PSG COLLEGE OF TECHNOLOGY

(AUTONOMOUS INSTITUTION)

COIMBATORE – 641004

ELECTRONICS AND COMMUNICATION ENGINEERING

19L511- MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

TOPIC : Finding the roots of the given algebraic expression of order 2

SUBMITTED BY,

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ROOTS OF QUADRATIC EQUATION

AIM:

To find the roots of the given algebraic quadratic expression (order 2).

SOFTWARE REQUIRED:

KEIL IDE, Program ISP

HARDWARE REQUIRED:

8051 Microcontroller Kit

THEORY:

Factoring quadratics is a method of expressing the polynomial as a product of its linear factors. It is a process that allows us to simplify quadratic expressions, find their roots and solve equations. A quadratic polynomial is of the form ax2 + bx + c, where a, b, c are real numbers. Factoring quadratics is a method that helps us to find the zeros of the quadratic equation ax2 + bx + c = 0.

The factor theorem relates the linear factors and the zeros of any polynomial. Every quadratic equation has two roots, say α and β. They are the zeros of the quadratic equation. Consider a quadratic equation f(x) = 0, where f(x) is a polynomial of degree 2. Suppose that $x = \alpha$ is one root of this equation. This means that $x = \alpha$ is a zero of the quadratic expression f(x). Thus, $(x - \alpha)$ should be a factor of f(x).

Similarly, if $x = \beta$ is the second root of f(x) = 0, then $x = \beta$ is a zero of f(x). Thus, $(x - \beta)$ should be a factor of f(x). Hence, factoring quadratics is a method of expressing the quadratic equations as a product of its linear factors, that is, $f(x) = (x - \alpha)(x - \beta)$.

The sum of the roots of the quadratic equation $ax^2 + bx + c = 0$ is given by $\alpha+\beta = -b/a$. The product of the roots in the quadratic equation $ax^2 + bx + c = 0$ is given by $\alpha\beta = c/a$.

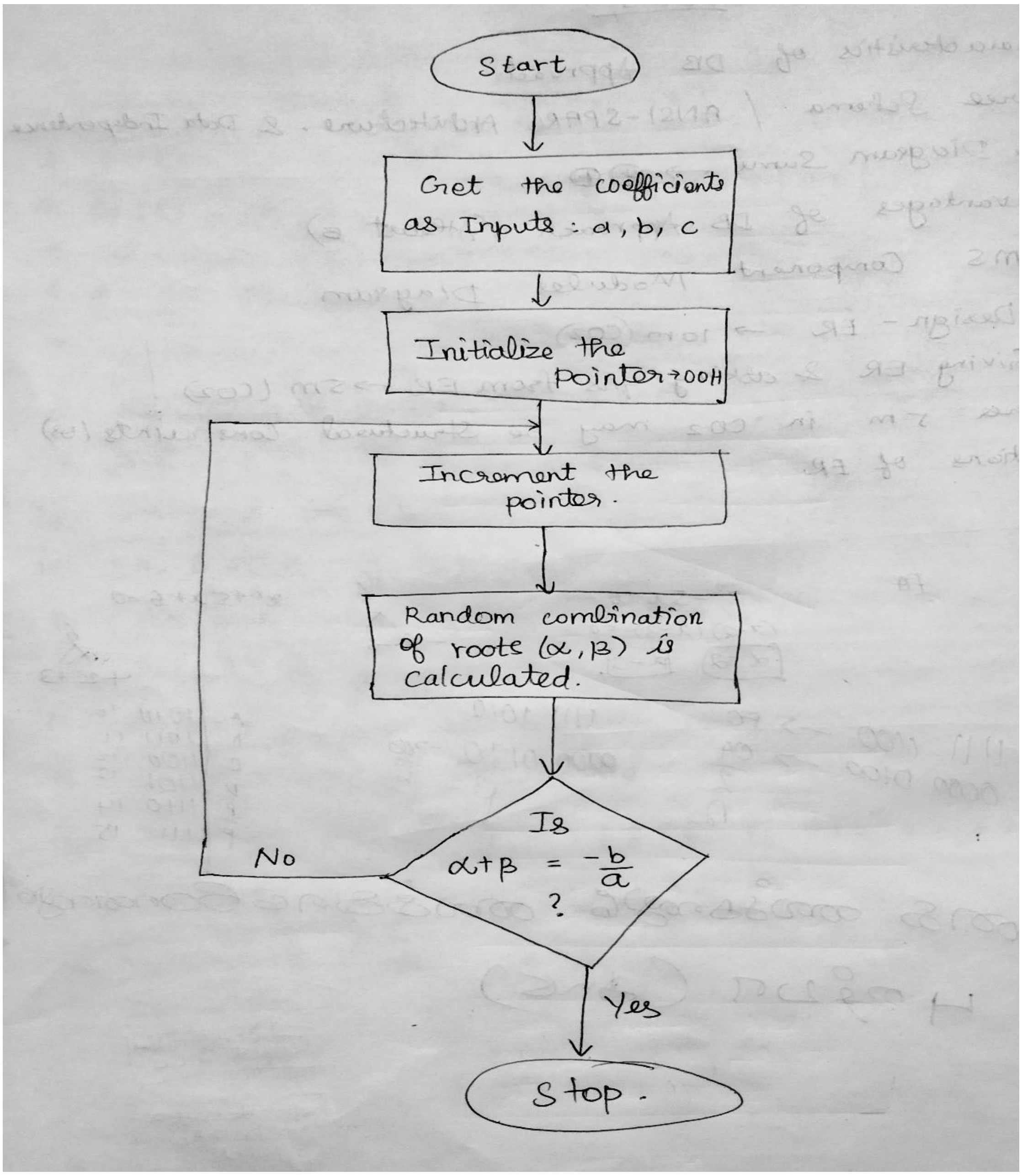
Factoring quadratics is also done by using a formula that gives us the roots of the quadratic equation and hence, the factors of the equation. If $ax^2 + bx + c = 0$ is a quadratic equation, a is the coefficient of x^2, b is the coefficient of x and c is the constant term. Then we find the value of x by using the formula:

$$x=[-b\pm\sqrt{(b2-4ac)}]/2a$$

Assume the quadratic equation input to be $x^2-5x+6=0$.

METHOD 1:

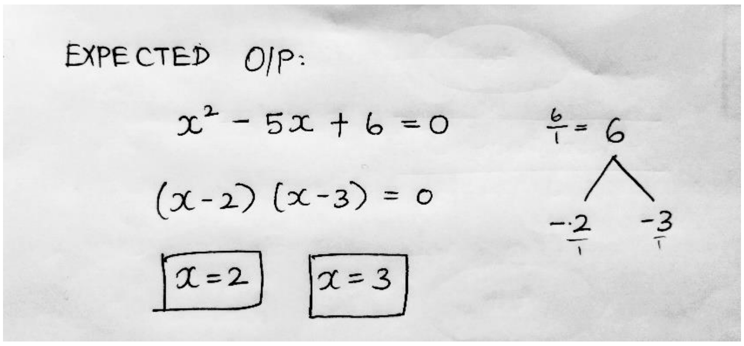
FLOWCHART:



CODE:

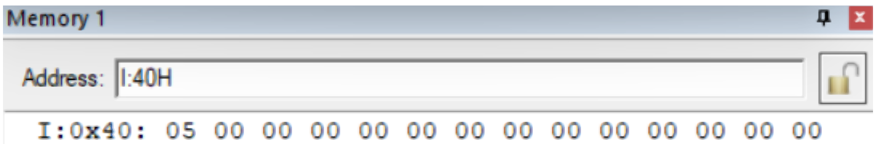
```
      MOV R2,#01H           //a
      MOV R1,#-05H          //b
      MOV R7,#05H           //-b
      MOV R0,#06H           //c
      MOV A,R0
      MOV B,R2
      DIV AB
      MOV R3,A
      MOV 40H,R7
      MOV R4,#00H
L1:   INC R4
      MOV A,R3
      MOV B,R4
      DIV AB
      MOV R5,A
      ADD A,R4
      CJNE A,40H,L1
      END                   //R4 AND R5 ARE ROOTS
```

EXPECTED OUTPUT:



ACTUAL OUTPUT:

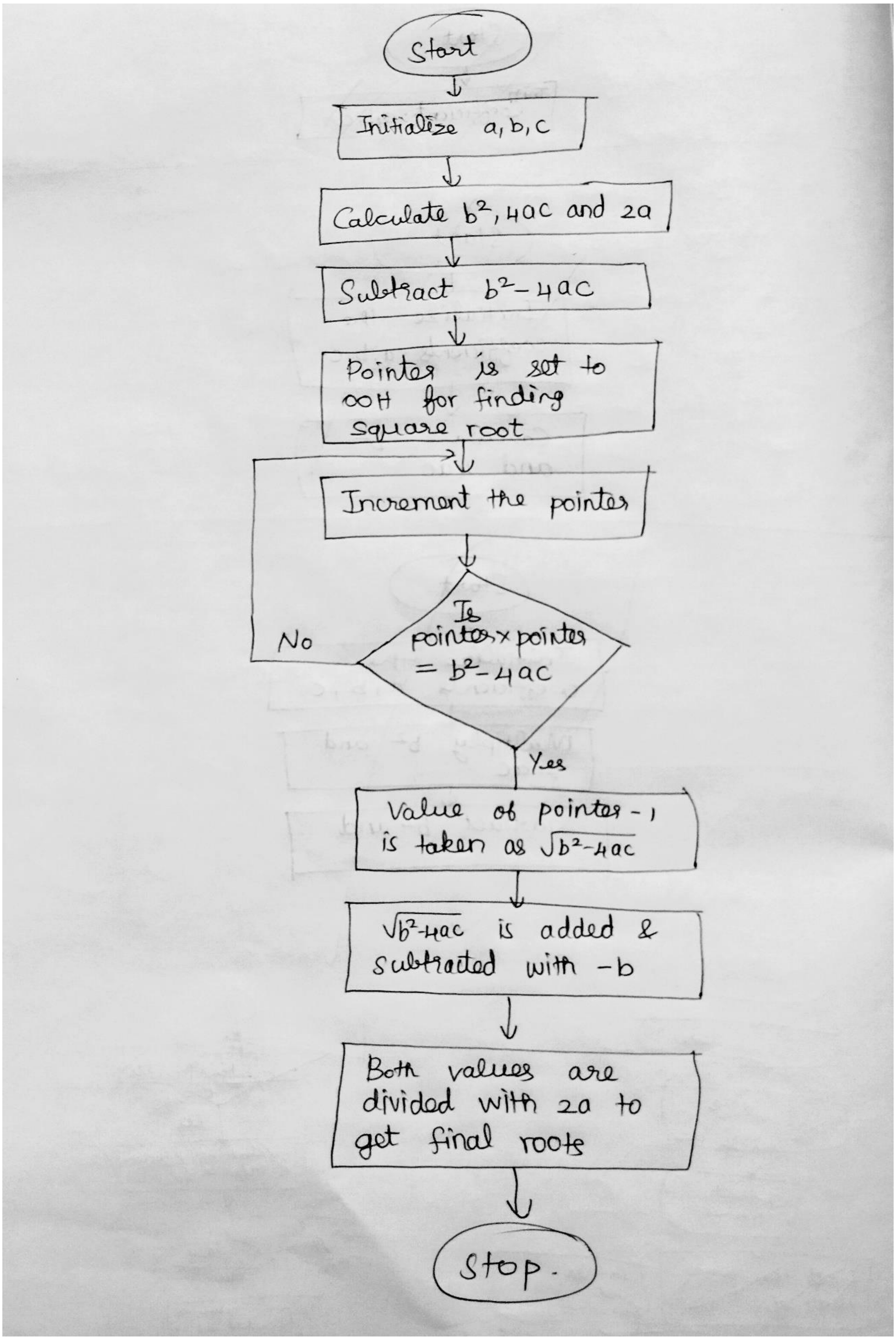
R4 AND R5 ARE ROOTS



R4:02H R5:03H

METHOD 2:

FLOWCHART:

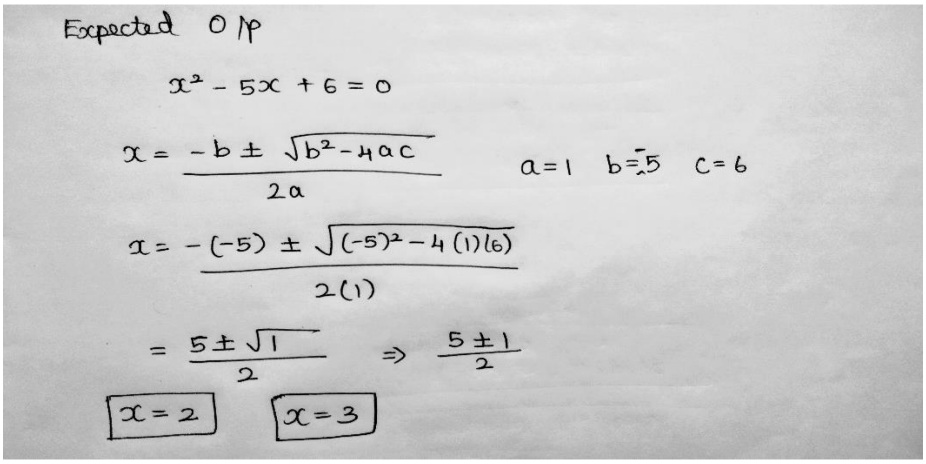


CODE:

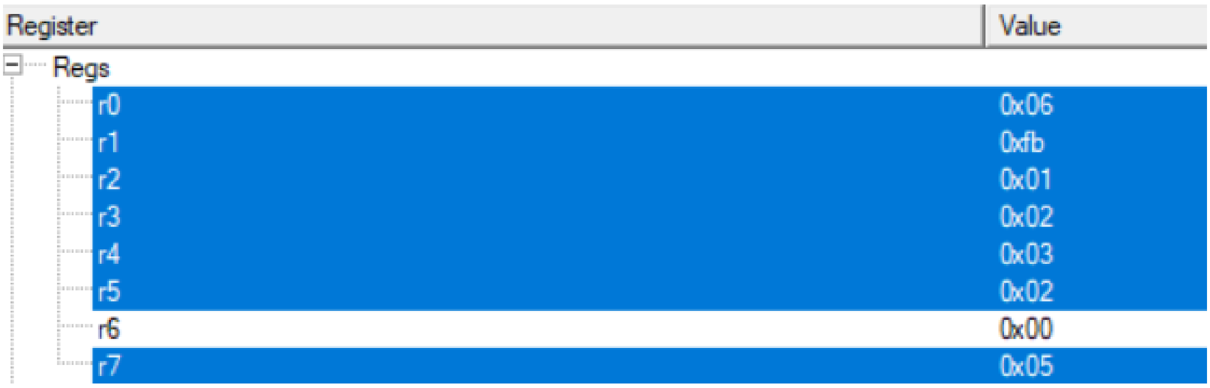
```
      MOV R2,#01H          //a:R2
      MOV R1,#-05H         //b:R1
      MOV R7,#05H          //-b:R7
      MOV R0,#06H          //c:R0
      MOV A,R1
      MOV B,R1
      MUL AB               //(b^2):40H
      MOV 40H,A
      MOV A,R2
      MOV B,R0
      MUL AB               //ac
      MOV B,#04H
      MUL AB               //4ac:41H
      MOV 41H,A
      MOV A,40H
      MOV B,41H
      CLR C
      SUBB A,B             //((b^2)-4ac):42H
      MOV 42H,A
      MOV A,#02H
      MOV B,R2
      MUL AB               //2a:43H
      MOV 43H,A
```

```
      MOV R3,#00H
RT:   MOV A,R3               //finding root
      MOV B,A
      MUL AB
      INC R3
      CJNE A,42H,RT
      MOV A,R3
      CLR C
      SUBB A,#01H            //sqrt((b^2)-4ac):44H
      MOV 44H,A
      MOV B,44H
      MOV A,R7
      ADD A,B                //-b+sqrt((b^2)-4ac):45H
      MOV 45H,A
      MOV B,43H
      DIV AB                 //(-b+sqrt((b^2)-4ac))/(2a)
      MOV R4,A               //R4 AS FIRST ROOT
      MOV B,44H
      MOV A,R7
      SUBB A,B               //-b-sqrt((b^2)-4ac):46H
      MOV 46H,A
      MOV B,43H
      DIV AB                 //(-b-sqrt((b^2)-4ac))/(2a)
      MOV R5,A               //R5 AS SECOND ROOT
      END
```

EXPECTED OUTPUT:

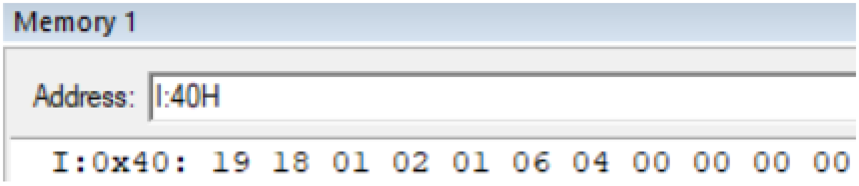


ACTUAL OUTPUT:



Register	Value
Regs	
r0	0x06
r1	0xfb
r2	0x01
r3	0x02
r4	0x03
r5	0x02
r6	0x00
r7	0x05

R4 AND R5 ARE ROOTS



R4:03H R5:02H

RESULT:

Thus, the roots of the given algebraic expression of order 2 is found and the output is verified using the assembly language & KEIL IDE.