Microcontroller and Microprocessors
Experiment - 2
Equation Solving and Boolean Reduction

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Equation Solving

Aim :- To solve the given equation ($5x^2 + 6xy + y^2 + 8$)

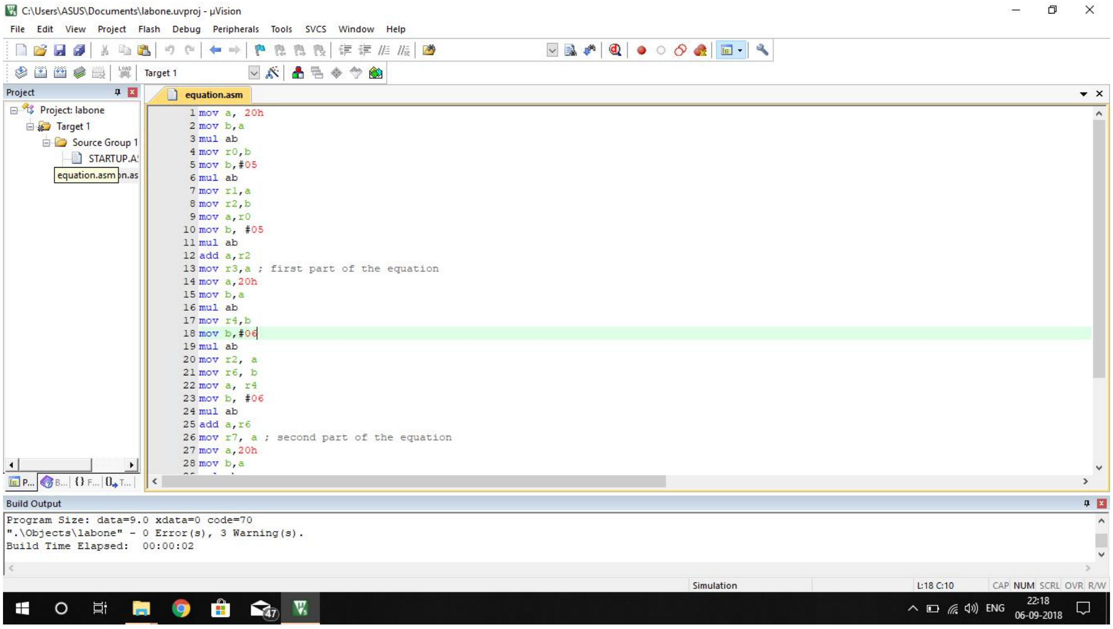
Procedure :-

1. Launch Keil uVision
2. Create a new project and load the NXP microcontroller P895V1RD2
3. Create a blank document and save the file with extension .asm
4. Load the saved .asm file under the target folder for the ongoing project.
5. Type the code and save the file once again
6. Build the target to check if there are any errors or warnings
7. If there are any errors, debug them and continue with step 8
8. Debug the program and note the values of accumulator and corresponding registers
9. Run the program and verify the updated values of the accumulator and corresponding registers

