SoCV hw5 Report

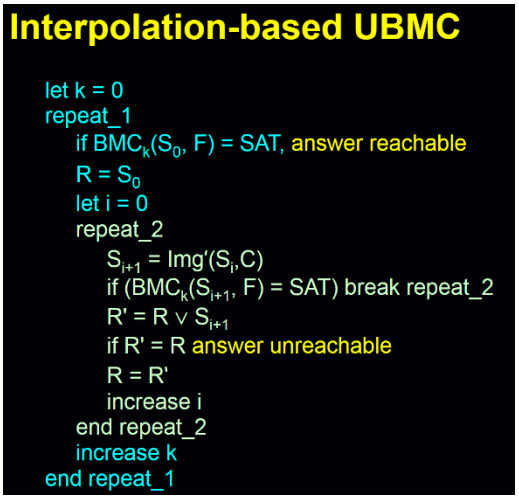
Name: Yu-Ting Cheng 鄭宇廷

ID: B08202013

1. Implementation

buildInitState(): Similar to hw3, setting all state to 0 is equivalent to AND all ~state, i.e. (~x0)&(~x1)&(~x2)… = 1. Therefore, I set the initState CirGate I as _cirMgr->const1 initially and AND it with all other states.

itpUbmc(): I implement this function based on the algorithm provided in lecture note 09 p.63. I use getItp() function to get the interpolation. To check the reachability has reach fixed point, I use createXorGate() function to check if R_prime == R.



2. Verification Results

(1) Basic

	gv	gv-ref

a.v	`setup> cirread -v ./design/SoCV/basic/a.v`
	`Converted 0 1-valued FFs and 16 DC-valued FFs.`
	`setup> set sys vrf`
	`vrf> satv itp -o 0`
	`Monitor "z1[0]" is safe.`
	`vrf> satv itp -o 1`
	`Monitor "z2[0]" is safe.`
	`vrf> satv itp -o 2`
	`Monitor "z3[0]" is safe.`
	`vrf> satv itp -o 3`
	`Monitor "z4[0]" is safe.`
	`vrf> satv itp -o 4`
	`Monitor "z5[0]" is safe.`
	`vrf> quit -f`
		`setup> cirread -v ./design/SoCV/basic/a.v`
		`Converted 0 1-valued FFs and 16 DC-valued FFs.`
		`setup> set sys vrf`
		`vrf> satv itp -o 0`
		`Monitor "z1[0]" is safe.`
		`vrf> satv itp -o 1`
		`Monitor "z2[0]" is safe.`
		`vrf> satv itp -o 2`
		`Monitor "z3[0]" is safe.`
		`vrf> satv itp -o 3`
		`Monitor "z4[0]" is safe.`
		`vrf> satv itp -o 4`
		`Monitor "z5[0]" is safe.`
		`vrf> quit -f`

b.v

```
setup> cirread -v ./design/SoCV/basic/b.v
Converted 0 1-valued FFs and 10 DC-valued FFs.

setup> set sys vrf

vrf> satv itp -o 0

Monitor "p1[0]" is safe.

vrf> satv itp -o 1

Monitor "p2[0]" is safe.

vrf> satv itp -o 2

Monitor "p3[0]" is safe.

vrf> satv itp -o 3

Monitor "p4[0]" is safe.

vrf> satv itp -o 4

Monitor "p5[0]" is violated.
0: x1
1: x1
2: x1
3: x1
4: x1
5: x1
6: x1
7: x1
8: x1
9: x1
10: x1
11: x1
12: x1
13: x1
14: x1
15: x1
16: x1
17: x1
18: x1
19: x1
20: x1
21: x1
22: x1
23: x1
24: x1
25: x1
26: x1
27: x1
28: x1
29: x1
30: x1
31: x1
32: x1
33: x1
34: x1
35: x1
36: x1
37: x1
38: x1
39: x1
40: x1
41: x1
42: xx
```

```
setup> cirread -v ./design/SoCV/basic/b.v
Converted 0 1-valued FFs and 10 DC-valued FFs.

setup> set sys vrf

vrf> satv itp -o 0

Monitor "p1[0]" is safe.

vrf> satv itp -o 1

Monitor "p2[0]" is safe.

vrf> satv itp -o 2

Monitor "p3[0]" is safe.

vrf> satv itp -o 3

Monitor "p4[0]" is safe.

vrf> satv itp -o 4

Monitor "p5[0]" is violated.
0: x1
1: x1
2: x1
3: x1
4: x1
5: x1
6: x1
7: x1
8: x1
9: x1
10: x1
11: x1
12: x1
13: x1
14: x1
15: x1
16: x1
17: x1
18: x1
19: x1
20: x1
21: x1
22: x1
23: x1
24: x1
25: x1
26: x1
27: x1
28: x1
29: x1
30: x1
31: x1
32: x1
33: x1
34: x1
35: x1
36: x1
37: x1
38: x1
39: x1
40: x1
41: x1
42: xx
```

