Functional Programming
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Homework 1

Due: Monday, September 16, 2002.

Guidelines

While we acknowledge that beauty is in the eye of the beholder, you should nonetheless strive for elegance in your code. Not every program which runs deserves full credit. Make sure to state invariants in comments which are sometimes implicit in the informal presentation of an exercise. If auxiliary functions are required, describe concisely what they implement. Do not reinvent wheels, and try to make your functions small and easy to understand. Use tasteful layout and avoid long winded and contorted code. None of the problems requires more than a few lines of code.

Exercise 1: Imagine you have to devise an elevator system in a house with five stories where each floor is equipped with one call button for the elevator. The owner of the building is not interested in how you will implement the controls, what he's interested in is that you know how to model a valid elevator ride. He suggests that all requests are recorded in lists in the order they were received.

$$\begin{array}{lrcl} \text{Stories:} & s & ::= & 1 \mid 2 \mid 3 \mid 4 \mid 5 \\ \text{Requests:} & r & ::= & \cdot \mid s; r \end{array}$$

With t we denote the the time, where we assume that every movement of the element happens in unit time. Assume that the elevator is on the first floor at time 0.

1. Define the meaning of judgment $r \vdash s/t$ by specifying a set of inference rules which reads as follows. It is possible to satisfy all requests r in t movements after the elevator arrives in story s.

2. Prove formally that for each list of requests, a valid elevator ride exists.

3. In your formal system, give a formal proof that there exists a derivation

$$\begin{array}{c} \mathcal{D} \\ 4; 2; \cdot \vdash s/t \end{array}$$

Exercise 2: (Extra credit) Implement your solution of Exercise in Twelf.