

COAL LAB 10

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Task 1:

```
File Edit View Git Project Build Debug Test Analyze Tools Extensions Window Help Search LABCOAL#10
T1.asm X
1 INCLUDE Irvine32.inc
2
3 .data
4 num1 DWORD 5
5 num2 DWORD 4
6 num3 DWORD 3
7 resultMsg BYTE "Product: ", 0
8
9 .code
10 ThreeProd PROC
11     push ebp
12     mov ebp, esp
13
14     mov eax, [ebp + 8]
15     imul eax, [ebp + 12]
16     imul eax, [ebp + 16]
17
18     mov edx, OFFSET resultMsg
19     call WriteString
20     call WriteDec
21     call Crlf
22
23     pop ebp
24     ret 12
25 ThreeProd ENDP
26
27 T1 PROC
28     push num3
29     push num2
30     push num1
31     call ThreeProd
32
33     exit
34 T1 ENDP
35 END T1
```

Output:

```
Product: 60
C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 4616) exited with
code 0 (0x0).
Press any key to close this window . . .
```

Task 2:

The screenshot shows the Microsoft Visual Studio interface with the assembly code editor open for the file T2.asm. The menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, and Help. The toolbar features icons for back, forward, search, and build operations. The status bar indicates Release mode, x86 architecture, and Local Windows Debugger. The code editor displays the following assembly code:

```
1 INCLUDE Irvine32.inc
2
3 .data
4 prompt1 BYTE "Enter first number: ", 0
5 prompt2 BYTE "Enter second number: ", 0
6 espMsg BYTE "ESP value: ", 0
7 resultMsg BYTE "GCD: ", 0
8 num1 DWORD ?
9 num2 DWORD ?
10
11 .code
12 Display PROC
13     push ebp
14     mov ebp, esp
15
16     mov edx, OFFSET espMsg
17     call WriteString
18     mov eax, esp
19     call WriteHex
20     call Crlf
21
22     mov eax, [ebp + 8]
23     mov edx, OFFSET resultMsg
24     call WriteString
25     call WriteDec
26     call Crlf
27
28     pop ebp
29     ret 4
30 Display ENDP
31
32 GCD PROC
33     push ebp
34     mov ebp, esp
35
36     mov edx, OFFSET espMsg
37     call WriteString
38     mov eax, esp
39     call WriteHex
40     call Crlf
41
42     mov eax, [ebp + 8]
43     mov ebx, [ebp + 12]
44
45 gcd_loop:
46     cmp ebx, 0
47     je gcd_done
48     mov edx, 0
49     div ebx
50     mov eax, ebx
51     mov ebx, edx
52     jmp gcd_loop
53
54 gcd_done:
55     push eax
56     call Display
```

The screenshot shows the Microsoft Visual Studio IDE interface. The top menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, and Help. The toolbar below the menu has icons for file operations like Open, Save, and Print. The status bar at the bottom indicates "62 %", "No issues found", and shows the current file path: C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 72) exited with code 0 (0x0). Press any key to close this window . . .".

The main code editor window displays assembly language for the file T2.asm:

