Metaprogramming with Macros

Eugene Burmako

École Polytechnique Fédérale de Lausanne
`http://scalamacros.org/`

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The essence of macros

Macros = programmable code transformers run inside the compiler

Example

```
(defmacro let (decl body)
  (cons
   (cons 'lambda
         (cons (list (car decl)) body))
   (cdr decl)))
```

let is a Lisp function. Since it is defined as a macro, it's automatically plugged into the compiler after being read.

Example

```
(defmacro let (decl body)
  (cons
   (cons 'lambda
         (cons (list (car decl)) body))
   (cdr decl)))

(let (x 42) (print x))
```

After the compiler reads a form that is an invocation of *let*, it yields control to the macro, passing it syntactic representations of the argument forms.

Example

```
(defmacro let (decl body)
  (cons
   (cons 'lambda
         (cons (list (car decl)) body))
   (cdr decl)))

~~(let (x 42) (print x))~~

((lambda (x) (print x)) 42)
```

The macro takes syntactic representations passed by the compiler, and reassembles them into a new form (this is called *macro expansion*).

After that the compiler replaces the macro invocation with the form produced by macro expansion. Compilation proceeds as if the programmer has written the resulting form in the first place.

Use cases

- Deeply embedded DSLs (database access, testing)
- Optimization (programmable inlining, fusion)
- Analysis (integrated proof-checker)
- Effects (effect containment and propagation)

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Actually all these scenarios are either already supported by Scala macros or will be supported in vNext!

Outline

Setting the stage

There are a lot of macro flavors classified by:

- Execution phase (lexical, syntactic, semantic)
- Meta-language (homogeneous, heterogeneous)

Macros

```
(defmacro let1 (decls body)
  (print decls)
  decls)
```

Outline

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