

Laboratory 9

week 9 (22-26 November 2021)

TASKS:

A. Please submit the assignment **A4**.

B. Please continue to work on the assignment the assignment **A5**.

The deadline of the assignment A5 is week 11 (6- 10 December 2021).

C. After the Seminar 9, Please start to work on the assignment **A6**. **The deadline of the assignment A6 is week 12 (13 - 17 December 2021).**

Assignment 6

You must extend the JAVA project from the assignment **A5**. You have to implement a Type Checker for your ToyLanguage programs using the rules discussed in Seminar 9. Therefore you have to do the following modifications:

1. **Interface Exp:** please add the following method to it:

Type typecheck(MyIDictionary<String,Type> typeEnv) throws MyException

2. **All Expression Classes must implement the method typecheck:**

```
class ValueExp implements Exp{
    Value e;
    ....
    Type typecheck(MyIDictionary<String,Type> typeEnv) throws MyException{
        return e.getType();
    }
}

class VarExp implements Exp{
    String id;
    ...
    Type typecheck(MyIDictionary<String,Type> typeEnv) throws MyException{
        return typeEnv.lookup(id);
    }
}

class ArithExp implements Exp{
    Exp e1;
    Exp e2;
    ....
    Type typecheck(MyIDictionary<String,Type> typeEnv) throws MyException{
        Type typ1, typ2;
        typ1=e1.typecheck(typeEnv);
        typ2=e2.typecheck(typeEnv);
```

```

        if typ1.equals(new IntType()) {
            if typ2.equals(new IntType()) {
                return new IntType();
            } else
                throw new MyException("second operand is not an integer");
        } else
            throw new MyException("first operand is not an integer");
    }
}

```

Please implement in a similar way the method `typecheck` for the `LogicExp` class and `RelationalExp` class.

```

class RHExp implements Exp{
    Exp e;
    ...
    Type typecheck(MyIDictionary<String,Type> typeEnv) throws MyException{
        Type typ=e.typecheck(typeEnv);
        if (typ instanceof RefType) {
            RefType reft =(RefType) typ;
            return reft.getInner();
        } else
            throw new MyException("the rH argument is not a Ref Type");
    }
}

```

3. **Interface Istmt:** please add the following method to it:

`MyIDictionary<String,Type> typecheck(MyIDictionary<String,Type> typeEnv) throws MyException`

4. **All Statement Classes must implement the method typecheck:**

```

class CompStmt implements Istmt {
    Istmt first;
    Istmt snd;
    .....
    MyIDictionary<String,Type> typecheck(MyIDictionary<String,Type> typeEnv) throws
    MyException{
        //MyIDictionary<String,Type> typEnv1 = first.typecheck(typeEnv);
        //MyIDictionary<String,Type> typEnv2 = snd.typecheck(typEnv1);
        //return typEnv2;
        return snd.typecheck(first.typecheck(typeEnv));
    }
}

```

```

class PrintStmt implements ISmt{
    Exp exp;
    ....
    MyIDictionary<String,Type> typecheck(MyIDictionary<String,Type> typeEnv) throws
    MyException{
        exp.typecheck(typeEnv);
        return typeEnv;
    }
}

```

```

class AssignStmt implements ISmt{
    String id;
    Exp exp;
    ....
    MyIDictionary<String,Type> typecheck(MyIDictionary<String,Type> typeEnv) throws
    MyException{
        Type typevar = typeEnv.lookup(id)
        Type typexp = exp.typecheck(typeEnv);
        if (typevar.equals(typexp))
            return typeEnv;
        else
            throw new MyException("Assignment: right hand side and left hand side
have different types ");
    }
}

```

```

class VarDeclStmt implements ISmt{
    string name;
    Type typ;
    ....
    MyIDictionary<String,Type> typecheck(MyIDictionary<String,Type> typeEnv) throws
    MyException{

        typeEnv.add(name,typ);
        return typeEnv;
    }
}

```

```

class IfStmt implements ISmt{
    Exp exp;
    ISmt thenS;
    ISmt elseS;
    ....
    MyIDictionary<String,Type> typecheck(MyIDictionary<String,Type> typeEnv) throws
    MyException{
        Type typexp=exp.typecheck(typeEnv);
        if (typexp.equals(new BoolType())) {
            thenS.typecheck(clone(typeEnv));
        }
    }
}

```

```

        elseS.typecheck(clone(typeEnv));
        return typeEnv;
    }
    else
        throw new MyException("The condition of IF has not the type bool");
}
}

```

Please implement in the same manner forkStmt and whileStmt.

```

class NewStmt implements IStmt{
    String id;
    Exp exp;
    ....
    MyIDictionary<String,Type> typecheck(MyIDictionary<String,Type> typeEnv) throws
    MyException{
        Type typevar = typeEnv.lookup(id)
        Type typexp = exp.typecheck(typeEnv);
        if (typevar.equals(new RefType(typexp)))
            return typeEnv;
        else
            throw new MyException("NEW stmt: right hand side and left hand side have
different types ");
    }
}

```

Please implement the method typecheck for all the other statements.

5. Please call the method typecheck for the input program before you create its associated PrgState. The execution is done only if the program passes the typechecker.