Code :-

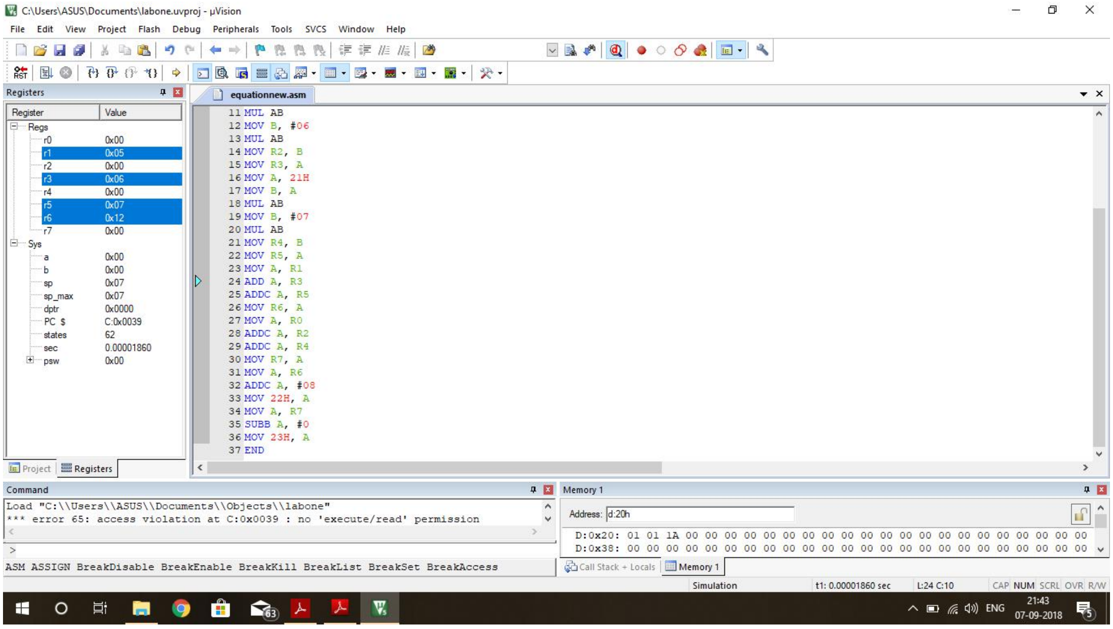
```
MOV A, 20H
MOV B, A
MUL AB
MOV R0, B
MOV B, #05
MUL AB
MOV R0, B
MOV R1, A
MOV A, 20H
MOV B, 21H
MUL AB
MOV B, #06
MUL AB
MOV R2, B
MOV R3, A
MOV A, 21H
MOV B, A
MUL AB
MOV B, #07
MUL AB
MOV R4, B
MOV R5, A
MOV A, R1
ADD A, R3
ADDC A, R5
MOV R6, A
MOV A, R0
ADDC A, R2
ADDC A, R4
MOV R7, A
MOV A, R6
ADDC A, #08
MOV 22H, A
MOV A, R7
SUBB A, #0
MOV 23H, A
END
```

<u>Pictures :-</u>



```
mov a, 20h
mov b,a
mul ab
mov r0,b
mov b,#05
mul ab
mov r1,a
mov r2,b
mov a,r0
mov b, #05
mul ab
add a,r2
mov r3,a ; first part of the equation
mov a,20h
mov b,a
mul ab
mov r4,b
mov b,#06
mul ab
mov r2, a
mov r6, b
mov a, r4
mov b, #06
mul ab
add a,r6
mov r7, a ; second part of the equation
mov a,20h
mov b,a
```

```
Program Size: data=9.0 xdata=0 code=70
".\Objects\labone" - 0 Error(s), 3 Warning(s).
Build Time Elapsed:  00:00:02
```


C:\Users\ASUS\Documents\labone.uvproj - µVision
File Edit View Project Flash Debug Peripherals Tools SVCS Window Help
Registers
equationnew.asm
Project
Registers
Command
Memory 1
Call Stack + Locals
Memory 1
Simulation
CAP NUM SCRL OVR R/W
ENG

Register	Value
Regs	
r0	0x00
r1	0x05
r2	0x00
r3	0x06
r4	0x00
r5	0x07
r6	0x12
r7	0x00
Sys	
a	0x00
b	0x00
sp	0x07
sp_max	0x07
dptr	0x0000
PC $	C:0x0039
states	62
sec	0.00001860
psw	0x00

```
MUL AB
MOV B, #06
MUL AB
MOV R2, B
MOV R3, A
MOV A, 21H
MOV B, A
MUL AB
MOV B, #07
MUL AB
MOV R4, B
MOV R5, A
MOV A, R1
ADD A, R3
ADDC A, R5
MOV R6, A
MOV A, R0
ADDC A, R2
ADDC A, R4
MOV R7, A
MOV A, R6
ADDC A, #08
MOV 22H, A
MOV A, R7
SUBB A, #0
MOV 23H, A
END
```

```
Load "C:\\Users\\ASUS\\Documents\\Objects\\labone"
*** error 65: access violation at C:0x0039 : no 'execute/read' permission
>
ASM ASSIGN BreakDisable BreakEnable BreakKill BreakList BreakSet BreakAccess
```

