Institut for Matematik og Datalogi
Syddansk Universitet

Assignment 1
Complexity and Computability — 2015

This is your first assignment in DM553. The assignment is due at 8:15 on Monday, March 9. You may write this either in Danish or English. Write your full name (or names if you do it together) clearly on the first page of your assignment (on the top, if it's not a cover page). Turn it in as a PDF file via Blackboard through your DM553 course. The assignment hand-in is in the menu for the course and is called "SDU Assignment". Keep the receipt it gives you proving that you turned your assignment in on time. Blackboard will not allow you to turn in an assignment late.

Cheating on this assignment is viewed as cheating on an exam. If you have questions about the assignment, come to Joan Boyar.

Please note that you must have this assignment approved in order to pass DM553. If it is not turned in on time, or if you do not get it approved, it will count as one of your two retries in the course, and you must have it approved on your only allowed retry for this assignment.

Assignment 1

Do the following problems. Write clear, complete answers, but not longer than necessary.

1. Consider the following grammar:

$$\begin{aligned} S &\rightarrow aCaS \mid bS \mid \epsilon \\ C &\rightarrow cC \mid \epsilon \end{aligned}$$

   (a) Define a DFA which recognizes the language generated by this language, using a state diagram.

   (b) Convert this DFA to an equivalent GNFA with two states, using the CONVERT procedure. Show all steps.

(c) What regular expression does your result indicate expresses the language recognized by your original DFA?

2. Show that $\{uv \mid u, v \in \Sigma^*, v \in L\}$ is a regular language if L is a regular language.

3. Let $L = \{a^i(ab)^j(ac)^{2i}\}$.

   (a) Give a context-free grammar, G, which generates L.

   (b) Is G ambiguous? Why or why not?

   (c) Show that L is not regular.

   (d) Show a derivation of *aaaababacacacacacac*.

   (e) Convert your grammar, G, to Chomsky Normal Form.

   (f) Define a PDA to recognize the language generated by this grammar, using a state diagram.

4. Show that $\{ww^Rw \mid w \in \{a, b\}^*\}$ is not context-free.

5. Prove the following statement true or false: If L_1 is a regular language and L_2 is not context-free, then $L_1 \cap L_2$ is not a regular language.