VLSI Testing and Design for Testability

Assignment3

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(a)、(b)

透過修改 typemuu.h 的 **PatternNum** 可以修改平行化運算有多少筆 pattern 同時運算

我根據 Assignment 2 產生 random pattern 的 code 產生兩組 10000 個 pattern 數據進行比對。

程式指令為:

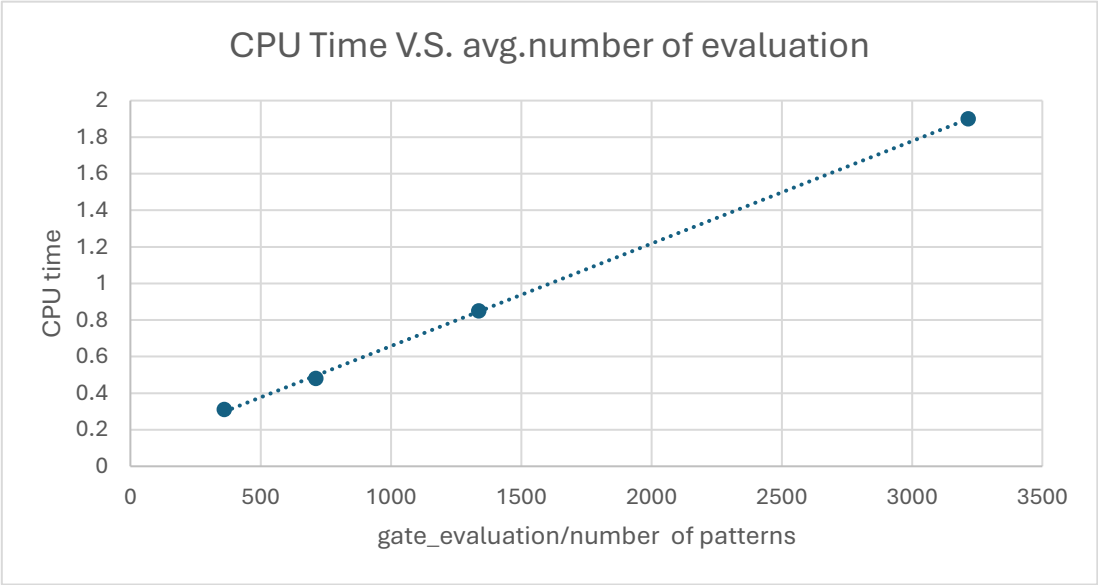
/usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input <絕對路徑+pattern_name> [絕對路徑+circuit_name]

1. c17.input with c17.bench (5 inputs, 2 outputs, 14 gates) 10000patterns

Pack number of patterns	1	4	8	16
CPU time	0.01	0	0	0
Maximum memory usage	2120	2116	2116	2120
Total evaluation times	66162	21715	11216	5624
Avg. evaluations num. (/pattern)	6.6162	2.1715	1.1216	0.5624
Avg. evaluations / gates number (%)	47.26%	15.51%	8.01%	4.02%

2. c7552.input with c7552.bench (207 inputs, 108 outputs, 5994 gates) 10000patterns

Pack number of patterns	1	4	8	16
CPU time	1.9	0.85	0.48	0.31
Maximum memory usage	4324	4324	4328	4324
Total evaluation times	32160101	13375541	7115937	3602665
Avg. evaluations num. (/pattern)	3216.01	1337.55	711.594	360.267
Avg. evaluations / gates number (%)	53.65%	22.31%	11.87%	6.01%



圖一、c7552.bench with c7552.input 趨勢圖

透過兩個 case 可得知，當 pack 的 pattern 越多，運行時間會越少。

但 memory 使用量不與 CPU time 正比關係。

從圖一可發現每一個 pattern evaluate 的次數會接近正比於 CPU time。

```
[s110305504@cad podem]$ make
g++ -c -O2 -Wall -DDEBUG  -o main.o main.cc
g++ -O2 -Wall -DDEBUG -o atpg readcircuit.tab.o lex.yy.o circuit.o main.o GetLongOpt.o atpg.o fsim.o sim.o psim.o stfsim.o tfatpg.o -lreadline -lcurses
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c17.input "/home/Student113/s110305504/VLSI_Testing/Assignment
2/circuits/iscas85/c17.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 66162
gate evaluation number/pattern: 6.6162
number of gate: 14
gate evaluation number/number of gates: 0.472586
total CPU time = 0.01

Average memory usage: 0
Maximum memory usage: 2120
```

圖二、c17 1 pack number of pattern

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c17.input "/home/Student113/s110305504/VLSI_Testing/Assignment
2/circuits/iscas85/c17.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 21715
gate evaluation number/pattern: 2.1715
number of gate: 14
gate evaluation number/number of gates: 0.155107
total CPU time = 0

Average memory usage: 0
Maximum memory usage: 2116
```

圖三、c17 4 pack number of pattern

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c17.input "/home/Student113/s110305504/VLSI_Testing/Assignment
2/circuits/iscas85/c17.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 11216
gate evaluation number/pattern: 1.1216
number of gate: 14
gate evaluation number/number of gates: 0.0801143
total CPU time = 0

Average memory usage: 0
Maximum memory usage: 2116
```

