RAT Assignment 1

CPE 233

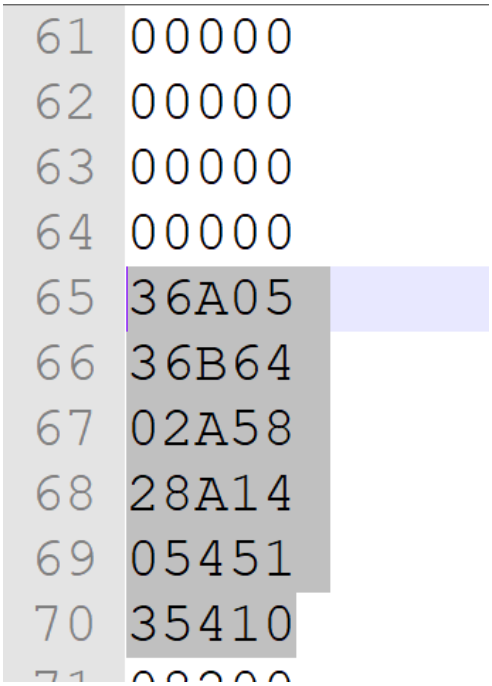
Luis Gomez & Brandon Grossman

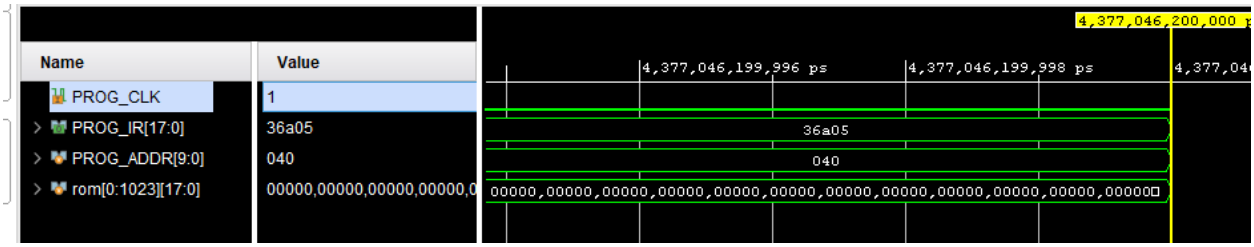
Part 1:

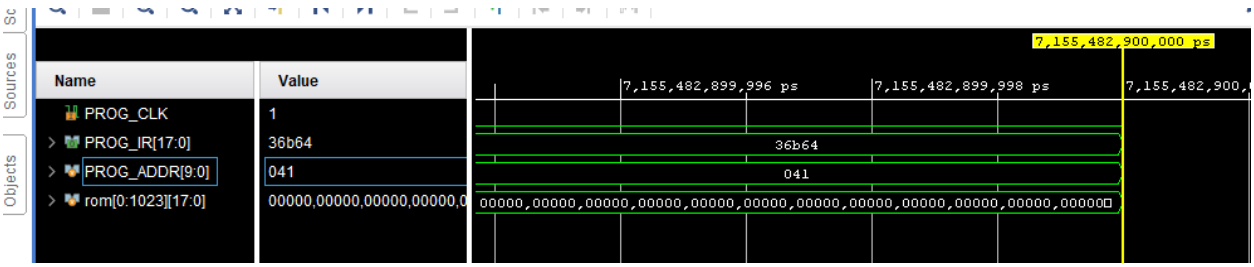
a) Completed program analysis table 2 for program A

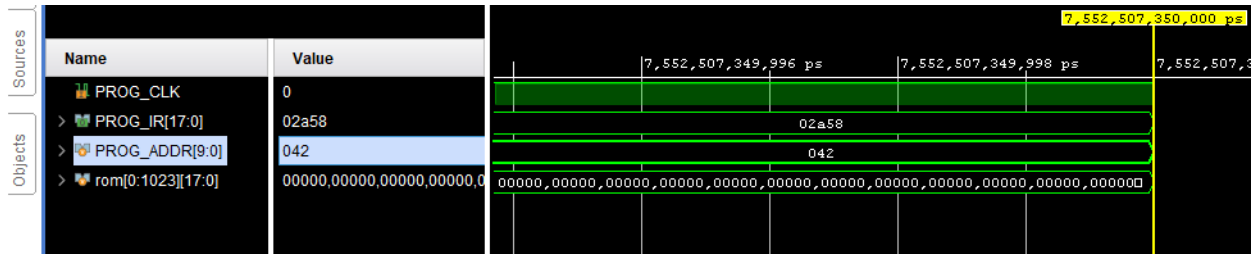
ProgROM Address	Instruction	Destination Register	C Flag	Z Flag	OUT (port_id)
0x40	MOV R10, 0x05	R10 = 0x05	x	x	x
0x41	MOV R11, 0x64	R11 = 0x64	x	x	x
0x42	ADD R10, R11	R10 = 0x69	0	0	x
0x43	ADD R10, 0x14	R10 = 0x7D	0	0	x
0x44	MOV R20, R10	R20 = 0x7D	x	x	x
0x45	OUT R20, LED_PORT	x	x	x	0x7d
0x46	BRN main_loop	x	x	x	x

