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A few comments on a correctness proof of a program for the "McCarthy Airline" reservation system.

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A program written in Pascal for the "McCarthy Airline" reservation system is described and its correctness is proved in [1, 2]. The present note contains a few comments on the problem and on the proof. A knowledge of Section 5.2 in [1] or Section 3 in [2] is taken for granted.

1. Comments on the problem

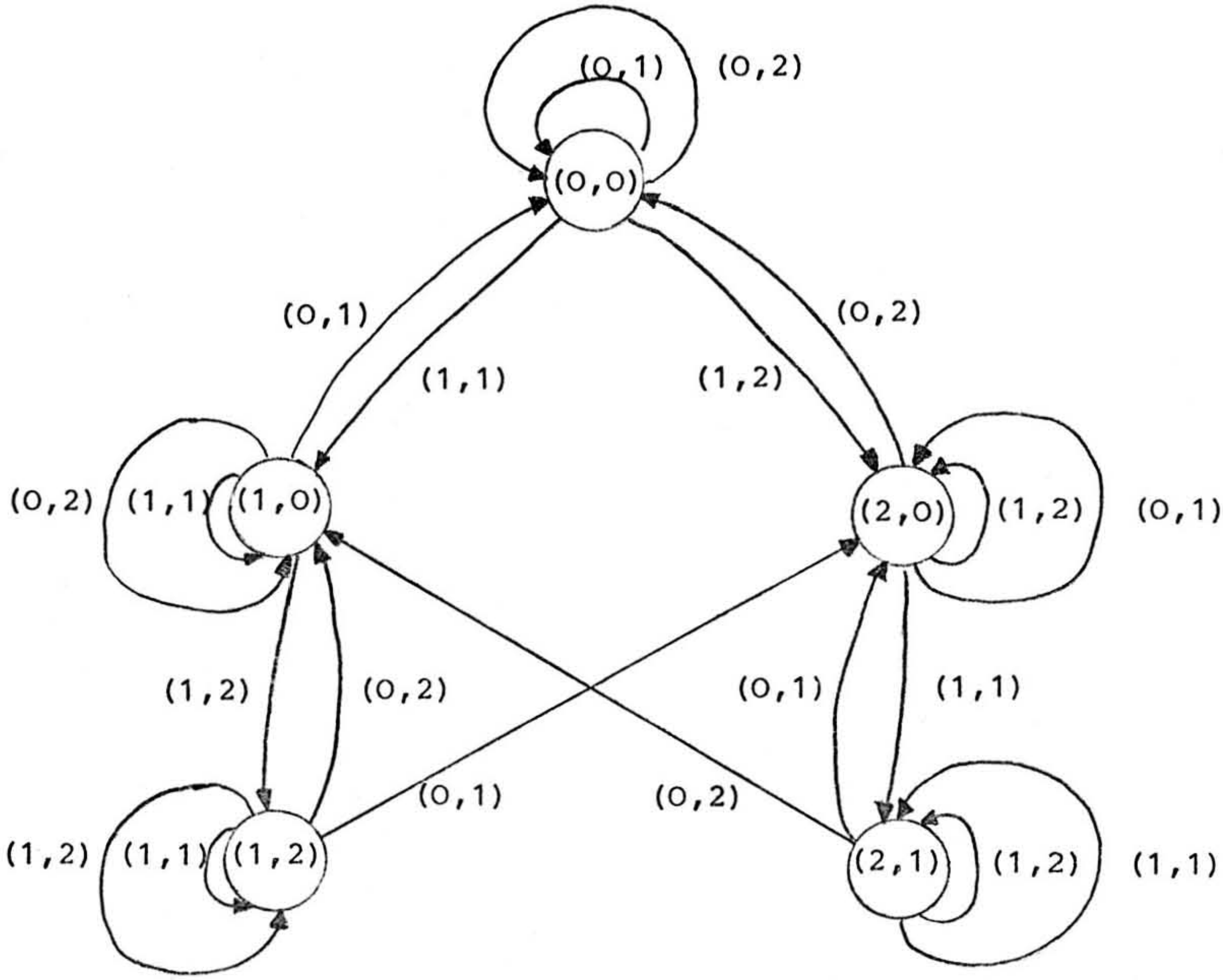
1.1. On the nature of the problem

A program for the McCarthy Airline reservation system is "special" in that it is a continuously interactive program; such a program maps an (unbounded) sequence of inputs into a sequence of outputs.

On the other hand the McCarthy Airline reservation problem is "trivial", because the output depends on three variables (st, wl and the input) which can only take a finite number of different values. The problem therefore corresponds to a finite automaton, - as is illustrated in the next section. Conversely, any finite automaton has the same "complexity" as the McCarthy Airline reservation system. A program for such a problem merely consists of a (more or less intelligent) coding of the (finite) transition table of this automaton.

1.2. Formulating the problem as a finite automaton

The McCarthy Airline reservation system is defined as a finite automaton of the Moore model (see e.g. [3]). The input symbols are pairs (rq, ps); each state corresponds to a pair (st, wl); the output produced by the state (st, wl) is st.



1.3. A more complex problem

An intrinsically more "complex" problem corresponds to an automaton which is not a finite one. An example of such an automaton is an automaton with 2 output symbols whose behaviour (see e.g. [3], p.296) is not a finite state language.

2. Comments on the proof

The correctness proof in [1, 2] is essentially an equivalence proof of two programs for the McCarthy Airline reservation system : the first program is written in Pascal, the second one in a recursive language (viz. LCF). This fact is striking when one tries to remake the proof for a program written in LUCID [4] or a program written in LISP rather than in Pascal : in both cases the proof is void (except for notational transformations).

A more "convincing" proof may be obtained by deriving the definition of stupdt and wlupdt directly from the transition table of the automaton. For instance:

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stupdt≡ λsq st wl .
  (st = 0) →
        (wl = 0) →
              (el1 sq = 0)
                 → (el2 sq = 1)
                        → 0 ,
                          0        ,
                   (el2 sq = 1)
                        → 1 ,
                          2        ,
   etc.
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Actually, the equivalence proof of this stupdt and the stupdt of [1, 2] consists in a trivial case study; the triviality of this proof is a direct result from the triviality of the McCarthy Airline reservation system i.e. from the fact it corresponds to a finite automaton.

References

[1] L.Aiello, M.Aiello, R.W.Weyhrauch, "The Semantics of Pascal in LCF", Artificial Intelligence Memo, Stanford University, 1974

[2] L.Aiello, M.Aiello, R.W.Weyhrauch, "Program correctness checked by machine : The reliability of a reservation system", Nota Interna B75-26, Ist. di Elaborazione della Informazione del C.N.R., Pisa, Dec. 1975

[3] M.A.Harrison, "Introduction to Switching and Automata Theory", McGraw-Hill, 1965

[4] E.A.Ascroft, W.W.Wadge, "Demystifying program proving : An informal introduction to Lucid", Res. Report CS-75-02, Dept. of Comp.Sc., University of Waterloo (Ont.), June 1975