CSE 331/503
Computer Organization
Homework 2
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## Used C Codes ( pseudo codes )

### 1 - str_to_array(char string[], int array[])

Converts int array in string format("1,2,5,75") to the int array.
Space Complexity -> O(n) - Time Complexity -> O(n)

**Code:**

```
int str_to_array(char string[],int array[]){

int num = 0;
int index = 0;
for(int i=0; string[i]!='\0'; i++)
{
        if( string[i] != ',' ){
                int digit = string[i] -'0';
                num*=10;
                num += digit;
        }
        else{
                array[index++] = num;
                num=0;
                }
}
array[index] = num;
return index;
}
```

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**2 - sub_seq_arr(int array[], int size, int result[])**

Makes a result table by using array.

Space Complexity -> O(1) (because array size is limited 10 if it was not limited, comp. would be O(n )

Time Complexity -> O($n^2$)

```
int sub_seq_arr(int array[], int size, int result[])
{
int max_index = 1;

for (int i = 0; i < size; i++)
{
        for (int j = 0; j < i; j++)
        {
                if (array[i] > array[j] && result[j] >= result[i])
                {
                        result[i] = result[j] + 1;
                        if (result[i] > result[max_index])
                        max_index = result[i];
                }
        }
}
return max_index;
}
```

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**3 - store_longest_seq ( int result[],  int array[],  int max_index,  int path[],  int size )**

Extracts longest path from result table
Space Complexity -> O(n)
Time Complexity   -> O(n)

```
void get_longest_path(int result[], int array[], int max_index, int path[], int size)
{
        int index = max_index;
        for (int i = size - 1; i >= 0; i--)
        {
                if (result[i] == index && (index == max_index || path[index] > array[i]))
                {
                        path[--index] = array[i];
                }
        }
}
```

**4 - int int_to_str ( int n, char str[10] )**
Converts int to string.
Space Complexity -> O(1)
Time Complexity -> O(1) (because max allowed number size is 10, otherwise would be O(n) . )

```
int int_to_str(int n, char str[10])
{
        char convertString[] = "0123456789";
        str[10]='\0';
        int i=9;
        while(n !=0){
                int digit = n%10;
                str[i--]= convertString[digit];
                n/=10;
        }
        return i+1;
}
```

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### 5 - void write_file(int arr[], int size)

Writes longest sequence array to output file
Space Complexity -> O(n)
Time Complexity -> O(n)

```
void write_file(int arr[], int size){
        for(int i=0; i<size; i++)
        {
                char str[10];
                int_to_str(arr[i],str);
                // print(str) to file
                // print(,)
        }
}
```

### 6 – print_results()

In this procedure I just read output file and print it .
Space Complexity -> O(n)
Time Complexity -> O(n)

### 7 – print_buffer()

In this procedure I just print the label named buffer.
Space Complexity -> O(n)
Time Complexity -> O(n)

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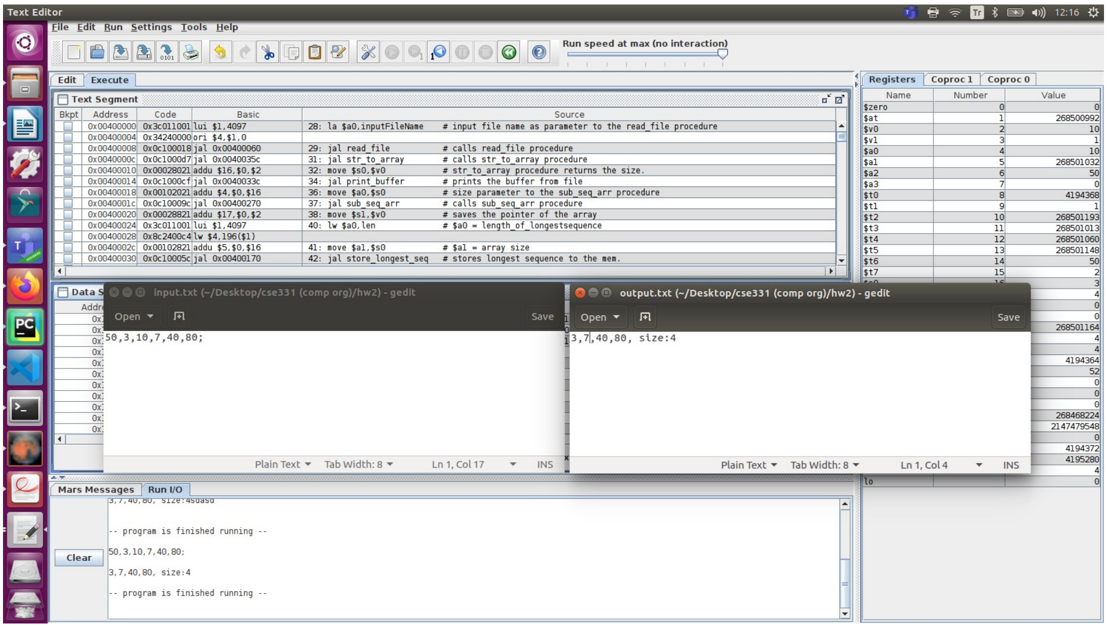
## Test Cases

**Explanation:** Input file must include just numbers and commas even not space and must be end with ‘;’.
Finds longest sequence and writes to the output file with size.



