# **CS 410 C++ to Assembly Activity Template**

**Step 1:** Explain the functionality of the C++ code.

## C++ Code Functionality

| **C++ Line of Code** | **Explanation of Functionality** |
| --- | --- |
| #include<iostream> | Enables input and output control |
| using namespace std; | Enables using names for objects and variables |
| int main() | Entry of program |
| { |  |
| int width=10; | Declares & initializes the width with a value of 10 |
| int height=5; | Declares & initializes the height with a value of 5 |
| int area; | Declares area as an integer with no initial value |
| area = width \* height; | Defines area to be width multiplied by height |
| cout<<endl<< area; | Outputs the area as a new line |
| return 0; | Signals the program was successful |
| } |  |

**Step 2:** Convert the C++ file into assembly code.

**Step 3:** Align each line of C++ code with the corresponding blocks of assembly code.

## C++ to Assembly Alignment

| **C++ Line of Code** | **Blocks of Assembly Code** |
| --- | --- |
|  | .file "assignment1\_1.cpp" |
|  | .text |
|  | .section .rodata |
|  | .type \_ZStL19piecewise\_construct, @object |
|  | .size \_ZStL19piecewise\_construct, 1 |
|  | \_ZStL19piecewise\_construct: |
|  | .zero 1 |
|  | .local \_ZStL8\_\_ioinit |
|  | .comm \_ZStL8\_\_ioinit,1,1 |
|  | .text |
| int main() | .globl main |
| .type main, @function |
| main: |
| .LFB1493: |
|  | .cfi\_startproc |
|  | pushq %rbp |
|  | .cfi\_def\_cfa\_offset 16 |
|  | .cfi\_offset 6, -16 |
|  | movq %rsp, %rbp |
|  | .cfi\_def\_cfa\_register 6 |
|  | subq $16, %rsp |
| int width=10; | movl $10, -12(%rbp) |
| int height=5; | movl $5, -8(%rbp) |
| area = width \* height; | movl -12(%rbp), %eax |
| imull -8(%rbp), %eax |
| movl %eax, -4(%rbp) |
|  | movq \_ZSt4endlIcSt11char\_traitsIcEERSt13basic\_ostreamIT\_T0\_ES6\_@GOTPCREL(%rip), %rax |
|  | movq %rax, %rsi |
|  | leaq \_ZSt4cout(%rip), %rdi |
|  | call \_ZNSolsEPFRSoS\_E@PLT |
|  | movq %rax, %rdx |
| cout<<endl<< area; | movl -4(%rbp), %eax |
| movl %eax, %esi |
|  | movq %rdx, %rdi |
|  | call \_ZNSolsEi@PLT |
| Return 0; | movl $0, %eax |
|  | leave |
|  | .cfi\_def\_cfa 7, 8 |
|  | ret |
|  | .cfi\_endproc |
|  | .LFE1493: |
|  | .size main, .-main |
|  | .type \_Z41\_\_static\_initialization\_and\_destruction\_0ii, @function |
|  | \_Z41\_\_static\_initialization\_and\_destruction\_0ii: |
|  | .LFB1979: |
|  | .cfi\_startproc |
|  | pushq %rbp |
|  | .cfi\_def\_cfa\_offset 16 |
|  | .cfi\_offset 6, -16 |
|  | movq %rsp, %rbp |
|  | .cfi\_def\_cfa\_register 6 |
|  | subq $16, %rsp |
|  | movl %edi, -4(%rbp) |
|  | movl %esi, -8(%rbp) |
|  | cmpl $1, -4(%rbp) |
|  | jne .L5 |
|  | cmpl $65535, -8(%rbp) |
|  | jne .L5 |
|  | leaq \_ZStL8\_\_ioinit(%rip), %rdi |
|  | call \_ZNSt8ios\_base4InitC1Ev@PLT |
|  | leaq \_\_dso\_handle(%rip), %rdx |
|  | leaq \_ZStL8\_\_ioinit(%rip), %rsi |
|  | movq \_ZNSt8ios\_base4InitD1Ev@GOTPCREL(%rip), %rax |
|  | movq %rax, %rdi |
|  | call \_\_cxa\_atexit@PLT |
|  | .L5: |
|  | nop |
|  | leave |
|  | .cfi\_def\_cfa 7, 8 |
|  | ret |
|  | .cfi\_endproc |
|  | .LFE1979: |
|  | .size \_Z41\_\_static\_initialization\_and\_destruction\_0ii, .-\_Z41\_\_static\_initialization\_and\_destruction\_0ii |
|  | .type \_GLOBAL\_\_sub\_I\_main, @function |
|  | \_GLOBAL\_\_sub\_I\_main: |
|  | .LFB1980: |
|  | .cfi\_startproc |
|  | pushq %rbp |
|  | .cfi\_def\_cfa\_offset 16 |
|  | .cfi\_offset 6, -16 |
|  | movq %rsp, %rbp |
|  | .cfi\_def\_cfa\_register 6 |
|  | movl $65535, %esi |
|  | movl $1, %edi |
|  | call \_Z41\_\_static\_initialization\_and\_destruction\_0ii |
|  | popq %rbp |
|  | .cfi\_def\_cfa 7, 8 |
|  | ret |
|  | .cfi\_endproc |
|  | .LFE1980: |
|  | .size \_GLOBAL\_\_sub\_I\_main, .-\_GLOBAL\_\_sub\_I\_main |
|  | .section .init\_array,"aw" |
|  | .align 8 |
|  | .quad \_GLOBAL\_\_sub\_I\_main |
|  | .hidden \_\_dso\_handle |
|  | .ident "GCC: (Ubuntu 7.5.0-3ubuntu1~18.04) 7.5.0" |
|  | .section .note.GNU-stack,"",@progbits |

