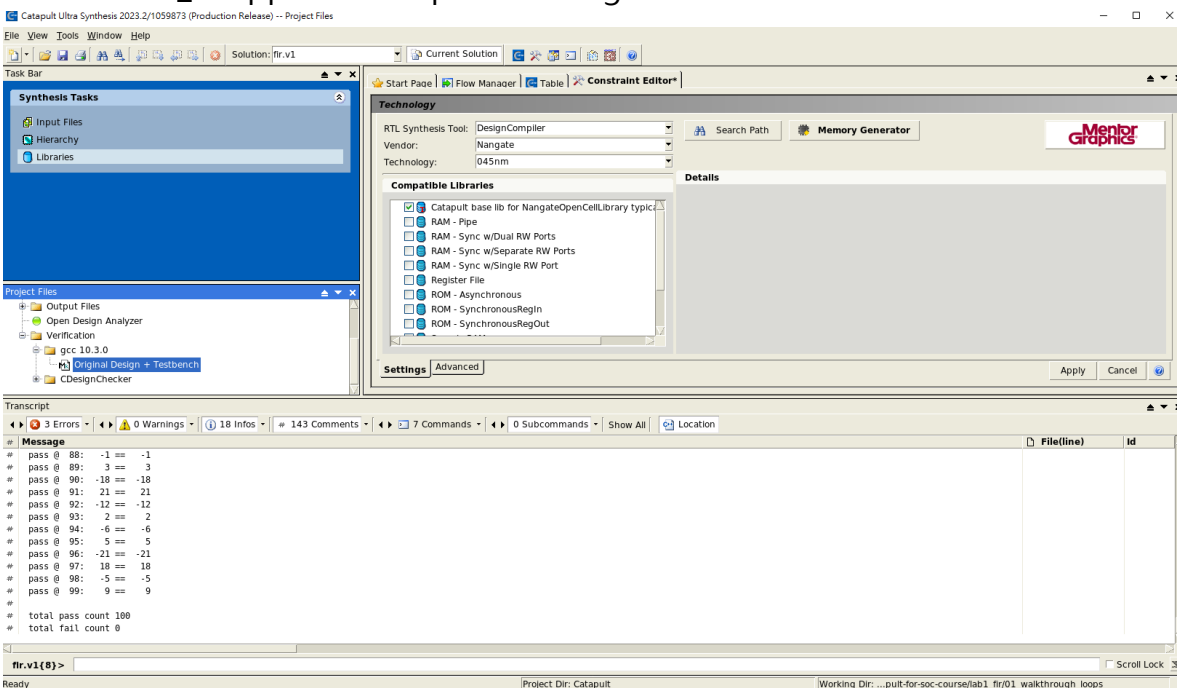
ASoC Lab-catapult-fir Report

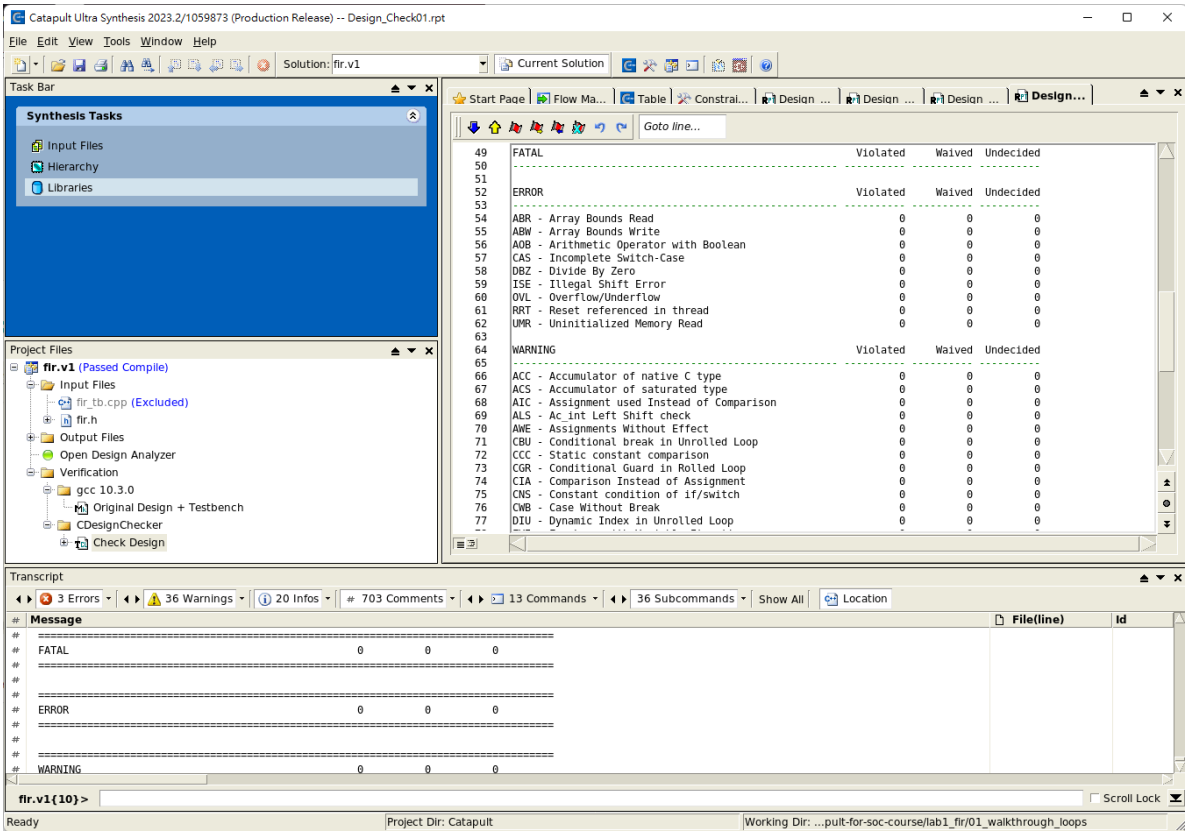
R12943012 蔡東翰

Part I : Walkthrough of Catapult C++ flow