Text Segment

| Bkpt | Address | Code | Basic | Source |
|---|---|---|---|---|
| □ | 0x00400000 | 0x3c011001 | lui $1,4097 | 28: la $a0,inputFileName # input file name as parameter to the read_file procedure |
| □ | 0x00400004 | 0x34240000 | ori $4,$1,0 | |
| □ | 0x00400008 | 0x0c100018 | jal 0x00400060 | 29: jal read_file # calls read_file procedure |
| □ | 0x0040000c | 0x0c1000d7 | jal 0x0040035c | 31: jal str_to_array # calls str_to_array procedure |
| □ | 0x00400010 | 0x00028021 | addu $16,$0,$2 | 32: move $s0,$v0 # str_to_array procedure returns the size. |
| □ | 0x00400014 | 0x0c1000cf | jal 0x0040033c | 34: jal print_buffer # prints the buffer from file |
| □ | 0x00400018 | 0x00102021 | addu $4,$0,$16 | 36: move $a0,$s0 # size parameter to the sub_seq_arr procedure |
| □ | 0x0040001c | 0x0c10009c | jal 0x00400270 | 37: jal sub_seq_arr # calls sub_seq_arr procedure |
| □ | 0x00400020 | 0x00028821 | addu $17,$0,$2 | 38: move $s1,$v0 # saves the pointer of the array |
| □ | 0x00400024 | 0x3c011001 | lui $1,4097 | 40: lw $a0,len # $a0 = length_of_longestsequence |
| □ | 0x00400028 | 0x8c2400c4 | lw $4,196($1) | |
| □ | 0x0040002c | 0x00102821 | addu $5,$0,$16 | 41: move $a1,$s0 # $a1 = array size |
| □ | 0x00400030 | 0x0c10005c | jal 0x00400170 | 42: jal store_longest_seq # stores longest sequence to the mem. |

| Name | Number | Value |
|---|---|---|
| $zero | 0 | 0 |
| $at | 1 | 268500992 |
| $v0 | 2 | 10 |
| $v1 | 3 | 1 |
| $a0 | 4 | 10 |
| $a1 | 5 | 268501032 |
| $a2 | 6 | 50 |
| $a3 | 7 | 0 |
| $t0 | 8 | 4194368 |
| $t1 | 9 | 1 |
| $t2 | 10 | 268501193 |
| $t3 | 11 | 268501013 |
| $t4 | 12 | 268501060 |
| $t5 | 13 | 268501148 |
| $t6 | 14 | 50 |
| $t7 | 15 | 2 |
| | | 3 |
| | | 4 |
| | | 0 |
| | | 0 |
| | | 268501164 |
| | | 4 |
| | | 4 |
| | | 4194364 |
| | | 52 |
| | | 0 |
| | | 0 |
| | | 0 |
| | | 268468224 |
| | | 2147479548 |
| | | 0 |
| | | 4194372 |
| | | 4195280 |
| | | 4 |
| lo | | 0 |