**Step 4:** Explain how the blocks of assembly code perform the same tasks as the C++ code.

## Assembly Functionality

| **Blocks of Assembly Code** | **Explanation of Functionality** |
| --- | --- |
| .file "assignment1\_1.cpp" | Specifies source is from assignment1\_1.cpp |
| .text | Identifies beginning of code |
| .section .rodata |  |
| .type \_ZStL19piecewise\_construct, @object |  |
| .size \_ZStL19piecewise\_construct, 1 |  |
| \_ZStL19piecewise\_construct: |  |
| .zero 1 |  |
| .local \_ZStL8\_\_ioinit |  |
| .comm \_ZStL8\_\_ioinit,1,1 |  |
| .text |  |
| .globl main | Declares main function as global |
| .type main, @function | Specifies main as a function |
| main: |  |
| .LFB1493: | Beginning of frame buffer |
| .cfi\_startproc |  |
| pushq %rbp |  |
| .cfi\_def\_cfa\_offset 16 |  |
| .cfi\_offset 6, -16 |  |
| movq %rsp, %rbp |  |
| .cfi\_def\_cfa\_register 6 |  |
| subq $16, %rsp |  |
| movl $10, -12(%rbp) | Move contents of 10 into -12(%rbp) |
| movl $5, -8(%rbp) | Move contents of 5 into -8(%rbp) |
| movl -12(%rbp), %eax | Move contents of -12(%rbp) to %eax |
| imull -8(%rbp), %eax | Multiply-8(%rbp) by %eax |
| movl %eax, -4(%rbp) | Move contents of %eax to -4(%rbp) |
| movq \_ZSt4endlIcSt11char\_traitsIcEERSt13basic\_ostreamIT\_T0\_ES6\_@GOTPCREL(%rip), %rax |  |
| movq %rax, %rsi |  |
| leaq \_ZSt4cout(%rip), %rdi |  |
| call \_ZNSolsEPFRSoS\_E@PLT |  |
| movq %rax, %rdx |  |
| movl -4(%rbp), %eax | Move contents of -4(%rbp) to %eax |
| movl %eax, %esi | Move contents of %eax to %esi |
| movq %rdx, %rdi |  |
| call \_ZNSolsEi@PLT |  |
| movl $0, %eax | Move contents of 0 to %eax |
| leave |  |
| .cfi\_def\_cfa 7, 8 |  |
| ret | Returns %eax |
| .cfi\_endproc |  |
| .LFE1493: | End of frame buffer |
| .size main, .-main |  |
| .type \_Z41\_\_static\_initialization\_and\_destruction\_0ii, @function |  |
| \_Z41\_\_static\_initialization\_and\_destruction\_0ii: |  |
| .LFB1979: |  |
| .cfi\_startproc |  |
| pushq %rbp |  |
| .cfi\_def\_cfa\_offset 16 |  |
| .cfi\_offset 6, -16 |  |
| movq %rsp, %rbp |  |
| .cfi\_def\_cfa\_register 6 |  |
| subq $16, %rsp |  |
| movl %edi, -4(%rbp) |  |
| movl %esi, -8(%rbp) |  |
| cmpl $1, -4(%rbp) |  |
| jne .L5 |  |
| cmpl $65535, -8(%rbp) |  |
| jne .L5 |  |
| leaq \_ZStL8\_\_ioinit(%rip), %rdi |  |
| call \_ZNSt8ios\_base4InitC1Ev@PLT |  |
| leaq \_\_dso\_handle(%rip), %rdx |  |
| leaq \_ZStL8\_\_ioinit(%rip), %rsi |  |
| movq \_ZNSt8ios\_base4InitD1Ev@GOTPCREL(%rip), %rax |  |
| movq %rax, %rdi |  |
| call \_\_cxa\_atexit@PLT |  |
| .L5: |  |
| nop |  |
| leave |  |
| .cfi\_def\_cfa 7, 8 |  |
| ret |  |
| .cfi\_endproc |  |
| .LFE1979: |  |
| .size \_Z41\_\_static\_initialization\_and\_destruction\_0ii, .-\_Z41\_\_static\_initialization\_and\_destruction\_0ii |  |
| .type \_GLOBAL\_\_sub\_I\_main, @function |  |
| \_GLOBAL\_\_sub\_I\_main: |  |
| .LFB1980: |  |
| .cfi\_startproc |  |
| pushq %rbp |  |
| .cfi\_def\_cfa\_offset 16 |  |
| .cfi\_offset 6, -16 |  |
| movq %rsp, %rbp |  |
| .cfi\_def\_cfa\_register 6 |  |
| movl $65535, %esi |  |
| movl $1, %edi |  |
| call \_Z41\_\_static\_initialization\_and\_destruction\_0ii |  |
| popq %rbp |  |
| .cfi\_def\_cfa 7, 8 |  |
| ret |  |
| .cfi\_endproc |  |
| .LFE1980: |  |
| .size \_GLOBAL\_\_sub\_I\_main, .-\_GLOBAL\_\_sub\_I\_main |  |
| .section .init\_array,"aw" |  |
| .align 8 |  |
| .quad \_GLOBAL\_\_sub\_I\_main |  |
| .hidden \_\_dso\_handle |  |
| .ident "GCC: (Ubuntu 7.5.0-3ubuntu1~18.04) 7.5.0" |  |
| .section .note.GNU-stack,"",@progbits |  |