圖四、c17 8 pack number of pattern

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c17.input "/home/Student113/s110305504/VLSI_Testing/Assignment
2/circuits/iscas85/c17.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 5624
gate evaluation number/pattern: 0.5624
number of gate: 14
gate evaluation number/number of gates: 0.0401714
total CPU time = 0

Average memory usage: 0
Maximum memory usage: 2120
```

圖五、c17 16 pack number of pattern

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c7552.input "/home/Student113/s110305504/VLSI_Testing/Assignme
nt2/circuits/iscas85/c7552.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 32160101
gate evaluation number/pattern: 3216.01
number of gate: 5994
gate evaluation number/number of gates: 0.536538
total CPU time = 1.9

Average memory usage: 0
Maximum memory usage: 4324
```

圖六、c7552 1 pack number of pattern

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c7552.input "/home/Student113/s110305504/VLSI_Testing/Assignme
nt2/circuits/iscas85/c7552.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 13375541
gate evaluation number/pattern: 1337.55
number of gate: 5994
gate evaluation number/number of gates: 0.223149
total CPU time = 0.85

Average memory usage: 0
Maximum memory usage: 4324
```

圖七、c7552 4 pack number of pattern

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c7552.input "/home/Student113/s110305504/VLSI_Testing/Assignment2/circuits/iscas85/c7552.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 7115937
gate evaluation number/pattern: 711.594
number of gate: 5994
gate evaluation number/number of gates: 0.118718
total CPU time = 0.48
```

圖八、c7552 8 pack number of pattern

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -plogicsim -input c7552.input "/home/Student113/s110305504/VLSI_Testing/Assignment2/circuits/iscas85/c7552.bench"
Start parsing input file
Finish reading circuit file
Run Parallel Logic simulation
gate evaluation number: 3602665
gate evaluation number/pattern: 360.267
number of gate: 5994
gate evaluation number/number of gates: 0.0601045
total CPU time = 0.31

