Recaffeinating Java

Modular and Concise Semantic Polymorphism for Java

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Abstract

mention CPS, language extensibility, syntax-driven transformation

Categories and Subject Descriptors CR-number [*subcategory*]: third-level

General Terms term1, term2

Keywords keyword1, keyword2

1. Introduction

Over the years, many programming language extensibility mechanisms have been proposed for interesting programming models (e.g., asynchronous programming [1], actor-based concurrency, parallel programming, workflows, database queries [7]). F# *computation expressions* [11], macros, Haskell Embedded DSLs (shallow/deep, do-notation for monads) are mechanisms that create a familiar look–and–feel syntactically without fixing the semantics of written code. Currently, vanilla Java lacks such kind of lightweight extensibility.

In this work we introduce such syntactic flexibility using *Object Algebras* [10] (hereafter **OAs**) as a device for the description of the semantics. OAs are simple to understand, they solve the expression problem, they have attracted a lot of attention in the research community in the area of interpreters and have a simple model of development. Overall, this will achieve an elegant and concise way in Java to author libraries that affect the semantics of code. The motivating observation for the current proposal is that F#'s builders of computation expressions [16, Chapter 6.3.10] have an 1-1 correspondence with the signature of an OA.

2. Background

mention fsharp

Our work is inspired by F#'s computation expressions. Async, AsyncSeq, Maybe, Cloud and many more define different semantics. the translation is made during type checking phase: can be characterised as type driven as shown but seems as a syntactic translation. F# is monadic + operators (Bind + Return are monadic). Seq isn't build with this pattern though.

mention Dart for the translation process

In F# asynchronous workflows are designated with the `async` label which corresponds to a computation expression defined in the standard library e.g.,

```
let getLength url = async {
  let! html = fetchAsync url
  do! Async.Sleep 1000
  return html.Length
}
```

The corresponding translation is type-driven:

```
async.Bind(fetchAsync(url), fun html ->
  async.Bind(Async.Sleep 1000, fun () ->
    async.Return(html.Length)))
```

3. Java transformation into CPS

3.1 Delimiting transformation at the method level

4. Embedded DSLs

4.1 Async

Recursive asynchronous fibonacci.

4.2 Yield with exceptions

A pull-based stream library.

4.3 Generating HTML

more sections to add

5. Related Work

We follow a similar approach with scala-virtualized [9] although we perform our translation via a separate rewriting tool.

Implementing First-Class Polymorphic Delimited Continuations by a Type Directed Selective CPS-Transform [12]

Vazou et al, in From Monads to Effects and Back [17] rely on the theory of Representing Monads [4] and represent everything as the continuation monad. We follow a similar approach based on the translation of Dart as described in [8]. Lightweight Monadic Programming [14] follows a type driven approach. Tagless Interpreters [2]

In [12], Tiark et al, provide a selective, type-driven translation to add delimited continuations adopting the reset/shift static variant. Our work provides certain variants of embedded DSLs (including transfer of control) but not in a generic way as provided with a framework like that. For control operations like yield we rely on a naive implementation via exceptions for exposition.

6. Future Work

That *Monads do not compose* has been identified in Steele's paper [13]. There are three approaches to solve this problem (as identified in [5]): monad transformers [6], the free monad as used in [15] and side–effect–request handlers [3]. One interesting research question is to study the differences between these three and identify early on, if we can borrow one technique and apply it to our design.

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