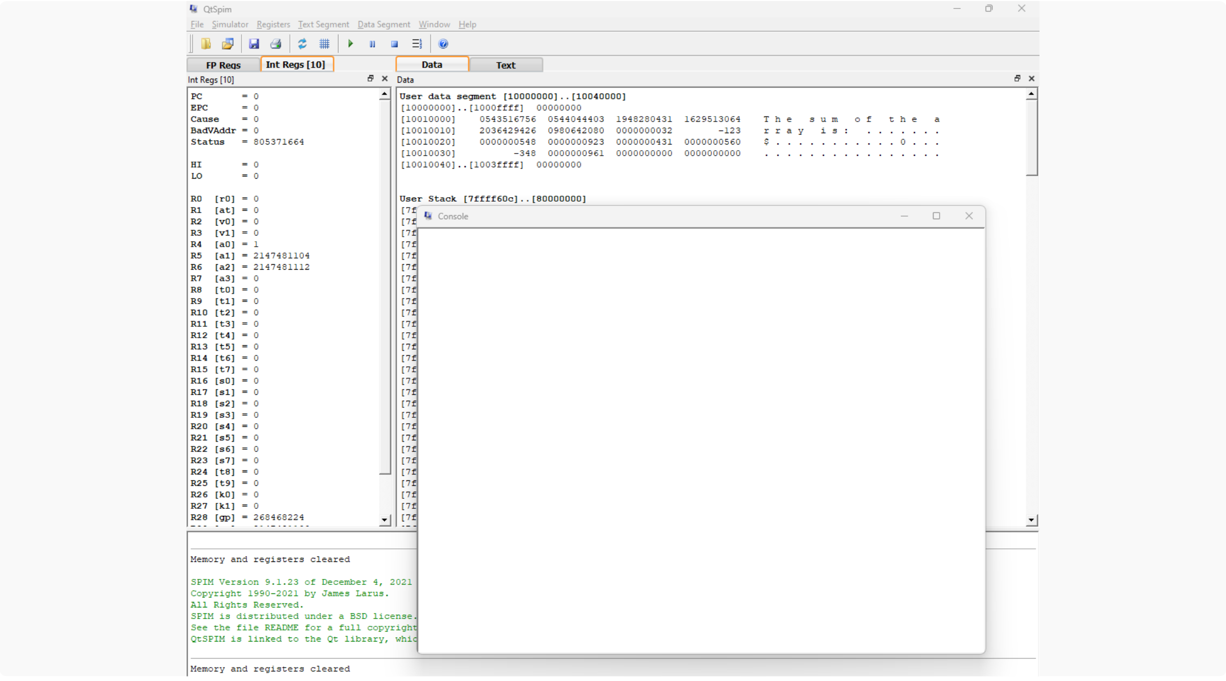
# Lab6

The arrsum.asm computes the sum of all the numbers in an array of integers. The main function invokes the subroutine, which uses a loop to add up all the elements of the array and returns the result to the main function. The main function then displays a message saying "The sum of the array is: " followed by the value of the sum. The program has been improved by calculating the number of elements in the array and by making the loop in the subroutine more efficient.