input.txt (~/Desktop/cse331 (comp org)/hw2) - gedit

```
50,3,10,7,40,80;
```

Plain Text · Tab Width: 8 · Ln 1, Col 17 · INS

output.txt (~/Desktop/cse331 (comp org)/hw2) - gedit

```
3,7,40,80, size:4
```

Plain Text · Tab Width: 8 · Ln 1, Col 4 · INS

Run I/O

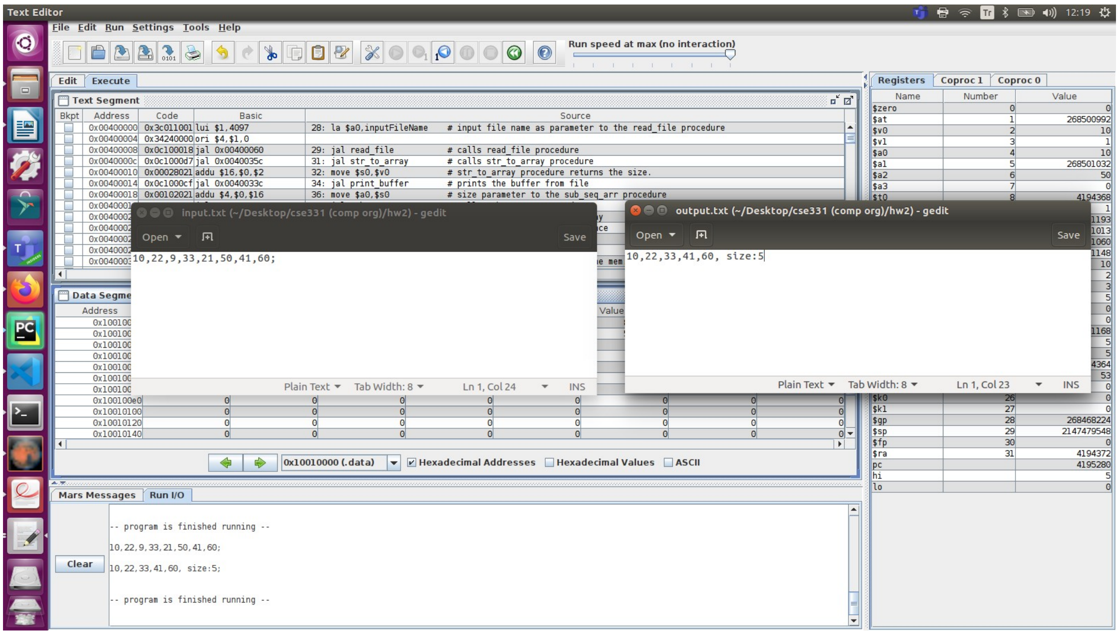
```
3,7,40,80, size:4sdasd


-- program is finished running --

50,3,10,7,40,80;

3,7,40,80, size:4

-- program is finished running --
```



Text Segment

| Bkpt | Address | Code | Basic | Source |
|---|---|---|---|---|
| □ | 0x00400000 | 0x3c011001 | lui $1,4097 | 28: la $a0,inputFileName # input file name as parameter to the read_file procedure |
| □ | 0x00400004 | 0x34240000 | ori $4,$1,0 | |
| □ | 0x00400008 | 0x0c100018 | jal 0x00400060 | 29: jal read_file # calls read_file procedure |
| □ | 0x0040000c | 0x0c1000d7 | jal 0x0040035c | 31: jal str_to_array # calls str_to_array procedure |
| □ | 0x00400010 | 0x00028021 | addu $16,$0,$2 | 32: move $s0,$v0 # str_to_array procedure returns the size. |
| □ | 0x00400014 | 0x0c1000cf | jal 0x0040033c | 34: jal print_buffer # prints the buffer from file |
| □ | 0x00400018 | 0x00102021 | addu $4,$0,$16 | 36: move $a0,$s0 # size parameter to the sub_seq_arr procedure |

Data Segment

| Address | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0x100100e0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0x10010100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0x10010120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0x10010140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

0x10010000 (.data) ☑ Hexadecimal Addresses ☐ Hexadecimal Values ☐ ASCII

| Name | Number | Value |
|---|---|---|
| $zero | 0 | 0 |
| $at | 1 | 268500992 |
| $v0 | 2 | 10 |
| $v1 | 3 | 1 |
| $a0 | 4 | 10 |
| $a1 | 5 | 268501032 |
| $a2 | 6 | 50 |
| $a3 | 7 | 0 |
| $t0 | 8 | 4194368 |
| | | 1 |
| | | 1193 |
| | | 1013 |
| | | 1060 |
| | | 1148 |
| | | 10 |
| | | 2 |
| | | 3 |
| | | 5 |
| | | 0 |
| | | 0 |
| | | 1168 |
| | | 5 |
| | | 5 |
| | | 4364 |
| | | 53 |
| | | 0 |
| $k0 | 26 | 0 |
| $k1 | 27 | 0 |
| $gp | 28 | 268468224 |
| $sp | 29 | 2147479548 |
| $fp | 30 | 0 |
| $ra | 31 | 4194372 |
| pc | | 4195280 |
| hi | | 5 |
| lo | | 0 |

input.txt (~/Desktop/cse331 (comp org)/hw2) - gedit

```
10,22,9,33,21,50,41,60;
```

Plain Text · Tab Width: 8 · Ln 1, Col 24 · INS

output.txt (~/Desktop/cse331 (comp org)/hw2) - gedit

```
10,22,33,41,60, size:5
```

Plain Text · Tab Width: 8 · Ln 1, Col 23 · INS

Run I/O

```
-- program is finished running --

10,22,9,33,21,50,41,60;

10,22,33,41,60, size:5;


-- program is finished running --
```

