Activity No. 3	
Hands-on Activity 2.1 Arrays, Pointers and Dynamic Memory Allocation	
Course Code: CPE010	**Program:** Computer Engineering
Course Title: Data Structures and Algorithms	**Date Performed:** September 11, 2024
Section: CPE21S4	**Date Submitted:** September 13, 2024
Name(s): Don Eleazar T. Fernandez	**Instructor:** Maria Rizette Sayo

6. Output

Screenshot

main.cpp

```cpp
private:
std::string studentName;
int studentAge;

public:
//constructor
Student(std::string newName ="John Doe", int newAge=18){
studentName = std::move(newName);
studentAge = newAge;
std::cout << "Constructor Called." << std::endl;
};

//deconstructor
~Student(){
std::cout << "Destructor Called." << std::endl;
}
//Copy Constructor
Student(const Student &copyStudent){
std::cout << "Copy Constructor Called" << std::endl;
studentName = copyStudent.studentName;
studentAge = copyStudent.studentAge;
}
//Display Attributes
void printDetails(){
std::cout << this->studentName << " " << this->studentAge << std::endl;
}
};

int main() {
Student student1("Roman", 28);
Student student2(student1);
Student student3;
student3 = student2;
return 0;
}
```

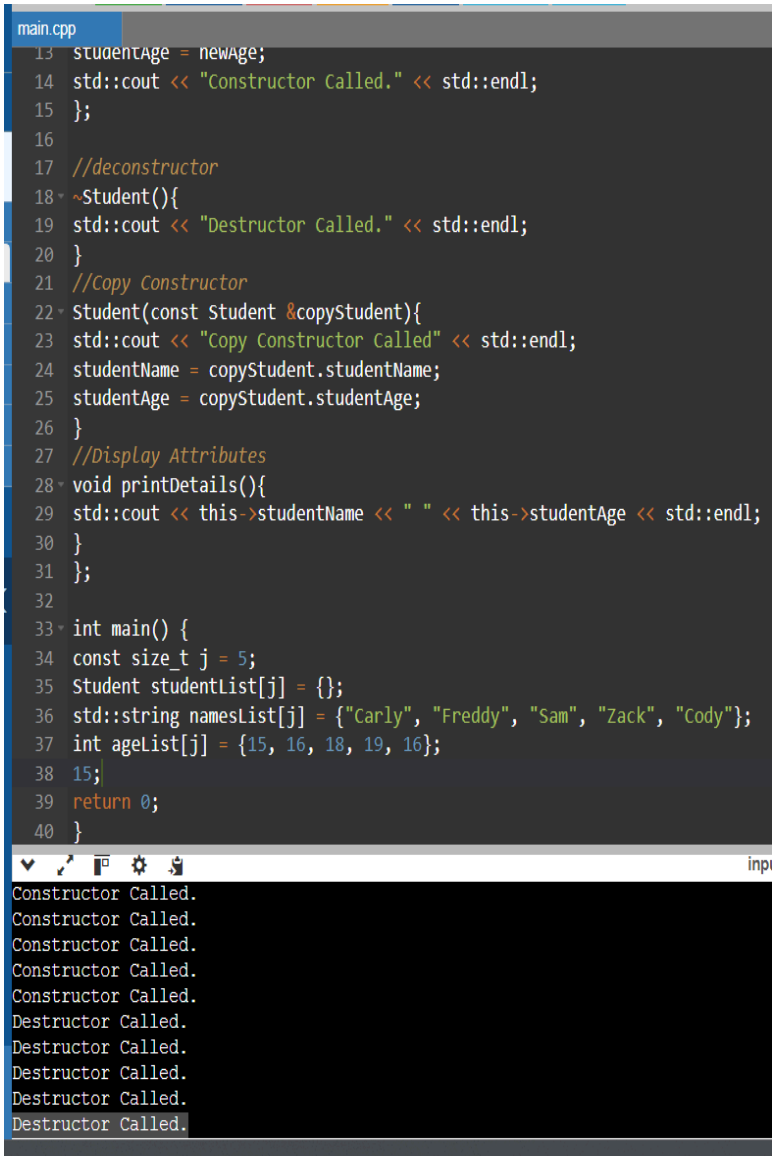
```
Constructor Called.
Copy Constructor Called
Constructor Called.
Destructor Called.
Destructor Called.
Destructor Called.


...Program finished with exit code 0
Press ENTER to exit console.
```

Observation

- The constructor initializes the object with the acquired input and passes it on to the parameters, while the deconstructor removes the object from the class. And the copy constructor actually creates an object by copying the existing object.

