to be handed to the departmental secretary by Monday 14th December 2009. Assignments handed in late will be marked down by 4 marks (out of 20) per day. No assignments will be accepted after Friday 18th December 2009.

The Department of Computer Science and AI takes a very serious view on plagiarism. Refer to the departmental website on plagiarism for more details:

http://www.cs.um.edu.mt/resources/plagiarism/

You are to solve all of the following problems.

Question 1 carries 3 marks each. Question 2 carries 4 marks. Question 3 carries 1 mark. Question 4 carries 8 marks. Question 5 and 6 carry 2 marks each.

1. Draw and formalise DFSAs accepting the following languages:
   (a) \{ab^n \mid n \geq 0\}.
   (b) \{ab^n \mid n \geq 2\}.
   (c) \{a^nc^m, b^nc^m \mid n, m \geq 0\}.

2. Consider the regular languages
   • \( L_1 = \{a^n \mid n \geq 1\} \), recognised by the grammar \( G_1 = (\{a\}, \{A\}, A, \{A \rightarrow a | aA\}) \)
   • \( L_2 = \{b^n \mid n \geq 0\} \), recognised by the grammar \( G_1 = (\{b\}, \{A\}, A, \{A \rightarrow \epsilon | bA\}) \)

   Construct an \( \epsilon \)-free regular grammar \( G_3 \) recognising the language \( L_1 \cup L_2 \).

3. Consider the following DFSA, M:

   ![DFSA Diagram]

   Formalise M.

4. Prove that \( \mathcal{T}(M) = \{a^n, b^n \mid n \geq 0\} \).

5. Consider the DFSA \( M' = (\{A\}, \{a,b\}, \{(A,a) \rightarrow A, (A,b) \rightarrow A\}, A, \{A\}) \). Show that \( \mathcal{T}(M') \neq \mathcal{T}(M) \).

6. Prove that \( \mathcal{T}(M) = \mathcal{L}(G_3) \).