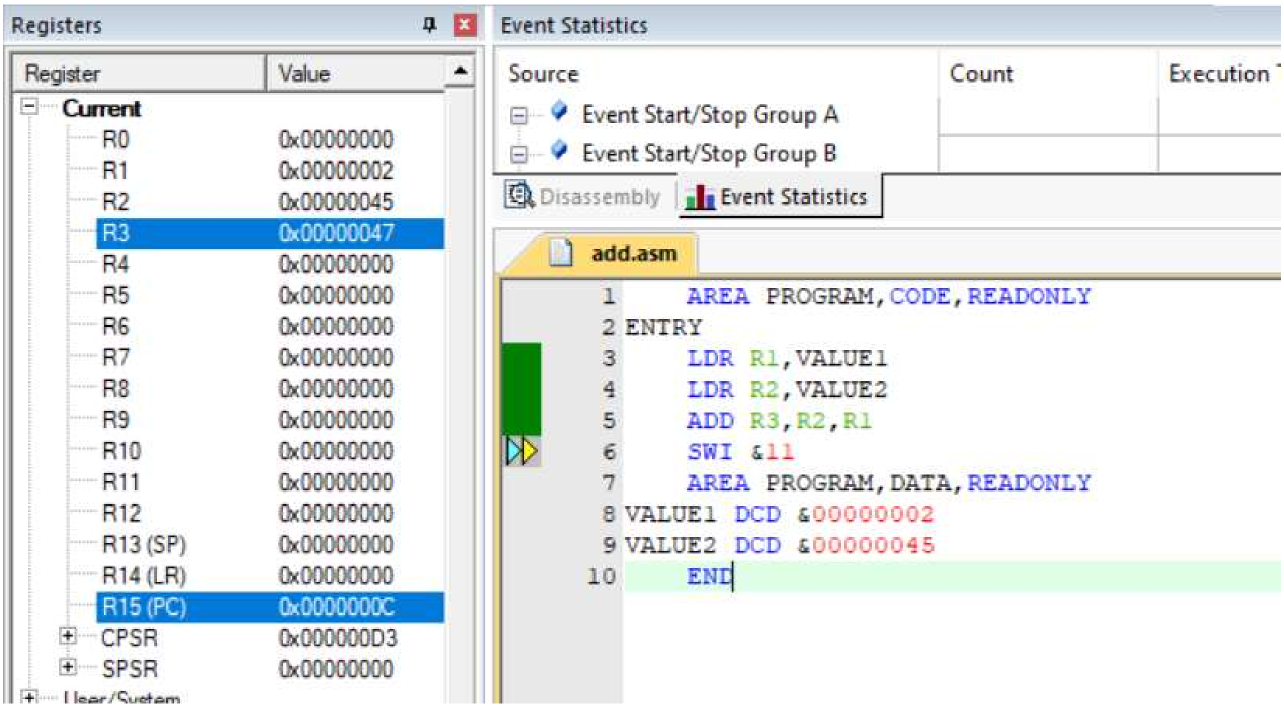
Assignment 1

Q1

a) Direct addressing addition



Register	Value
Current	
R0	0x00000000
R1	0x00000002
R2	0x00000045
R3	0x00000047
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000000
R15 (PC)	0x0000000C
CPSR	0x000000D3
SPSR	0x00000000

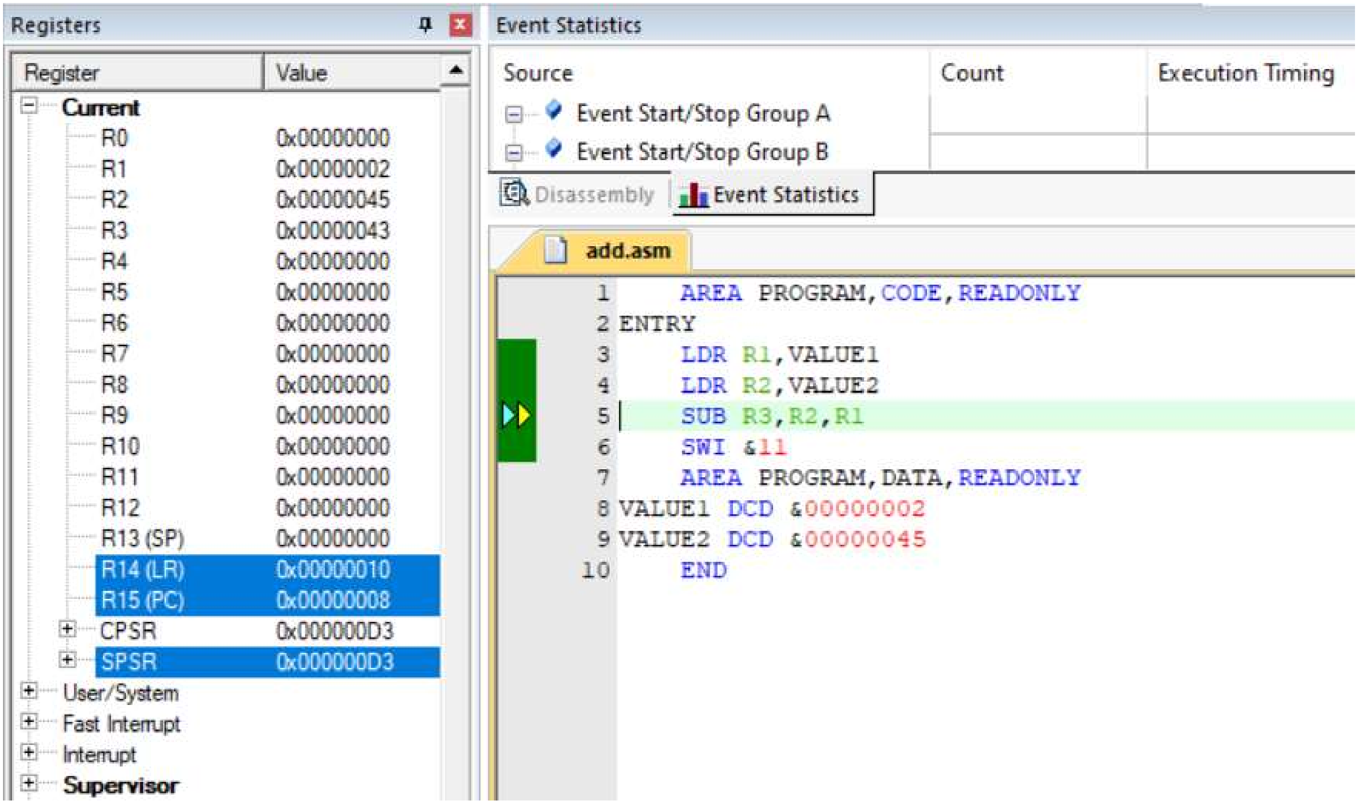
```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R1,VALUE1
    LDR R2,VALUE2
    ADD R3,R2,R1
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
VALUE2 DCD &00000045
    END
```

Result Stored in R3

CODE:

