

CS311 – Computational Structures – HW3

Thursday, April 14, 2011
due in class Thursday, April 21, 2011

Answer each question below. Write your answers neatly on paper. Be sure your name is on the paper, and the paper is clearly identified as Homework 3.

1. Problem 6, Section 11.2, page 727. RegExp \rightarrow NFA. Show enough steps to identify what algorithm you are using. (5 points each)
2. Problem 9, Section 11.2, page 728. NFA \rightarrow RegExp. Show the steps of algorithm 11.5 that you use. (5 points)
3. Problem 2, Section 11.3, page 743. Lambda Closures. Build a table for each part. Clearly identify the "unions". (15 points)
4. Problem 10, Section 11.3, page 745, parts b and c. RegExp \rightarrow NFA \rightarrow DFA \rightarrow MinDFA. (15 points) Show enough steps to convince me you know the algorithms. (15 points each)
5. A Binary Tree (BT) is defined (inductively) as follows
 - single root node, R , (with no children) is a BT
 - if x and y are BTs then $(N \ x \ y)$ is a BT with subtrees x and y .

Two functions on BTs are `edgeCount` and `nodeCount` which have the following properties

- 1 `edgeCount(R) = 0`
- 2 `edgeCount(N t1 t2) = 2 + edgeCount(t1) + edgeCount(t2)`
- 3 `nodeCount(R) = 1`
- 4 `nodeCount(N m n) = 1 + nodeCount(m) + nodeCount(n)`

Prove by structural induction that for all BT t the following property holds: $edgeCount(t) = nodeCount(t) - 1$.

- What is the induction variable? (2 points)
- What is the formula as a function of the induction variable. (2 points)
- Use the definition of BT to help you formulate the structure of the proof (One case for each way you can make a BT). Write down the parts of the proof based on the structure of BT. (4 points) Which cases have induction hypotheses?
- Carry out the steps of the proof, label each step with the properties you use. (4 points)
- Write down any facts about arithmetic that you use in your proof. (4 points)

(16 points)

6. Draw a DFA with 3 or more states. (2 points)
 - Describe the language described by that DFA in English. (4 points)

- Draw a second DFA which accepts exactly those strings not accepted by the original DFA. (4 points)
- Describe in general terms how you derived the second DFA from the first DFA. (4 points)

(14 points)