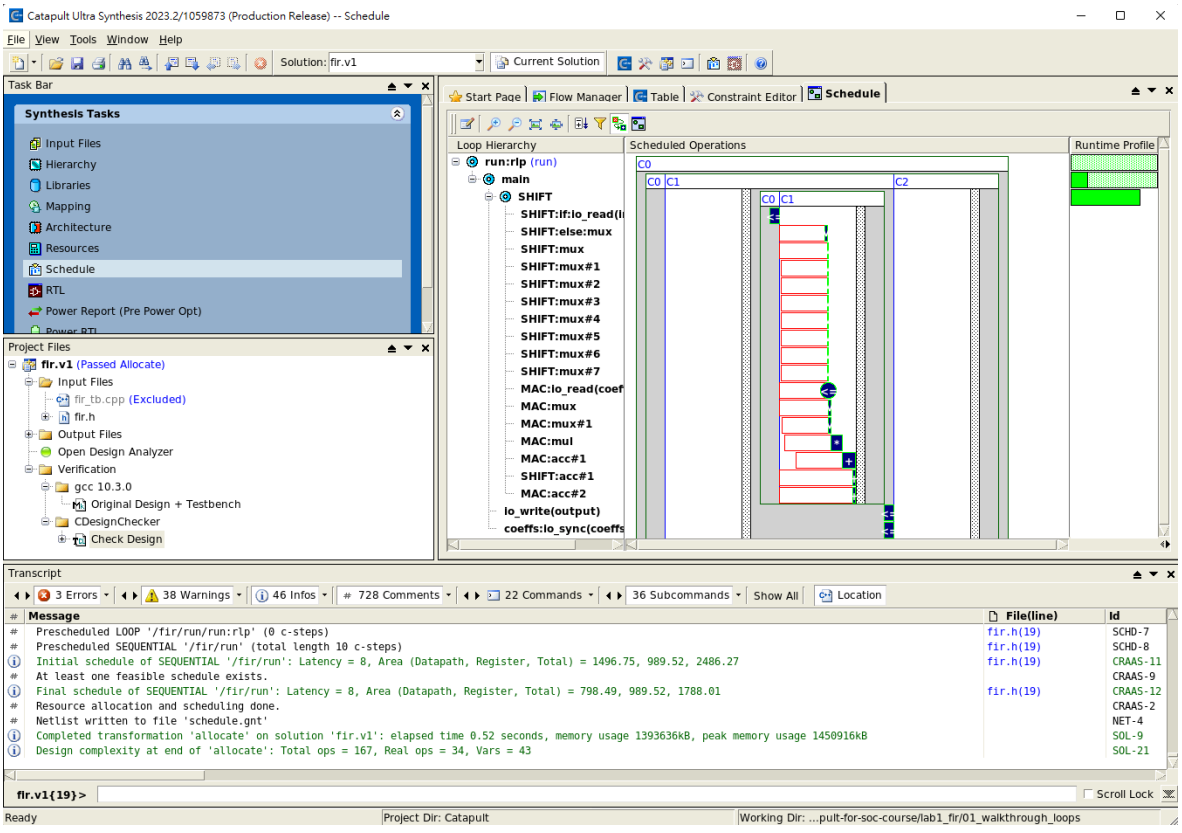
1. 將 fir.h 與 fir_tb.cpp 匯入 catapult 並使用 gcc 編譯執行結果如下圖:



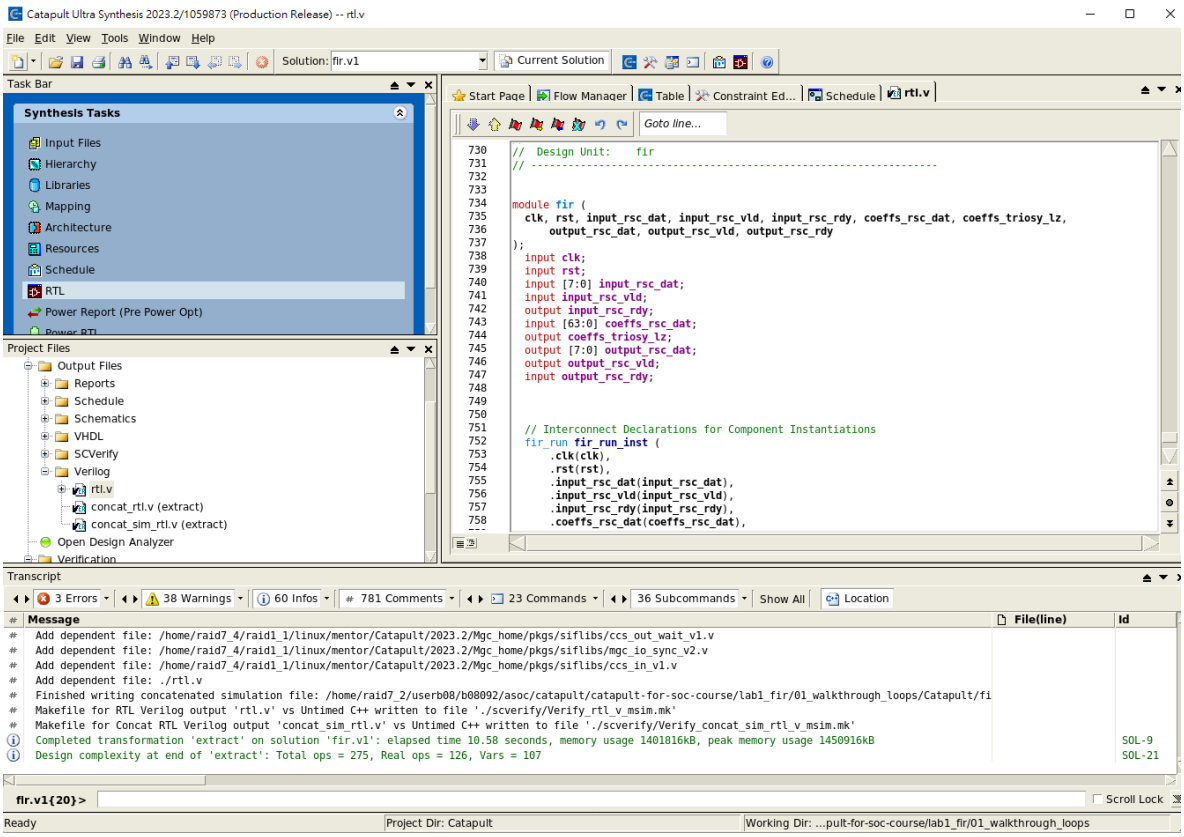
2. 跑 CDesignChecker 結果如下圖:



