

Homework VI

1. [15 points]

Using the revised version of the calculator presented on the class Web page, draw the abstract syntax tree and show how to use the semantic equations to evaluate the key sequence $10M^+ + 6 + / - = xM^R$.

2. [15 points]

This problem refers to the revised version of the calculator presented on the class Web page. You are to add a clear entry (**CE**) key to the calculator. The purpose of this key is to zero the display, but otherwise leave the state of the calculator unchanged. It should be valid to press this key at any time. Add the BNF to include this new key in the language, provide appropriate semantic equations, and justify their correctness.

3. [45 points]

Extend the Wren syntax and denotational semantics in our text (Fig. 9.11) to incorporate three new operations. Add the increment operators of C to Wren. That is, allow (integer) subexpressions of the forms $\langle \text{variable} \rangle ++$ and $++\langle \text{variable} \rangle$. The semantics are to follow that of C — namely, as an expression, $x++$ denotes the value of x prior to increment, while $++x$ denotes the value of x subsequent to increment; the evaluation of either subexpression causes the side-effect that x is incremented. Lastly, add the Java conditional expression $-- \langle \text{boolean expr} \rangle ? \langle \text{integer expr} \rangle : \langle \text{integer expr} \rangle --$ whose value is that of the first integer expression when the Boolean is true and the second when it is false.

Develop the changes for both the syntax and denotational semantics for these added features. Discuss your choice of the precedence selected for the new operators (e.g., what does $b ? x : y + z$ mean), and how your changes to the Wren syntax/semantics achieve it. Provide the relevant BNF and semantic equations, and include a convincing argument that your formal definition insures that the informally stated behavior is obtained.