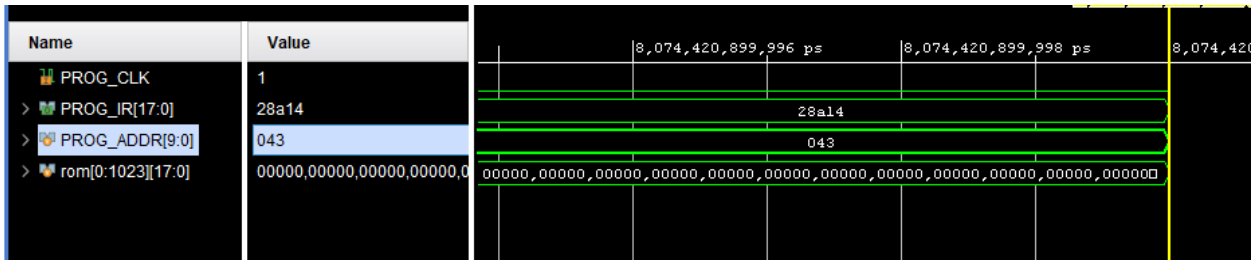
b) Simulation Documentation

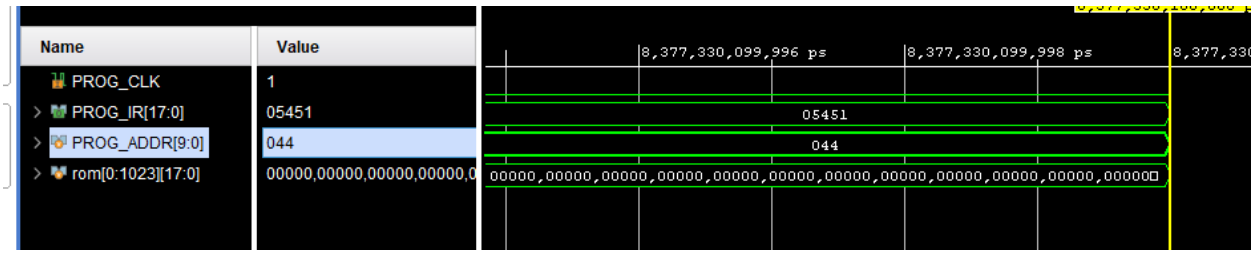


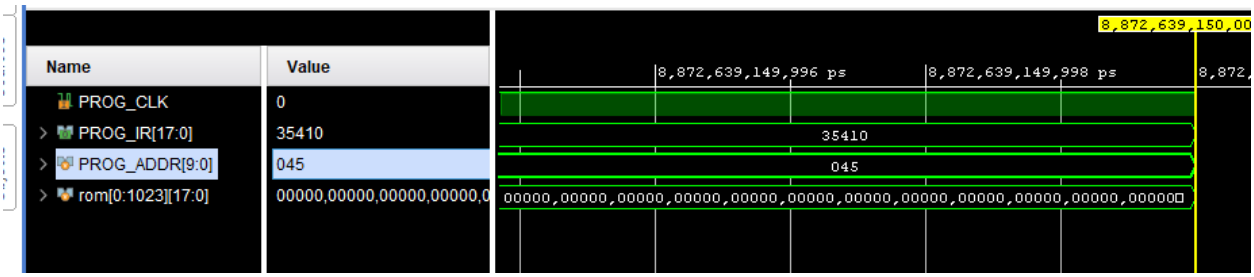

Name
Value
PROG_CLK
1
PROG_IR[17:0]
36a05
PROG_ADDR[9:0]
040
rom[0:1023][17:0]
00000,00000,00000,00000,0
4,377,046,200,000 p
4,377,046,199,996 ps
4,377,046,199,998 ps
4,377,04
36a05
040
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Sources
Objects
Name
Value
PROG_CLK
1
PROG_IR[17:0]
36b64
PROG_ADDR[9:0]
041
rom[0:1023][17:0]
00000,00000,00000,00000,0
7,155,482,900,000 ps
7,155,482,899,996 ps
7,155,482,899,998 ps
7,155,482,900,
36b64
041
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Sources
Objects
Name
Value
PROG_CLK
0
PROG_IR[17:0]
02a58
PROG_ADDR[9:0]
042
rom[0:1023][17:0]
00000,00000,00000,00000,0
7,552,507,350,000 ps
7,552,507,349,996 ps
7,552,507,349,998 ps
7,552,507,3
02a58
042
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
1
PROG_IR[17:0]
28a14
PROG_ADDR[9:0]
043
rom[0:1023][17:0]
00000,00000,00000,00000,0
8,074,420,899,996 ps
8,074,420,899,998 ps
8,074,420
28a14
043
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
1
PROG_IR[17:0]
05451
PROG_ADDR[9:0]
044
rom[0:1023][17:0]
00000,00000,00000,00000,0
8,377,330,099,996 ps
8,377,330,099,998 ps
8,377,330
05451
044
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
0
PROG_IR[17:0]
35410
PROG_ADDR[9:0]
045
rom[0:1023][17:0]
00000,00000,00000,00000,0