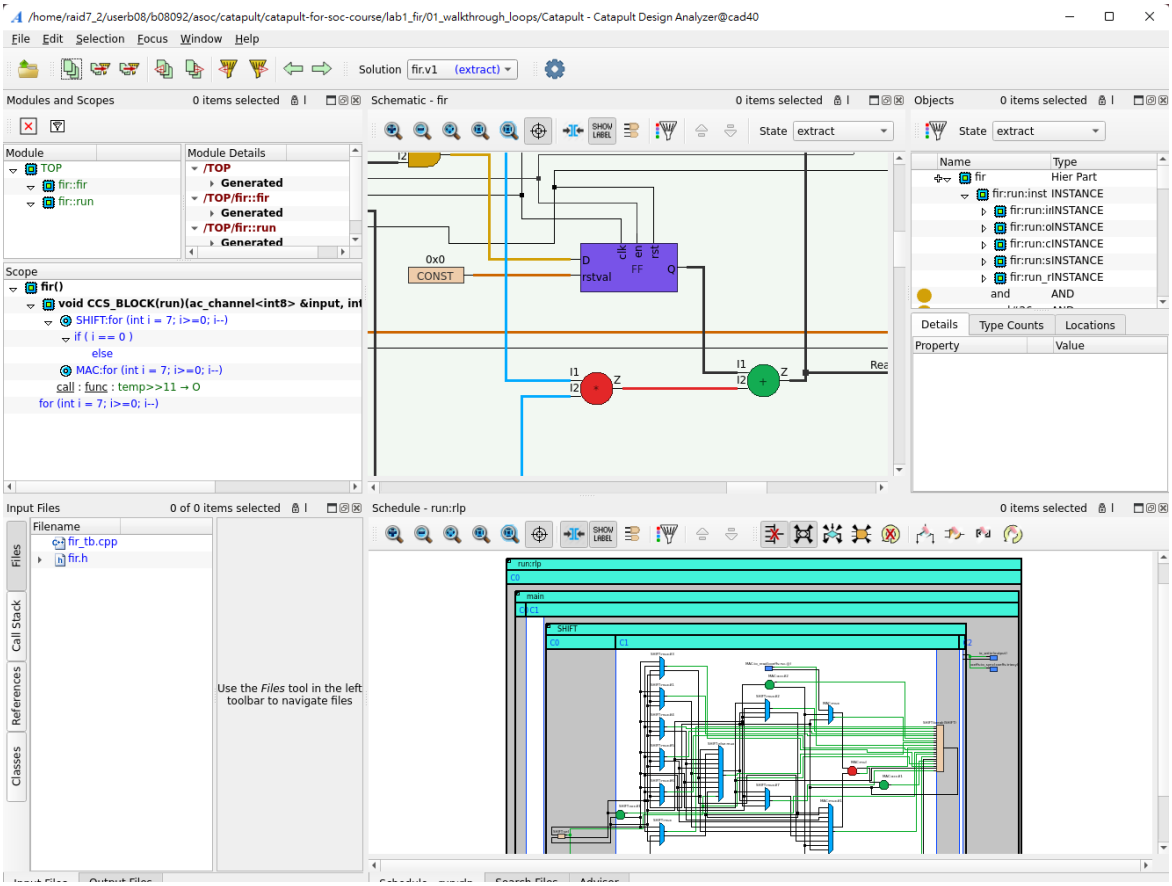
3. Scheduling 後截圖如下:



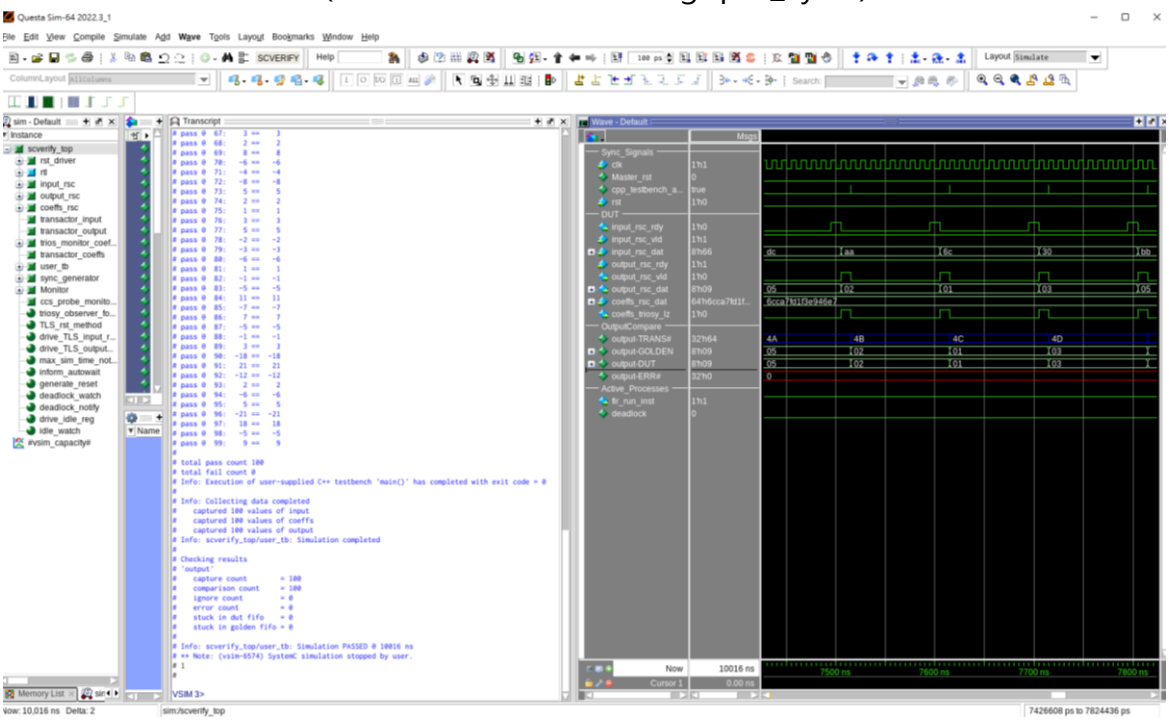
4. RTL 後截圖如下:



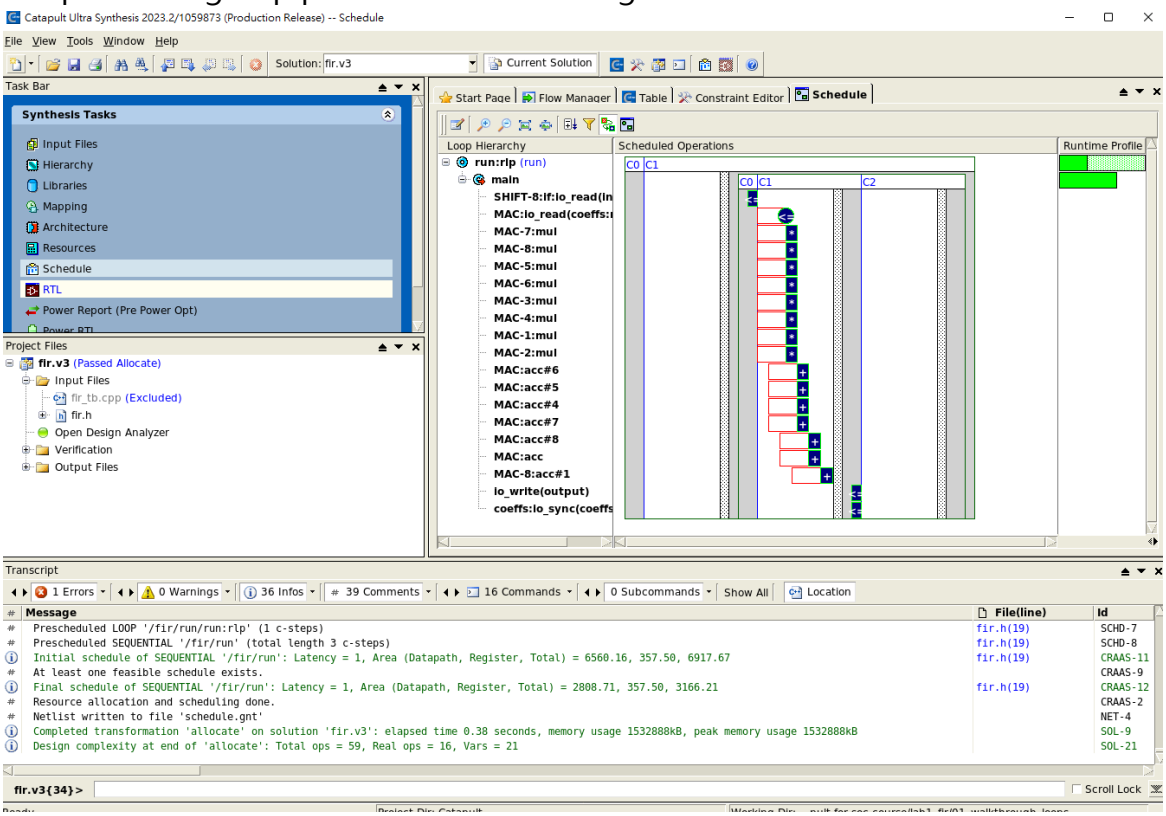
5. Design Analyzer 截圖: (可以看到一個加法器與一個乘法器構造)



