Name: Akash Shivaji Varude

Roll No: 231110006

Assignment 2

Naming Conventions for this report:

The program which does not contains any unknown variable : NoHoleProgram

The program which contains unknown variable : HoleProgram

1. Implementation Details:

I have Implemented this assignment on kachua version2. All test cases Programs are stored in kachuacore/tests folder

Steps to run this assignment:

Step1: Make Json files for both codes

To make Json file run following command (following is example to make json file for test program 'eqtest4')

kachua.py -t 10 -se tests/eqtest4.tl -d{':x':5,':y':100} -c{':c1':1,':c2':1}

Similarly, make json file for program cotaining unknown variables also

Step2 : Make .kw file

Run following command on any empty .tl file.

python kachua.py -O filename.tl

This will generate optimized.kw file in kachuacore folder. I have copied it in chironframework/Submission folder and renamed it as eqtest.kw

Step3 : Run symbSubmission.py file

first goto Submission folder and run following command

symbSubmission.py eqtest.kw -e'["x", "y"]'

By default symbSubmission.py reads *testData1.json* and *testData2.json* files. If you want to read different files then just change names of files in checkEq() function

2. Example of expression given to z3 solver by checkeq() function:

Hardcoded Example:
tmp="And(Implies(And(x<=42,Not(False)),And(m==x,o==x+c1+c2)),Implies(Not(x<=42),And(m==x,o==x+c2)))
s.addConstraint("And(Implies((And(x==5,y==100)),And("+tmp+",And(m==5,o==45))),Implies((And(x==43,y==100)),And("+tmp+",And(m==43,o==65))))")

3. Programs and Outputs for testCases:

eqtest5.tl

```
:y = :x
if :x > 100 [
   :x = :x + 10
   :y = :y + 20
   :z = :z + 30
]
:y = :y + 22
:x = :x + 33
:z = :z + 44
```

eqtest6.tl

```
:y = :x
if :x > 100 [
   :y = :y + :c1 + :c2
   :x = :x + :c3 + :c4
   :z = :z + :c5 + :c6
]
else[
    :y = :y + :c1
    :x = :x + :c3
    :z = :z + :c5
]
```

Output is:

```
assertion :  [And(Implies(And(x == 5, y == 100),
             And(And(Implies(Not(x > 100),
                             And(x1 == x + c3, y1 == x + c1)),
                     Implies(And(x > 100, Not(False)),
                             And(x1 == x + c3 + c4,
                                 y1 == x + c1 + c2))),
                 And(x1 == 38, y1 == 27))),
     Implies(And(x == 101, y == 100),
             And(And(Implies(Not(x > 100),
                             And(x1 == x + c3, y1 == x + c1)),
                     Implies(And(x > 100, Not(False)),
                             And(x1 == x + c3 + c4,
                                 y1 == x + c1 + c2))),
                 And(x1 == 144, y1 == 143))))]
model printing [x = 0,
 y = 100,
 c3 = 33,
 c1 = 22,
 y1 = 144,
 x1 = 39,
 c4 = 10,
 c2 = 20]
```

Eqtest1.tl

```
:y = :x
if :x <= 42 [
    :y = :y + 40
] else [
    :y = :y + 22
]
```

eqtest2.tl

```
:y = :x
if :x <= 42 [
    :y = :y + :c1
]
:y = :y + :c2
```

Output is:

```
assertion :  [And(Implies(And(x == 5, y == 100),
            And(And(Implies(x <= 42,
                            And(x1 == x, y1 == x + c1 + c2)),
                    Implies(Not(x <= 42),
                            And(x1 == x, y1 == x + c2))),
                And(x1 == 5, y1 == 45))),
     Implies(And(x == 43, y == 100),
            And(And(Implies(x <= 42,
                            And(x1 == x, y1 == x + c1 + c2)),
                    Implies(Not(x <= 42),
                            And(x1 == x, y1 == x + c2))),
                And(x1 == 43, y1 == 65)))))]
model printing [x = 0, y = 100, c2 = 22, y1 = 65, x1 = 43, c1 = 18]
```

Eqtest11.tl

```
if :x>40
[
    if :x == 50
    [
        :y = :y + 40
    ]
    else
    [
        :y = :y + 20
    ]
]
:y = :y + 30
```

eqtest12.tl

```
if :x>40
[
    if :x == 50
    [
        :y = :y + :c1
    ]
    else
    [
        :y = :y + :c2
    ]
]
else
[
    :y = :y + :c3
]
```

Output is:

```
assertion :  [And(Implies(And(x == 5, y == 100),
             And(And(Implies(Not(x > 40),
                             And(x1 == x, y1 == y + c3)),
                     Implies(And(x > 40,
                                 Not(x == 50),
                                 Not(False)),
                             And(x1 == x, y1 == y + c2)),
                     Implies(And(x > 40,
                                 x == 50,
                                 Not(False),
                                 Not(False)),
                             And(x1 == x, y1 == y + c1))),
                 And(x1 == 5, y1 == 130))),
     Implies(And(x == 41, y == 100),
             And(And(Implies(Not(x > 40),
                             And(x1 == x, y1 == y + c3)),
                     Implies(And(x > 40,
                                 Not(x == 50),
                                 Not(False)),
                             And(x1 == x, y1 == y + c2)),
                     Implies(And(x > 40,
                                 x == 50,
                                 Not(False),
                                 Not(False)),
                             And(x1 == x, y1 == y + c1))),
                 And(x1 == 41, y1 == 150))),
     Implies(And(x == 50, y == 100),
             And(And(Implies(Not(x > 40),
                             And(x1 == x, y1 == y + c3)),
                     Implies(And(x > 40,
                                 Not(x == 50),
                                 Not(False)),
                             And(x1 == x, y1 == y + c2)),
                     Implies(And(x > 40,
                                 x == 50,
                                 Not(False),
                                 Not(False)),
                             And(x1 == x, y1 == y + c1))),
                 And(x1 == 50, y1 == 170))))]
model printing [y = 100,
 x = 0,
 y1 = 130,
 x1 = 5,
 c3 = 30,
 c2 = 50,
 c1 = 70]
```