Average memory usage: 0
Maximum memory usage: 4324
```

圖九、c7552 16 pack number of pattern

(c) write a compiled code simulator based on a fixed number (16) of parallel patterns

我透過修改 psim.cc 中的 ParallelEvaluate(gptr)和 ParallelLogicSim()來完成平行化處理

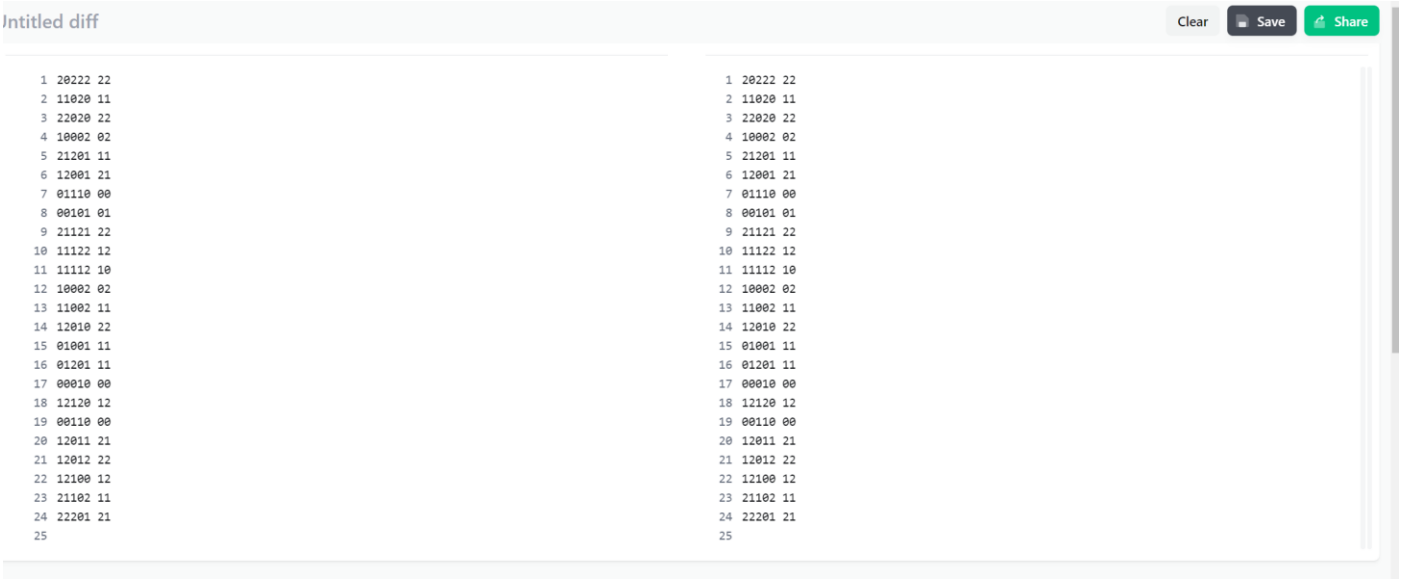
並通過在 psim.cc 創建一個 Simulator() function 來呼叫上述兩個修改後的 function。

此外，相比助教給的 c17.cc **我有多引入一個函式庫 cstdlib**，為了使用避免 system 沒有被宣告

產生這個錯誤 error: ‘system’ was not declared in this scopesystem("ps aux | grep a.out ");

其他寫檔部分可以使用原本給的 source code 去修改即可。

下圖左邊為我使用 c17 執行檔產出，右邊為助教給的 c17.output 之值



圖十、c17 執行結果 c17.ouput(助教)對比

我使用前面使用過的

c7552.input with c7552.bench (207 inputs, 108 outputs, 5994 gates) 10000patterns 進行測試

我在 sim.cc 把 printIO 改成寫檔，並使用 diffchecker 確認兩者之 output 一樣。結果如下

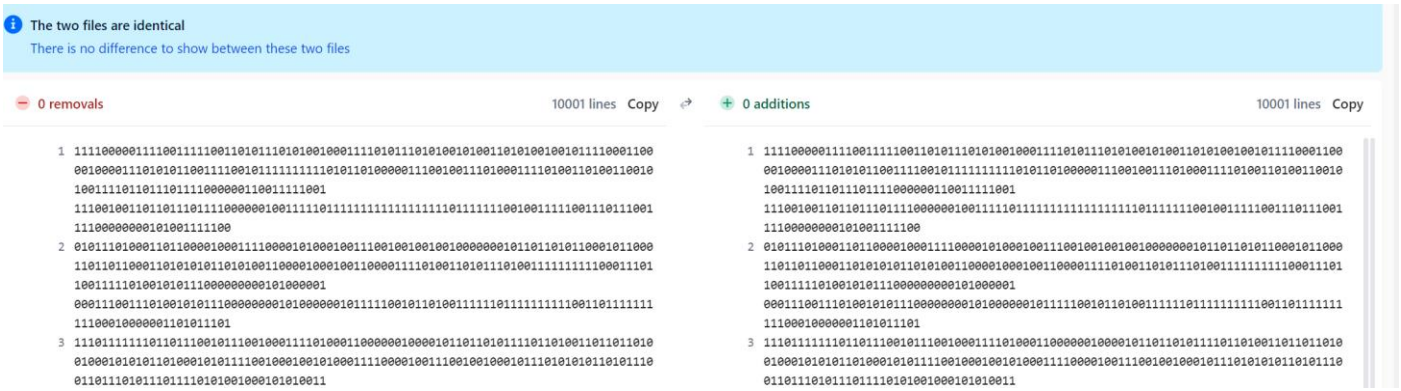
```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./c7552
Total CPU Time = 0.46
s110305+  1199  0.0  0.0 113284  1228 pts/7    S+   17:43   0:00 sh -c ps aux | grep a.out
s110305+  1201  0.0  0.0 112808   988 pts/7    S+   17:43   0:00 grep a.out
Average memory usage: 0
Maximum memory usage: 15104
```

圖十一、simulator 產生結果

```
[s110305504@cad podem]$ /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg -logicsim -input c7552.input "/home/Student113/s110305504/VLSI_Testing/Assignment2/circuits/iscas85/c7552.bench"
Start parsing input file
Finish reading circuit file
Run logic simulation
total CPU time = 2.02

Average memory usage: 0
Maximum memory usage: 4336
```

圖十二、logicsim 產生結果(將 output 改成寫檔進行比對)



圖十三、兩者結果對比發現輸出一樣

```
// void CIRCUIT::PrintIO()
// {
//     register unsigned i;
//     for (i = 0;i<No_PI();++i) { file << PIGate(i)->GetValue(); }
//     file << " ";
//     for (i = 0;i<No_PO();++i) { file << POGate(i)->GetValue(); }
//     file << endl;
//     return;
// }

void CIRCUIT::PrintIO()
{
    register unsigned i;
    for (i = 0;i<No_PI();++i) { cout << PIGate(i)->GetValue(); }
    cout << " ";
    for (i = 0;i<No_PO();++i) { cout << POGate(i)->GetValue(); }
    cout << endl;
    return;
}
```

圖十四、PrintIO 示意圖

如需驗證正確型，可將上面註解 printIO 取消註解，註解下面 printIO 以利寫檔觀察。

	Compiled Simulator	LOGICSIM
CPU time	0.46	2.02
Max Memory usuage	15104	4336

從上表可發現，simulator 產生的 cc 檔經過編譯後運行速度明顯快於 PODEM 提供的 logicsim 模擬。然而 simulator 的模擬所使用的最大記憶體明顯大於 logicsim 的模擬。

Memory 測試指令: /usr/bin/time -f "Average memory usage: %K \nMaximum memory usage: %M\n" ./atpg …(後續指令)

指令 make

編譯 g++ -o <執行檔名稱> <名字.cc 檔>

simulator 產生之指令範例

./atpg -simulator xxx.cc -input xxx.input /path/xxx.bench

Ex: ./atpg -simulator c7552.cc -input c7552.input /path/c7552.bench