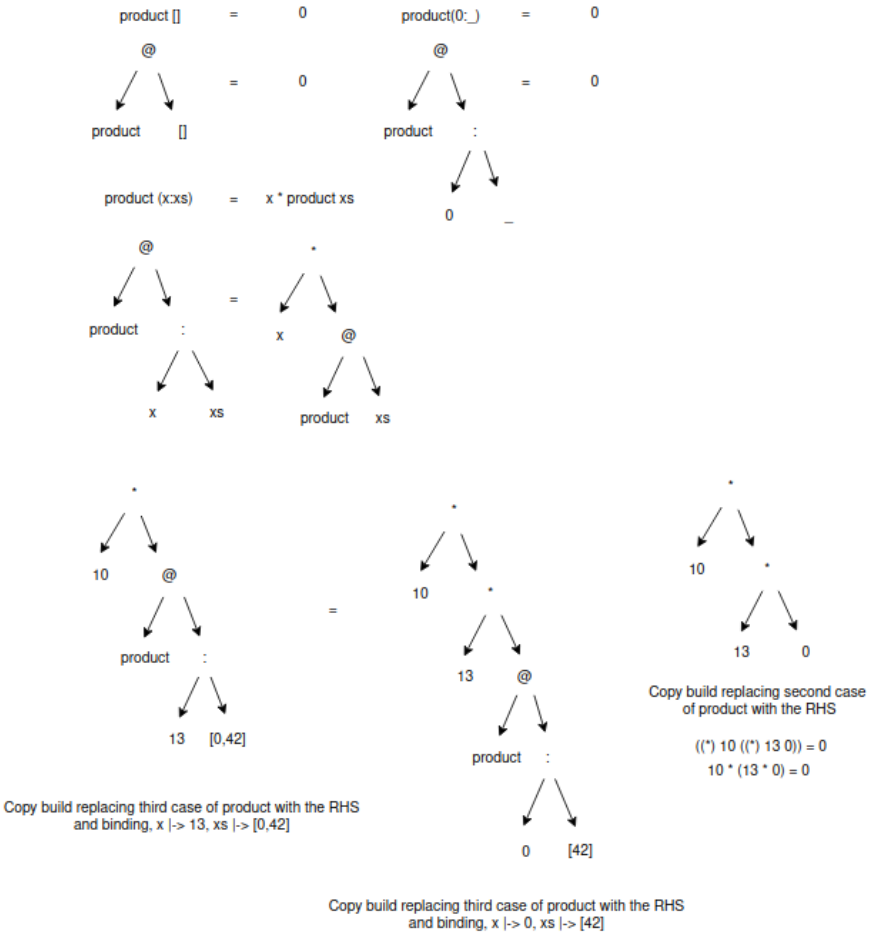
AST Exam Solutions

1 2018 Q3

1.1 Part (a)

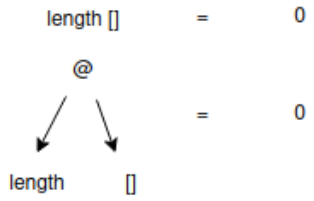
```
product []     = 1
product (0:_)  = 0
product (x:xs) = x * product xs
product [10,13,0,42]

product (10:[13,0,42])     = 10 * product [13,0,42] -- third case
10 * product (13:[0,42])   = 10 * (13 * product [0,42]) -- third case
10 * (13 * product (0:[42])) = 10 * (13 * 0) -- second case
```