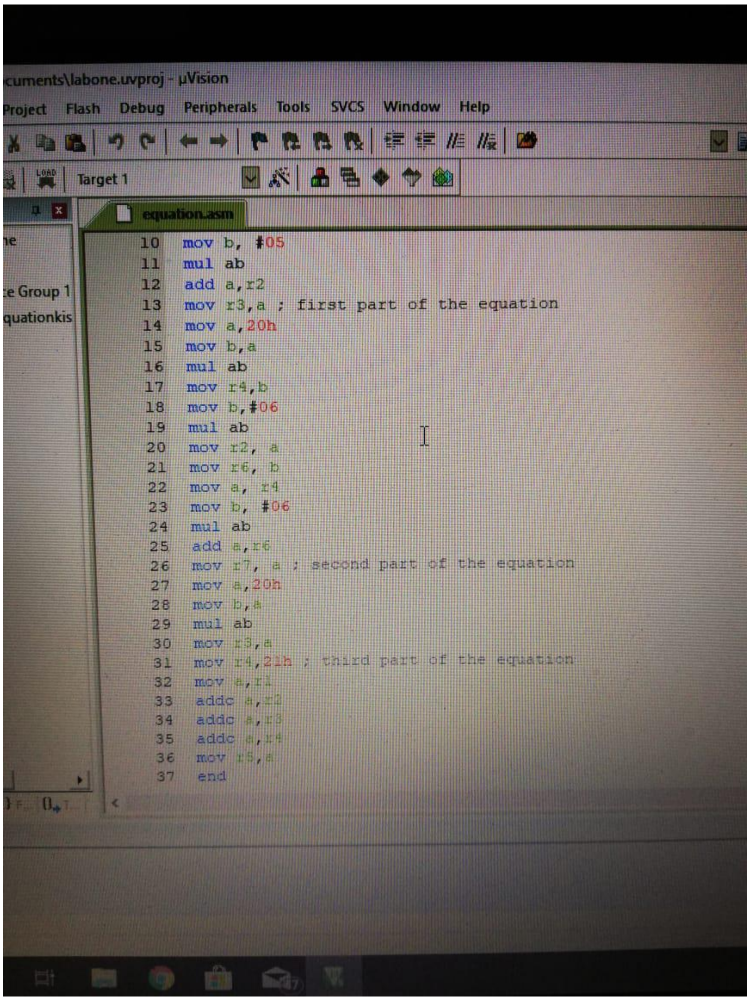
Address: d:20h

```
D:0x20: 01 01 1A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D:0x38: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

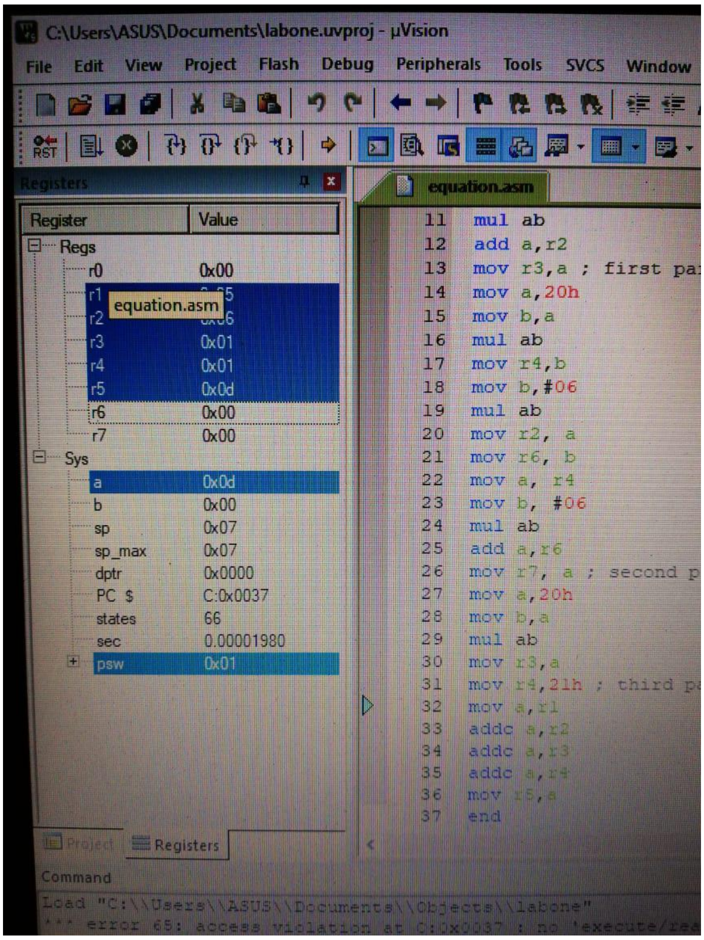
t1: 0.00001860 sec L:24 C:10

21:43
07-09-2018

Lab Pictures


cuments\labone.uvproj - µVision
Project Flash Debug Peripherals Tools SVCS Window Help
Target 1
equation.asm
ne
e Group 1
quationkis

