

## Assignment 6 Report

Output of homework6.dfy:

```
# Homework6.dfy X
F:\> Desktop > CSE 210A > Assignment > CSE-210A > Assignment 6 > Homework6.dfy

2 references
40 lemma sameElements<T>(tree:Tree<T>, element:T)
41 ensures treeContains(tree, element) <=> listContains(flatten(tree), element)
42
43 {
44   match tree
45   case Leaf => {}
46   case Node(leftTree, rightTree, x) => {
47     sameElements(leftTree, x);
48     sameElements(rightTree, x);
49     appendListContains(flatten(leftTree), flatten(rightTree), element);
50
51     calc { treeContains(tree, element);
52           == treeContains(Node(leftTree, rightTree, x), element);
53           == treeContains(leftTree, element) || treeContains(rightTree, element) || x == element;
54           == listContains(flatten(leftTree), element) || listContains(flatten(rightTree), element);
55           == listContains(Cons(x, flatten(leftTree)), element) || listContains(flatten(rightTree), element);
56           == listContains(append(cons(x, flatten(leftTree)), flatten(rightTree)), element);
57           == listContains(Cons(x, append(flatten(leftTree), flatten(rightTree))), element);
58           == listContains(flatten(tree), element);
59         }
60   }
61 }
62
63 OUTPUT TERMINAL DEBUG CONSOLE PROBLEMS 10
verify all1
all verifyfile:///F:/XIA/Desktop/CSE20210A/Assignment/CSE-210A/Assignment%206/Homework6.dfy
The verifier process ended with code 0
Local: 2.3.0
Remote:2.3.0
```

Output of ExtraCredit.dfy:

```
# ExtraCredit.dfy X
F:\> Desktop > CSE 210A > Assignment > CSE-210A > Assignment 6 > ExtraCredit.dfy

1 datatype Exp = Const(int) | Var(string) | Plus(Exp, Exp) | Mult(Exp, Exp)
2
3
4 references
5 function eval(e:Exp, store:map<string, int>):int
6 {
7   match e
8   case Const(n) => n
9   case Var(s) => if(s in store) then store[s] else 1
10  case Plus(e1, e2) => eval(e1, store) + eval(e2, store)
11  case Mult(e1, e2) => eval(e1, store) * eval(e2, store)
12 }
13
14 //fill this function in to make optimizeFeatures work
15 references
16 function optimize(e:Exp):Exp
17 {
18   match e
19   case Const(n) => Const(n)
20   case Var(s) => Var(s)
21   case Plus(e1, e2) =>
22     var e1' := optimize(e1);
23     var e2' := optimize(e2);
24     match (e1', e2') {
25       case (Const(a), Const(b)) => Const(a + b)
26     }
27   case Mult(e1, e2) =>
28     var e1' := optimize(e1);
29     var e2' := optimize(e2);
30     match (e1', e2') {
31       case (Const(a), Const(b)) => Const(a * b)
32     }
33   }
34 }
35
36 OUTPUT TERMINAL DEBUG CONSOLE PROBLEMS 9 Dafny Language Server
verify all1
all verifyfile:///F:/XIA/Desktop/CSE20210A/Assignment/CSE-210A/Assignment%206/ExtraCredit.dfy
The verifier process ended with code 0
Local: 2.3.0
Remote:2.3.0
c:\Users\Jesse\.vscode\extensions\correctnesslab.dafny-vscode-0.37.2\dafny\dafny\ Dafny.exe /compile:1;/nologo;/F:\Desktop\CSE 210A\Assignment\CSE 210A\Assignment 6\ExtraCredit.dfy
```

## Problem Tab:

```
# Homework6.dfy X ExtraCredit.dfy
P: > Desktop > CSE 210A > Assignment > CSE-210A > Assignment 6 > Homework6.dfy
1 datatype Tree<T> = Leaf | Node(Tree<T>, Tree<T>, T)
2 datatype List<T> = Nil | Cons(T, List<T>)
3
4 0 references
5 function flatten<T>(tree:Tree<T>):List<T>
6 {
7     match tree
8     case Leaf => Nil
9     case Node(leftTree, rightTree, x) => Cons(x, append(flatten(leftTree), flatten(rightTree)))
10 }
11
12 0 references
13 function append<T>(xs:List<T>, ys:List<T>):List<T>
14 {
15     match xs
16     case Nil => ys
17     case Cons(x, xs') => Cons(x, append(xs', ys))
18 }
19
```

OUTPUT TERMINAL DEBUG CONSOLE PROBLEMS 18

- ExtraCredit.dfy F:\Desktop\CSE 210A\Assignment\CSE-210A\Assignment 6 5
  - decreases e.store Dafny VSCode [3, 9]
  - decreases e Dafny VSCode [13, 9]
  - decreases e.s Dafny VSCode [70, 7]
  - = Dafny VSCode [80, 2]
  - = Dafny VSCode [89, 2]
- Homework6.dfy F:\Desktop\CSE 210A\Assignment\CSE-210A\Assignment 6 10
  - decreases tree Dafny VSCode [4, 9]
  - decreases xs,ys Dafny VSCode [11, 9]
  - decreases tree Dafny VSCode [18, 9]
  - decreases xs Dafny VSCode [25, 9]
  - [induction xs,ys] Dafny VSCode [33, 6]
  - decreases xs,ys Dafny VSCode [33, 6]
  - = Dafny VSCode [41, 16]
  - [induction tree] Dafny VSCode [49, 6]
  - decreases tree Dafny VSCode [49, 6]
  - = Dafny VSCode [59, 12]