Computer Science & Engineering 505
Concepts of Programming Languages

Assignment 7
December 3, 1997
Due: December 12, 1997

1. Consider the following Kaleidoscope constraint constructor that finds the sum of the elements in an array:

```
constructor sum(a : Array) = (result : Float);
    local s: Float;
    for i := 1 to a.size do
        s := s + a[i];
    end for;
    result := s;
end constructor sum;
```

   The resulting constraint will only work in one direction: given an array, you can use it to find the sum of the elements, but given a fixed sum and all but one element of an array, it won't find a value for the remaining element. Write a different constructor that can be used multi-directionally, so that for example you *can* find the value for the remaining element.

   (Hint: the reason the above version of sum isn't multi-directional is that it uses a one-way assignment statement. Rather than s := s + a[i] you'll want a constraint of the form something = somthing + a[i].)

2. Experiment with CLP($\mathcal{R}$)'s constraint solver. For example, give some goals such as

```
X=2*Y, X=6.
2*X+Y=7, X+Y=5.
X<8, X<7.
X>5, X<4.
```

   You don't need to hand in anything for this question.

3. The resistors program on orcas in `~borning/505/resistors` has rules for resistor, battery, ammeter, voltmeter, and electrical_ground that let you conveniently wire up and simulate electrical circuits. There are also some sample circuits defined in the file. (See in particular the ladder rule, which shows off CLP($\mathcal{R}$)'s programming language capabilities.)

   (a) Experiment with the sample goals.

   (b) Construct and demonstrate the following circuit:

4. Add a rule or rules for a (perfect) switch:

   switch(Lead1,Lead2,State) :- ...

   The currents in the two leads must always be equal and opposite. If State=on then the switch rule should constrain the voltages at the two nodes to be equal; if State=off the switch should constrain the current through the switch to be 0. Find the current in the ammeter in the following circuit for both states of the switch: