Refactoring Functional Programs

Experience of building refactoring tools for Haskell and Erlang

We have built tools for refactoring programs written in the functional languages Haskell and Erlang.

We report on the experience of tool building, contrast the two tools, and these tools with their OO equivalents.

Functional Programming

Functional programs are distinctive in emphasising values rather than variables, and in making functions first-class data. Modern functional languages also offer fine control over side-effects.

Haskell and Erlang

Functional languages differ considerably. Haskell is strongly typed, evaluated lazily, and has layout-sensitive syntax. Erlang is weakly typed, strict and layout-insensitive.

Haskell has a *de jure* standard, Haskell 98, and a *de facto* standard implementation, Glasgow Haskell. Open-Source Erlang has a controlled series of system releases.

Functional refactorings

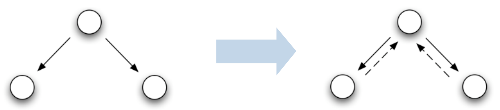
Some refactorings have OO equivalents, e.g. generalisation

```
-export([printList/1]).

printList([H|T]) ->
  io:format("~p\n",[H]),
  printList(T);
printList([]) -> true.

printList([1,2,3])
```

```
-export([printList/2]).

printList(F,[H|T]) ->
  F(H),
  printList(F, T);
printList(F,[]) -> true.

printList(
  fun(H) ->
    io:format("~p\n", [H])
  end,
  [1,2,3]).
```

Generalise `printList` over the print operation; this is wrapped in a `fun`, containing the side-effect.

Others address functional / concurrent aspects: e,g, convert asynchronous to synchronous communications.

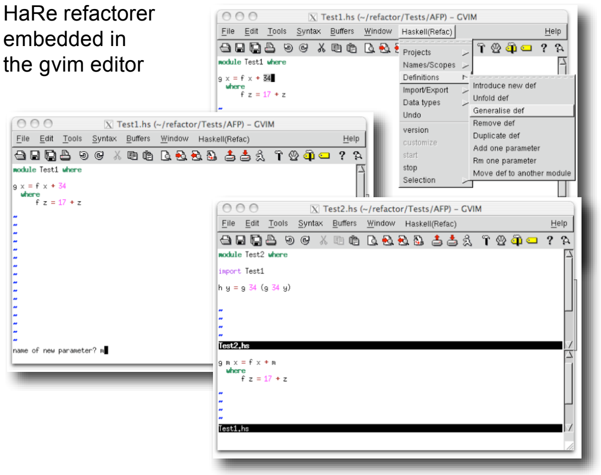


```
pid! {self(),msg}


{Parent,msg} ->
  body
```

```
pid! {self(),msg},
receive {pid, ok}-> ok

{Parent,msg} ->
  Parent! {self(),ok},
  body
```

The tools - HaRe (Haskell) and Wrangler (Erlang) - include structural, naming, data type and module refactorings.

HaRe refactorer embedded in the gvim editor



```
module Test1 where

g x = f x + 34
  where
    f z = 17 + z
```

```
module Test1 where

g x = f x + 34
  where
    f z = 17 + z

name of new parameter? m
```

```
module Test2 where

import Test1

h y = g 34 (g 34 y)

Test2.hs
g m x = f x + m
  where
    f z = 17 + z

Test1.hs
```

Experience report

Cover the complete language of the standard … including as much of the **macro mechanism** and **pre-processor** as possible. ***De facto* standards** more relevant than *de jure*.

Integrate with IDEs, and make sure these are those used in practice. If they are editors (emacs, gvim) also work with tools: **makefiles** and **test frameworks**.

Preserve program appearance: **layout** and **comments** crucial. Pretty printers do not always do this … and even a ten line program can become unrecognisable.

Refactoring = Transformation + Condition: in practice it is much more difficult to implement the condition (e.g. preserve binding structure) than transform (e.g substitute names).

A refactoring will have many **variants**: e.g. operate on one / all / some occurrences when generalising. **How to present these alternatives to the user?**

Compensate or fail? If a condition fails, should the system compensate for this and perform the refactoring, or fail, and expect the user to make the compensation explicitly?

Infrastructure is needed to support the analysis … use existing systems whenever possible.

User-defined refactorings: what is the right language? Should it be an API, or a domain-specific language?

Implementing a refactoring system which will be used by the practising programmer requires it to meet a variety of non-functional usability constraints as well as presenting choices and variants to the user.

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HaRe www.cs.kent.ac.uk/projects/refactor-fp/
Wrangler www.cs.kent.ac.uk/projects/forse/wrangler/doc/

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