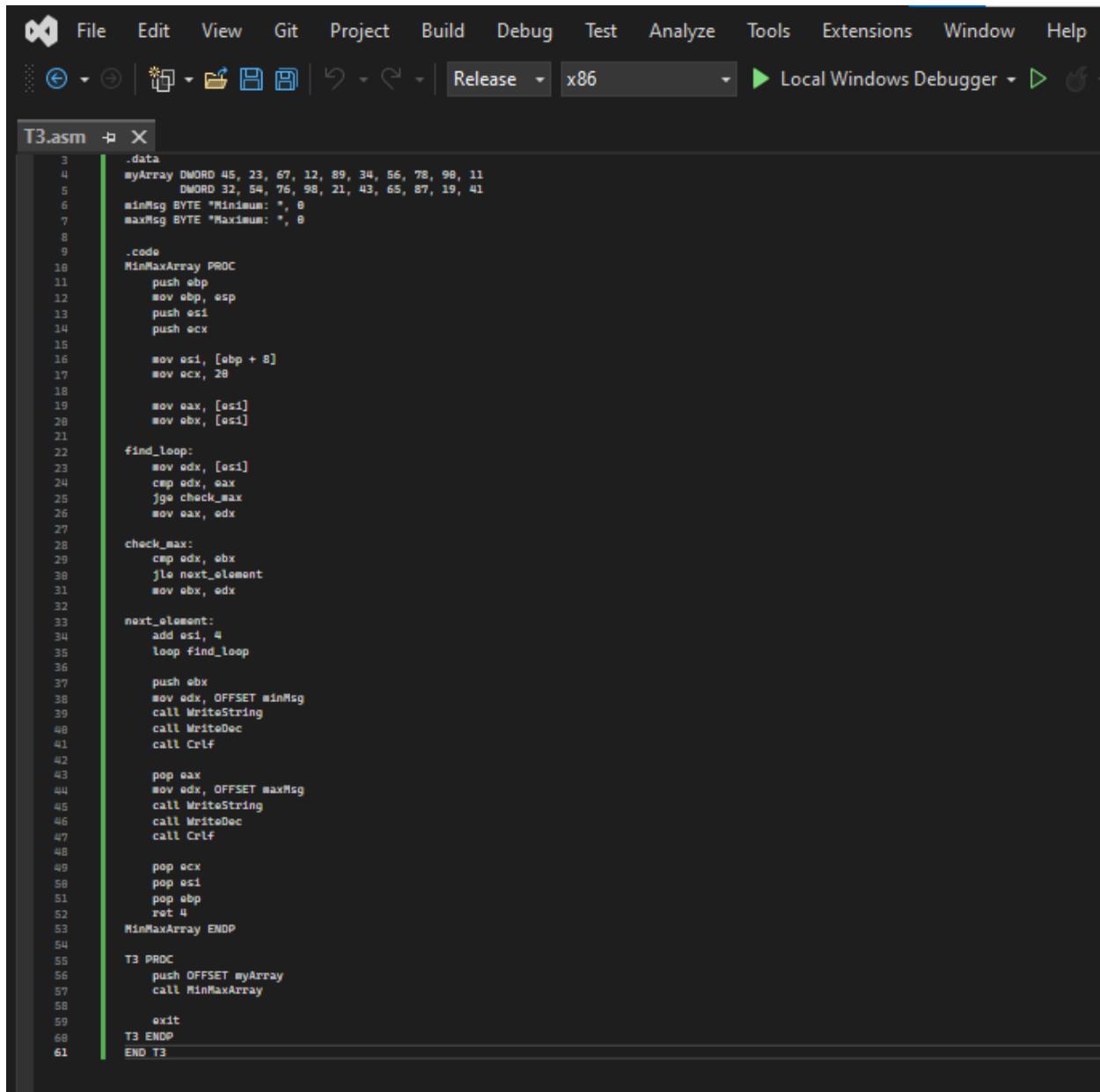
```
57      pop ebp
58      ret 8
59      GCD ENDP
60
61 TakeInput PROC
62     push ebp
63     mov ebp, esp
64
65     mov edx, OFFSET espMsg
66     call WriteString
67     mov eax, esp
68     call WriteHex
69     call Crlf
70
71     mov edx, OFFSET prompt1
72     call WriteString
73     call ReadDec
74     mov num1, eax
75
76     mov edx, OFFSET prompt2
77     call WriteString
78     call ReadDec
79     mov num2, eax
80
81     push num2
82     push num1
83     call GCD
84
85     pop ebp
86     ret
87 TakeInput ENDP
88
89 T2 PROC
90     call TakeInput
91     exit
92 T2 ENDP
93 END T2
94
```

Output:

```
ESP value: 008FFA40
Enter first number: 20
Enter second number: 4
ESP value: 008FFA30
ESP value: 008FFA24
GCD: 4

C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 72) exited with code 0 (0x0).
Press any key to close this window . . .
```

Task 3:



