Modelling Call-Time Choice as Effect using Scoped Free Monads

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Modelling Curry programs in a language like Haskell requires a transformation of non-deterministic code into a semantically equivalent, deterministic program. First, we have a look at the direct representation of non-determinism used in the KiCS2 implementation as described by Braßel et al. [2011].

Non-determinism in Curry is not limited to *flat* non-determinism but can occur within components of data structures and anywhere in a computation. This means that expressing non-determinism via Haskell's list monad is not sufficient to model Curry's non-determinism. Instead, existing data types receive additional constructors that represent failure and the choice between two values. For example, the extended list data type looks as follows.

TODO: Example

```
data List a = Nil | Cons a (List a) | Choice (List a) (List a) | Fail
```

Since this transformation adds new constructors, all functions need to cover these cases, too. The new rules return `Fail` if the function's argument is a failed computation and distribute function calls to both branches if the argument is a choice.

One issue with this approach is that call-time choice is not implemented yet. If a choice is duplicated during evaluation, this information cannot be recovered later. Therefore, each `Choice` constructor has an additional `ID` argument that identifies the same choices. Since each choice needs a fresh ID, functions use an additional `IDSupply` argument when choices are created.

The evaluation of a non-deterministic value is implemented by transforming the value into a search tree which can be traversed with different search strategies. In the process, each choice ID's decision is stored and then repeated if the same ID is encountered again.

While this approach is useful when the host language supports laziness and sharing, another approach is necessary to model these effects in a language without these features. Fischer et al. [2009] ...

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Bibliography

Bernd Braßel, Michael Hanus, Björn Peemöller, and Fabian Reck. KiCS2: A new compiler from curry to haskell. In *Proceedings of the 20th International Conference on Functional and Constraint Logic Programming*, WFLP'11, pages 1–18, Berlin, Heidelberg, 2011. Springer-Verlag. ISBN 978-3-642-22530-7. URL `http://dl.acm.org/citation.cfm?id=2032603.2032605`.

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