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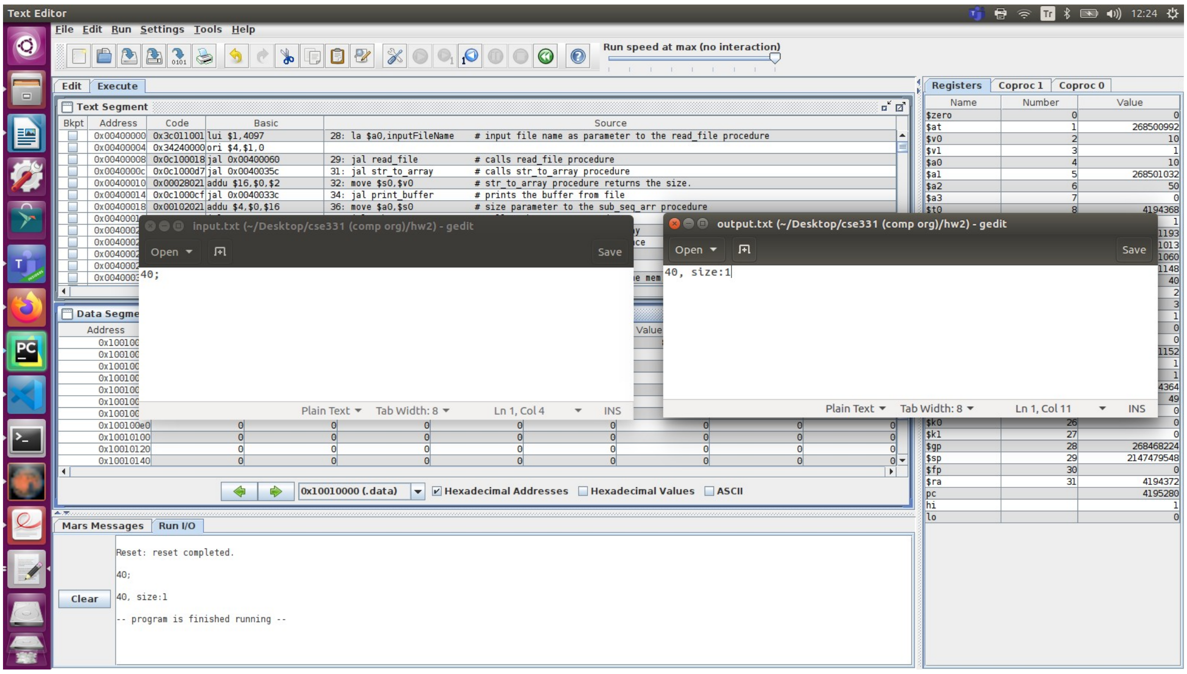

Text Editor
File Edit Run Settings Tools Help
Run speed at max (no interaction)
Edit Execute
Text Segment
Data Segment
Registers Coproc 1 Coproc 0
Open Save
Plain Text Tab Width: 8 Ln 1, Col 4 INS
Tab Width: 8 Ln 1, Col 11 INS
0x10010000 (.data)
☑ Hexadecimal Addresses ☐ Hexadecimal Values ☐ ASCII
Mars Messages Run I/O
Clear
12:24

| Bkpt | Address | Code | Basic | Source |
|---|---|---|---|---|
| ☐ | 0x00400000 | 0x3c011001 | lui $1,4097 | 28: la $a0,inputFileName # input file name as parameter to the read_file procedure |
| ☐ | 0x00400004 | 0x34240000 | ori $4,$1,0 | |
| ☐ | 0x00400008 | 0x0c100018 | jal 0x00400060 | 29: jal read_file # calls read_file procedure |
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| ☐ | 0x00400014 | 0x0c1000cf | jal 0x0040033c | 34: jal print_buffer # prints the buffer from file |
| ☐ | 0x00400018 | 0x00102021 | addu $4,$0,$16 | 36: move $a0,$s0 # size parameter to the sub_seq_arr procedure |

input.txt (~/Desktop/cse331 (comp org)/hw2) - gedit

```
40;
```

output.txt (~/Desktop/cse331 (comp org)/hw2) - gedit

```
40, size:1
```

| Name | Number | Value |
|---|---|---|
| $zero | 0 | 0 |
| $at | 1 | 268500992 |
| $v0 | 2 | 10 |
| $v1 | 3 | 1 |
| $a0 | 4 | 10 |
| $a1 | 5 | 268501032 |
| $a2 | 6 | 50 |
| $a3 | 7 | 0 |
| $t0 | 8 | 4194368 |
| $k0 | 26 | 0 |
| $k1 | 27 | 0 |
| $gp | 28 | 268468224 |
| $sp | 29 | 2147479548 |
| $fp | 30 | 0 |
| $ra | 31 | 4194372 |
| pc | | 4195280 |
| hi | | 1 |
| lo | | 0 |

```
Reset: reset completed.

40;

40, size:1

-- program is finished running --
```