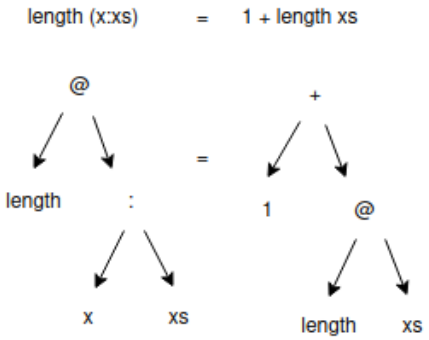


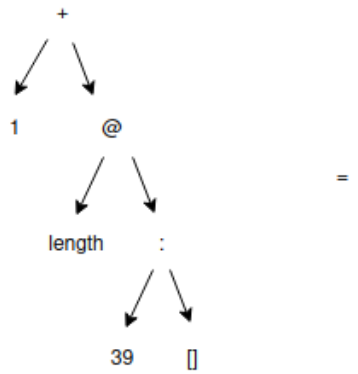
2 2018 Q3

2.1 Part (a)

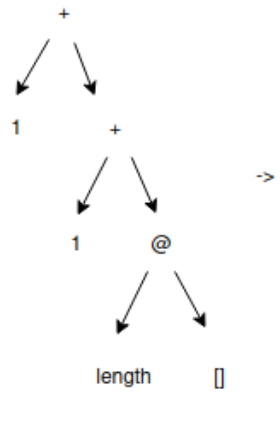
```
length [] = 0
length (x:xs) 1 + length xs
length [3,39]

length (3:[39])   = 1 + length [39] -- second case
1 + length ([39]) = 1 + (1 + length []) -- second case
1 + (1 length [])   = 1 + (1 + 0) -- first case
```

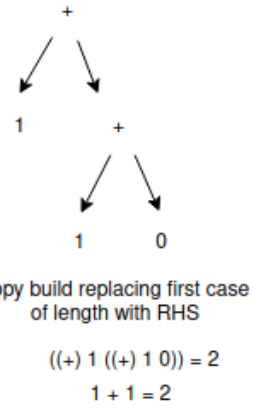






Copy build replacing second case of length with the RHS and binding, xs |-> [39]





copy build replacing first case of length with RHS

((+) 1 ((+) 1 0)) = 2

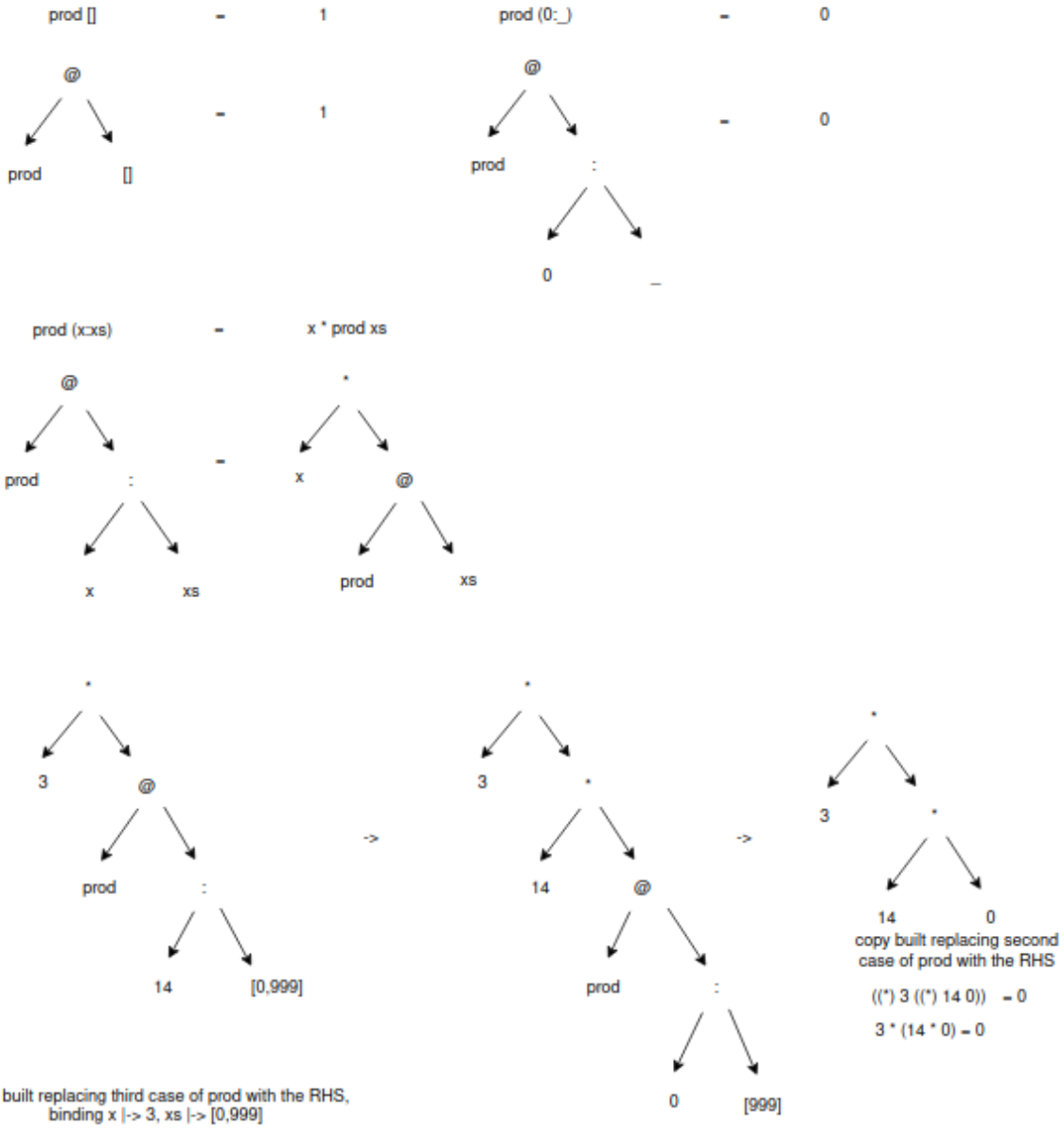
1 + 1 = 2

Copy build replacing second case of length with the RHS and binding, xs |-> []

3 2016 Q3

3.1 Part (b)

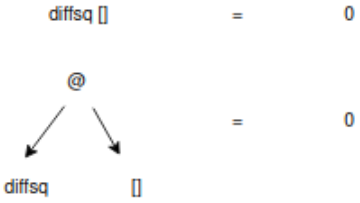
```
prod []     = 1
prod (0:_)  = 0
prod (x:xs) = x * product xs
prod [3,14,0,999]

prod (3:[14,0,999])    = 3 * prod [14,0,999] -- third case
3 * product (13:[0,42])   = 3 * (14 * prod [0,42]) -- third case
3 * (13 * product (0:[42])) = 3 * (14 * 0) -- second case
```

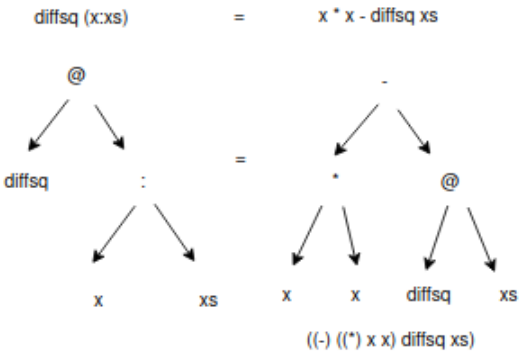


4 2015 Q4

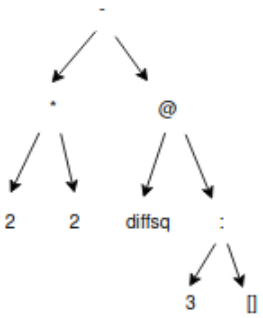
4.1 Part (a)

```
diffsq []     = 0
diffsq (x:xs) = x * x - diffsq xs
diffsq [2,3]

diffsq (2:[3])          = (2 * 2) - diffsq [3] -- second case
(2 * 2) - diffsq (3:[]) = (2 * 2) - ((3 * 3) - diffsq []) -- second case
(2 * 2) - ((3 * 3) - diffsq []) = (2 * 2) - ((3 * 3) - 0) -- first case
```