Table 2-1. Initial Driver Program

Screenshot	
Observation	- The output reveals that the constructor is called five times, once for each student. Five calls to the destructor demonstrate that each object has been cleaned up when the program finishes. This illustrates how constructors and destructors should be used when managing objects in an array.

```
main.cpp
13 studentAge = newAge;
14 std::cout << "Constructor Called." << std::endl;
15 };
16
17 //deconstructor
18 ~Student(){
19 std::cout << "Destructor Called." << std::endl;
20 }
21 //Copy Constructor
22 Student(const Student &copyStudent){
23 std::cout << "Copy Constructor Called" << std::endl;
24 studentName = copyStudent.studentName;
25 studentAge = copyStudent.studentAge;
26 }
27 //Display Attributes
28 void printDetails(){
29 std::cout << this->studentName << " " << this->studentAge << std::endl;
30 }
31 };
32
33 int main() {
34 const size_t j = 5;
35 Student studentList[j] = {};
36 std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
37 int ageList[j] = {15, 16, 18, 19, 16};
38 15;
39 return 0;
40 }
```

```
Constructor Called.
Constructor Called.
Constructor Called.
Constructor Called.
Constructor Called.
Destructor Called.
Destructor Called.
Destructor Called.
Destructor Called.
Destructor Called.
```

Table 2-2. Modified Driver Program with Student Lists

Loop A	Run Debug Stop Share Save {} Beautify
	main.cpp
	``cpp
	std::cout << "Constructor Called." << std::endl;
	};
	
	//deconstructor
	~Student(){
	std::cout << "Destructor Called." << std::endl;
	}
	//Copy Constructor
	Student(const Student &copyStudent){
	std::cout << "Copy Constructor Called" << std::endl;
	studentName = copyStudent.studentName;
	studentAge = copyStudent.studentAge;
	}
	//Display Attributes
	void printDetails(){
	std::cout << this->studentName << " " << this->studentAge << std::endl;
	}
	};
	
	int main() {
	const size_t j = 5;
	Student studentList[j] = {};
	std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
	int ageList[j] = {15, 16, 18, 19, 16};
	for(int i = 0; i < j; i++){ //Loop A
	Student *ptr = new Student(namesList[i], ageList[i]);
	studentList[i] = *ptr;
	}
	/*for(int i = 0; i < j; i++){ //loop B
	studentList[i].printDetails();
	}*/
	return 0;
	}
	``
	``
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Destructor Called.
	Destructor Called.
	Destructor Called.
	Destructor Called.
	Destructor Called.
	``
	Observation
	- In Loop A, the constructor is called five times. Though no delete operation was done, each object's memory was not deallocated which resulted in ten. This means that the memory was not released until the program's execution is complete, and the destructors only take effect for the studentList array objects.

Loop B	main.cpp
	``
	std::cout << "Constructor Called." << std::endl;
	};
	