The screenshot shows the Microsoft Visual Studio IDE interface with the assembly editor open. The menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, and Help. The toolbar has icons for file operations like Open, Save, and Print. The status bar indicates Release mode, x86 architecture, and Local Windows Debugger. The assembly code in the editor is as follows:

```
.data
myArray DWORD 45, 23, 67, 12, 89, 34, 56, 78, 98, 11
        DWORD 32, 54, 76, 98, 21, 43, 65, 87, 19, 41
minMsg BYTE "Minimum: ", 0
maxMsg BYTE "Maximum: ", 0

.code
MinMaxArray PROC
    push ebp
    mov ebp, esp
    push esi
    push ecx

    mov esi, [ebp + 8]
    mov ecx, 28

    mov eax, [esi]
    mov ebx, [esi]

    find_loop:
        mov edx, [esi]
        cmp edx, eax
        jge check_max
        mov eax, edx

    check_max:
        cmp edx, ebx
        jle next_element
        mov ebx, edx

    next_element:
        add esi, 4
        loop find_loop

    push ebx
    mov edx, OFFSET minMsg
    call WriteString
    call WriteDec
    call Crlf

    pop eax
    mov edx, OFFSET maxMsg
    call WriteString
    call WriteDec
    call Crlf

    pop ecx
    pop esi
    pop ebp
    ret 4
MinMaxArray ENDP

T3 PROC
    push OFFSET myArray
    call MinMaxArray

    exit
T3 ENDP
END T3
```

Output:

```
Minimum: 11
Maximum: 98

C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 6084) exited with
code 0 (0x0).
Press any key to close this window . . .
```

Task 4:

The screenshot shows the Microsoft Visual Studio Code interface with the following details:

- File Bar:** File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help.
- Toolbars:** Standard toolbar with icons for file operations.
- Status Bar:** Shows "91 %", a green checkmark icon, and "No issues found".

The main editor window displays the assembly code for `T4.asm`:

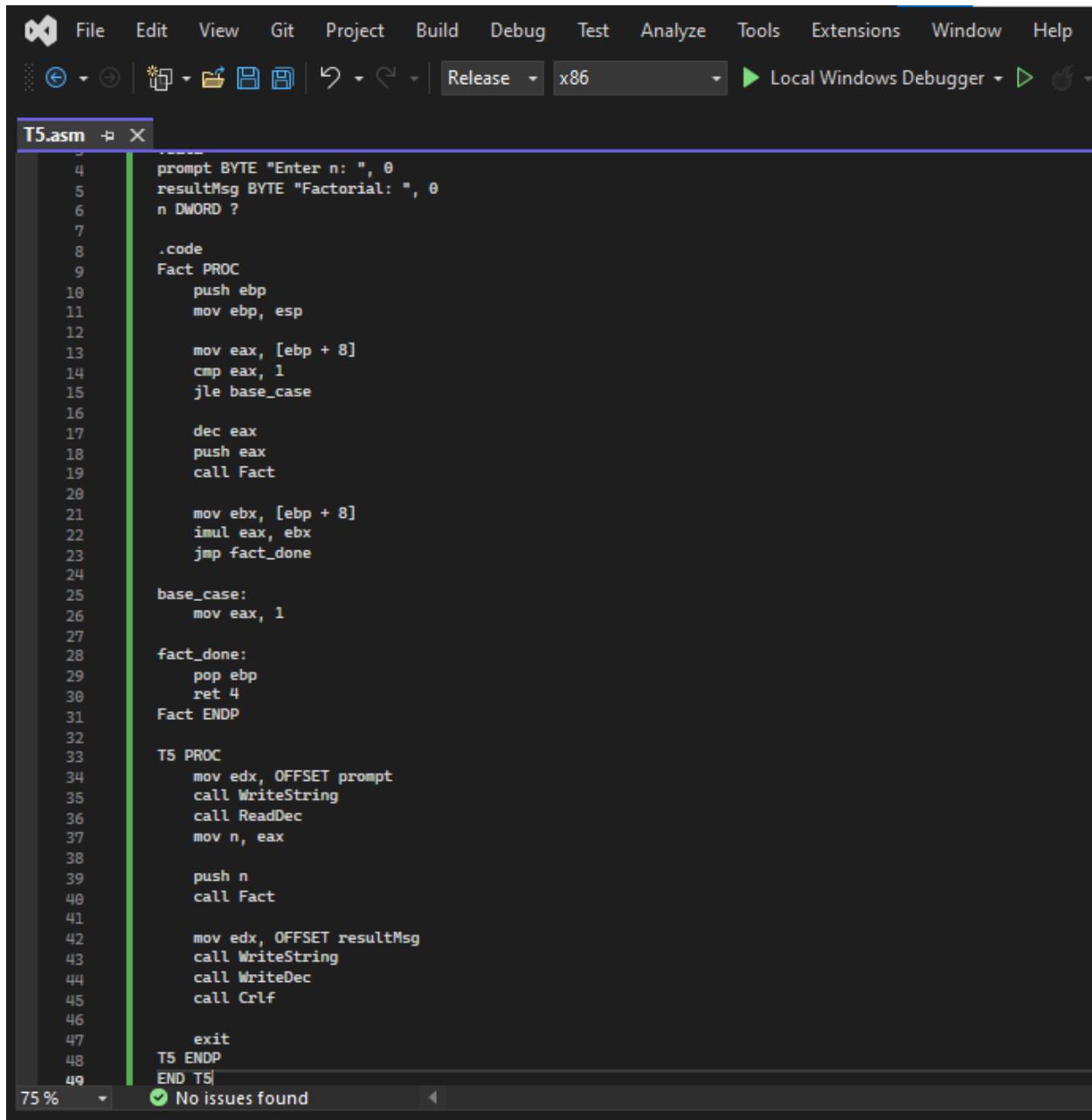
```
1 INCLUDE Irvine32.inc
2
3 .data
4 prompt BYTE "Enter a number: ", 0
5 resultMsg BYTE "Square: ", 0
6
7 .code
8 LocalSquare PROC
9     enter 4, 0
10
11    mov edx, OFFSET prompt
12    call WriteString
13    call ReadDec
14    mov [ebp - 4], eax
15
16    mov eax, [ebp - 4]
17    imul eax, eax
18
19    mov edx, OFFSET resultMsg
20    call WriteString
21    call WriteDec
22    call Crlf
23
24    leave
25    ret
26 LocalSquare ENDP
27
28 T4 PROC
29     call LocalSquare
30     exit
31 T4 ENDP
32 END T4
```