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        LDR R2,VALUE2
        ADD R3,R2,R1
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
VALUE2 DCD &00000045
        END
```

Direct addressing Subtraction



Register	Value
Current	
R0	0x00000000
R1	0x00000002
R2	0x00000045
R3	0x00000043
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000010
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x000000D3
User/System	
Fast Interrupt	
Interrupt	
Supervisor	

Source	Count	Execution Timing
Event Start/Stop Group A		
Event Start/Stop Group B		

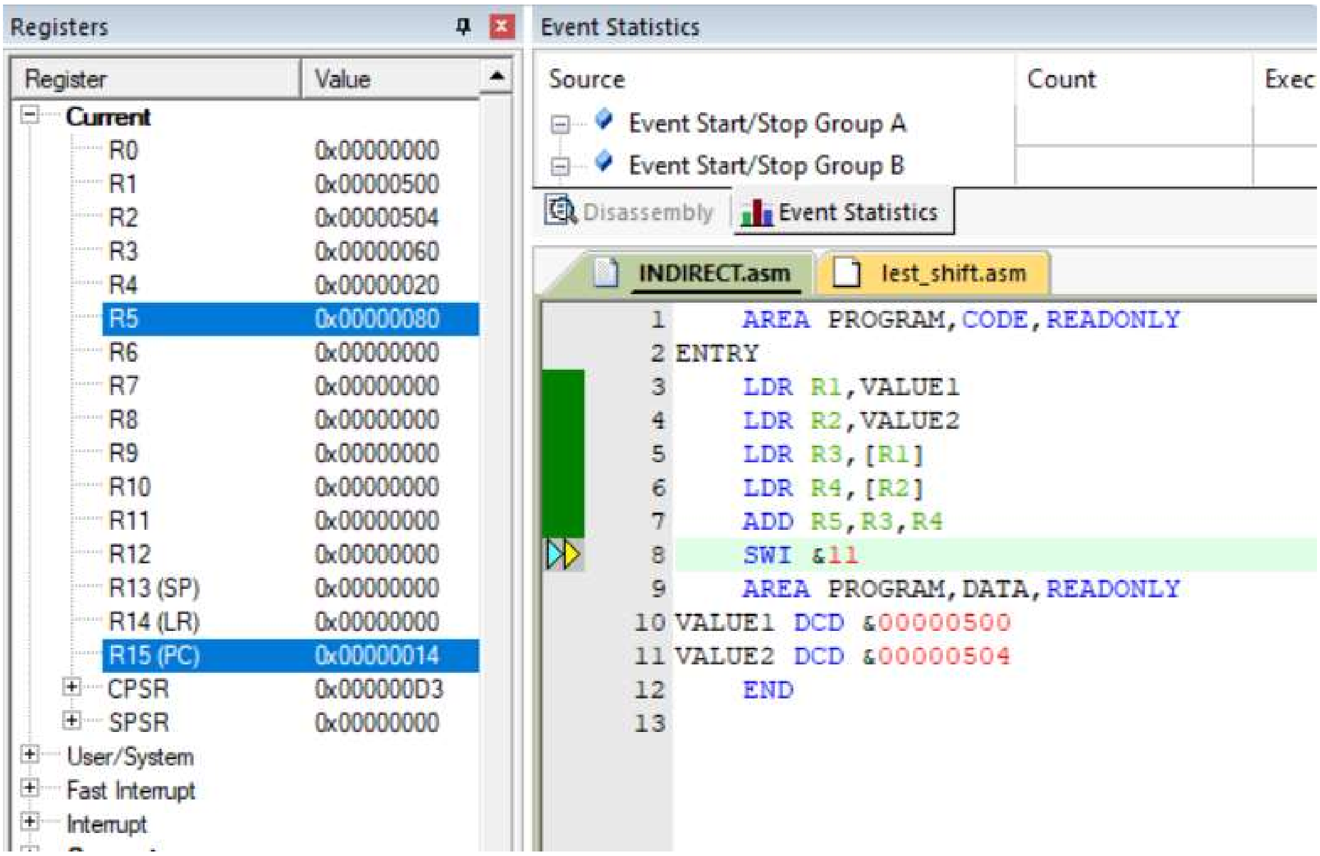
```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R1,VALUE1
    LDR R2,VALUE2
    SUB R3,R2,R1
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
VALUE2 DCD &00000045
    END
```

Result Stored in R3

CODE:

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        LDR R2,VALUE2
        SUB R3,R2,R1
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
VALUE2 DCD &00000045
        END
```

b) Indirect Addressing Addition



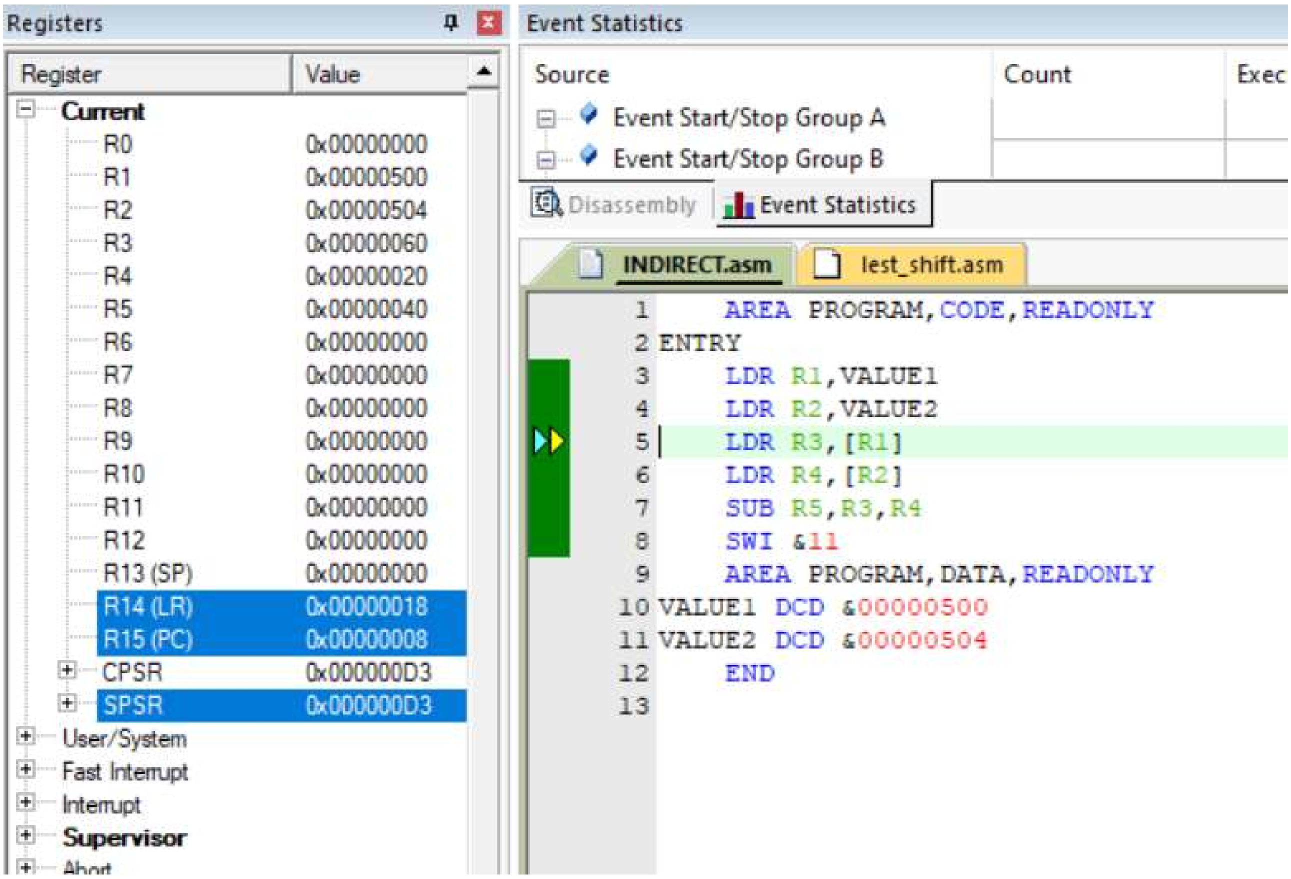
Register	Value
Current	
R0	0x00000000
R1	0x00000500
R2	0x00000504
R3	0x00000060
R4	0x00000020
R5	0x00000080
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000000
R15 (PC)	0x00000014
CPSR	0x000000D3
SPSR	0x00000000
User/System	
Fast Interrupt	
Interrupt	

```
      AREA PROGRAM,CODE,READONLY
ENTRY
      LDR R1,VALUE1
      LDR R2,VALUE2
      LDR R3,[R1]
      LDR R4,[R2]
      ADD R5,R3,R4
      SWI &11
      AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000500
VALUE2 DCD &00000504
      END
```

