```java
import components.naturalnumber.NaturalNumber;
import components.naturalnumber.NaturalNumber2;
import components.simplereader.SimpleReader;
import components.simplereader.SimpleReader1L;
import components.simplewriter.SimpleWriter;
import components.simplewriter.SimpleWriter1L;
import components.xmltree.XMLTree;
import components.xmltree.XMLTree1;

/**
 * Program to evaluate XMLTree expressions of {@code NaturalNumber}.
 *
 * @author Kevin Haller
 *
 */
public final class XMLTreeNNExpressionEvaluator {

    /**
     * Private constructor so this utility class cannot be instantiated.
     */
    private XMLTreeNNExpressionEvaluator() {
    }

    /**
     * Evaluate the given expression.
     *
     * @param exp
     *            the {@code XMLTree} representing the expression
     * @return the value of the expression
     * @requires <pre>
     * [exp is a subtree of a well-formed XML arithmetic expression]  and
     *  [the label of the root of exp is not "expression"]
     * </pre>
     * @ensures evaluate = [the value of the expression]
     */
    private static NaturalNumber evaluate(XMLTree exp) {

        //Result NaturalNumber
        NaturalNumber result = new NaturalNumber2(0);
        //Constant NaturalNumber zero
        NaturalNumber zero = new NaturalNumber2(0);

        if (exp.label().equals("plus")) {
            //Plus Operator
            NaturalNumber childZero = evaluate(exp.child(0));
            NaturalNumber childOne = evaluate(exp.child(1));
            result.add(childZero);
            result.add(childOne);
        } else if (exp.label().equals("minus")) {
            //Subtraction Operator
            NaturalNumber childZero = evaluate(exp.child(0));
            NaturalNumber childOne = evaluate(exp.child(1));

            //Catch of illegal operation
            if (childZero.compareTo(childOne) > 0) {
                childZero.subtract(childOne);
                result.add(childZero);
```

```
58              } else {
59                components.utilities.Reporter.fatalErrorToConsole(
60                        "ERROR! Violation of .subtract requires clause. child0 < child1");
61              }
62
63          } else if (exp.label().equals("times")) {
64              //Multiplication Operator
65              NaturalNumber childZero = evaluate(exp.child(0));
66              NaturalNumber childOne = evaluate(exp.child(1));
67              childZero.multiply(childOne);
68              result.add(childZero);
69          } else if (exp.label().equals("divide")) {
70              //Division Operator
71              NaturalNumber childZero = evaluate(exp.child(0));
72              NaturalNumber childOne = evaluate(exp.child(1));
73
74              //Catch of illegal operation
75              if (childOne.compareTo(zero) > 0) {
76                  childZero.divide(childOne);
77                  result.add(childZero);
78              } else {
79                components.utilities.Reporter.fatalErrorToConsole(
80                        "ERROR! Violation of .divide requires clause. child1 <= 0");
81              }
82          } else {
83              //Number
84              NaturalNumber numNode = new NaturalNumber2(
85                      exp.attributeValue("value"));
86              result.copyFrom(numNode);
87          }
88
89          return result;
90
91      }
92
93      /**
94       * Main method.
95       *
96       * @param args
97       *            the command line arguments
98       */
99      public static void main(String[] args) {
100         SimpleReader in = new SimpleReader1L();
101         SimpleWriter out = new SimpleWriter1L();
102
103         out.print("Enter the name of an expression XML file: ");
104         String file = in.nextLine();
105         while (!file.equals("")) {
106             XMLTree exp = new XMLTree1(file);
107             out.println(evaluate(exp.child(0)));
108             out.print("Enter the name of an expression XML file: ");
109             file = in.nextLine();
110         }
111
112         in.close();
113         out.close();
114     }
```

115
116 }
117