Handout 1

Interpretation and Compilation
23-OCT-2018
due
9-NOV-2018: 23:59

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Goal

Implement a complete interpreter for the basic imperative-functional language specified

Use the approach developed in the lectures

- LL(1) parser using JAVACC
- AST model
- Environment based evaluator
- Dynamic type checking – issue proper error messages for runtime type errors

Fully understanding the handout statement is part of the handout as well. Contact me if you need help.

Submission Instructions

Create a bitbucket repository

Add me (lcaires@fct.unl.pt) as a team member

Send me the repository URL in an email with subject

ICL HO1 XXXXX YYYYY

where XXXXX etc are the student numbers (members of the group)

Abstract Syntax

```
EE -> EE ; EE | EE := EE
    | num | id | bool | let (id = EE)+ in EE end
    | fun id*-> EE end
    | EE ( EE* )
    | new EE | <!> EE
    | if EE then EE else EE end
    | while EE do EE end
    | EE binop EE
    | unop EE
```

Concrete Syntax

```
EM -> E(<;>EM)*                          ASTSeq(E1,E2)
E -> EA(< == > EA)?                      ASTEq(EA,EA)
EA -> T(<+>EA)*                          ASTAdd(E1,E2)
T -> F ( (<*>T)*                         ASTMul(F,T)
       | (<(>AL<)>)*                     ASTApply(F,AL)
       | <:=> E)                         ASTAssign(F,E)
AL -> (EM(<,>AL)*)?
PL -> (id(<,>PL)*)?
F -> num | id | bool | let (id = EM)+ in EM end
   | fun PL -> EM end | <(> EM <)>
   | new F | <!> F
   | if EM then EM else EM end               ASTIf(EM,EM,EM)
   | while EM do EM end                      ASTWhile(EM,EM)
```

Basic operations

Arithmetic operations (on integer values)

E+E, E-E, E*E, E/E, -E

Relational operations

E==E, E>E, E<E, E<=E, E>=E

Logical operations (on boolean values)

E && E, E || E, ~E

AST(schematic)

```
interface ASTNode {
IValue eval(Environment env) ...
}



class AST??? implements ASTNode {


}
```

IValues (schematic)

```
interface IValue {
void show();
}

//Value constructors
VInt(n)
Closure(args,body,env)
VBool(t)
VCell(value)
```

IValues (schematic)

```
class VInt implements IValue {
int v;
VInt(int v0) { v = v0; }
int getval() { return v;}
}
```

IValues (schematic)

```
class VCell implements IValue {
IValue v;
VCell(IValue v0) { v = v0; }
IValue get() { return v;}
void set(IValue v0) { v = v0;}
}
```

IValues (schematic)

```
class ASTAdd implements ASTNode {

IValue eval(Environmnent env) {
v1 = left.eval(env);
if (v1 instanceof  VInt) {
  v2 = right.eval(env)
  if (v2 instanceof VInt) {
      return new Vint((VInt)v1).getval()+((VInt)v2).getval())
}
throw TypeError("illegal arguments to + operator");
}
```

Examples

```
(new 3) := 6;;

let a = new 5 in a := !a + 1; !a end;;

let x = new 10
    s = new 0  in
while !x>0 do
    s := !s + !x ; x := !x – 1
end; !s
end;;
```

Examples

```
let  f = fun n, b->
          let
            x = new n
            s = new b
          in
             while !x>0 do
               s := !s + !x ; x := !x – 1
             end;
             !s
          end
        end
in f(10,0)+f(100,20)
end;;
```