Output:

```
Enter a number: 15
Square: 225

C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 14264) exited with
code 0 (0x0).
Press any key to close this window . . .
```

Task 5:



The screenshot shows the Microsoft Visual Studio IDE interface with the following details:

- Menu Bar:** File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help.
- Toolbar:** Includes icons for Undo, Redo, Find, Replace, Copy, Paste, Cut, and others.
- Status Bar:** Shows "Release" and "x86" under the toolbar, and "Local Windows Debugger" in the status bar.
- Code Editor:** The file "T5.asm" is open. The assembly code is as follows:

```
1    prompt BYTE "Enter n: ", 0
2    resultMsg BYTE "Factorial: ", 0
3    n DWORD ?
4
5    .code
6    Fact PROC
7        push ebp
8        mov ebp, esp
9
10       mov eax, [ebp + 8]
11       cmp eax, 1
12       jle base_case
13
14       dec eax
15       push eax
16       call Fact
17
18       mov ebx, [ebp + 8]
19       imul eax, ebx
20       jmp fact_done
21
22   base_case:
23       mov eax, 1
24
25   fact_done:
26       pop ebp
27       ret 4
28   Fact ENDP
29
30   T5 PROC
31       mov edx, OFFSET prompt
32       call WriteString
33       call ReadDec
34       mov n, eax
35
36       push n
37       call Fact
38
39       mov edx, OFFSET resultMsg
40       call WriteString
41       call WriteDec
42       call Crlf
43
44       exit
45   T5 ENDP
46 END T5
```

The code implements a recursive factorial function. It prompts the user for input, calls the recursive function, and then prints the result. The assembly code uses standard conventions like pushing and popping the current stack frame pointer (ebp) and using ebx as a temporary register for multiplication.