	//deconstructor
	~Student(){
	std::cout << "Destructor Called." << std::endl;
	}
	//Copy Constructor
	Student(const Student &copyStudent){
	std::cout << "Copy Constructor Called" << std::endl;
	studentName = copyStudent.studentName;
	studentAge = copyStudent.studentAge;
	}
	//Display Attributes
	void printDetails(){
	std::cout << this->studentName << " " << this->studentAge << std::endl;
	}
	};
	
	int main() {
	const size_t j = 5;
	Student studentList[j] = {};
	std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
	int ageList[j] = {15, 16, 18, 19, 16};
	/*for(int i = 0; i < j; i++){ //loop A
	Student *ptr = new Student(namesList[i], ageList[i]);
	studentList[i] = *ptr;
	}*/
	for(int i = 0; i < j; i++){ //loop B
	studentList[i].printDetails();
	}
	return 0;
	}
	``
	``
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	John Doe 18
	John Doe 18
	John Doe 18
	John Doe 18
	John Doe 18
	Destructor Called.
	Destructor Called.
	Destructor Called.
	Destructor Called.
	Destructor Called.
	``
	Observation
	- An array of Student objects was formed in the main function, but there is a problem with student initialization, which causes all students to be printed as "John Doe" rather than by their own names.

Output	main.cpp
	``
	~Student(){
	std::cout << "Destructor Called." << std::endl;
	}
	//Copy Constructor
	Student(const Student &copyStudent){
	std::cout << "Copy Constructor Called" << std::endl;
	studentName = copyStudent.studentName;
	studentAge = copyStudent.studentAge;
	}
	//Display Attributes
	void printDetails(){
	std::cout << this->studentName << " " << this->studentAge << std::endl;
	}
	};
	
	int main() {
	const size_t j = 5;
	Student studentList[j] = {};
	std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
	int ageList[j] = {15, 16, 18, 19, 16};
	for(int i = 0; i < j; i++){ //loop A
	Student *ptr = new Student(namesList[i], ageList[i]);
	studentList[i] = *ptr;
	}
	for(int i = 0; i < j; i++){ //loop B
	studentList[i].printDetails();
	}
	return 0;
	}
	``
	``
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Constructor Called.
	Carly 15
	Freddy 16
	Sam 18
	Zack 19
	Cody 16
	Destructor Called.
	Destructor Called.
	Destructor Called.
	Destructor Called.
	Destructor Called.
	``
	Table 2-3. Final Driver Program

Observation	- The earlier problem was addressed this time, which properly initializes and shows the name and age of each student. The object initialization and cleanup were successful.

Modification	```
	for(int i = 0; i < j; i++){ //loop A
	Student *ptr = new Student(namesList[i], ageList[i]);
	studentList[i] = *ptr;
	}
	for(int i = 0; i < j; i++){ //loop B
	studentList[i].printDetails();
	}
	``
	Table 2-4. Modifications/Corrections Necessary

Observation	- The program ensures the initialization of the studentList in Loop A. Only the initialized data from the studentList is read by Loop B. In short, Loop B handles data output while Loop A handles object construction.

