

# Programming Languages

## First Phase Report - Lazy Lists

José António Ribeiro da Silva Lopes  
ist1103938

### Big Step Evaluation rules

$$\frac{}{\mathcal{E}; S; \text{lcons}(M, N) \Downarrow \text{lcons}(M, N, \mathcal{E}); S}$$
$$\frac{\mathcal{E}; S; M \Downarrow \text{nil}; S' \quad \mathcal{E}; S'; N \Downarrow U; S''}{\mathcal{E}; S; \text{match } M\{ \mid \text{nil} \rightarrow N \mid y :: z \rightarrow K\} \Downarrow U; S''}$$
$$\frac{\mathcal{E}; S; M \Downarrow \text{lcons}(I, J, \mathcal{E}_I); S' \quad \mathcal{E}_I; S'; I \Downarrow R; S'' \quad \mathcal{E}_I; S''; J \Downarrow T; S''' \quad \mathcal{E}[y \rightarrow R; z \rightarrow T]; S'''; K \Downarrow U; S''''}{\mathcal{E}; S; \text{match } M\{ \mid \text{nil} \rightarrow N \mid y :: z \rightarrow K\} \Downarrow U; S''''}$$

### Implementation

When evaluating an AST node corresponding to a lazy list, the values of both `M` and `N` are only saved as other AST nodes, meaning they have yet to be evaluated. Once they are, via the match construct, they become proper IValues and a flag flips to true in order to indicate that they indeed have been evaluated. All of this information is saved in a VLCons IValue.

The structure of an ASTLCons node is, then, the following:

```
public class ASTLCons implements ASTNode {
    ASTNode head, tail;

    public ASTLCons(ASTNode head, ASTNode tail) {
        this.head = head;
        this.tail = tail;
    }

    public IValue eval(Environment<IValue> e) throws InterpreterError {
        return new VLCons(this.head, this.tail, e);
    }
}
```

And the structure of VLCons is as follows:

```
public class VLCons implements IValue {
    ASTNode head, tail;
    Environment<IValue> e;

    IValue evaluatedHead = null;
    IValue evaluatedTail = null;
    boolean headWasEvaluated = false;
    boolean tailWasEvaluated = false;

    public VLCons(ASTNode head, ASTNode tail, Environment<IValue> e) {
        this.head = head;
        this.tail = tail;
    }
}
```

```

    this.e = e;
  }
  ...
}

```

The magic happens inside the match node, in the case where it matches a non nil list, because then, `M` and `N` are evaluated. Like so:

```

// VLCons.java
...
public IValue getHead() throws InterpreterError {
    if (!this.headWasEvaluated) {
        this.evaluatedHead = this.head.eval(this.e);
        this.headWasEvaluated = true;
    }
    return this.evaluatedHead;
}

public IValue getTail() throws InterpreterError {
    if (!this.tailWasEvaluated) {
        this.evaluatedTail = this.tail.eval(this.e);
        this.tailWasEvaluated = true;
    }
    return this.evaluatedTail;
}
...
// ASTMatch.java
...
VLCons lc1 = (VLCons) v1;

IValue v2 = lc1.getHead();
IValue v3 = lc1.getTail();
Environment<IValue> en = new Environment<IValue>(e);
en.assoc(headName, v2);
en.assoc(tailName, v3);

return consCase.eval(en);
...

```