Output:

```
Enter n: 5
Factorial: 120

C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 6372) exited with
code 0 (0x0).
Press any key to close this window . . .
```

Task 6:

The screenshot shows the Microsoft Visual Studio interface with the assembly code editor open for the file **T6.asm**. The menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, and Help. The toolbar contains icons for file operations like Open, Save, and Build. The status bar indicates Release mode, x86 architecture, and Local Windows Debugger.

```
1 INCLUDE Irvine32.inc
2 .
3 p BYTE "Enter number: ",0
4 np BYTE "Not all prime",0
5 lm BYTE "Largest prime = ",0
6 nums DWORD 4 DUP(?)
7 .code
8
9 T6 PROC
10 call Clrscr
11 mov ecx,4
12 lea edi, nums
13
14 readLoop:
15 mov edx, OFFSET p
16 call WriteString
17 call ReadInt
18 mov [edi], eax
19 add edi,4
20 loop readLoop
21
22 lea esi, nums
23 mov ecx,4
24
25 checkLoop:
26 mov eax, [esi]
27 push eax
28 call CheckPrime
29 add esp,4
30 cmp eax,1
31 jne notAllPrime
32 add esi,4
33 loop checkLoop
34 jmp allPrime
35
36 notAllPrime:
37 mov edx, OFFSET np
38 call WriteString
39 call CrLf
40 ret
41
42 allPrime:
43 lea eax, nums
44 push eax
45 call LargestPrime
46 add esp,4
47 call CrLf
48 ret
49 T6 ENDP
50
51 CheckPrime PROC
52 push ebp
53 mov ebp, esp
54
55 mov eax, [ebp+8]
56 cmp eax,2
```

The screenshot shows the Microsoft Visual Studio IDE interface. The menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, and Help. The toolbar contains icons for back, forward, search, and file operations. The status bar at the bottom indicates "56 %", "No issues found", and "C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 11384) exited with code -1073741819 (0xc0000005). Press any key to close this window . . .".

The main window displays the assembly code for T6.asm:

```
55    mov eax, [ebp+4]
56    cmp eax,2
57    jl notPrime
58
59    mov ebx, eax
60    mov ecx,2
61
62    primeLoop:
63    mov edx,8
64    mov eax, ebx
65    div ecx
66    cmp edx,8
67    je notPrime
68
69    inc ecx
70
71    mov edx, ecx
72    imul edx, ecx
73
74    cmp edx, ebx
75    jle primeLoop
76
77    mov eax,1
78    jmp finish
79
80    notPrime:
81    mov eax,0
82
83    finish:
84    pop ebp
85    ret 4
86    CheckPrime ENDP
87
88    LargestPrime PROC
89    push ebp
90    mov ebp, esp
91
92    mov esi, [ebp+8]
93    mov ecx,4
94    mov edi,0
95
96    findLoop:
97    mov eax, [esi]
98    cmp eax, edi
99    jle next
100   mov edi, eax
101   next:
102   add esi,4
103   loop findLoop
104
105   mov edx, OFFSET lm
106   call WriteString
107   mov eax, edi
108   call WriteInt
109
110   pop ebp
111   ret 4
112   LargestPrime ENDP
113
114 END T6
```

Output:

```
Enter number: 5
Enter number: 8
Enter number: 7
Enter number: 9
Not all prime

C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL#10.exe (process 11384) exited with
code -1073741819 (0xc0000005).
Press any key to close this window . . .
```

Task 7:

The screenshot shows the Microsoft Visual Studio IDE interface. The menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, and Help. The toolbar includes icons for file operations like Open, Save, and Print, along with build and debug tools. The status bar at the bottom indicates "62 %", "No issues found", and "C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL10.exe (process 13340) exited with code 32 (0x20). Press any key to close this window . . .".

```
5     .data
6     arr DWORD 64,34,25,12,22,11,90
7     n DWORD LENGTHOF arr
8
9     .code
10
11    T7 PROC
12        mov esi, OFFSET arr
13        mov ecx, n
14
15        L1:
16            mov eax, [esi]
17            call WriteDec
18            mov al, ' '
19            call WriteChar
20            add esi, 4
21            loop L1
22            call Crlf
23
24            INVOKE BubbleSort, ADDR arr, n
25
26            mov esi, OFFSET arr
27            mov ecx, n
28
29        L2:
30            mov eax, [esi]
31            call WriteDec
32            mov al, ' '
33            call WriteChar
34            add esi, 4
35            loop L2
36            call Crlf
37
38        ret
39    T7 ENDP
40
41    BubbleSort PROC pArr:PTR DWORD, count:DWORD
42        mov ebx, count
43        dec ebx
44        outer_loop:
45            mov esi, pArr
46            mov ecx, ebx
47        inner_loop:
48            mov eax, [esi]
49            cmp eax, [esi+4]
50            jle no_swap
51            xchq eax, [esi+4]
52            mov [esi], eax
53        no_swap:
54            add esi, 4
55            loop inner_loop
56            dec ebx
57            jnz outer_loop
58        ret
59    BubbleSort ENDP
60
61 END T7
```