c.v

```
setup> do ./hw/hw5/tests/c.dofile

setup> cirread -v ./design/SoCV/basic/c.v
Converted 0 1-valued FFs and 6 DC-valued FFs.

setup> set sys vrf

vrf> satv itp -o 0

Monitor "z0[0]" is violated.
0: x0

vrf> satv itp -o 1

Monitor "z1[0]" is violated.
0: x0
1: x1
2: x0
3: x1
4: x0
5: xx

vrf> satv itp -o 2

Monitor "z2[0]" is violated.
0: x1
1: x1
2: x0
3: x1
4: x0
5: x1
6: xx

vrf> satv itp -o 3

Monitor "z3[0]" is safe.

vrf> quit -f
```

```
setup> do ./hw/hw5/tests/c.dofile

setup> cirread -v ./design/SoCV/basic/c.v
Converted 0 1-valued FFs and 6 DC-valued FFs.

setup> set sys vrf

vrf> satv itp -o 0

Monitor "z0[0]" is violated.
0: x0

vrf> satv itp -o 1

Monitor "z1[0]" is violated.
0: x0
1: x1
2: x0
3: x1
4: x0
5: xx

vrf> satv itp -o 2

Monitor "z2[0]" is violated.
0: x1
1: x1
2: x0
3: x1
4: x0
5: x1
6: xx

vrf> satv itp -o 3

Monitor "z3[0]" is safe.

vrf> quit -f
```

(2) HWMCC testcases

UNSAT cases

Testcase	Result	Time(s)	Memory usage (MB)
pdtpmsfpmult.aig	Monitor “1348” is safe	7.75	35.3
6s6.aig	Monitor “5369” is safe	24.65	48.48
pj2018.aig	Monitor “26898” is safe	67.25	118
6s136.aig	Monitor “25378” is safe	231.7	200.4
6s206rb025.aig	Monitor “141223” is safe	2.44	141
6s221rb18.aig	Monitor “201417” is safe	4.62	181.1
6s326rb02.aig	Monitor “25376” is safe	137.9	174
6s327rb10.aig	Monitor “25050” is safe	0.75	27.39
6s380b129.aig	Monitor “43668” is safe	2.17	43.06

SAT cases

Testcases	Result	Time(s)	Memory usage (MB)
6s307rb06.aig	Monitor "37108" is violated.	3.42	74.95
abp4pold.aig	Monitor "955" is violated.	26.23	93.32
bob9234spec7neg.aig	Monitor "813" is violated.	227.5	48.7
bobpci215.aig	Monitor "4469" is violated.	15.91	40.57
6s374b029.aig	Monitor "326273" is violated.	60.91	279.8
6s388b07.aig	Monitor "34359" is violated.	0.05	19.35

(3) Vending Machine

gv

```
tim2811@venv2:~/socv/socv-1122$ ./gv
setup> cirread -v ./design/SoCV/vending/vending-abs.v
Converted 0 1-valued FFs and 20 DC-valued FFs.

setup> set sys vrf

vrf> satv itp -o 0

Monitor "z0[0]" is safe.

vrf> usage
Period time used : 0.02 seconds
Total time used  : 0.02 seconds
Peak memory used   : 22.06 M Bytes
Total memory used  : 10.26 M Bytes
Current memory used: 48.77 M Bytes

vrf> satv itp -o 1

Monitor "z1[0]" is safe.

vrf> usage
Period time used : 0.01 seconds
Total time used  : 0.03 seconds
Peak memory used   : 22.31 M Bytes
Total memory used  : 10.53 M Bytes
Current memory used: 49.04 M Bytes

vrf> satv itp -o 2

Monitor "z2[0]" is safe.

vrf> usage
Period time used : 0.01 seconds
Total time used  : 0.04 seconds
Peak memory used   : 22.69 M Bytes
Total memory used  : 10.92 M Bytes
Current memory used: 49.43 M Bytes

vrf> quit -f
```