arrsum: before


QtSpim
File Simulator Registers Text Segment Data Segment Window Help
FP Regs
Int Regs [10]
Data
Text
Int Regs [10]
Data
Console

```
PC       = 0
EPC      = 0
Cause    = 0
BadVAddr = 0
Status   = 805371664

HI       = 0
LO       = 0

R0  [r0] = 0
R1  [at] = 0
R2  [v0] = 0
R3  [v1] = 0
R4  [a0] = 1
R5  [a1] = 2147481104
R6  [a2] = 2147481112
R7  [a3] = 0
R8  [t0] = 0
R9  [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
R22 [s6] = 0
R23 [s7] = 0
R24 [t8] = 0
R25 [t9] = 0
R26 [k0] = 0
R27 [k1] = 0
R28 [gp] = 268468224
```

```
User data segment [10000000]..[10040000]
[10000000]..[1000ffff]  00000000
[10010000]    0543516756  0544044403  1948280431  1629513064    T h e   s u m   o f   t h e   a
[10010010]    2036429426  0980642080  0000000032        -123    r r a y   i s :   . . . . . . .
[10010020]    0000000548  0000000923  0000000431  0000000560    $ . . . . . . . . . . . . 0 . . .
[10010030]          -348  0000000961  0000000000  0000000000    . . . . . . . . . . . . . . . .
[10010040]..[1003ffff]  00000000


User Stack [7ffff60c]..[80000000]
```

```
Memory and registers cleared

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Memory and registers cleared
```
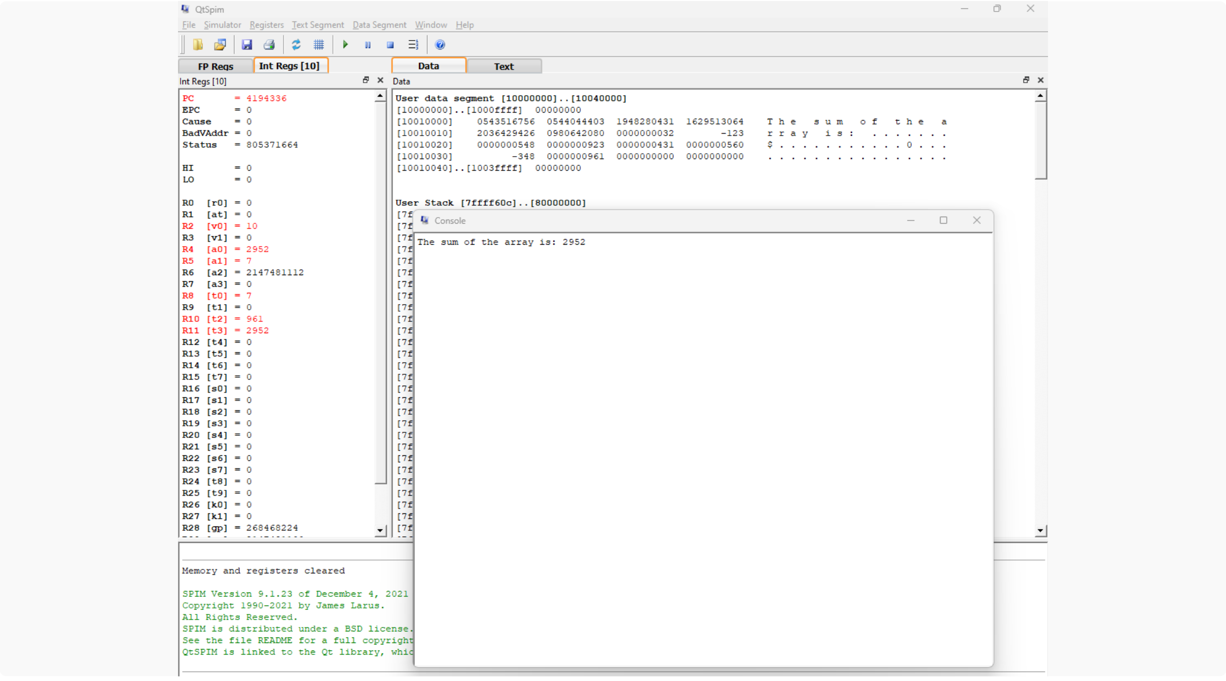

after:


QtSpim
File Simulator Registers Text Segment Data Segment Window Help
FP Regs
Int Regs [10]
Data
Text
Int Regs [10]
Data
Console

```
PC       = 4194336
EPC      = 0
Cause    = 0
BadVAddr = 0
Status   = 805371664

HI       = 0
LO       = 0

R0  [r0] = 0
R1  [at] = 0
R2  [v0] = 10
R3  [v1] = 0
R4  [a0] = 2952
R5  [a1] = 7
R6  [a2] = 2147481112
R7  [a3] = 0
R8  [t0] = 7
R9  [t1] = 0
R10 [t2] = 961
R11 [t3] = 2952
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
R22 [s6] = 0
R23 [s7] = 0
R24 [t8] = 0
R25 [t9] = 0
R26 [k0] = 0
R27 [k1] = 0
R28 [gp] = 268468224
```

```
User data segment [10000000]..[10040000]
[10000000]..[1000ffff]  00000000
[10010000]    0543516756  0544044403  1948280431  1629513064    T h e   s u m   o f   t h e   a
[10010010]    2036429426  0980642080  0000000032        -123    r r a y   i s :   . . . . . . .
[10010020]    0000000548  0000000923  0000000431  0000000560    $ . . . . . . . . . . . . 0 . . .
[10010030]          -348  0000000961  0000000000  0000000000    . . . . . . . . . . . . . . . .
[10010040]..[1003ffff]  00000000


User Stack [7ffff60c]..[80000000]
```

```
The sum of the array is: 2952
```

```
Memory and registers cleared

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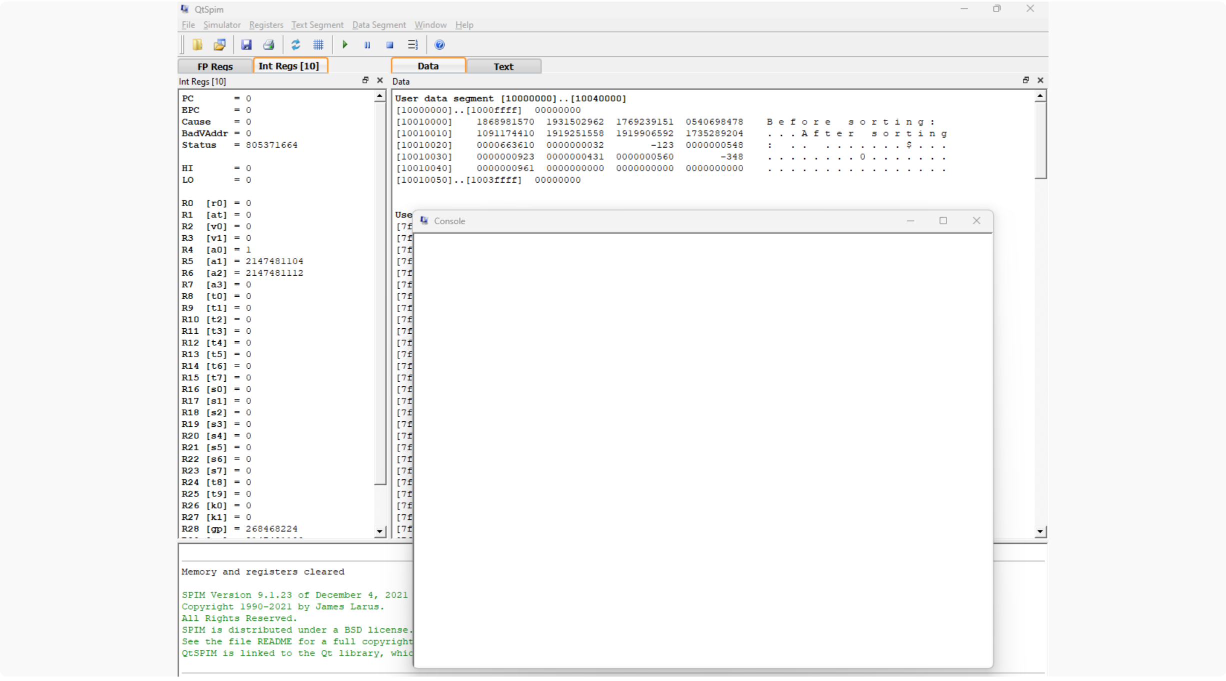
isort.asm is an implementation of the Insertion Sort algorithm. The sorting algorithm sorts the values in the array by repeatedly comparing the current value with the previous values and moving the larger values one step to the right until it finds the correct position for the current value. The print subroutine outputs each value in the array, separated by spaces. The program starts by prints the  initial array. It then calls the sorting function, which rearranges the values in the array. The program finishes by printing the sorted array along with the necessary labels.

isort:before


QtSpim
File Simulator Registers Text Segment Data Segment Window Help
FP Regs
Int Regs [10]
Data
Text
Int Regs [10]
Data
Console

```
PC       = 0
EPC      = 0
Cause    = 0
BadVAddr = 0
Status   = 805371664

HI       = 0
LO       = 0

R0  [r0] = 0
R1  [at] = 0
R2  [v0] = 0
R3  [v1] = 0
R4  [a0] = 1
R5  [a1] = 2147481104
R6  [a2] = 2147481112
R7  [a3] = 0
R8  [t0] = 0
R9  [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
R22 [s6] = 0
R23 [s7] = 0
R24 [t8] = 0
R25 [t9] = 0
R26 [k0] = 0
R27 [k1] = 0
R28 [gp] = 268468224
```

```
User data segment [10000000]..[10040000]
[10000000]..[1000ffff]  00000000
[10010000]    1868981570  1931502962  1769239151  0540698478    B e f o r e   s o r t i n g :
[10010010]    1091174410  1919251558  1919906592  1735289204    . . . A f t e r   s o r t i n g
[10010020]    0000663610  0000000032        -123  0000000548    :   . .   . . . . . . . $ . . .
[10010030]    0000000923  0000000431  0000000560        -348    . . . . . . . . 0 . . . . . . .
[10010040]    0000000961  0000000000  0000000000  0000000000    . . . . . . . . . . . . . . . .
[10010050]..[1003ffff]  00000000
```

