T-79.5102 **Autumn 2007**
Special Course in Computational Logic
Tutorial 6

1. A team of m people plan to carry out all pieces of furniture from an n-storey building having no elevator. There are two kinds of items to carry: light and heavy. Each person is capable of carrying light items whereas two persons are necessary for the heavy ones. The goal is to carry out this task in an optimal number of steps using the following atomic operations:

$\mathsf{CLIMB}(x)$	Person x climbs up one floor.
$\mathsf{DESCEND}(x)$	Person x descends one floor.
$\mathsf{CARRY}(x, y)$	Person x carries a light item y down one floor.
$\mathsf{CARRY}(x, y, z)$	Persons x and y carry a heavy item z down one floor.

In the initial situation all persons are on the ground floor, i.e., the first floor, and all items and movers end up on the ground floor in the end.

(a) Represent the planning problem described above as an `smodels` program.

(b) Use `smodels` to find a solution for the following problem instance:

- Both parameters m and n have 3 as their the value.
- There are three light items: a chair (2nd floor), a table (3rd floor) and a flowerpot (3rd floor).
- There are two heavy items: a piano (2nd) and a sofa (3rd).

2. Consider a logistics domain with the following operators:

$\mathsf{LoadTruck}(o, t)$	Load object o on truck t.
$\mathsf{UnloadTruck}(o, t)$	Unload object o from truck t.
$\mathsf{DriveTruck}(tr, l1, l2)$	Drive truck t from location $l1$ to location $l2$.
$\mathsf{LoadAirplane}(o, a)$	Load object o on airplane a.
$\mathsf{UnloadAirplane}(o, a)$	Unload object o from airplane a.
$\mathsf{FlyAirplane}(a, l1, l2)$	Fly airplane a from location $l1$ to location $l2$.

The source code of `lparse` includes an encoding of this problem (solving this problem from the scratch and on your own may take a while).

(a) Get acquainted with the encoding and check how

- the preconditions and effects of operators are described, and
- the frame axioms and time are formalized.

(b) There are three cities Pittsburgh (pgh), Boston (bos), and Los Angeles (la) under consideration. Each city c has three locations, the down town (c_dt), the airport (c_ap), and the post office (c_po) relevant to the logistics problem being solved. There are two airplanes $a1$ and $a2$ for the delivery of items between airports. Moreover, there is a truck available in each city for local transport. Suppose there are three objects, namely packages $p1$, $p2$, and $p3$, to be transported. Solve the problem instance described in Figure 1 using `smodels`.

$\mathsf{At}(p1, pgh\_po).$ $\mathsf{At}(p2, pgh\_po).$ $\mathsf{At}(p3, pgh\_po).$ $\mathsf{At}(a1, pgh\_ap).$ $\mathsf{At}(a2, pgh\_ap).$ $\mathsf{At}(t1, bos\_po).$ $\mathsf{At}(t2, pgh\_po).$ $\mathsf{At}(t3, la\_po).$	$\mathsf{At}(p1, bos\_po).$ $\mathsf{At}(p2, la\_po).$ $\mathsf{At}(p3, bos\_po).$

Figure 1: Specifications of initial and final situations