```
mov b, #05
mul ab
add a,r2
mov r3,a ; first part of the equation
mov a,20h
mov b,a
mul ab
mov r4,b
mov b,#06
mul ab
mov r2, a
mov r6, b
mov a, r4
mov b, #06
mul ab
add a,r6
mov r7, a ; second part of the equation
mov a,20h
mov b,a
mul ab
mov r3,a
mov r4,21h ; third part of the equation
mov a,r1
addc a,r2
addc a,r3
addc a,r4
mov r5,a
end
```


C:\Users\ASUS\Documents\labone.uvproj - µVision
File Edit View Project Flash Debug Peripherals Tools SVCS Window
RST
Registers
equation.asm
Project
Registers
Command

Register	Value
Regs	
r0	0x00
r1	0x05
r2	0x06
r3	0x01
r4	0x01
r5	0x0d
r6	0x00
r7	0x00
Sys	
a	0x0d
b	0x00
sp	0x07
sp_max	0x07
dptr	0x0000
PC $	C:0x0037
states	66
sec	0.00001980
psw	0x01

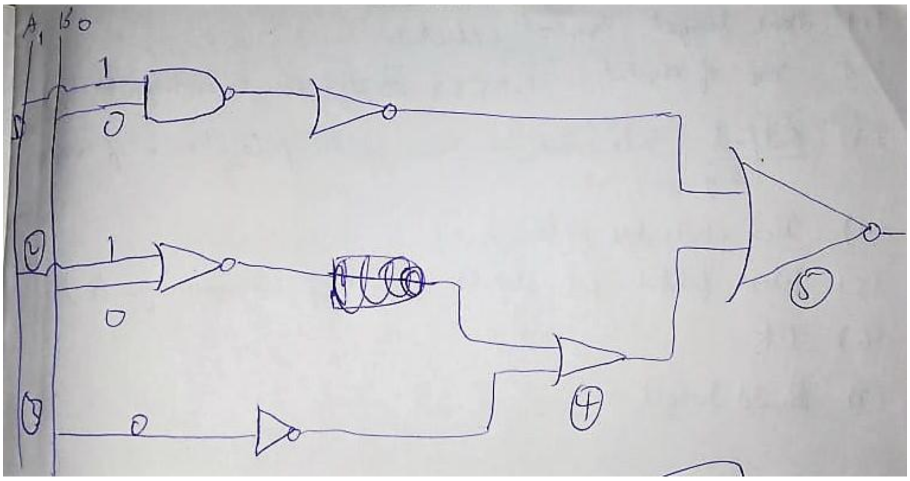
```
mul ab
add a,r2
mov r3,a ; first pa
mov a,20h
mov b,a
mul ab
mov r4,b
mov b,#06
mul ab
mov r2, a
mov r6, b
mov a, r4
mov b, #06
mul ab
add a,r6
mov r7, a ; second p
mov a,20h
mov b,a
mul ab
mov r3,a
mov r4,21h ; third pa
mov a,r1
addc a,r2
addc a,r3
addc a,r4
mov r5,a
end
```