Result stored in R5

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        LDR R2,VALUE2
        LDR R3,[R1]
        LDR R4,[R2]
        ADD R5,R3,R4
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000500
VALUE2 DCD &00000504
        END
```

Indirect Addressing subtraction



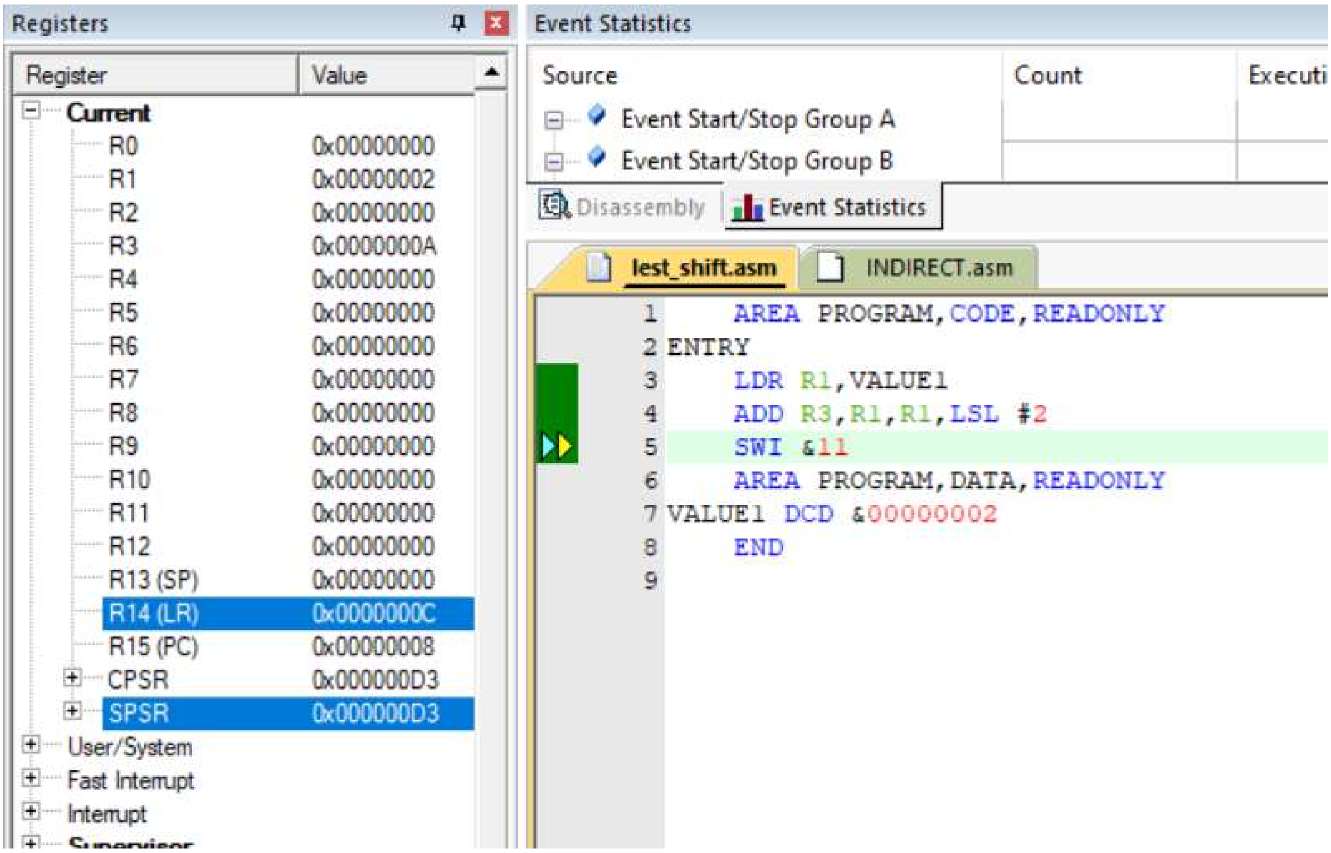
Register	Value
Current	
R0	0x00000000
R1	0x00000500
R2	0x00000504
R3	0x00000060
R4	0x00000020
R5	0x00000040
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000018
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x000000D3
User/System	
Fast Interrupt	
Interrupt	
Supervisor	
Abort	

```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R1,VALUE1
    LDR R2,VALUE2
    LDR R3,[R1]
    LDR R4,[R2]
    SUB R5,R3,R4
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000500
VALUE2 DCD &00000504
    END
```

Result stored in R5

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        LDR R2,VALUE2
        LDR R3,[R1]
        LDR R4,[R2]
        SUB R5,R3,R4
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000500
VALUE2 DCD &00000504
        END
```

c) Barrel shifter addition



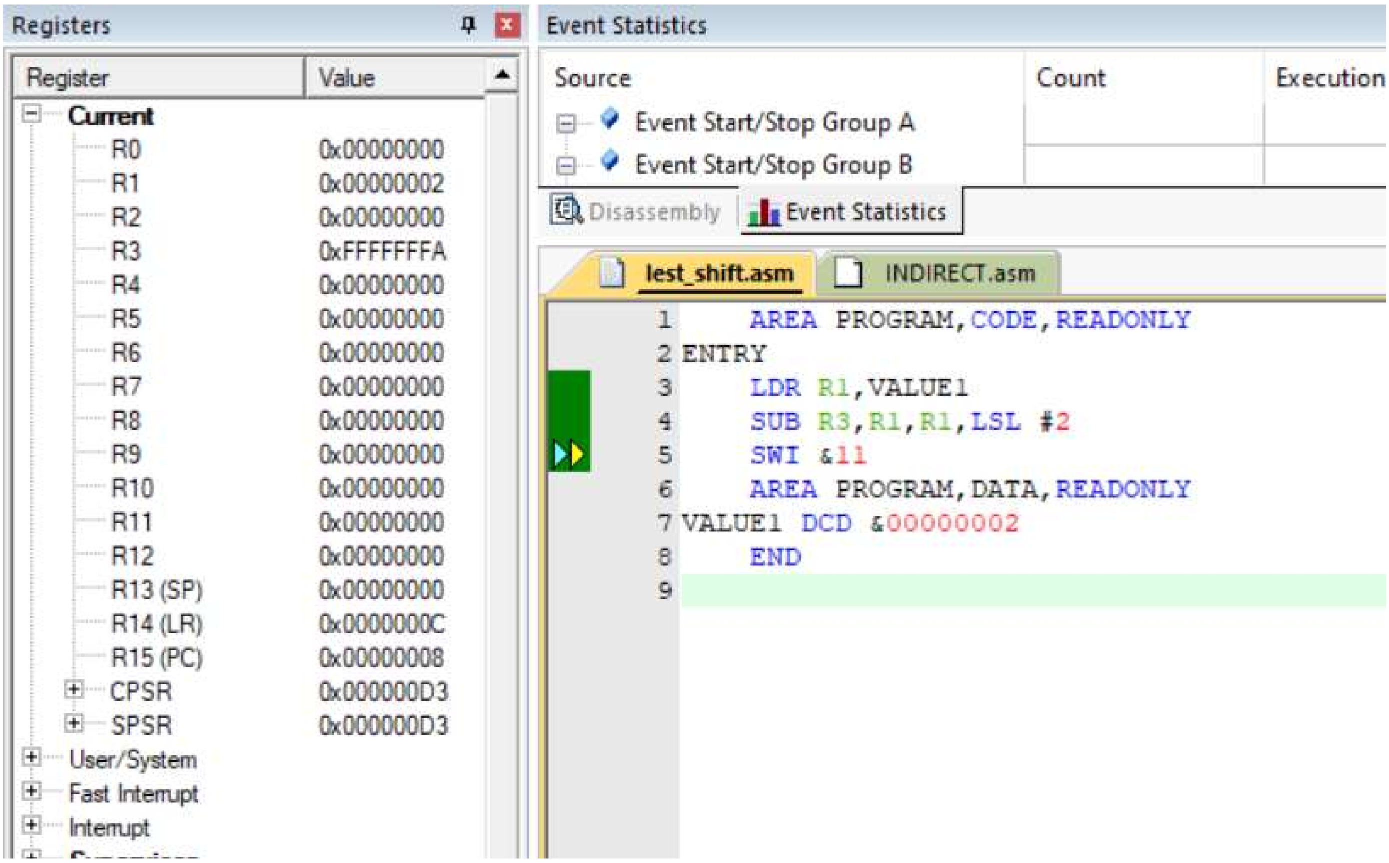
Register	Value
R0	0x00000000
R1	0x00000002
R2	0x00000000
R3	0x0000000A
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x0000000C
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x000000D3

```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R1,VALUE1
    ADD R3,R1,R1,LSL #2
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
    END
```

