

# Interpreters, Part 2

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## Define the Types – Types.hs

```
1 data Exp = IntExp Integer
2           | IntOpExp String Exp Exp
3           | RelOpExp String Exp Exp
4           | BoolOpExp String Exp Exp
5           | BoolExp Bool
6   deriving (Show, Eq)
7
8 data Val = IntVal Integer
9           | BoolVal Bool
10  deriving (Show, Eq)
```

## Eval – Bools, and, or

```
1 boolOps = [ ("&&", (&&))
2             , ("||", (||))]
3
4 liftBoolOp f (BoolVal i1) (BoolVal i2) = BoolVal (f i1 i2)
5 liftBoolOp f _ _ = BoolVal False
6
7 eval (BoolExp b) _ = BoolVal b
8
9 eval (BoolOpExp op e1 e2) env =
10   let v1 = eval e1 env
11       v2 = eval e2 env
12       Just f = lookup op boolOps
13   in liftBoolOp f v1 v2
```

## Adding Comparisons

```
1 relOps = [ (" $<$ ", ( $<$ ) ) , (" $<=$ ", ( $<=$ ) ) , (" $>$ ", ( $>$ ) )
2           , (" $>=$ ", ( $<=$ ) ) , (" $==$ ", ( $<=$ ) ) , (" $/=$ ", ( $/=$ ) ) ]
3
4 liftRelOp f (IntVal i1) (IntVal i2) = BoolVal (f i1 i2)
5 liftRelOp f _ _ = BoolVal False
6
7 eval (RelOpExp op e1 e2) env =
8   let v1 = eval e1 env
9       v2 = eval e2 env
10      Just f = lookup op relOps
11   in liftRelOp f v1 v2
```

## A Simple Let Expression

- ▶ We want to define local variables:

```
1 i4> 3 + let x = 2 + 3 in x * x end
2 IntVal 28
```

- ▶ Need two new Exp constructors.

```
1 data Exp = VarExp String
2           | LetExp String Exp Exp
3           | ...
```

## Coding Eval for Variables

- ▶ For variables, we look them up in the environment.

```
1 eval (VarExp var) env =  
2   case lookup var env of  
3     Just val -> val  
4     Nothing -> IntVal 0
```

## Coding Eval for Let

```
1 eval (LetExp var e1 e2) env =  
2   let v1 = eval e1 env  
3   in eval e2 (insert var v1 env)
```

- ▶ The `insert var v1 env` call acts like pushing a value onto a stack!

## Next Time

- ▶ You now have some interesting things for your interpreter.
- ▶ The reference implementation is in `i4`.
- ▶ We've also added a `IfExp` to the types if you want to try adding this.