

Fifth Tutorial Sheet: Solutions (sort of)

1. Not really a solution; the point was to get you using maude and making sense of:

```
Warning: <standard input>, line 13: ambiguous term, two parses are:
1 1 + (1 0)
-versus-
(1 1 + 1) 0
```

```
Arbitrarily taking the first as correct.
reduce in NUMERAL-EXPRESSION : 1 1 + (1 0) .
rewrites: 0 in 0ms cpu (0ms real) (~ rewrites/second)
result NumeralExp: 1 1 + (1 0)
```

2. Give equations to define multiplication for unary numerals:

```
eq M * 0 = 0 .
eq M * succ(N) = M * N + M .
```

Do the same for exponentiation.

```
eq M ** 0 = succ(0) .
eq M ** succ(N) = M ** N * M .
```

Just for fun: addition is repeatedly adding one; multiplication is repeatedly adding; and exponentiation is repeatedly multiplying — what's the next operation, and define it in Maude:

```
*** "tower" exponentiation ("power tower"?)
op _|^|_ : Nat Nat -> Nat [ prec 25 ].

eq M |^| 0 = M .
eq M |^| succ(N) = M |^| N ** M .
```

3. Again, the point of this is to get you using Maude. Hopefully, the results you got agreed with the Solutions given to Problem Sheet 4.
4. Similar. Maybe you're asking yourself at this point if you could use Maude to code up *any* model?
5. Play Spot the Model with the equations in ARITHMETIC.
Hope you had fun!