Result stored in R3

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        ADD R3,R1,R1,LSL #2
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
        END
```

Barrel Shifter Subtraction



Register	Value
Current	
R0	0x00000000
R1	0x00000002
R2	0x00000000
R3	0xFFFFFFFA
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x0000000C
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x000000D3
User/System	
Fast Interrupt	
Interrupt	

Source	Count	Execution
Event Start/Stop Group A		
Event Start/Stop Group B		

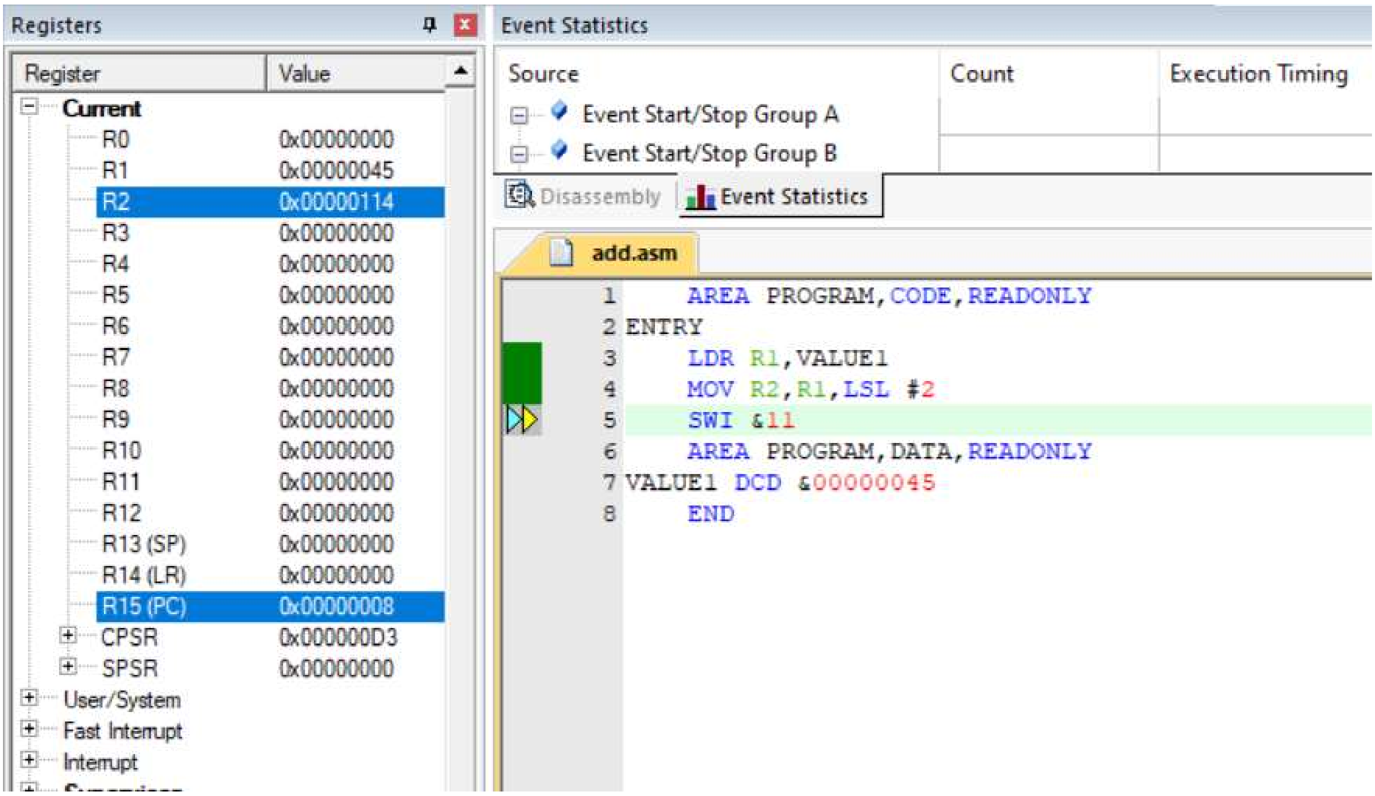
```
     AREA PROGRAM,CODE,READONLY
ENTRY
     LDR R1,VALUE1
     SUB R3,R1,R1,LSL #2
     SWI &11
     AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
     END

```

Result stored in R3

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        SUB R3,R1,R1,LSL #2
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000002
        END
```

Q2) Left Shift



Register	Value
Current	
R0	0x00000000
R1	0x00000045
R2	0x00000114
R3	0x00000000
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000000
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x00000000
User/System	
Fast Interrupt	
Interrupt	

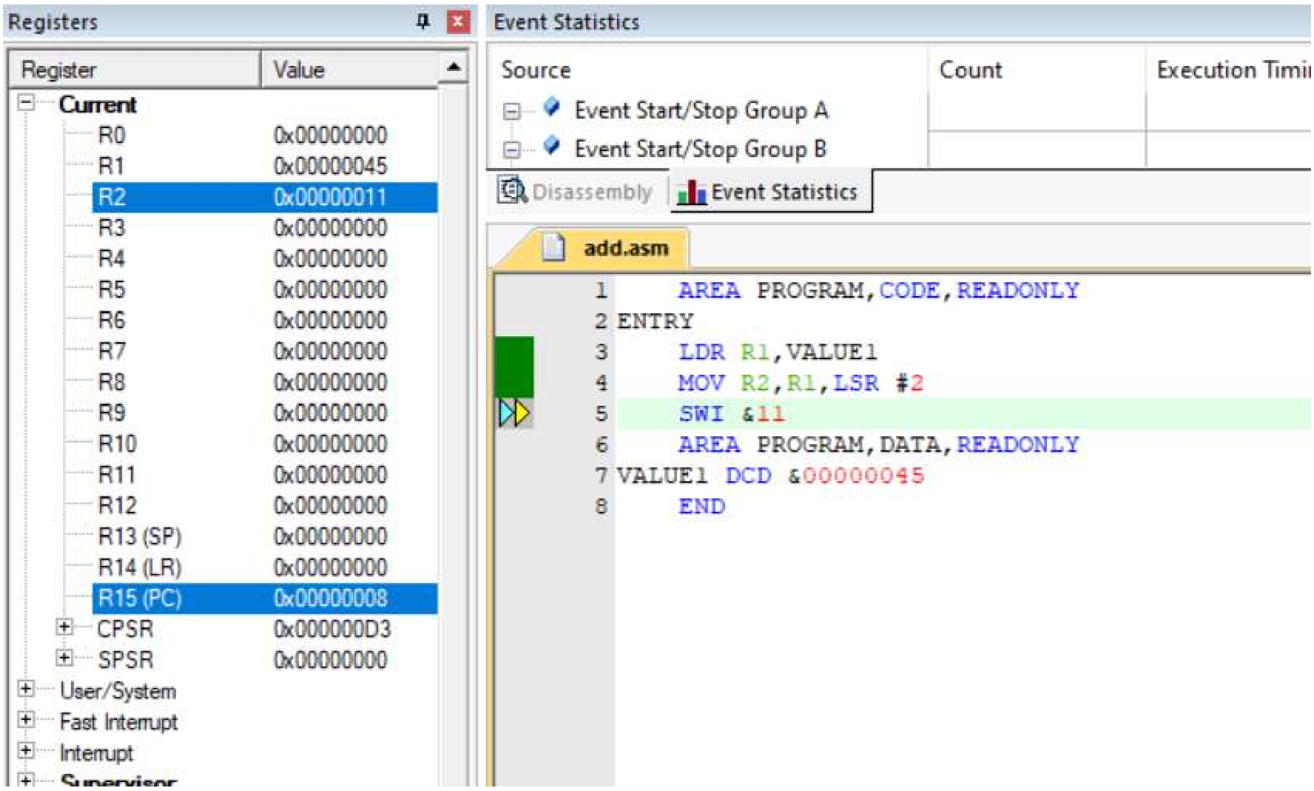
Source	Count	Execution Timing
Event Start/Stop Group A		
Event Start/Stop Group B		

```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R1,VALUE1
    MOV R2,R1,LSL #2
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000045
    END
```