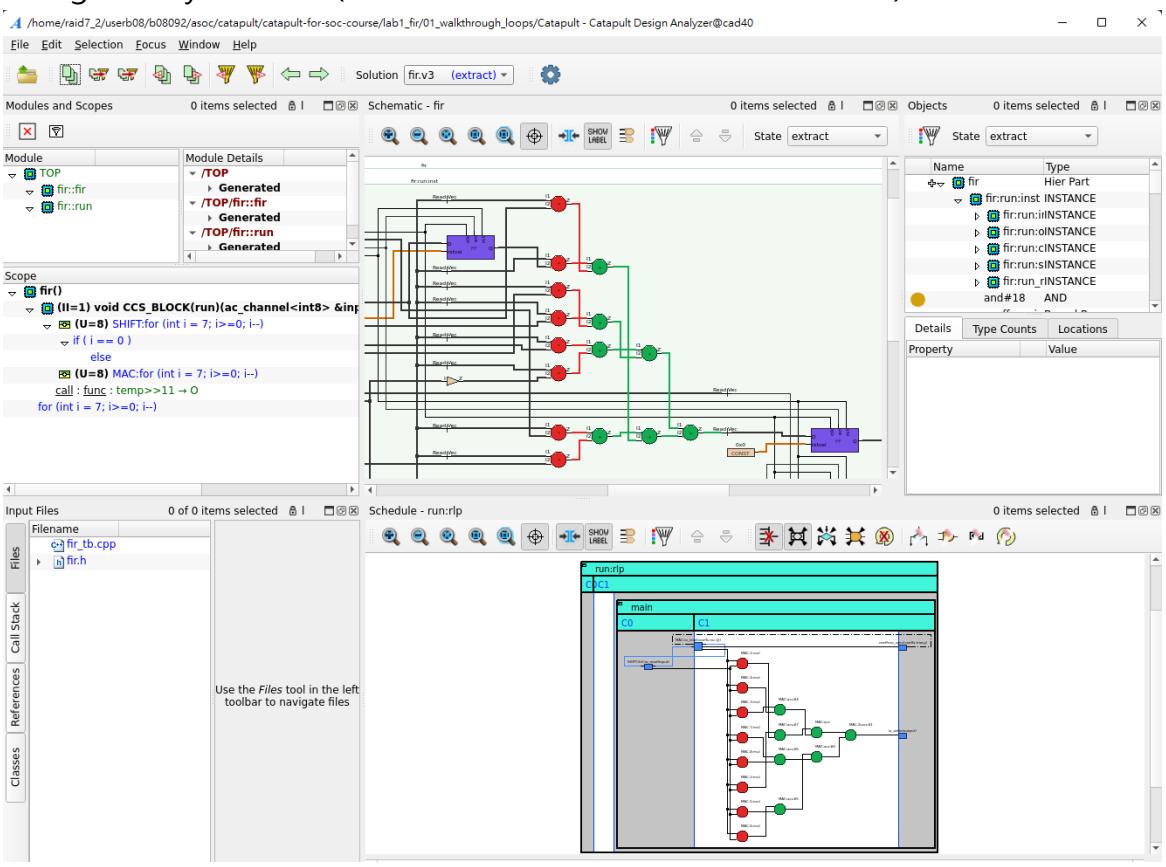
6. RTL Verification 截圖: (以及波形圖可看出 throughput_cycle)



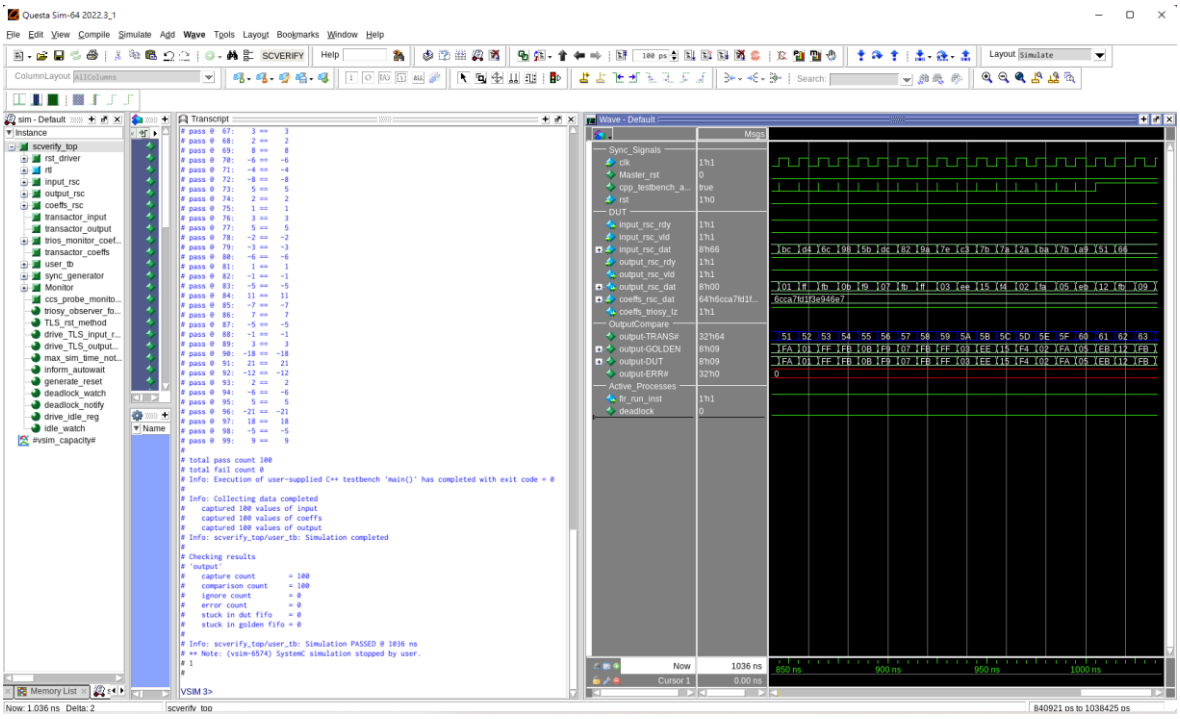
7. Loop unrolling 與 pipeline 後的 scheduling 如下圖:



8. Design Analyzer 截圖: (可以看到 7 個加法器與 8 個乘法器構造)



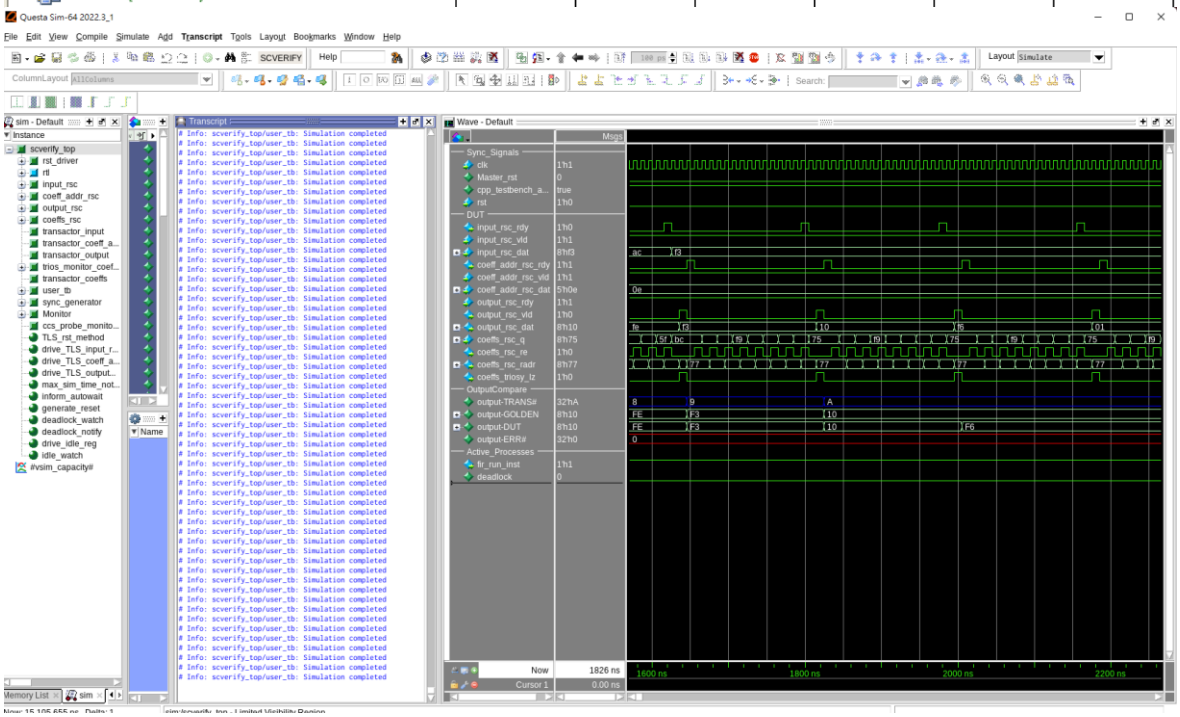
9. RTL Verification 截圖: (以及波形圖可看出 throughput_cycle)



Part II : Memory Interface

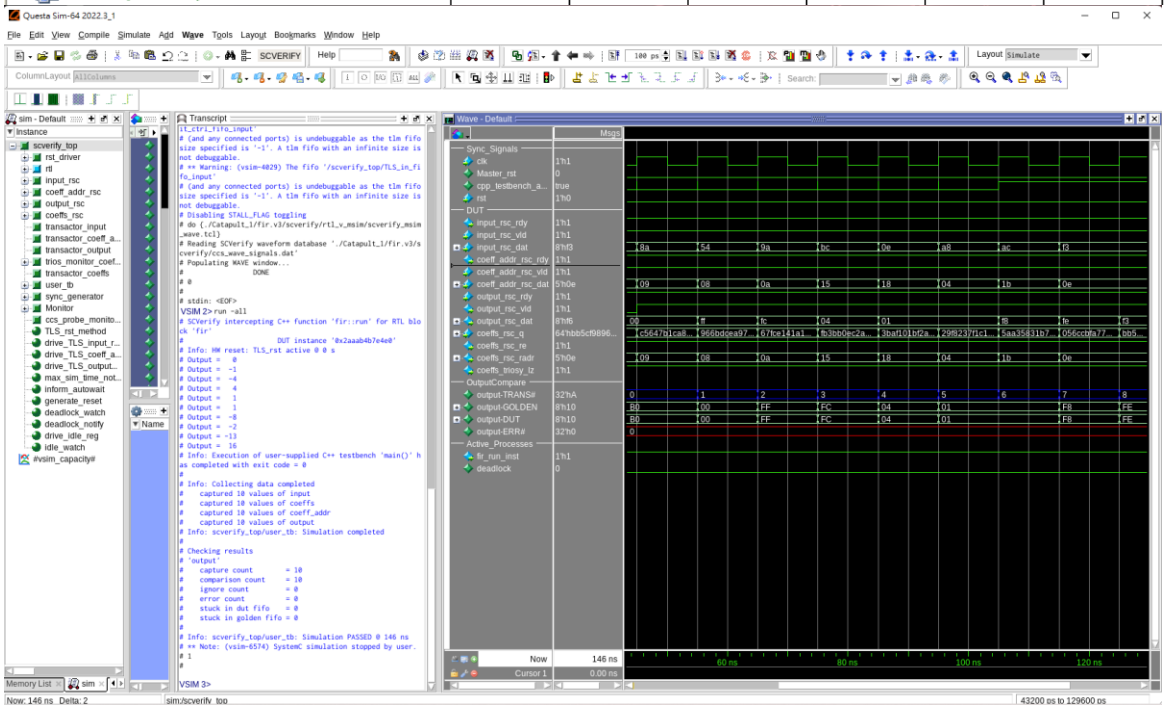
1. 跑 directive.tcl 檔後結果如下: (要將 options set Input/TargetPlatform x86_64 這行指令複製到 tcl 檔內一起跑才不會有 bug)