```
Load "C:\\Users\\ASUS\\Documents\\Objects\\labone"
*** error 65: access violation at C:0x0037 : no 'execute/rea
```

Conclusion :- Through Keil we can see that equation solving is not a big task and can be done in seconds using different values. The program ran successfully and the results were same as of theory.

Boolean Reduction

Aim :- To solve the given boolean expression using keil.



Procedure :-

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Logic :-

- Compute all the logic gates and store them in accumulators for further operations

For OR and NOR gates:

- Use ORL command to perform OR logic between A and B (A + B)
- Use CPL command after ORL command to obtain NOR logic ((A + B)')

For AND and NAND gates:

- Use ANL command to perform AND logic between A and B (AB)
- Use CPL command after ANL command to obtain NAND logic ((AB)')

For XOR gates:

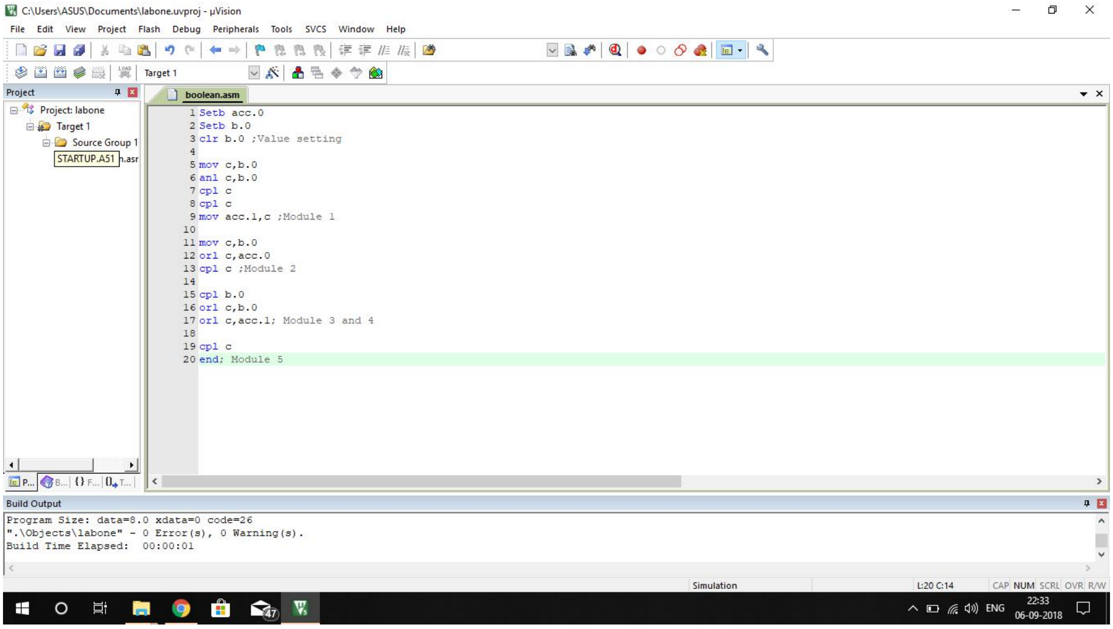
- Use CPL command to obtain A' and B' and store them in 2 new Accumulators.
- Use ANL command to perform AND logic between A' and B and A and B' and obtain A'B and B'A and store them in Accumulators
- Use ORL command to perform OR logic between A'B and B'A to get the final XOR gate (A'B + B'A).

Code :-