8,872,639,150,00
8,872,639,149,996 ps
8,872,639,149,998 ps
8,872,
35410
045
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000

Part 2:

Given the following .mem file

```
 0: 00000
... ...
40: 37DFC
41: 29D01
42: 37EFA
43: 37F05
44: 01EFA
45: 03EEA
46: 0820B
47: 00000
```

Hex Listing 2: prog_rom.mem Segment for Reverse Engineering

a) Completed Disassembly table

ProgROM Address	Machine Code	**Hex Listing**	Assembly Instruction
0x40	1 1011 11101 1111 1100	**37DFC**	MOV R29, 0xFC
0x41	1 0100 11101 0000 0001	**29D01**	ADD R29, 0x01
0x42	1 1011 11110 1111 1010	**37EFA**	MOV R30, 0xFA
0x43	1 1011 11111 0000 0101	**37F05**	MOV R31, 0x05
0x44	0 0000 11110 11111 0 10	**01EFA**	EXOR R30, R31
0x45	0 0001 11110 11101 0 10	**03EEA**	SUB R30, R29
0x46	0 0100 00 0100 0001 0 11	**0820B**	BRNE 0x41
0x47	0 0000 00000 00000 0 00	**00000**	AND R00, R00

b) Typed Assembly code for reversed engineered prog_rom segment

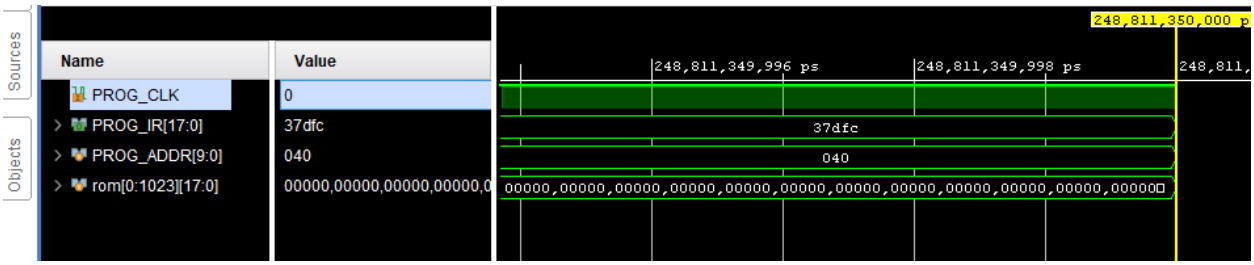
```
1  .CSEG
2  .ORG 0x40
3
4  main_loop:  MOV R29, 0xFC    ; Move 252 to Reg 29
5              ADD R29, 0x01    ; R29 = 252 + 1
6              MOV R30, 0xFA    ; Move 250 to Reg 30
7              MOV R31, 0x05    ; Move 5 to Reg 31
8              EXOR R30, R31    ; 0000 0101 ( Bitwise EXOR ) 1111 1010 = 1111 1111 = 0xFF
9              SUB R30, R29     ; R30 = 255 - 253
10             BRNE 0x41        ; if Z = 0 go to line 41
11
```