Solution	Latency...	Latency...	Throug...	Throug...	Slack	Total Area
solution.v1 (new)						
fir.v1 (extract)	**17**	**170.00**	**18**	**180.00**	**7.68**	**1461.69**



2. 再進行 unroll 與 pipeline，並且增加了記憶體資料寬度後的結果如下圖:

Solution	Latency...	Latency...	Throug...	Throug...	Slack	Total Area
solution.v1 (new)						
fir.v1 (extract)	17	170.00	18	180.00	7.68	1461.69
fir.v3 (extract)	**2**	**20.00**	**1**	**10.00**	**7.58**	**4024.42**



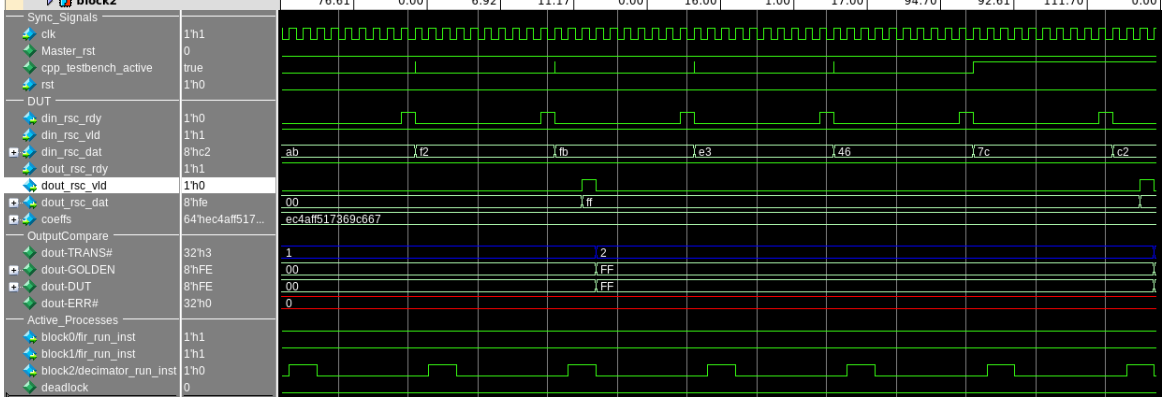
Part III : Multiple blocks

1. 跑 directive.tcl 檔後結果如下: (圖中可見 latency=9, throughput_cycle=10, block0_area=1381.2, block1_area=1381.2, block2_area=111.7)

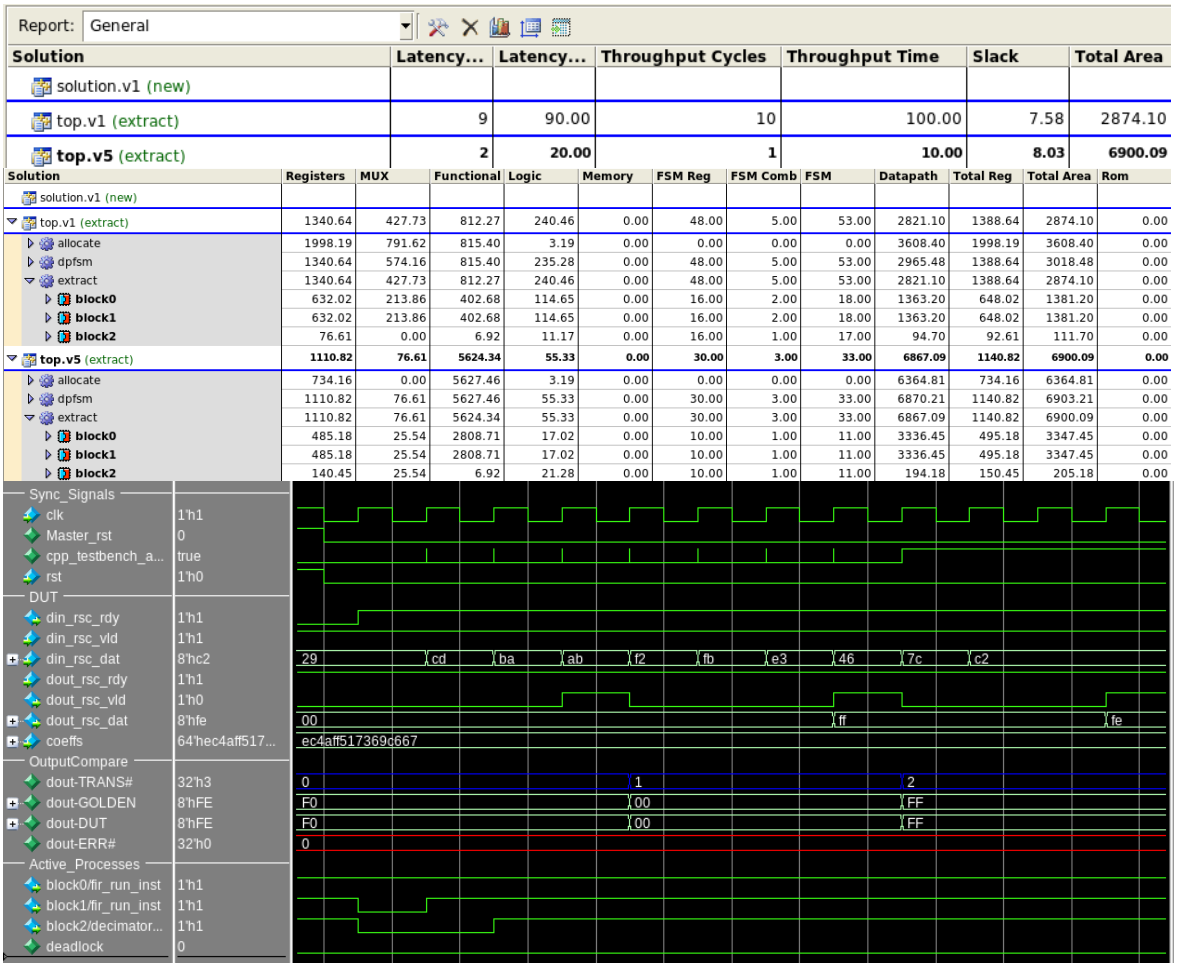
Solution	Latency...	Latency...	Throug...	Throug...	Slack	Total Area
solution.v1 (new)						
top.v1 (extract)	**9**	**90.00**	**10**	**100.00**	**7.58**	**2874.10**