```
Setb acc.0
Setb b.0
clr b.0 ;Value setting
mov c,b.0
anl c,b.0
cpl c
cpl c
mov acc.1,c ;Module 1
```

mov c,b.0
orl c,acc.0
cpl c ;Module 2
cpl b.0
orl c,b.0
orl c,acc.1; Module 3 and 4
cpl c
end; Module 5

Pictures :-

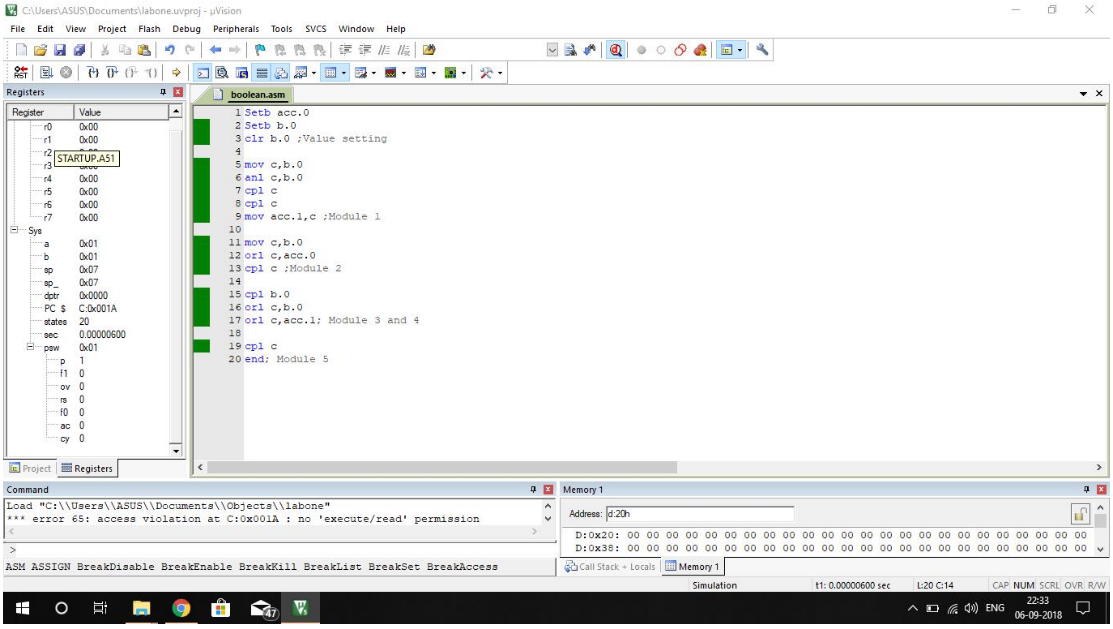


C:\Users\ASUS\Documents\labone.uvproj - µVision

```
Setb acc.0
Setb b.0
clr b.0 ;Value setting

mov c,b.0
anl c,b.0
cpl c
cpl c
mov acc.1,c ;Module 1

mov c,b.0
orl c,acc.0
cpl c ;Module 2

cpl b.0
orl c,b.0
orl c,acc.1; Module 3 and 4

cpl c
end; Module 5
```

Build Output

```
Program Size: data=8.0 xdata=0 code=26
".\Objects\labone" - 0 Error(s), 0 Warning(s).
Build Time Elapsed:  00:00:01
```



C:\Users\ASUS\Documents\labone.uvproj - µVision

File Edit View Project Flash Debug Peripherals Tools SVCS Window Help
Registers
STARTUP.A51
boolean.asm
Project
Registers

Register	Value
r0	0x00
r1	0x00
r2	
r3	
r4	0x00
r5	0x00
r6	0x00
r7	0x00
Sys	
a	0x01
b	0x01
sp	0x07
sp_	0x07
dptr	0x0000
PC $	C:0x001A
states	20
sec	0.00000600
psw	0x01
p	1
f1	0
ov	0
rs	0
f0	0
ac	0
cy	0

```
Setb acc.0
Setb b.0
clr b.0 ;Value setting

mov c,b.0
anl c,b.0
cpl c
cpl c
mov acc.1,c ;Module 1

mov c,b.0
orl c,acc.0
cpl c ;Module 2

cpl b.0
orl c,b.0
orl c,acc.1; Module 3 and 4

cpl c
end; Module 5
```

Command

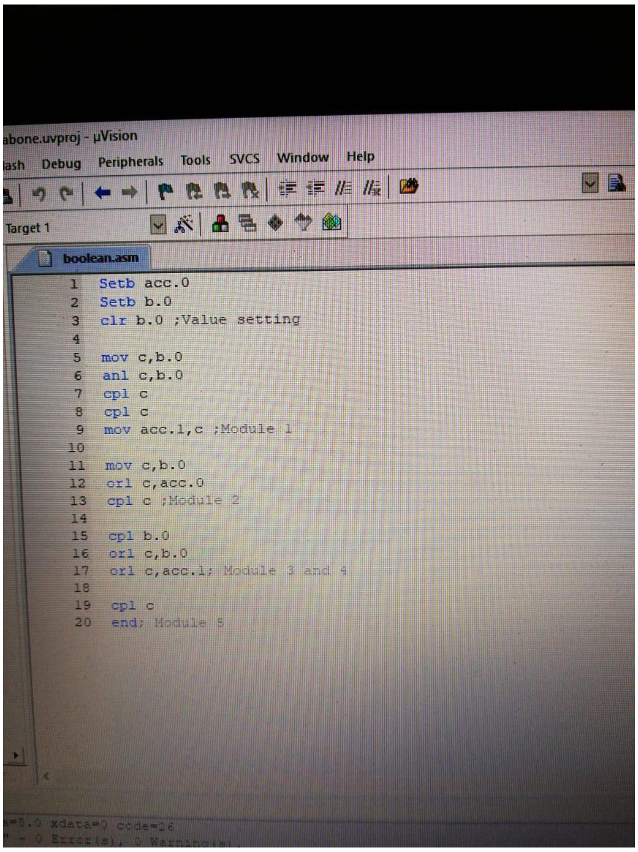
```
Load "C:\\Users\\ASUS\\Documents\\Objects\\labone"
*** error 65: access violation at C:0x001A : no 'execute/read' permission
>
ASM ASSIGN BreakDisable BreakEnable BreakKill BreakList BreakSet BreakAccess
```

Memory 1

Address: d:20h