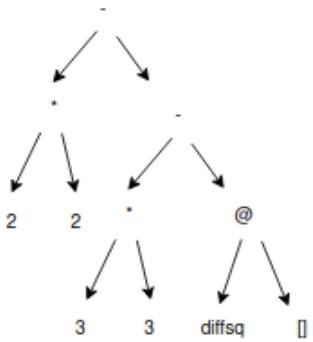


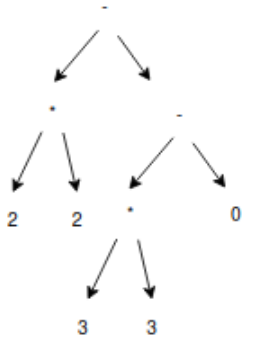


((-) ((*) x x) diffsq xs)



copy built replacing second case of diffsq with the RHS, binding x |-> 2, xs |-> [3]





copy built replacing first case of diffsq with the RHS

((-) ((*) 2 2) ((-) ((*) 3 3) 0)) = -5

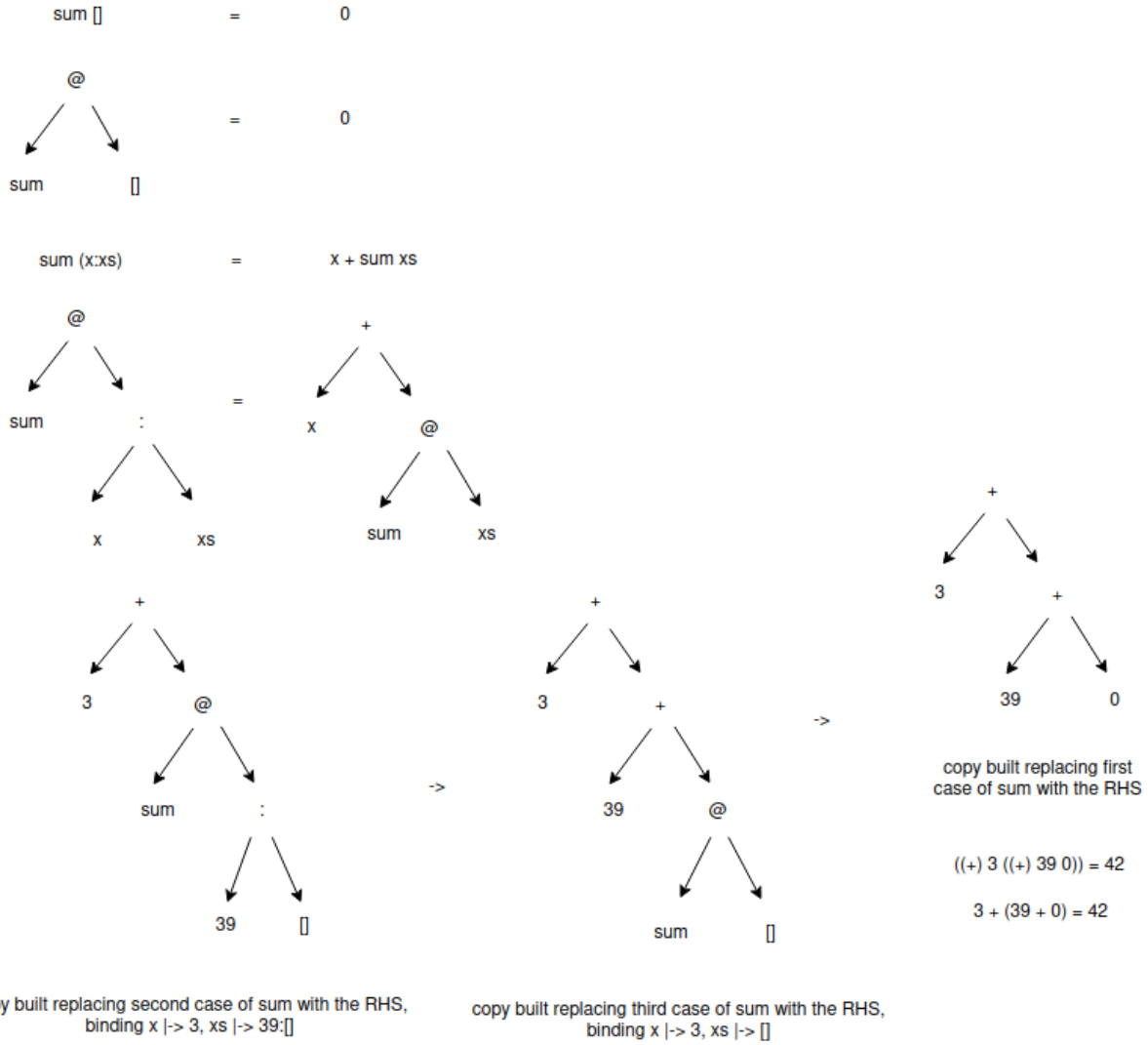
(2 * 2) - (3 * 3) - 0 = -5

copy built replacing third case of diffsq with the RHS, binding x |-> 3, xs |-> []

5 2014 Q4

5.1 Part (a)

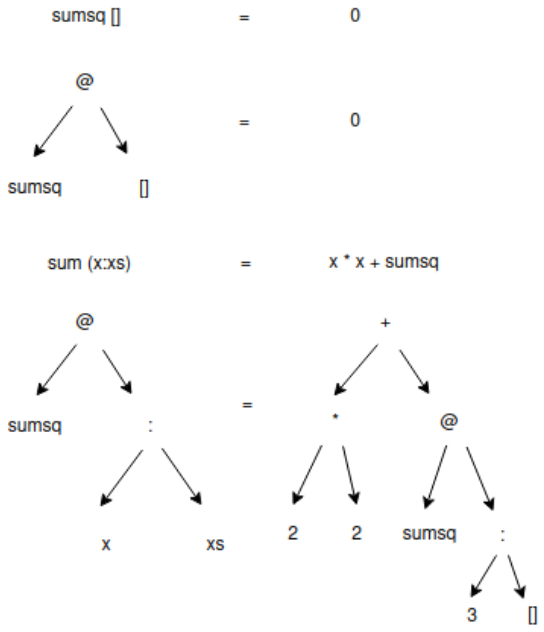
```
sum []     = 0
sum (x:xs) = x + sum xs
sum [3,39]

sum (3:[39])    = 3 + sum [39] -- second case
3 + sum (39:[]) = 3 + (39 + sum []) -- second case
3 + (39 + sum []) = 3 + (39 + 0) -- first case
```

