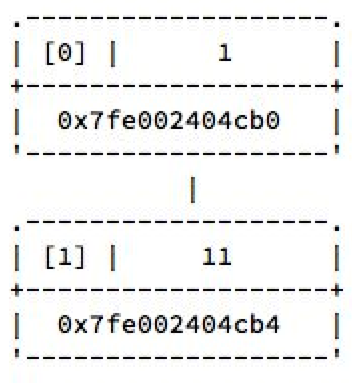
LW 9.1: Pass By Value

Objectives

- To understand that:
    - argument passing is similar to initialization,
    - when a function is called, each formal argument is *initialized* by its corresponding actual argument, and
    - when a variable is provided as a formal parameter, the corresponding actual argument's value will be copied into a local object of the called function.

Labwork

1. There are questions at the end of this document that you will respond to for credit.
2. Using Putty (PC) or terminal (Mac), log-in to `compute.cse.tamu.edu`
3. Create an empty directory for this labwork. In a terminal (e.g. PuTTY) navigate to this directory.
4. Download the source code into your directory from: https://drive.google.com/open?id=0B_ouNNuWgNZCc1lYMHhSUERVWU0
5. Verify you copied the file with the following command:
   `ls`
6. Compile using the following command:
   `g++-7.2.0 -std=c++17 -Wall -Wextra -pedantic -fsanitize=address,undefined *.cpp`
7. Inspect the source code. Use your editor of choice for files on the CSE servers.
    a. You will encounter four calls to a function that you haven't seen before, `vis::print`.
        i. This (i.e., `vis::print`) is a function whose implementation you need not be concerned about: This function `vis::print` to output the elements of a vector for you. (Written by Michael Nowak.)
        ii. For instance, when calling `vis::print(v)`, where `v` was defined as a `vector<int>` initialized with `{1,11}` (i.e., `vector<int> v = {1,11}`), the following output was generated:



```
.--------------------.
| [0] |      1       |
+--------------------+
|   0x7fe002404cb0   |
'--------------------'
          |
.--------------------.
| [1] |     11       |
+--------------------+
|   0x7fe002404cb4   |
'--------------------'
```

- The value of each element of the vector v is contained in its own box:

```
.--------------------.
| [0] |       1      |
+--------------------+
|   0x7fe002404cb0   |
'--------------------'
           |
```

  - On the first line of the box, the integer contained between the brackets (here, [0]) is the index of that respective element in the vector v:

```
.-------
| [0] |
+-------
```

  - Also on the first line of the box is the value stored at that index in the vector (here, 1):

```
--------------.
|      1      |
--------------+
```

  - The hexadecimal value shown on the second line of the box is the address in memory where that integer value is being stored (here, v.at(0); this will likely be ***different*** each time you run your program):

```
+--------------------+
|   0x7fa9b9500000   |
'--------------------'
```

b. On line 27, you will see that a vector<int> named vint, is initialized with four elements, {2, 4, 6, 8}.

c. On line 30, you will see that we use the vis::print function to print vint's contents after initialization.

d. On line 33, you will see the initialization of an object named half_sum of type int with the return value from vint_half_sum(vint).

   i. Note: the value used to initialize half_sum will be computed by that function call.

e. Jumping down to the definition of vint_half_sum on line 51, you'll see that when vint is provided to vint_half_sum as an actual argument. The corresponding formal argument vector<int> v will be initialized as an element-wise copy of vint.

   i. Here, we can essentially view this process as the occurrence of an implicit vector<int> v = vint; statement that is evaluated directly before the execution of the function body of vint_half_sum..

f. Therefore, from line 33, the formal argument of the function is initialized with the actual argument, and then the execution of the program continues from function body of vint_half_sum on line 53.

   i. On line 54, prints v using vis::print.

ii. From 55-62, calculates the “half sum” of `v`.

iii. On line 65, use `vis::print` to display the elements of `v` directly before returning the half-sum from the function.

iv. The return statement on line 66 returns a copy of the value stored in `sum`, which is used to initialize `half_sum`, the int object declared on line 33 in the main function.

g. On line 37, prints `vint` again using `vis::print` before returning from the program to the operating system.

8. Now that you understand what’s going on, compile the code and run it.
9. Carefully, observe the output printed to the screen and then answer the following questions in the fields provided:

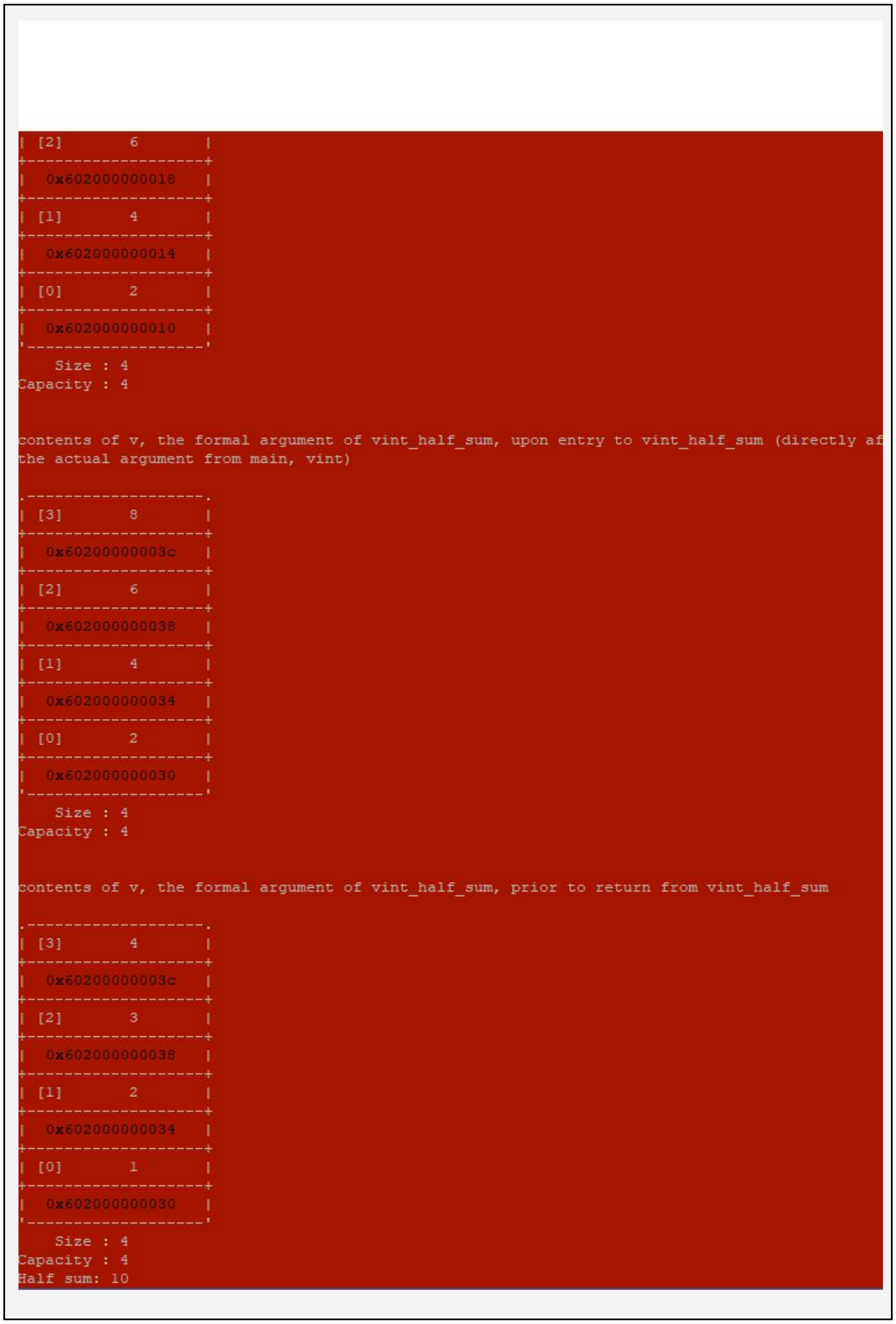
   a. Explain why the modification of `v` in `vint_half_sum` does not mutate (i.e. change) the actual argument `vint:`

   v is a copy of vint, and is not tied to vint in any way. They are two separate vectors that hold the same values.

   b. What information included in the output produced by the calls to `vis::print` in `main` with `vint` and in `vint_half_sum` supports your response to 8a?

   The memory addresses for each value in v and vint are different, and the values after vint_half_sum call are the same as before the vint_half_sum call.

   c. Capture the output written to the terminal window by this program in the form of a screenshot; if you cannot include everything, that’s okay. Drag and drop or paste your screenshot to the box below:



```
| [2]       6       |
+-------------------+
|  0x602000000018   |
+-------------------+
| [1]       4       |
+-------------------+
|  0x602000000014   |
+-------------------+
| [0]       2       |
+-------------------+
|  0x602000000010   |
'-------------------'
    Size : 4
Capacity : 4


contents of v, the formal argument of vint_half_sum, upon entry to vint_half_sum (directly af
the actual argument from main, vint)

.-------------------.
| [3]       8       |
+-------------------+
|  0x60200000003c   |
+-------------------+
| [2]       6       |
+-------------------+
|  0x602000000038   |
+-------------------+
| [1]       4       |
+-------------------+
|  0x602000000034   |
+-------------------+
| [0]       2       |
+-------------------+
|  0x602000000030   |
'-------------------'
    Size : 4
Capacity : 4


contents of v, the formal argument of vint_half_sum, prior to return from vint_half_sum

.-------------------.
| [3]       4       |
+-------------------+
|  0x60200000003c   |
+-------------------+
| [2]       3       |
+-------------------+
|  0x602000000038   |
+-------------------+
| [1]       2       |
+-------------------+
|  0x602000000034   |
+-------------------+
| [0]       1       |
+-------------------+
|  0x602000000030   |
'-------------------'
    Size : 4
Capacity : 4
Half sum: 10
```

Submission

- Save this completed labwork as a PDF [File -> Download As -> PDF Document (.pdf)] and submit to **Gradescope** for grading.