Software 4

Arrays in Assembly

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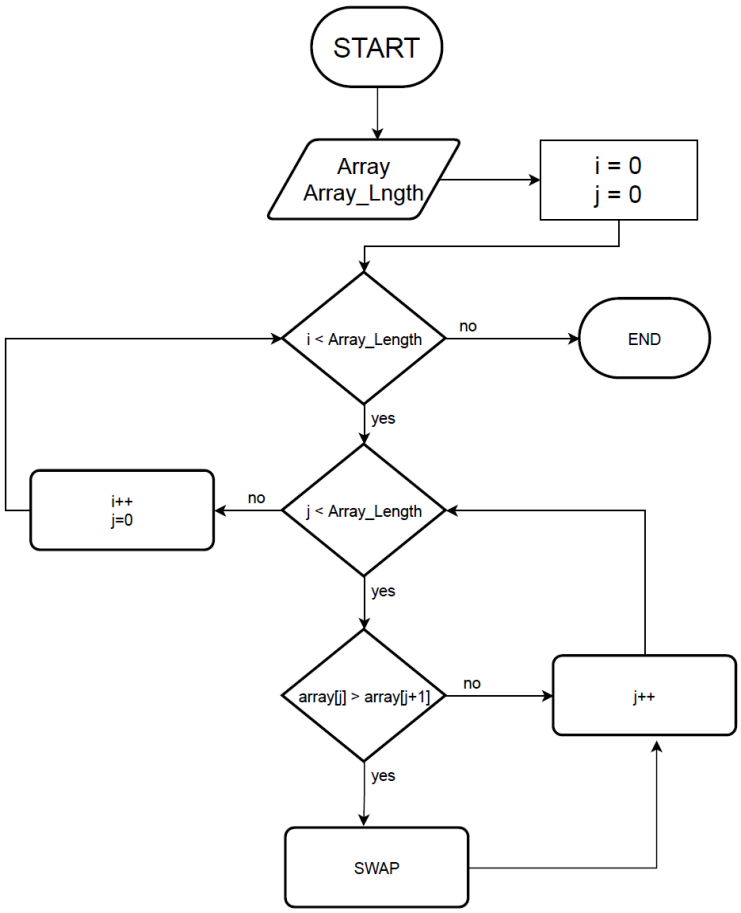
Description

In this software lab, we tried to gain more experience for writing assembly language programs. The lab is to design an assembly program that implements a bubble sort on a 16-element array of data.

Flowchart



Verification

```
.data
Array: .word 1, 121, 43, 11, 2, 4, 7, 99, 100, 101, 6, 11, 5, 12, 23, 66
```