Result Stored in R2

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        MOV R2,R1,LSL #2
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000045
        END
```

Right Shift



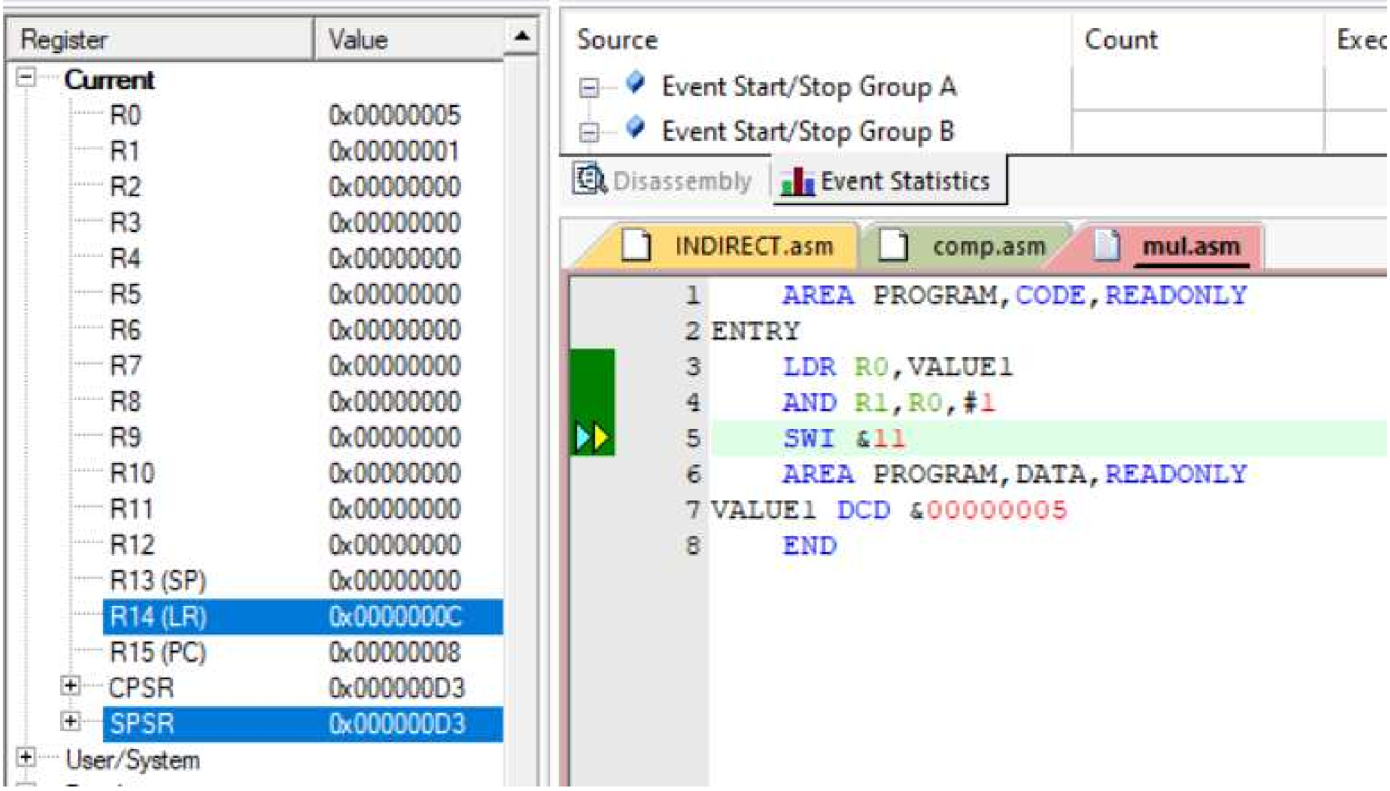
Register	Value
Current	
R0	0x00000000
R1	0x00000045
R2	0x00000011
R3	0x00000000
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000000
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x00000000
User/System	
Fast Interrupt	
Interrupt	
Supervisor	

```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R1,VALUE1
    MOV R2,R1,LSR #2
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000045
    END
```

Result Stored in R2

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R1,VALUE1
        MOV R2,R1,LSR #2
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000045
        END
```

Q3) Even Odd



Register	Value
Current	
R0	0x00000005
R1	0x00000001
R2	0x00000000
R3	0x00000000
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x0000000C
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x000000D3
User/System	

```
      AREA PROGRAM,CODE,READONLY
ENTRY
      LDR R0,VALUE1
      AND R1,R0,#1
      SWI &11
      AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000005
      END
```