Output:

```
64 34 25 12 22 11 90
11 12 22 25 34 64 90

C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL10.exe (process 13340) exited with
code 32 (0x20).
Press any key to close this window . . .
```

Task 8:

The screenshot shows the Microsoft Visual Studio interface with the assembly code editor open for the file `T8.asm`. The menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, and Help. The toolbar contains icons for file operations like Open, Save, and Build. The status bar indicates "Release x86 Local Windows Debugger". The code editor displays the following assembly code:

```
1 INCLUDE Irvine32.inc
2
3 TakeInput PROTO
4 Armstrong PROTO :DWORD
5 Display PROTO :DWORD
6
7 .data
8 msg1 BYTE "Enter a number: ",0
9 msg2 BYTE "ESP = ",0
10 msgArm BYTE "Armstrong",0
11 msgNot BYTE "Not Armstrong",0
12 num DWORD ?
13
14 .code
15
16 T8 PROC
17     INVOKE TakeInput
18     INVOKE Armstrong, num
19     INVOKE Display, eax
20     ret
21 T8 ENDP
22
23 TakeInput PROC
24     mov edx, OFFSET msg1
25     call WriteString
26     call ReadInt
27     mov num, eax
28     mov edx, OFFSET msg2
29     call WriteString
30     mov eax, esp
31     call WriteDec
32     call Crlf
33     ret
34 TakeInput ENDP
35
36 Armstrong PROC val:DWORD
37     mov eax, val
38     mov ebx, eax
39     mov ecx, 0
40     L1:
41     mov edx, 0
42     mov edi, ebx
43     mov ebx, 10
44     div ebx
45     mov ebx, edi
46     mov edx, eax
47     mov eax, ebx
48     mov ebx, eax
49     imul ebx, ebx
50     imul ebx, eax
51     add ecx, ebx
52     mov eax, edx
53     mov ebx, eax
54     test eax, eax
55     jnz L1
56     mov eax, ecx
```

The status bar at the bottom shows "62 %" and a green checkmark indicating "No issues found".

The screenshot shows the Microsoft Visual Studio interface with the assembly code editor open for the file T8.asm. The menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, and Tools. The toolbar has icons for back, forward, search, and other project-related functions. The status bar shows Release, x86, and Local. The code editor displays the following assembly code:

```
56    mov eax, val
57    mov ebx, val
58    cmp eax, ebx
59    sete al
60    movzx eax, al
61    mov edx, OFFSET msg2
62    call WriteString
63    mov eax, esp
64    call WriteDec
65    call Crlf
66    ret
67 Armstrong ENDP
68
69 Display PROC res:DWORD
70     mov edx, OFFSET msg2
71     call WriteString
72     mov eax, esp
73     call WriteDec
74     call Crlf
75     mov eax, res
76     cmp eax, 1
77     jne NI
78     mov edx, OFFSET msgArm
79     call WriteString
80     jmp D1
81
82 NI:
83     mov edx, OFFSET msgNot
84     call WriteString
85
86 D1:
87     call Crlf
88     ret
89 Display ENDP
END T8
```

Output:

```
Enter a number: 153
ESP = 15726752
ESP = 15726744
ESP = 15726744
Not Armstrong

C:\Users\Lenovo\OneDrive\Desktop\BAI-3\COAL LAB\LABCOAL#10\LABCOAL#10\Release\LABCOAL10.exe (process 9644) exited with c
ode 15726744 (0xefff898).
Press any key to close this window . . .
```