```
Memory and registers cleared

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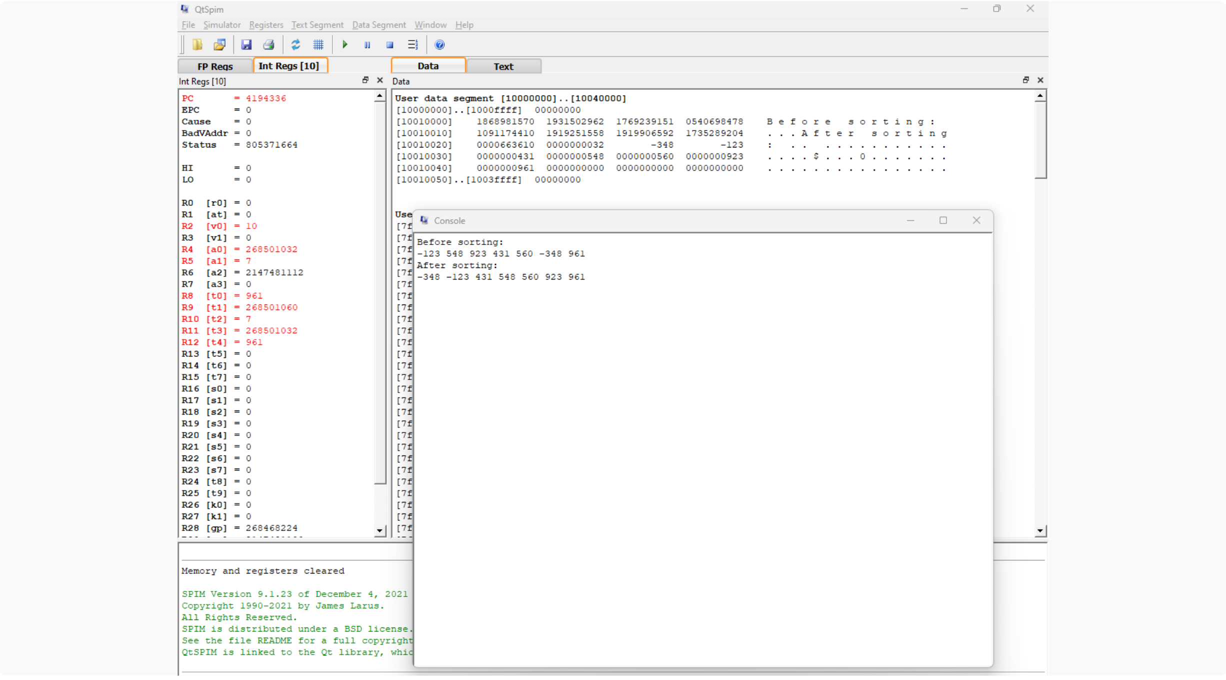
After


QtSpim
File Simulator Registers Text Segment Data Segment Window Help
FP Regs
Int Regs [10]
Data
Text
Int Regs [10]
Data
Console

```
PC       = 4194336
EPC      = 0
Cause    = 0
BadVAddr = 0
Status   = 805371664

HI       = 0
LO       = 0

R0  [r0] = 0
R1  [at] = 0
R2  [v0] = 10
R3  [v1] = 0
R4  [a0] = 268501032
R5  [a1] = 7
R6  [a2] = 2147481112
R7  [a3] = 0
R8  [t0] = 961
R9  [t1] = 268501060
R10 [t2] = 7
R11 [t3] = 268501032
R12 [t4] = 961
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
R22 [s6] = 0
R23 [s7] = 0
R24 [t8] = 0
R25 [t9] = 0
R26 [k0] = 0
R27 [k1] = 0
R28 [gp] = 268468224
```

```
User data segment [10000000]..[10040000]
[10000000]..[1000ffff]  00000000
[10010000]    1868981570  1931502962  1769239151  0540698478    B e f o r e   s o r t i n g :
[10010010]    1091174410  1919251558  1919906592  1735289204    . . . A f t e r   s o r t i n g
[10010020]    0000663610  0000000032        -348        -123    :   . .   . . . . . . . . . . .
[10010030]    0000000431  0000000548  0000000560  0000000923    . . . . $ . . . 0 . . . . . . .
[10010040]    0000000961  0000000000  0000000000  0000000000    . . . . . . . . . . . . . . . .
[10010050]..[1003ffff]  00000000
```

```
Before sorting:
-123 548 923 431 560 -348 961
After sorting:
-348 -123 431 548 560 923 961
```

```
Memory and registers cleared

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```