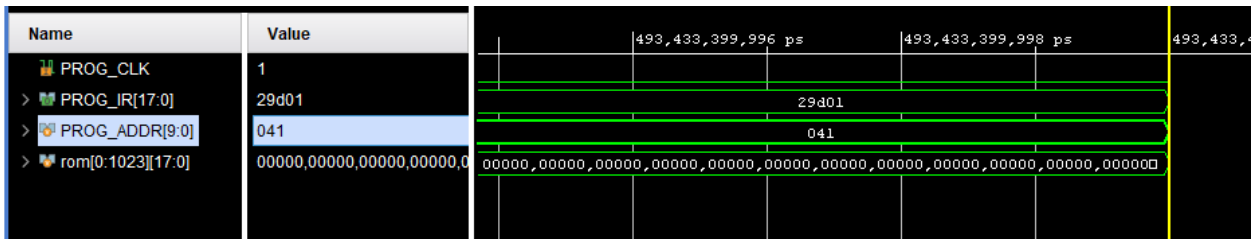
c) Completed table 3 for reversed engineered prog_rom segment

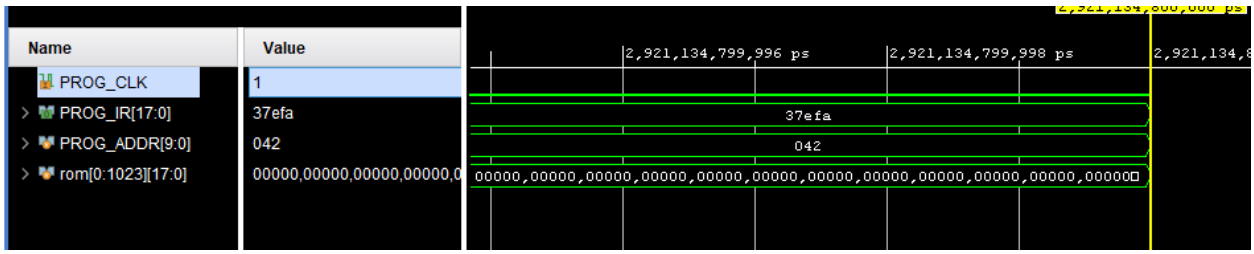
ProgROM Address	Assembly Instruction	Destination Register	C Flag	Z Flag	OUT(port_id)
0x40	MOV R29, 0xFC	R29 = 0xFC	x	x	x
0x41	ADD R29, 0x01	R29 = 0xFD	0	0	x
0x42	MOV R30, 0xFA	R30 = 0xFA	x	x	x
0x43	MOV R31, 0x05	R31 = 0x05	x	x	x
0x44	EXOR R30, R31	R30 = 0xFF	x	0	x
0x45	SUB R30, R29	R30=0x02	0	0	x
0x46	BRNE 0x41	x	x	x	x

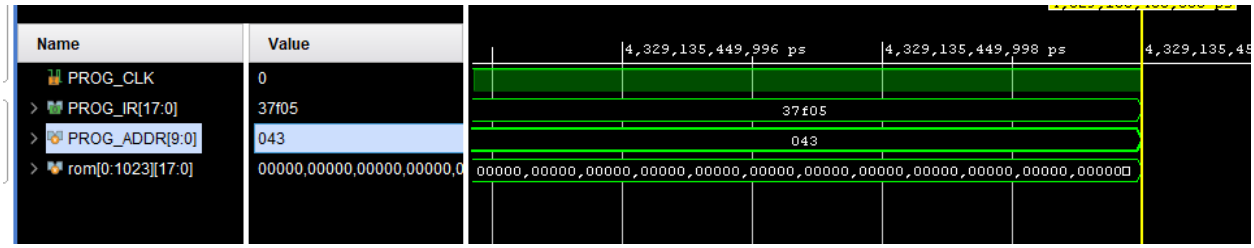
d) Simulation documentation

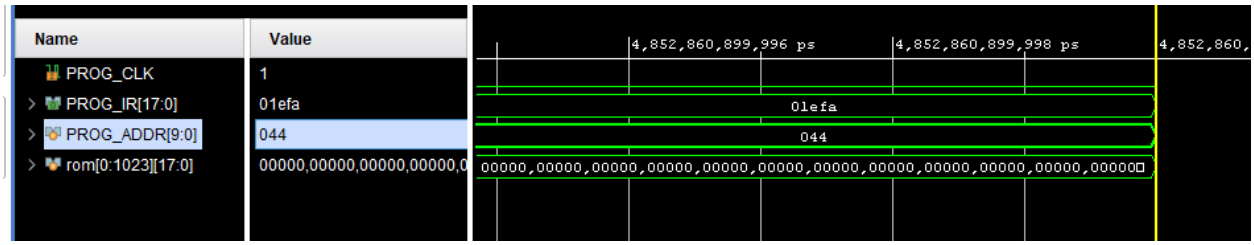
```
64 00000
65 37DFC
66 29D01
67 37EFA
68 37F05
69 01EFA
70 03EEA
71 0820B
72 08200
73 00000
74 00000
```

