Proving and Disproving Equivalence of Functional Programming Assignments

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Is this solution correct?

```scala
def uniq(lst: List[Int]): List[Int] =
  distinct(List(), lst)

def distinct(a: List[Int], b: List[Int]): List[Int] =
  b match
    case Nil() => a
    case Cons(x, xs) =>
      if isin(x, a) then distinct(a, xs)
      else distinct(a ++ List(x), xs)

def isin(n: Int, lst: List[Int]): Boolean =
  lst.foldRight(false)( (e, acc) =>
    (e == n || acc)
  )
```

Effective in Practice

- Evaluation on over 4000 student submissions
- 86% overall success rate
- 96% success rate for single-function programs

Going Further

- Stainless: a tool for verifying Scala programs: github.com/epfl-lara/stainless
- PLDI’23 paper: "Proving and Disproving Equivalence of FP Assignments"
- Interested in joint work or a project? Contact us!

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Rigorous Automated Grading

Functional Induction

- Proofs by induction on the function’s execution trace

Function Call Matching

Clustering Algorithm

- Scaling to hundreds of student submissions
- Discovery of tests and intermediate solutions