T-79.231 Parallel and Distributed Digital Systems
Homework Assignment 4, October 10, 2003 **Marko Mäkelä**

Temporal Logic and High Level Nets

Specification Patterns have been proposed as a user-friendly interface to temporal logic. A collection of specification patterns for linear temporal logic is available at `http://www.cis.ksu.edu/santos/spec-patterns/ltl.html`. The idea is that a template corresponding to the requirement is looked up in the collection and the propositions are substituted, e.g., "p holds exactly when the signal lamp is lit."

1. Connect the following formulae and requirements so that each formula and requirement is used exactly once. Give a verbal interpretation for every proposition, that is, define when the propositions should hold.

   (1) $\Box(p \to \Box q)$ (3) $\Box(p \to \Box(q \to \Diamond r))$
   (2) $(\Diamond r) \to \Diamond(r \land \Diamond s)$ (4) $\Box((p \land \bigcirc\Diamond q) \to \bigcirc\Diamond(q \land \Diamond r))$

   (a) once the fuse is blown, the device remains powered off
   (b) the program can be terminated by typing Q and Enter
   (c) after the power has been restored, the server responds to requests again
   (d) some time after the phone has gone off hook, a dial tone will sound

2. Give three finite automata corresponding to the formulae $(1),(2)$ and (3) such that the formula holds in the initial state and the other two formulae do not hold. In each state of the automaton, specify those propositions that hold. Hints: The proposition s can be always false, and the automata can consist of two states.

   Example: an automaton with only one state where only p and q hold fulfills the formula (1) but not (3). If the formula (2) did not hold in this automaton, the automaton would be a valid solution for the formula (1).

3. An n-storey building contains a group of m elevators. There are call buttons at each floor that can be used to obtain an elevator for travelling upwards or downwards. Also, there are buttons in the lift cages with which the particular lift can be told to travel to the specified floors. Model the system with the MARIA language and generate reachability graphs with as many values of the parameters n and m as possible. Ensure that the reachability graphs are strongly connected. For simplicity, you may assume that the lift cages lack doors and that they jump directly from one floor to another. However, there must be separate call buttons for travelling upwards and downwards.

Return the answer to the mailbox located between rooms B 336 and B 337 in the Computer Science Building, 3rd floor, by 8 p.m. on November 17, 2003. You may also return your answer in Postscript or PDF format to Jukka.Honkola@hut.fi.