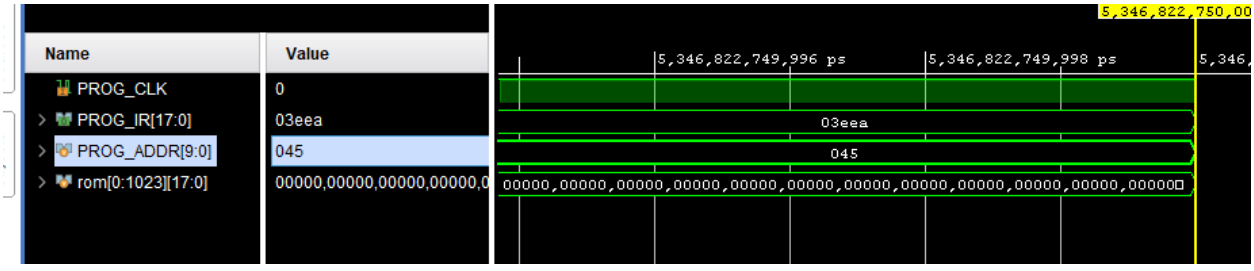

Sources
Objects
Name
Value
PROG_CLK
0
PROG_IR[17:0]
37dfc
PROG_ADDR[9:0]
040
rom[0:1023][17:0]
00000,00000,00000,00000,0
248,811,350,000 p
248,811,349,996 ps
248,811,349,998 ps
248,811,
37dfc
040
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000

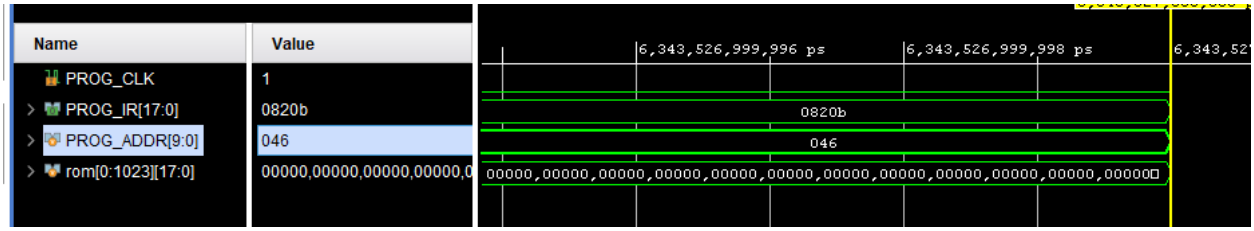

Name
Value
PROG_CLK
1
PROG_IR[17:0]
29d01
PROG_ADDR[9:0]
041
rom[0:1023][17:0]
00000,00000,00000,00000,0
493,433,399,996 ps
493,433,399,998 ps
493,433,
29d01
041
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
1
PROG_IR[17:0]
37efa
PROG_ADDR[9:0]
042
rom[0:1023][17:0]
00000,00000,00000,00000,0
2,921,134,799,996 ps
2,921,134,799,998 ps
2,921,134,8
37efa
042
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
0
PROG_IR[17:0]
37f05
PROG_ADDR[9:0]
043
rom[0:1023][17:0]
00000,00000,00000,00000,0
4,329,135,449,996 ps
4,329,135,449,998 ps
4,329,135,45
37f05
043
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
1
PROG_IR[17:0]
01efa
PROG_ADDR[9:0]
044
rom[0:1023][17:0]
00000,00000,00000,00000,0
4,852,860,899,996 ps
4,852,860,899,998 ps
4,852,860,
01efa
044
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
0
PROG_IR[17:0]
03eea
PROG_ADDR[9:0]
045
rom[0:1023][17:0]
00000,00000,00000,00000,0
5,346,822,750,00
5,346,822,749,996 ps
5,346,822,749,998 ps
5,346,
03eea
045
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000


Name
Value
PROG_CLK
1
PROG_IR[17:0]
0820b
PROG_ADDR[9:0]
046
rom[0:1023][17:0]
00000,00000,00000,00000,0
6,343,526,999,996 ps
6,343,526,999,998 ps
0820b
046
00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000