

Meeting 12 - Functions and Dynamic Scoping

Bor-Yuh Evan Chang

Thursday, October 3, 2024

Meeting 12 - Functions and Dynamic Scoping



What questions does your neighbor have?

[📄 In-Class Slides](#)

[📄 In-Class Jupyter](#)

[📖 Book Chapter](#)

Announcements

- HW1 scores released
- Review with Peer on Unit 2 Thu-Fri Oct 3-4 to prepare for exam
- HW3 due Monday 6pm
- Exam on Units 1-2 next Tue Oct 8
 - 50 minutes in class
 - Accommodation letters confirmed (some weeks ago)?
 - Look out for note on Piazza about the extended-time location
 - During class time
- Accelerated section enrollment

Today

- Functions and Dynamic Scoping
- Triage Your Questions
 - HW3?
- Revisit Operational Semantics

Questions?

- Preview:
 - What is static versus dynamic scoping?
- Review:
 - What is the correspondence between judgment forms/inference rules/judgments and code?
 - What is a *big-step operational semantics*?

Questions?

Functions Are Values

```
defined trait Expr
defined class N
defined class Var
defined class ConstDecl
```

$$\begin{array}{llll} \text{values} & v & ::= & (x) \Rightarrow e_1 \\ \text{expressions} & e & ::= & e_1(e_2) \\ \text{variables} & x & & \end{array} \quad (1)$$

```
defined class Fun
defined class Call
defined function isValue
defined type Env
defined class DynamicTypeError
```


Dynamic Scoping

Rule

EvalCall

???

$$E \vdash e_1(e_2) \Downarrow v'$$

Implementation

```
defined function eval
```

Dynamic Type Error

Instrumented Implementation

```
defined function eval  
defined function eval
```

Test Case

1 ???

Dynamic Scoping

```
e_dynamicScoping: ConstDecl = ConstDecl(  
  x = "x",  
  e1 = N(n = 1.0),  
  e2 = ConstDecl(  
    x = "g",  
    e1 = Fun(x = "y", e1 = Var(x = "x")),  
    e2 = Call(  
      e1 = Fun(x = "x", e1 = Call(e1 = Var(x = "g"), e2 = N(n = 2.0))),  
      e2 = N(n = 3.0)  
    )  
  )  
)
```

```
scala.NotImplementedError: an implementation is missing  
scala.Predef$.  
$qmark$qmark$qmark(Predef.scala:345)  
ammonite.$sess.cmd2$Helper.isValue(cmd2.sc:1)  
ammonite.$sess.cmd8$Helper.eval(cmd8.sc:5)  
ammonite.$sess.cmd8$Helper.eval(cmd8.sc:39)  
ammonite.$sess.cmd11$Helper.<init>(cmd11.sc:1)  
ammonite.$sess.cmd11$.<clinit>(cmd11.sc:7)
```

Fixing Dynamic Scoping

Closures

```
expressions e ::=
values      v ::=
variables   x
```

```
scala.NotImplementedError: an implementation is missing
  scala.Predef$. $\$$ qmark $\$$ qmark $\$$ qmark(Predef.scala:345)
  ammonite. $\$$ sess.cmd12$Helper.<init>(cmd12.sc:1)
  ammonite. $\$$ sess.cmd12$.<clinit>(cmd12.sc:7)
```

Rules

EvalFun

$$\frac{\text{???}}{E \vdash (x) \Rightarrow e \Downarrow (x) \Rightarrow e[E]}$$

EvalCall

$$\frac{\text{???}}{E \vdash e_1(e_2) \Downarrow v'}$$

Implementation

```
scala.NotImplementedError: an implementation is missing  
  scala.Predef$.$qmark$qmark$qmark(Predef.scala:345)  
  ammonite.$sess.cmd14$Helper.<init>(cmd14.sc:1)  
  ammonite.$sess.cmd14$.<clinit>(cmd14.sc:7)
```