Quarter Square Multiplication:

Two quantities can be multiplied using quarter squares by employing the following identity some attribute to Babylonian mathematics:

$$\left\lfloor \frac{(x+y)^2}{4} \right\rfloor - \left\lfloor \frac{(x-y)^2}{4} \right\rfloor = \frac{1}{4}\left(\left(x^2+2xy+y^2\right)-\left(x^2-2xy+y^2\right)\right) = \frac{1}{4}(4xy) = xy.$$

If *x* + *y* is odd then *x*-*y* will also be odd, this means any fraction will cancel out, so no accuracy is lost by discarding the remainder.

Formula: $\frac{1}{4}(x^2 + y^2)^2 - \frac{1}{4}(x^2 - y^2)^2$

Algorithm:

```
int res=0
// Quarter square for the sum of x and y
int q1 =(¼)* ((x + y)^ 2);

// Quarter square for the difference of x and y
int q2 =(¼)* ((x - y) ^ 2);

// Formula for Quarter Square Multiplication
int result = (q1) - (q2);
```

RISC-V Code:

```
# Quarter Square Multiplication for Multiplying 2 Numbers in RISC-V
Assembly Language


.data
    # Initialize the data section with the two numbers to be
multiplied
    num1:   .word 7
    num2:   .word 5
    result: .word 0


.text
    # Program starts at the .text section
    la x1, result
    # Load the first number into register t0
    lw t0, num1


    # Load the second number into register t1
    lw t1, num2


    # Calculate (a+b)^2
    add t2, t0, t1
    mul t2, t2, t2
    srli t2, t2, 2  # t2 = 1/4 * (a+b)^2


    # Calculate (a-b)^2
    sub t3, t0, t1
    mul t3, t3, t3
    srli t3, t3, 2  # t3 = 1/4 * (a-b)^2


    # Calculate the final result: 1/4 * (a+b)^2 - 1/4 * (a-b)^2
    sub t4, t2, t3

    # Store the final result in the result variable
    sw t4, 0(x1)



    # Halt the program
```

```
nop
```

Output:

Expected results:
135*243 = 32805
135*(-897) = -121095

Obtained results:

Memory viewer

Address	Word	Byte 0	Byte 1	Byte 2	Byte 3
0x10000008	32805	37	128	0	0
0x10000004	243	243	0	0	0
0x10000000	135	135	0	0	0

Execution info

Cycles:	15
Instrs. retired:	15
CPI:	1
IPC:	1
Clock rate:	10.20 Hz

Memory viewer

Address	Word	Byte 0	Byte 1	Byte 2	Byte 3
0x10000008	-121095	249	38	254	255
0x10000004	-897	127	252	255	255
0x10000000	135	135	0	0	0

Execution info

Cycles:	15
Instrs. retired:	15
CPI:	1
IPC:	1
Clock rate:	10.42 Hz