Report: Area Score

Solution	Registers	MUX	Functional	Logic	Memory	FSM Reg	FSM Comb	FSM	Datapath	Total Reg	Total Area	Rom
solution.v1 (new)												
top.v1 (extract)	**1340.64**	**427.73**	**812.27**	**240.46**	**0.00**	**48.00**	**5.00**	**53.00**	**2821.10**	**1388.64**	**2874.10**	**0.00**
allocate	1998.19	791.62	815.40	3.19	0.00	0.00	0.00	0.00	3608.40	1998.19	3608.40	0.00
dpfsm	1340.64	574.16	815.40	235.28	0.00	48.00	5.00	53.00	2965.48	1388.64	3018.48	0.00
extract	1340.64	427.73	812.27	240.46	0.00	48.00	5.00	53.00	2821.10	1388.64	2874.10	0.00
block0	632.02	213.86	402.68	114.65	0.00	16.00	2.00	18.00	1363.20	648.02	1381.20	0.00
block1	632.02	213.86	402.68	114.65	0.00	16.00	2.00	18.00	1363.20	648.02	1381.20	0.00
block2	76.61	0.00	6.92	11.17	0.00	16.00	1.00	17.00	94.70	92.61	111.70	0.00



2. 為將 throughput_cycle 降至 1，我們模仿前面的方法將所有 main 進行 pipeline，所有 SHIFT 與 MAC 函式進行 unroll，即發現成功達成目標，如下圖:



Report: General

Solution	Latency...	Latency...	Throughput Cycles	Throughput Time	Slack	Total Area
solution.v1 (new)						
top.v1 (extract)	9	90.00	10	100.00	7.58	2874.10
top.v5 (extract)	**2**	**20.00**	**1**	**10.00**	**8.03**	**6900.09**

Solution	Registers	MUX	Functional	Logic	Memory	FSM Reg	FSM Comb	FSM	Datapath	Total Reg	Total Area	Rom
solution.v1 (new)												
top.v1 (extract)	1340.64	427.73	812.27	240.46	0.00	48.00	5.00	53.00	2821.10	1388.64	2874.10	0.00
allocate	1998.19	791.62	815.40	3.19	0.00	0.00	0.00	0.00	3608.40	1998.19	3608.40	0.00
dpfsm	1340.64	574.16	815.40	235.28	0.00	48.00	5.00	53.00	2965.48	1388.64	3018.48	0.00
extract	1340.64	427.73	812.27	240.46	0.00	48.00	5.00	53.00	2821.10	1388.64	2874.10	0.00
block0	632.02	213.86	402.68	114.65	0.00	16.00	2.00	18.00	1363.20	648.02	1381.20	0.00
block1	632.02	213.86	402.68	114.65	0.00	16.00	2.00	18.00	1363.20	648.02	1381.20	0.00
block2	76.61	0.00	6.92	11.17	0.00	16.00	1.00	17.00	94.70	92.61	111.70	0.00
top.v5 (extract)	**1110.82**	**76.61**	**5624.34**	**55.33**	**0.00**	**30.00**	**3.00**	**33.00**	**6867.09**	**1140.82**	**6900.09**	**0.00**
allocate	734.16	0.00	5627.46	3.19	0.00	0.00	0.00	0.00	6364.81	734.16	6364.81	0.00
dpfsm	1110.82	76.61	5627.46	55.33	0.00	30.00	3.00	33.00	6870.21	1140.82	6903.21	0.00
extract	1110.82	76.61	5624.34	55.33	0.00	30.00	3.00	33.00	6867.09	1140.82	6900.09	0.00
block0	485.18	25.54	2808.71	17.02	0.00	10.00	1.00	11.00	3336.45	495.18	3347.45	0.00
block1	485.18	25.54	2808.71	17.02	0.00	10.00	1.00	11.00	3336.45	495.18	3347.45	0.00
block2	140.45	25.54	6.92	21.28	0.00	10.00	1.00	11.00	194.18	150.45	205.18	0.00

然而，增加 throughput 的代價便是面積變得比原來大上許多，block0 與 block1 從 1381.2 上升至 3347.45，且 block2 從 111.70 上升至 205.18。