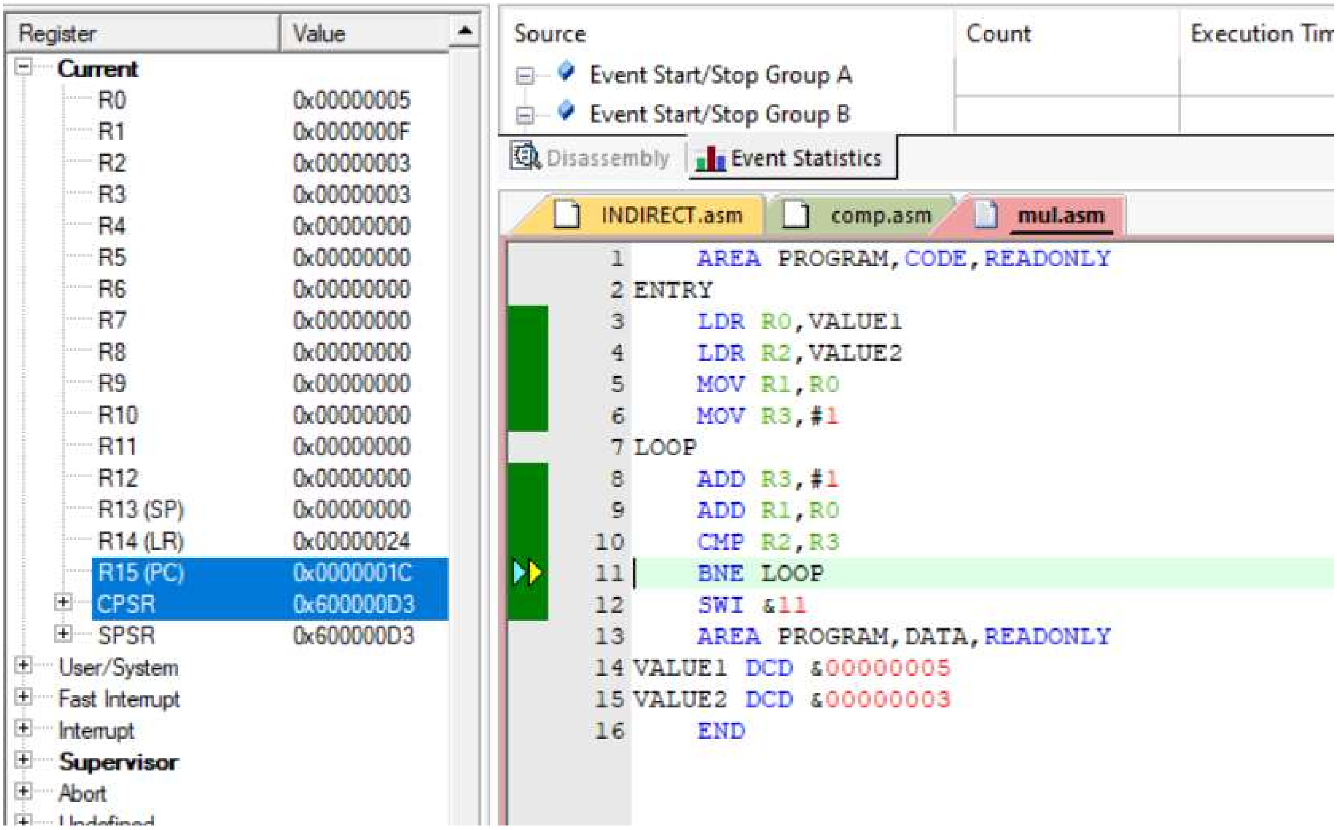
Result is stored in R1

If R1 is 1 number is odd

If R1 is 0 number is even

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,VALUE1
        AND R1,R0,#1
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000005
        END
```

Q4) Multiplication using repeated addition



Register	Value
Current	
R0	0x00000005
R1	0x0000000F
R2	0x00000003
R3	0x00000003
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000024
R15 (PC)	0x0000001C
CPSR	0x600000D3
SPSR	0x600000D3

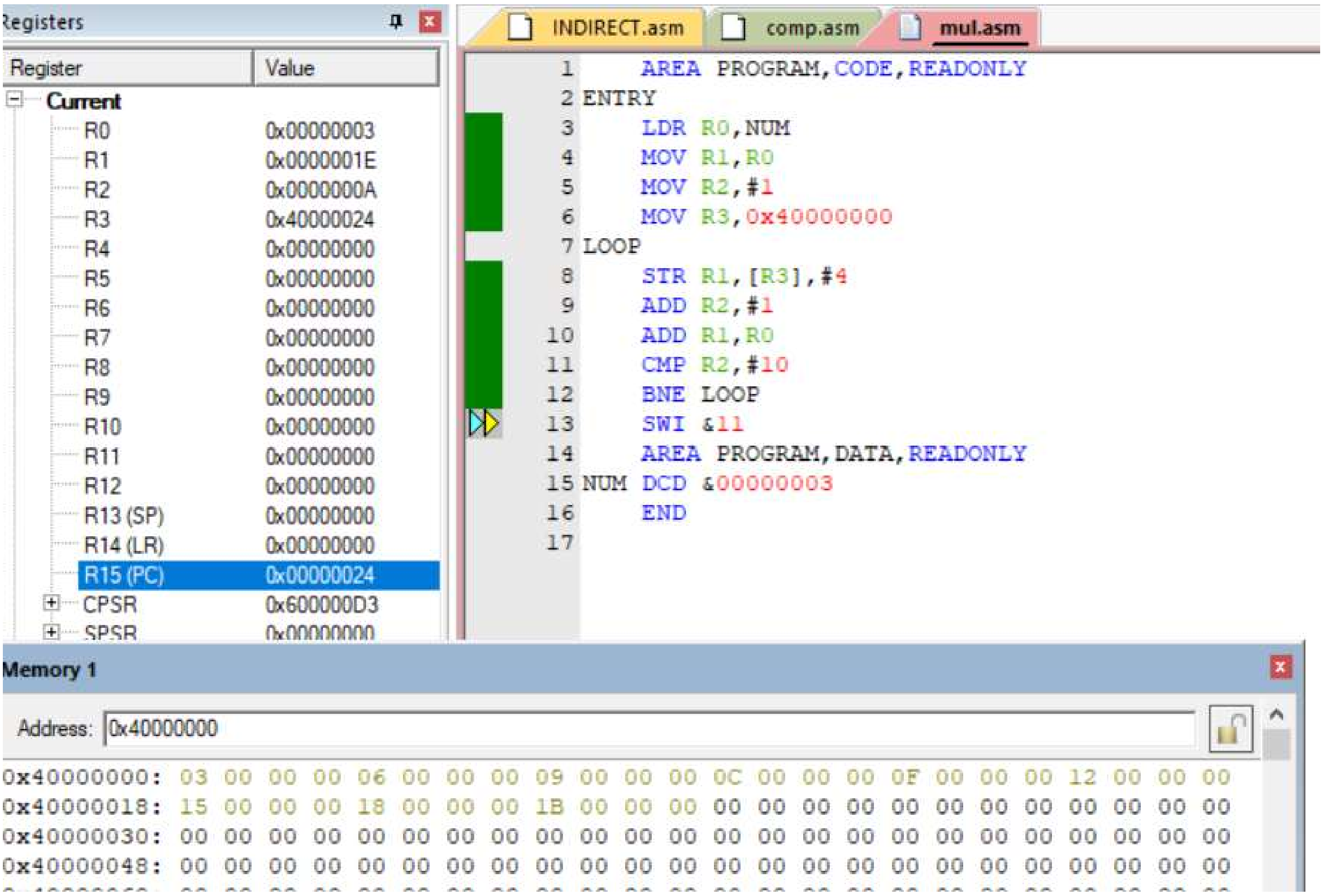
Source	Count	Execution Tim
Event Start/Stop Group A		
Event Start/Stop Group B		

```
      AREA PROGRAM,CODE,READONLY
ENTRY
      LDR R0,VALUE1
      LDR R2,VALUE2
      MOV R1,R0
      MOV R3,#1
LOOP
      ADD R3,#1
      ADD R1,R0
      CMP R2,R3
      BNE LOOP
      SWI &11
      AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000005
VALUE2 DCD &00000003
      END
```

Result Stored in R1

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,VALUE1
        LDR R2,VALUE2
        MOV    R1,R0
        MOV R3,#1
LOOP
        ADD R3,#1
        ADD R1,R0
        CMP R2,R3
        BNE LOOP
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000005
VALUE2 DCD &00000003
        END
```

Q5) Multiplication Table



Register	Value
Current	
R0	0x00000003
R1	0x0000001E
R2	0x0000000A
R3	0x40000024
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000000
R15 (PC)	0x00000024
CPSR	0x600000D3
SPSR	0x00000000

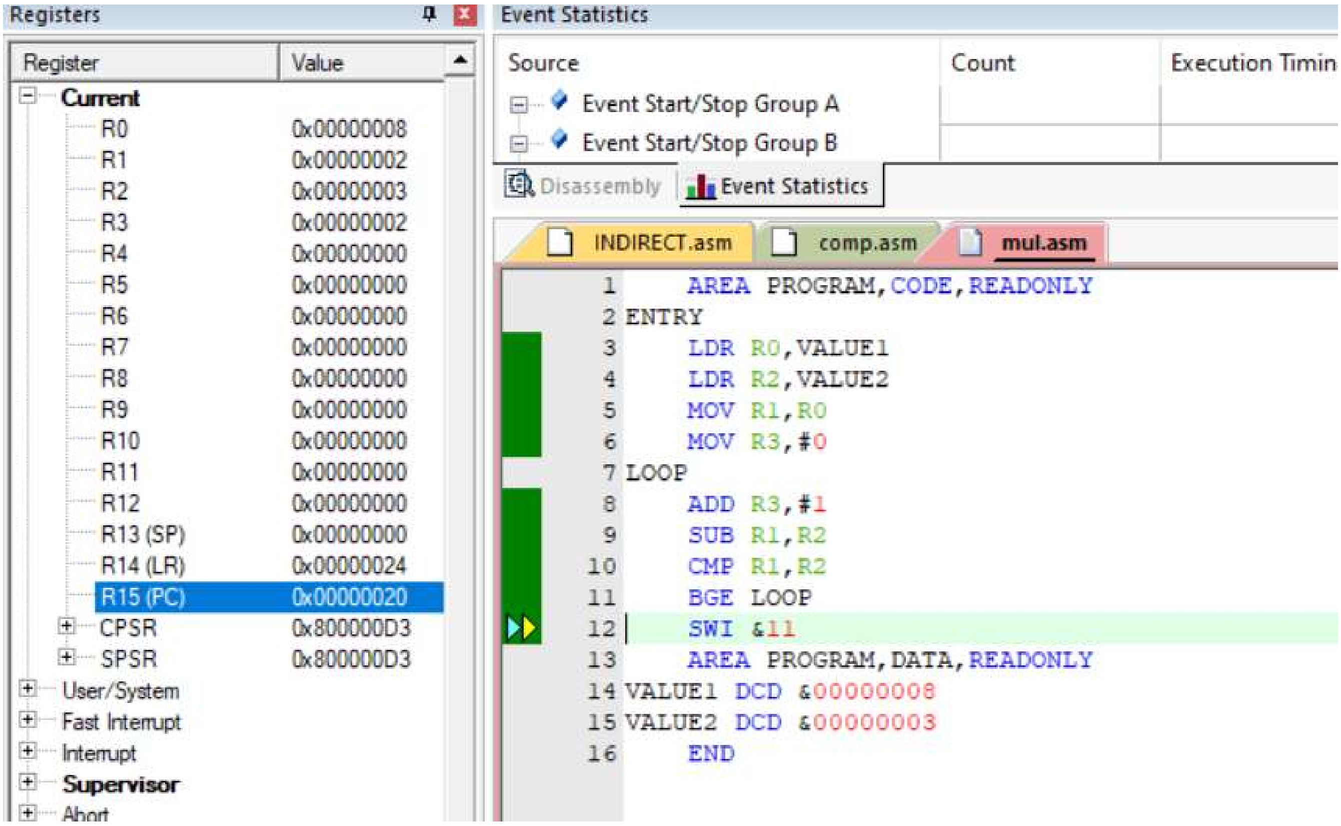
```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R0,NUM
    MOV R1,R0
    MOV R2,#1
    MOV R3,0x40000000
LOOP
    STR R1,[R3],#4
    ADD R2,#1
    ADD R1,R0
    CMP R2,#10
    BNE LOOP
    SWI &11
    AREA PROGRAM,DATA,READONLY
NUM DCD &00000003
    END
```