gv-ref

```
tim2811@venv2:~/socv/socv-1122$ ./hw/hw5/gv-ref
setup> cirread -v ./design/SoCV/vending/vending-abs.v
Converted 0 1-valued FFs and 20 DC-valued FFs.

setup> set sys vrf

vrf> satv itp -o 0

Monitor "z0[0]" is safe.

vrf> usage
Period time used : 0.03 seconds
Total time used  : 0.03 seconds
Peak memory used   : 21.8 M Bytes
Total memory used  : 10.26 M Bytes
Current memory used: 48.88 M Bytes

vrf> satv itp -o 1

Monitor "z1[0]" is safe.

vrf> usage
Period time used : 0 seconds
Total time used  : 0.03 seconds
Peak memory used   : 22.05 M Bytes
Total memory used  : 10.53 M Bytes
Current memory used: 49.16 M Bytes

vrf> satv itp -o 2

Monitor "z2[0]" is safe.

vrf> usage
Period time used : 0.01 seconds
Total time used  : 0.04 seconds
Peak memory used   : 22.3 M Bytes
Total memory used  : 10.8 M Bytes
Current memory used: 49.43 M Bytes

vrf> quit -f
```

3. Comparison with the ref program and other model checker

The results (xxx monitor is safe/violated) are all identical between my implementation gv and gv-ref. Therefore, I only list the time latency and memory usage comparison between gv and gv-ref in the following table:

UNSAT

	gv		gv-ref	
Testcase	Time(s)	Memory usage (MB)	Time(s)	Memory usage (MB)
pdtpmsfpmult.aig	7.75	35.3	2.29	24.73
6s6.aig	24.65	48.48	27.12	48.54
pj2018.aig	67.25	118	4.21	48.96
6s136.aig	231.7	200.4	129.3	171.3
6s206rb025.aig	2.44	141	1.96	118.9
6s221rb18.aig	4.62	181.1	4.41	165.4
6s326rb02.aig	137.9	174	781	320.9
6s327rb10.aig	0.75	27.39	0.62	25.66
6s380b129.aig	2.17	43.06	1.77	44.27

SAT

	gv		gv-ref	
Testcase	Time(s)	Memory usage (MB)	Time(s)	Memory usage (MB)
6s307rb06.aig	3.42	74.95	3.68	71.39
abp4pold.aig	26.23	93.32	19.92	93.57
bob9234spec7neg.aig	227.5	48.7	20.46	18.89
bobpci215.aig	15.91	40.57	14.27	38.95
6s374b029.aig	60.91	279.8	63.95	282.9
6s388b07.aig	0.05	19.35	0.04	17.92

We can see that most of the testcases perform nearly well compared to gv-ref in terms of time latency and memory usage, except it takes around 10 times latency in two testcases (pj2018 and bob9234spec7neg). In testcases 6s326rb02, our implementation gv is 5.6 times faster in time latency and 1.8 times smaller in memory usage than gv-ref.

Comparing interpolation-based UBMC with BDD-based method in hw3, we can see that interpolation-based UBMC performs significantly better than BDD-based method in terms of total time latency and total memory usage. I use the same “vending_abs.v” file to test the performance of itp-ubmc method and bdd-based method. The following table shows the results:

	gv	gv-ref
ITP-UBMC (hw5)	vrf> usage Period time used : 0.02 seconds Total time used : 0.02 seconds Peak memory used : 22.69 M Bytes Total memory used : 10.8 M Bytes Current memory used: 49.31 M Bytes	vrf> usage Period time used : 0.04 seconds Total time used : 0.04 seconds Peak memory used : 22.3 M Bytes Total memory used : 10.81 M Bytes Current memory used: 49.43 M Bytes
BDD (hw3)	vrf> usage Period time used : 0.01 seconds Total time used : 70.33 seconds Peak memory used : 526.8 M Bytes Total memory used : 543.7 M Bytes Current memory used: 582.2 M Bytes	vrf> usage Period time used : 0 seconds Total time used : 73.25 seconds Peak memory used : 526.2 M Bytes Total memory used : 543.7 M Bytes Current memory used: 582.1 M Bytes