IsaRARE: Automatic translation of term rewrite rules into Isabelle/HOL lemmas

User and Reference Manual

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1 Introduction

IsaRARE is a plugin for Isabelle that transforms rewrite rules in the RARE language into Isabelle lemmas. It serves two main purposes:

1. Verification: Proving a lemma generated by IsaRARE indicates that the corresponding rule is sound.

2. Reconstruction: If rule is used in a proof certificate by an external solver, the generated lemmas can be used by the smt method during the reconstruction of that proof inside of Isabelle.

2 Set-up and Quick Usage

IsaRARE itself does not require any prerequisites but to execute the bitvector examples in the Tests/ folder a copy of the Archive of Formal Proofs (AFP) is needed. The tool can be used simply by importing IsaRARE.thy:

```
theory IsaRARE
  imports HOL−CVC.Smtlib-String HOL−CVC.SMT-CVC
  keywords parse-rare-file parse-rare :: diag
begin
```

The two keywords the theory provides are used as follows:

1. To parse a single RARE rule use:

parse-rare <input rare rule as string>

Example usage:

parse-rare "(define-rule bool-eq-true ((t Bool)) (= t true) t)"

2. To parse a RARE file:

parse-rare-file <input rare file, theory imports, new theory name>

Example usage

parse-rare-file "/IsaRARE/Tests/example_rewrites" "Parent_Theory" "Example_Rewrites"

More information can be found in Section 6.

3 The RARE language

4 Components

```
ML-file ‹src/isarare-config.ML›
ML-file ‹src/parse-rare.ML›
ML-file ‹src/rare-impl-assump.ML›
ML-file ‹src/rare-lists.ML›
ML-file ‹src/write-rewrite-as-lemma.ML›
```

```
ML ‹
 open Parse-RARE
 open Write-Rewrite-as-Lemma

 (*TODO: Can I use: Library.cat-lines?*)
 fun string-of-rewrite ctxt s
  = (Write-Rewrite-as-Lemma.write-thy (Parse-RARE.parse-rewrites ctxt [s]) THEORY-NAME
IMPORTING-THEORIES ctxt)

 fun print-rewrite (cs:string) (t:Toplevel.transition) :  Toplevel.transition =
  Toplevel.keep (fn toplevel => (fn state =>
    Print-Mode.with-modes [] (fn () => writeln (string-of-rewrite state cs)) ())
(Toplevel.context-of toplevel)) t

 val - =
  Outer-Syntax.command command-keyword‹parse-rare› parse a single rule in
rare format (provided as a string) and output lemma
    ( Parse.string >> print-rewrite);

val ISARARE-HOME = OS.FileSys.getDir()

 val semi = Scan.option keyword‹;›; (*TODO: Do not need?*)
val x = OS.Process.getEnv

 val - =  Outer-Syntax.local-theory command-keyword‹parse-rare-file› parse file
in rare format and output lemmas. <rare-file, import theories, target-theory>
    (((Parse.string -- Parse.string)  -- Parse.string)
    >> (fn ((file-name,theory-imports),theory-name) => fn lthy =>
  let
          (*Built new path*)
          val file-path = Path.explode file-name
          val new-theory-name = theory-name ^ .thy
          val ctxt = Local-Theory.target-of lthy
        val res-path = Path.append (Path.dir file-path) (Path.basic new-theory-name)

          (*Calculate result*)
          (*val lines = raw-explode ( hd  (Bytes.contents (Bytes.read file-path))) ;*)
          val lines = Bytes.split-lines (Bytes.read file-path)
         val res =  (Write-Rewrite-as-Lemma.write-thy (Parse-RARE.parse-rewrites
ctxt lines) theory-name theory-imports ctxt)
          val - = (Output.writeln res)

          val - =
           Bytes.write
            res-path (Bytes.string res)
          val - = @{print} (done writing to file, res-path)
 in  lthy
```

end))
›

lemmas *cvc-arith-rewrite-defs* = *SMT.z3div-def*

5 Options

5.1 General

IsaRARE-HOME<file_path> can be used to change IsaRARE's home directory (which is the location this file resides in by default). This is used to provide a relative path to the Tests directory within Isabelle.

5.2 Traces and Debugging

To control the amount of information IsaRARE prints set *IsaRARE-verbose* to <true|false>

declare[[*IsaRARE-verbose* = *true*]]

For debugging information set *IsaRARE-verbose* to <true|false>

declare[[*IsaRARE-debug* = *true*]]

5.3 Proofs

declare[[*IsaRARE-implAssump* = *true*]]
declare[[*IsaRARE-listsAsVar* = *false*]]
declare[[*IsaRARE-proofStrategy* = *Minimum*]]
declare[[*ML-print-depth=10000*]]

6 Usage

7 Test

parse-rare-file *Tests/mixed-rewrites* *Mixed-Rewrites*

8 Expansions (Experts)

end