Address: 0x40000000

```
0x40000000: 03 00 00 00 06 00 00 00 09 00 00 00 0C 00 00 00 0F 00 00 00 12 00 00 00
0x40000018: 15 00 00 00 18 00 00 00 1B 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x40000030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x40000048: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,NUM
        MOV R1,R0
        MOV R2,#1
        MOV R3,0x40000000
LOOP
        STR R1,[R3],#4
        ADD R2,#1
        ADD R1,R0
        CMP R2,#10
        BNE LOOP
        SWI &11
        AREA PROGRAM,DATA,READONLY
NUM DCD &00000003
        END
```

Q6) Division using subtraction



Register	Value
Current	
R0	0x00000008
R1	0x00000002
R2	0x00000003
R3	0x00000002
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000024
R15 (PC)	0x00000020
CPSR	0x800000D3
SPSR	0x800000D3
User/System	
Fast Interrupt	
Interrupt	
Supervisor	
Abort	

Event Statistics

Source	Count	Execution Timin
Event Start/Stop Group A		
Event Start/Stop Group B		

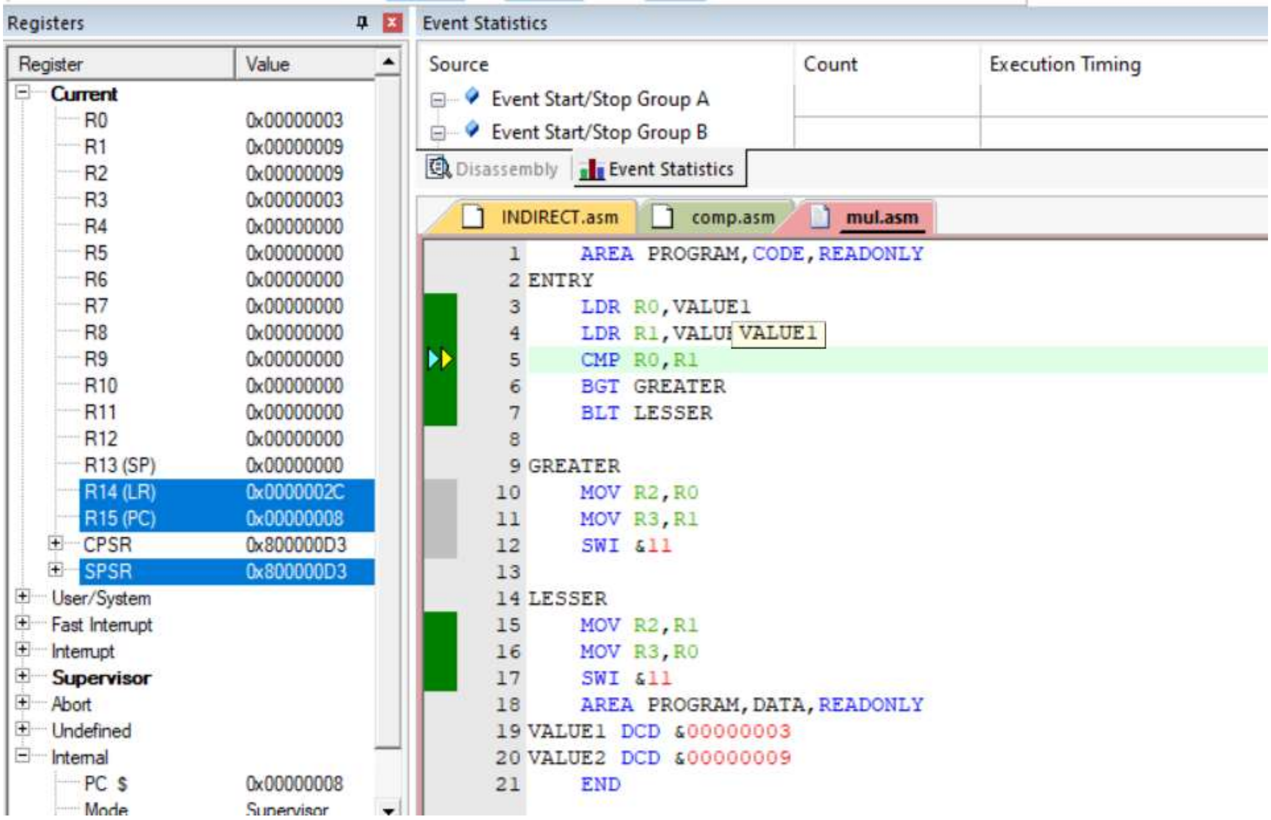
```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,VALUE1
        LDR R2,VALUE2
        MOV R1,R0
        MOV R3,#0
LOOP
        ADD R3,#1
        SUB R1,R2
        CMP R1,R2
        BGE LOOP
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000008
VALUE2 DCD &00000003
        END
```

Result stored in R3

And remainder in R1

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,VALUE1
        LDR R2,VALUE2
        MOV    R1,R0
        MOV R3,#0
LOOP
        ADD R3,#1
        SUB R1,R2
        CMP R1,R2
        BGE LOOP
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000006
VALUE2 DCD &00000003
        END
```

Q7) Greatest and smallest of 2 numbers



```
Register        Value
Current
  R0            0x00000003
  R1            0x00000009
  R2            0x00000009
  R3            0x00000003
  R4            0x00000000
  R5            0x00000000
  R6            0x00000000
  R7            0x00000000
  R8            0x00000000
  R9            0x00000000
  R10           0x00000000
  R11           0x00000000
  R12           0x00000000
  R13 (SP)      0x00000000
  R14 (LR)      0x0000002C
  R15 (PC)      0x00000008
  CPSR          0x800000D3
  SPSR          0x800000D3
User/System
Fast Interrupt
Interrupt
Supervisor
Abort
Undefined
Internal
  PC $          0x00000008
  Mode          Supervisor
```

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,VALUE1
        LDR R1,VALUI VALUE1
        CMP R0,R1
        BGT GREATER
        BLT LESSER

GREATER
        MOV R2,R0
        MOV R3,R1
        SWI &11

LESSER
        MOV R2,R1
        MOV R3,R0
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000003
VALUE2 DCD &00000009
        END
```