```
D:0x20: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D:0x38: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Lab Pictures



```
Setb acc.0
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clr b.0 ;Value setting

mov c,b.0
anl c,b.0
cpl c
cpl c
mov acc.1,c ;Module 1

mov c,b.0
orl c,acc.0
cpl c ;Module 2

cpl b.0
orl c,b.0
orl c,acc.1; Module 3 and 4

cpl c
end; Module 5
```
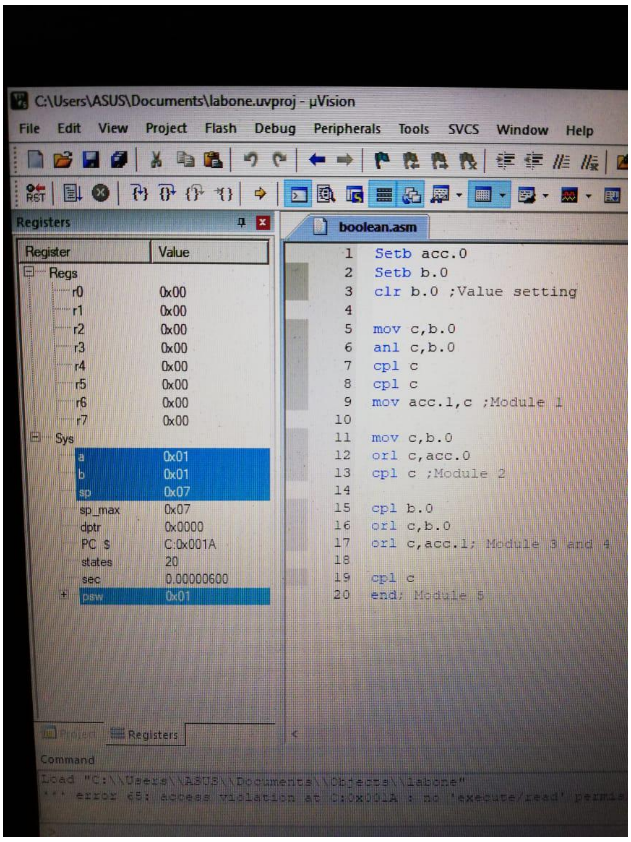

```
a=8.0 xdata=0 code=26
" - 0 Error(s), 0 Warning(s).
```



Register	Value
Regs	
r0	0x00
r1	0x00
r2	0x00
r3	0x00
r4	0x00
r5	0x00
r6	0x00
r7	0x00
Sys	
a	0x01
b	0x01
sp	0x07
sp_max	0x07
dptr	0x0000
PC $	C:0x001A
states	20
sec	0.00000600
psw	0x01

```
Setb acc.0
Setb b.0
clr b.0 ;Value setting

mov c,b.0
anl c,b.0
cpl c
cpl c
mov acc.1,c ;Module 1

mov c,b.0
orl c,acc.0
cpl c ;Module 2

cpl b.0
orl c,b.0
orl c,acc.1; Module 3 and 4

cpl c
end; Module 5
```

```
Load "C:\\Users\\ASUS\\Documents\\Objects\\labone"
*** error 65: access violation at C:0x001A : no 'execute/read' permis
```

Conclusion :- The boolean reduction was done easily using Keil and the result matches with the theoretical result.