Fig 1: Input Assigned

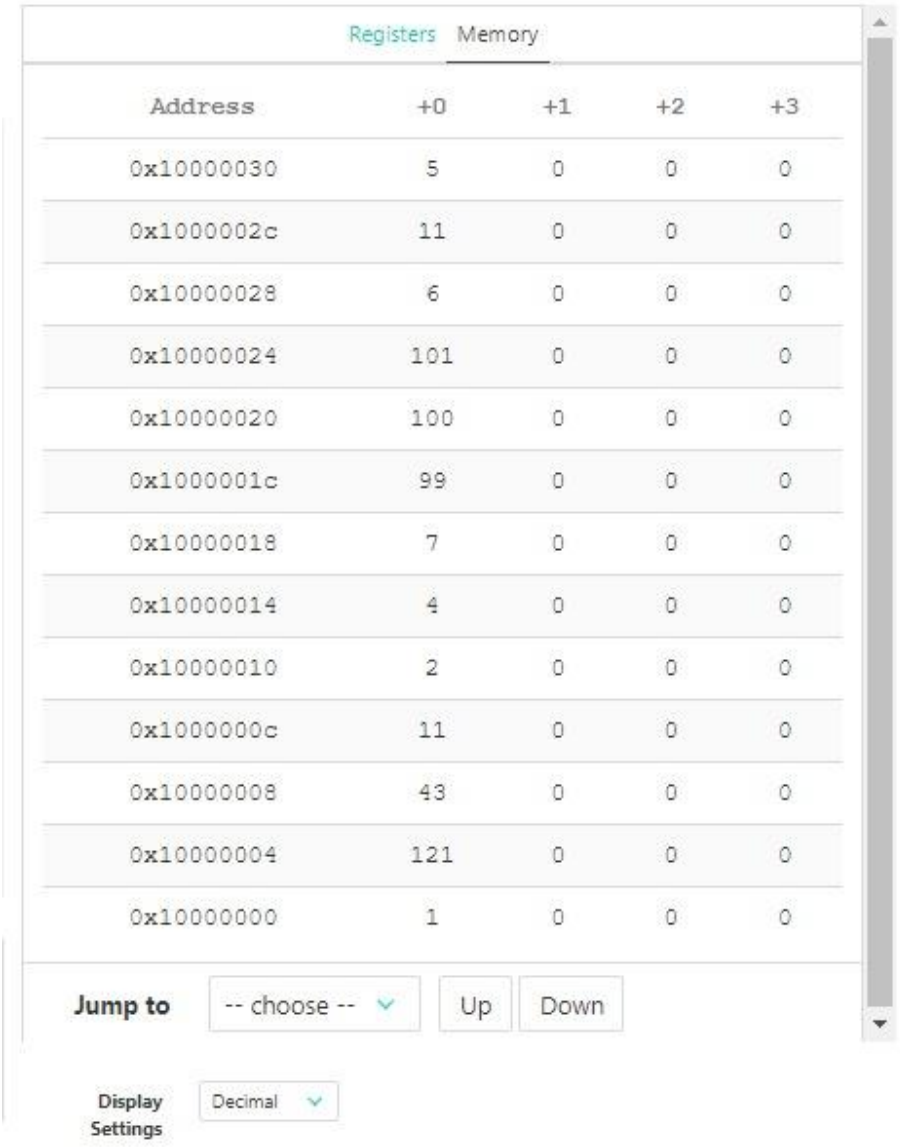


Fig 2: Input in memories

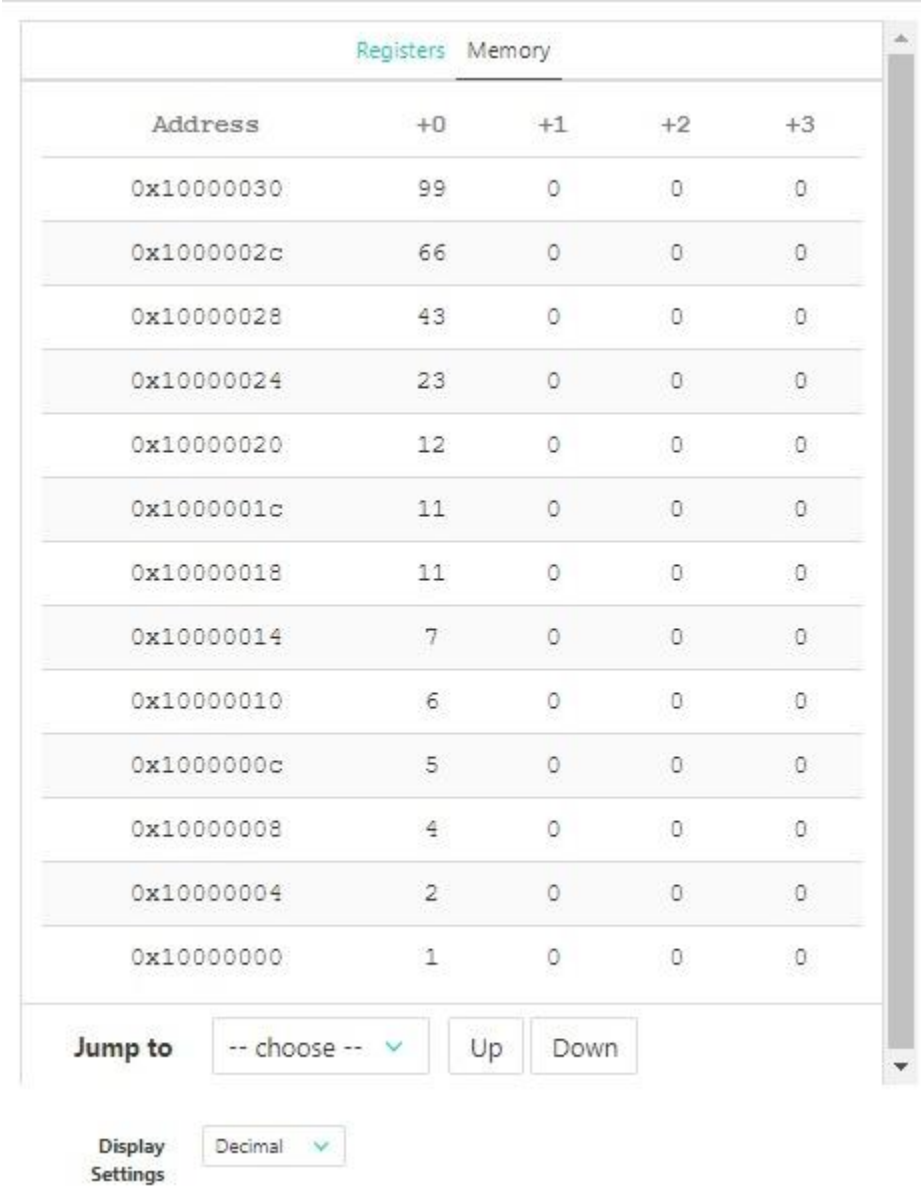


Fig 3: Sorted after run

Assembly code

```
.data
Array: .word 1, 121, 43, 11, 2, 4, 7, 99, 100, 101, 6, 11, 5, 12, 23, 66

.text
main:
        la      a0, Array
        li      a1, 15

        jal     ra, bubble_sort
        j       end


bubble_sort:
        addi    sp, sp, -32
        sw      ra, 28(sp)
        sw      s0, 24(sp)
        addi    s0, sp, 32
        sw      a0, -12(s0)
        sw      a1, -16(s0)
        mv      a0, zero
        sw      a0, -24(s0)
        j       For_i
For_i:
        lw      a0, -24(s0)
        lw      a1, -16(s0)
        bge     a0, a1, sort_done
        mv      a0, zero
        sw      a0, -28(s0)
        j       For_j
For_j:
        lw      a0, -28(s0)
        lw      a1, -16(s0)
        bge     a0, a1, inc_i

if_greater:
        lw      a0, -12(s0)
        lw      a1, -28(s0)
        slli    a1, a1, 2
        add     a0, a0, a1
        lw      a1, 0(a0)
        lw      a0, 4(a0)
        bge     a0, a1, inc_j

swap:
        lw      a0, -12(s0)
        lw      a1, -28(s0)
        slli    a1, a1, 2
        add     a0, a0, a1
        lw      a0, 0(a0)
        sw      a0, -20(s0)
        lw      a0, -12(s0)
        lw      a1, -28(s0)
        slli    a1, a1, 2
```

```
        add     a0, a0, a1
        lw      a1, 4(a0)
        sw      a1, 0(a0)
        lw      a0, -20(s0)
        lw      a1, -12(s0)
        lw      a2, -28(s0)
        slli    a2, a2, 2
        add     a1, a1, a2
        sw      a0, 4(a1)
        j       inc_j
inc_j:
        lw      a0, -28(s0)
        addi    a0, a0, 1
        sw      a0, -28(s0)
        j       For_j
inc_i:
        lw      a0, -24(s0)
        addi    a0, a0, 1
        sw      a0, -24(s0)
        j       For_i
sort_done:
        lw      s0, 24(sp)
        lw      ra, 28(sp)
        addi    sp, sp, 32
        ret

end:
                addi    a0, x0, 10
        ecall
```