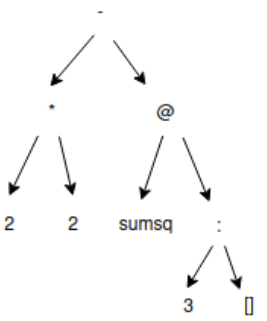


6 2013 Q4

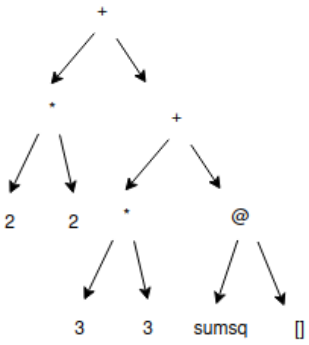
6.1 Part (a)

```
sumsq []     = 0
sumsq (x:xs) = x * x - diffsq xs
sumsq [2,3]

sumsq (2:[3])           = (2 * 2) + diffsq [3] -- second case
(2 * 2) + sumsq (3:[]) = (2 * 2) + ((3 * 3) + sumsq []) -- second case
(2 * 2) + ((3 * 3) + sumsq []) = (2 * 2) + ((3 * 3) + 0) -- first case
```

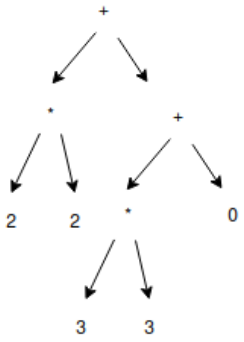




copy built replacing second case of sumsq with the RHS, binding x |-> 2, xs |-> [3]



copy built replacing third case of sumsq with the RHS, binding x |-> 3, xs |-> []



copy built replacing first case of sumsq with the RHS

((+) ((*) 2 2) ((+) ((*) 3 3) 0)) = 13

(2 * 2) + (3 * 3) + 0 = 13