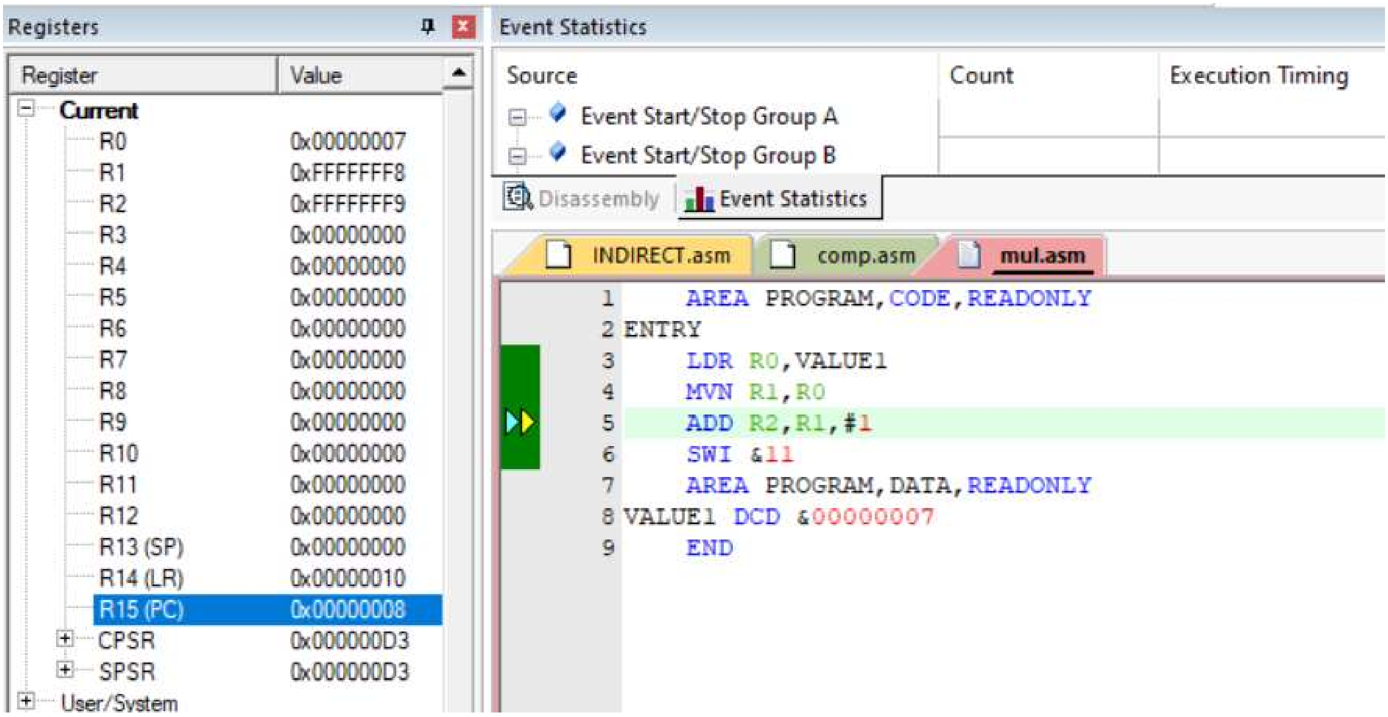
GREATER IS STORED IN R2 AND LESSER IN R3

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,VALUE1
        LDR R1,VALUE2
        CMP R0,R1
        BGT GREATER
        BLT LESSER

GREATER
        MOV R2,R0
        MOV R3,R1
        SWI &11

LESSER
        MOV R2,R1
        MOV R3,R0
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000003
VALUE2 DCD &00000009
        END
```

Q8)1’s and 2’s complement of a number



Register	Value
Current	
R0	0x00000007
R1	0xFFFFFFF8
R2	0xFFFFFFF9
R3	0x00000000
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000010
R15 (PC)	0x00000008
CPSR	0x000000D3
SPSR	0x000000D3
User/System	

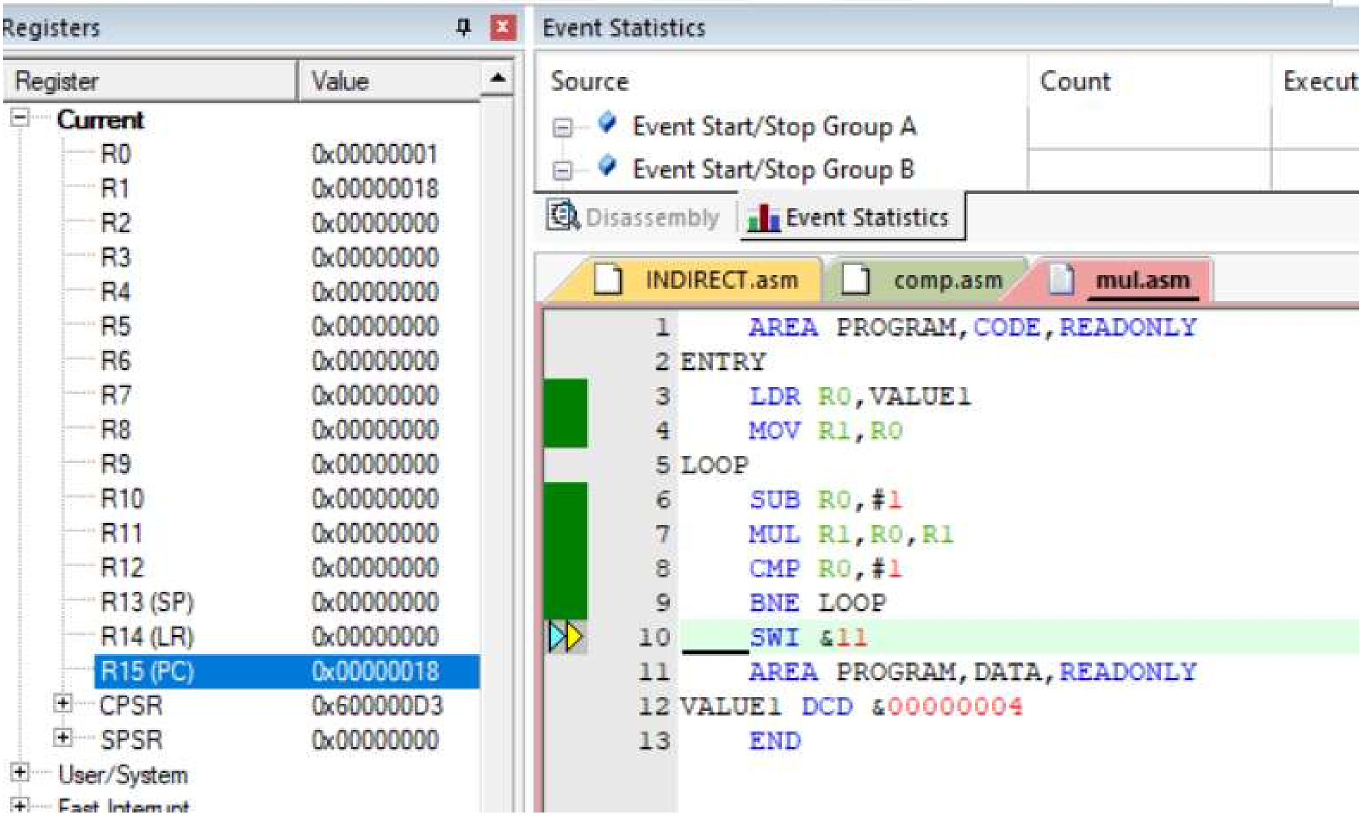
```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R0,VALUE1
    MVN R1,R0
    ADD R2,R1,#1
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000007
    END
```

1’s complement is stored in R1

2’s complement is stored in R2

```
	AREA PROGRAM,CODE,READONLY
ENTRY
	LDR R0,VALUE1
	MVN R1,R0
	ADD R2,R1,#1
	SWI &11
	AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000007
	END
```

Q9) Factorial of a number



Register	Value
Current	
R0	0x00000001
R1	0x00000018
R2	0x00000000
R3	0x00000000
R4	0x00000000
R5	0x00000000
R6	0x00000000
R7	0x00000000
R8	0x00000000
R9	0x00000000
R10	0x00000000
R11	0x00000000
R12	0x00000000
R13 (SP)	0x00000000
R14 (LR)	0x00000000
R15 (PC)	0x00000018
CPSR	0x600000D3
SPSR	0x00000000

```
    AREA PROGRAM,CODE,READONLY
ENTRY
    LDR R0,VALUE1
    MOV R1,R0
LOOP
    SUB R0,#1
    MUL R1,R0,R1
    CMP R0,#1
    BNE LOOP
    SWI &11
    AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000004
    END
```

Result is stored in R1

```
        AREA PROGRAM,CODE,READONLY
ENTRY
        LDR R0,VALUE1
        MOV R1,R0
LOOP
        SUB R0,#1
        MUL R1,R0,R1
        CMP R0,#1
        BNE LOOP
        SWI &11
        AREA PROGRAM,DATA,READONLY
VALUE1 DCD &00000004
        END
```