

Exercises to the Lecture FSVT

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sheet 7

Exercise 1:

Let specifications ELEMENT and NAT be given as:

```

spec   ELEMENT
uses   BOOL
sorts  E
opns   eq : E, E → Bool
vars   x, y, z :→ E
eqns   eq(x, x) = true
        eq(x, y) = eq(y, x)
        eq(x, y) = true and eq(y, z) = true implies eq(x, z) = true

```

```

spec   NAT
uses   BOOL
sorts  N
opns   0 :→ N
        s : N → N
        equal : N, N → Bool
vars   n, m :→ N
eqns   equal(0, 0) = true
        equal(0, s(n)) = false
        equal(s(n), 0) = false
        equal(s(n), s(m)) = equal(n, m)

```

Give a parametrized specification for sets over ELEMENT with the operations INSERT and REMOVE and prove:

1. The signature morphism $\sigma : \text{ELEMENT} \rightarrow \text{NAT}$ given by $\sigma(E) = N$ and $\sigma(\text{eq} = \text{equal})$ is no specification morphism.
2. $(T_{\text{NAT}})|\sigma$ is a model of ELEMENT, i.e. it is a correct parameter assignment.
3. Does your specification satisfy $(T_{\text{VALUE}})|_{\text{NAT}} \cong T_{\text{NAT}}$, i.e. is VALUE an extension of NAT? Is it an enrichment?

Exercise 2:

Consider the mu -calculus with the following rules for arbitrary $X, Y \in \{m, i, u\}^*$:

$$\left\{ \frac{Xi}{Xiu}, \frac{mY}{mYY}, \frac{XiiiY}{XuY}, \frac{XuY}{XY} \right\}$$

1. Is the reduction system it is based on terminating?
2. Do $mi \rightarrow mu$, $mu \rightarrow mi$ resp. hold? Prove your claim.

Exercise 3:

Prove the properties of the multiset ordering following definition 8.22 on slide 284.

Exercise 4:

Prove that the proof ordering from slide 285 is noetherian.

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