

HOMWORK 2 — CS 818A3 — SPRING 2005

Problem 1

When

$$\exists \alpha, \beta. (\mathbf{lseg} \alpha (i, j) * \mathbf{lseg} \beta (j, k)) \wedge \gamma = \alpha \cdot \beta,$$

we say that j is an *interior pointer* of the list segment described by $\mathbf{lseg} \gamma (i, k)$.

1. Give an assertion describing a list segment with two interior pointers j_1 and j_2 , such that j_1 comes before than, or at the same point as, j_2 in the ordering of the elements of the list segment.
2. Give an assertion describing a list segment with two interior pointers j_1 and j_2 , where there is no constraint on the relative positions of j_1 and j_2 .
3. Prove that the first assertion implies the second.

Problem 2

A *braced list segment* is a list segment with an interior pointer j to its last element; in the special case where the list segment is empty, j is **nil**. Formally,

$$\mathbf{brlseg} \epsilon (i, j, k) \stackrel{\text{def}}{=} \mathbf{emp} \wedge i = k \wedge j = \mathbf{nil}$$

$$\mathbf{brlseg} \alpha \cdot a (i, j, k) \stackrel{\text{def}}{=} \mathbf{lseg} \alpha (i, j) * j \mapsto a, k.$$

1. Prove the assertion

$$\mathbf{brlseg} \alpha (i, j, k) \Rightarrow \mathbf{lseg} \alpha (i, k).$$

2. Give an annotated specification of a command that changes the final pointer of a braced list segment from k to l . The command should not construct or deallocate any list structure, and it should not change the value of j . It should satisfy

$$\{\mathbf{brlseg} \alpha (i, j, k)\} \cdots \{\mathbf{brlseg} \alpha (i, j, l)\}.$$

3. Give an annotated specification of a command that concatenates two braced list segments. The command should not construct or deallocate any list structure, and it should not change the value of k_2 . It should satisfy

$$\{\mathbf{brlseg} \alpha (i_1, j_1, k_1) * \mathbf{brlseg} \beta (i_2, j_2, k_2)\}$$

...

$$\{\mathbf{brlseg} \alpha \cdot \beta (i_1, j, k_2)\}.$$

4. Give an annotated specification of a command that appends an item a at the beginning of a braced list segment. The command should not change the value of k , and should satisfy

$$\{\mathbf{brlseg} \alpha (i, j, k)\} \cdots \{\mathbf{brlseg} a \cdot \alpha (i, j, k)\}.$$

5. Give an annotated specification of a command that appends an item a at the end of a braced list segment. The command should not change the value of k , and should satisfy

$$\{\mathbf{brlseg} \alpha (i, j, k)\} \cdots \{\mathbf{brlseg} \alpha \cdot a (i, j, k)\}.$$

6. Give an annotated specification of a command that deletes an item a from the beginning of a nonempty braced list segment. The command should not change the value of k , and should satisfy

$$\{\mathbf{brlseg} a \cdot \alpha (i, j, k)\} \cdots \{\mathbf{brlseg} \alpha (i, j, k)\}.$$