

Computer Structure - Spring 2004

Assignment No. 2

Firm Deadline: March 18th - before the beginning of the lecture

1. (*Suggested by Arnon Warshavsky*). Consider computing Boolean expressions using a spreadsheet application (i.e. Excel). The value stored in each cell should be a Boolean value. The value of a cell may either be constant or determined by an expression whose parameters are values of other cells. For simplicity, assume that the expressions contain only the Boolean operators: NOT, OR, AND.
 - Define a “legal” spreadsheet such that the values of the cells are well defined. Try a few examples of illegal spreadsheets to see if your definition is actually used in the application.
 - Try to input illegal spread sheet - does Excel allow it?
 - How do spreadsheet applications guarantee the legality of a spreadsheet?
2. Write a (recursive) algorithm that is given as input a combinational circuit and outputs the propagation delay of the circuit. Prove the correctness of your algorithm. (You may use the algorithm from Question 2 as a procedure). What is the complexity of the algorithm?
3. This question is about the running time of the algorithm for computing the delay of a combinational circuit and for simulating it.

Consider a combinational circuit C . We define the size of C to be the number of gates plus the sum of the sizes of the nets.

The total amount of time spent in the relaxation steps of the algorithm is linear in the size of the circuit, and hence the running time of the algorithm for computing the propagation delay is linear. Simulation requires computing the Boolean function implemented by each gate. To maintain linear running time, we must assume that each Boolean function is computable in time that is linear in the number of inputs plus outputs of the Boolean function.

- Prove that the total amount of time spent in the relaxation steps is linear in the number nodes if the fan-in of each gate is constant (say, at most 3).

Note that it is not true that each relaxation step can be done in constant time if the fan-in of the gates is not constant.
 - Prove linear running time in the number of nodes if (i) every net feeds a single input terminal and (ii) the number of outputs of each gate is constant. (You may not assume that the fan-in of every gate is constant.)
4. Answer question 2.4 in Chapter 2 of the lecture notes.