CSE 2231 – Software 2: Software Development and Design

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Project #2: NaturalNumber Implementation on String

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```
import components.naturalnumber.NaturalNumber;
import components.naturalnumber.NaturalNumberSecondary;

/**
 * {@code NaturalNumber} represented as a {@code String} with implementations of
 * primary methods.
 *
 * @convention <pre>
 * [all characters of $this.rep are '0' through '9']  and
 * [$this.rep does not start with '0']
 * </pre>
 * @correspondence <pre>
 * this = [if $this.rep = "" then 0
 *         else the decimal number whose ordinary depiction is $this.rep]
 * </pre>
 *
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 *
 */
public class NaturalNumber3 extends NaturalNumberSecondary {

    /*
     * Private members ------------------------------------------------------
     */

    /**
     * Representation of {@code this}.
     */
    private String rep;

    /**
     * Creator of initial representation.
     */
    private void createNewRep() {
        this.rep = "";
    }

    /*
     * Constructors ---------------------------------------------------------
     */

    /**
     * No-argument constructor.
     */
    public NaturalNumber3() {
        this.createNewRep();
    }

    /**
     * Constructor from {@code int}.
     *
     * @param i
     *            {@code int} to initialize from
     */
    public NaturalNumber3(int i) {
        assert i >= 0 : "Violation of: i >= 0";

        /*
         * According to the representation invariant {@convention} tag and the
         * abstraction function {@correspondence} tag.
         */

        if (i == 0) {
            this.rep = ""; // the empty {@code String} this.rep is zero (0).
        } else {
            this.rep = Integer.toString(i);
        }
    }

    /**
     * Constructor from {@code String}.
     *
     * @param s
     *            {@code String} to initialize from
     */
    public NaturalNumber3(String s) {
        assert s != null : "Violation of: s is not null";
        assert s.matches("0|[1-9]\\d*") : ""
                + "Violation of: there exists n: NATURAL (s = TO_STRING(n))";

        /*
         * According to the representation invariant {@convention} tag and the
         * abstraction function {@correspondence} tag.
         */

        if (s.equals("0")) {
            this.rep = ""; // the empty {@code String} this.rep is zero (0).
        } else {
            this.rep = s;
        }
    }

    /**
     * Constructor from {@code NaturalNumber}.
     *
     * @param n
     *            {@code NaturalNumber} to initialize from
     */
    public NaturalNumber3(NaturalNumber n) {
        assert n != null : "Violation of: n is not null";

        /*
         * According to the representation invariant {@convention} tag and the
         * abstraction function {@correspondence} tag.
         */

        if (n.isZero()) {
            this.rep = ""; // the empty {@code String} this.rep is zero (0).
        } else {
            this.rep = n.toString();
        }
    }

    /*
     * Standard methods ------------------------------------------------------
     */

    @Override
    public final NaturalNumber newInstance() {
        try {
            return this.getClass().getConstructor().newInstance();
        } catch (ReflectiveOperationException e) {
            throw new AssertionError(
                    "Cannot construct object of type " + this.getClass());
        }
    }
```

```
@Override
public final void clear() {
    this.createNewRep();
}

@Override
public final void transferFrom(NaturalNumber source) {
    assert source != null : "Violation of: source is not null";
    assert source != this : "Violation of: source is not this";
    assert source instanceof NaturalNumber3 : ""
            + "Violation of: source is of dynamic type NaturalNumberExample";
    /*
     * This cast cannot fail since the assert above would have stopped
     * execution in that case.
     */
    NaturalNumber3 localSource = (NaturalNumber3) source;
    this.rep = localSource.rep;
    localSource.createNewRep();
}

/*
 * Kernel methods ---------------------------------------------------------
 */

@Override
public final void multiplyBy10(int k) {
    assert 0 <= k : "Violation of: 0 <= k";
    assert k < RADIX : "Violation of: k < 10";

    if ((this.rep.isEmpty()) && (k == 0)) {
        this.rep = "";
    } else {
            this.rep = this.rep.concat(Integer.toString(k));
        }
    }

    @Override
    public final int divideBy10() {
        int lastDigit;
        if (this.rep.isEmpty()) {
            lastDigit = 0;
        } else {
            char lastCharacter = this.rep.charAt(this.rep.length() - 1);
            this.rep = this.rep.substring(0, this.rep.length() - 1);
            lastDigit = Character.getNumericValue(lastCharacter);
        }
        return lastDigit;
    }

    @Override
    public final boolean isZero() {
        return this.rep.isEmpty();
    }

}
```