

Sixth Tutorial Sheet: Solutions

1. Add equations to this module that define addition.

```
vars M N : NumeralExp .
var D : Digit .

eq 0 + N = N .

eq 1 + 0 = 1 .
eq 1 + 1 = 1 0 .
eq 1 + N 0 = N 1 .
eq 1 + N 1 = (1 + N)0 .

eq M 0 + 0 = M 0 .
eq M 0 + 1 = M 1 .
eq M 0 + N D = (M + N)D .

eq M 1 + 0 = M 1 .
eq M 1 + 1 = (M + 1)0 .
eq M 1 + N 0 = (M + N)1 .
eq M 1 + N 1 = (M + N + 1)0 .
```

2. Play Spot the Model with these equations.

Using the given model, only the first, second, sixth and ninth equations are satisfied (bonus problem: give assignments to the variables that show the other equations aren't satisfied). You may have used different equations and different models

3. Simplify the following (use Maude to check your answers):

- (a) `initial [['x + 1]]`
Should be: 1
- (b) `initial [[2 * 'x]]`
Should be: 0
- (c) `initial ; 'x := 1 [[2 * 'x]]`
Should be: 2
- (d) `initial ; 'y := 1 [[2 * 'x]]`
Should be: 0
- (e) `initial ; 'x := 'x + 1 [[2 * 'x]]`
Should be: 2

4. Simplify the following, where s is an arbitrary store:

(a) $s \text{ } [[\text{'x'} + 1]]$

Should be: $(s[[\text{'x'}]]) + 1$

(b) $s \text{ ; } \text{'x'} := 1 \text{ } [[2 * \text{'x'}]]$

Should be: 2

(c) $s \text{ ; } \text{'y'} := 1 \text{ ; } \text{'x'} := \text{'y'} + 1 \text{ } [[2 * \text{'x'}]]$

Should be: 4

(d) $s \text{ ; } \text{'x'} := \text{'x'} + \text{'y'} \text{ ; } \text{'y'} := \text{'x'} - \text{'y'} \text{ ; } \text{'x'} := \text{'x'} - \text{'y'} \text{ } [[\text{'x'}]]$

Should be: $s[[\text{'y'}]]$