7. Supplementary Activity

```
#include <iomanip>
#include <iostream>
#include <vector>
#include <string>
using namespace std;

class GroceryItem {
private:
    string name;
    int price;
    int quantity;

public:
    // The constructor
    GroceryItem(const string & name, int price, int quantity)
        : name(name), price(price), quantity(quantity) {}

    // The destructor
    virtual ~GroceryItem() {}

    // The copy constructor
    GroceryItem(const GroceryItem & other)
        : name(other.name), price(other.price), quantity(other.quantity) {}

    // The copy assignment operator
    GroceryItem & operator = (const GroceryItem & other) {
        if (this != &other) {
            name = other.name;
            price = other.price;
            quantity = other.quantity;
        }
        return *this;
    }

    int calculateSum() const {
        return price * quantity;
    }

    void display() const {
        cout << left << setw(10) << name << "PHP " << setw(4) << price << "x" << setw(2) << quantity << endl;
    }

    const string & getName() const {
        return name;
    }
};

// Class for Fruit
class Fruit : public GroceryItem {
public:
    Fruit(const string & name, int price, int quantity)
```

```
        : GroceryItem(name, price, quantity) {}

    ~Fruit() {}
};

// Class for Vegetable
class Vegetable : public GroceryItem {
public:
    Vegetable(const string & name, int price, int quantity)
        : GroceryItem(name, price, quantity) {}

    ~Vegetable() {}
};

// Function to display all items in the list
void displayGroceryList(const vector <GroceryItem*> & groceryList) {
    for (const auto & item : groceryList) {
        item -> display();
    }
}

// Function to calculate the total sum of all items in the list
int totalSum(const vector <GroceryItem*> & groceryList) {
    int sum = 0;
    for (const auto & item : groceryList) {
        sum += item -> calculateSum();
    }
    return sum;
}

// Function to delete an item from the list
void deleteItem(vector <GroceryItem*> & groceryList, const string& itemName) {
    for (auto it = groceryList.begin(); it != groceryList.end(); ++it) {
        if ((*it) -> getName() == itemName) {
            delete *it;
            groceryList.erase(it);
            break;
        }
    }
}

int main() {
    // Problem 2: Create an array GroceryList
    vector <GroceryItem*> groceryList = {
        new Fruit("Apple", 10, 7),
        new Fruit("Banana", 10, 8),
        new Vegetable("Broccoli", 60, 12),
        new Vegetable("Lettuce", 50, 10)
    };
    cout << "Grocery List:\n";
    displayGroceryList(groceryList);
```

```
    // Problem 3: Calculate the total sum
    cout << "\nTotal Sum: PHP " << totalSum(groceryList) << endl;

    // Problem 4: Delete Lettuce and deallocate memory
    deleteItem(groceryList, "Lettuce");
    cout << "\nGrocery List (After the deletion of Lettuce):\n";
    displayGroceryList(groceryList);
    cout << "\nTotal Sum: PHP " << totalSum(groceryList) << endl;
    for (auto & item : groceryList) {
        delete item;
    }

    return 0;
}
```

8. Conclusion

The activity has discussed the destructor, copy constructor, and copy assignment operator, which developed the use of classes in C++ and furthered the functionality. The task on the procedure was easy for me to perform and understand as everything was laid out. Contrary to the supplementary activity, it was complex to dissect at first, where different constructors were required. The activity gave me the realization that I performed it quite unwell, as I was confused on how I would do it.

9. Assessment Rubric

Table 2 - 1:

```
#include <iostream>

#include <string.h>


class Student{

private:

std::string studentName;

int studentAge;


public:

//constructor

Student(std::string newName ="John Doe", int newAge=18){

studentName = std::move(newName);

studentAge = newAge;

std::cout << "Constructor Called." << std::endl;

};
```

```
//deconstructor
~Student(){
std::cout << "Destructor Called." << std::endl;
}
//Copy Constructor
Student(const Student &copyStudent){
std::cout << "Copy Constructor Called" << std::endl;
studentName = copyStudent.studentName;
studentAge = copyStudent.studentAge;
}
//Display Attributes
void printDetails(){
std::cout << this->studentName << " " << this->studentAge << std::endl;
}
};

int main() {
Student student1("Roman", 28);
Student student2(student1);
Student student3;
student3 = student2;
return 0;
}
```

Table 2 - 2:

```
#include <iostream>
#include <string.h>

class Student{
private:
std::string studentName;
int studentAge;
```

```
public:
//constructor
Student(std::string newName ="John Doe", int newAge=18){
studentName = std::move(newName);
studentAge = newAge;
std::cout << "Constructor Called." << std::endl;
};

//deconstructor
~Student(){
std::cout << "Destructor Called." << std::endl;
}
//Copy Constructor
Student(const Student &copyStudent){
std::cout << "Copy Constructor Called" << std::endl;
studentName = copyStudent.studentName;
studentAge = copyStudent.studentAge;
}
//Display Attributes
void printDetails(){
std::cout << this->studentName << " " << this->studentAge << std::endl;
}
};

int main() {
const size_t j = 5;
Student studentList[j] = {};
std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
int ageList[j] = {15, 16, 18, 19, 16};
15;
return 0;
}
```

Table 2 - 3:

```
#include <iostream>
#include <string.h>

class Student{
private:
std::string studentName;
int studentAge;

public:
//constructor
Student(std::string newName ="John Doe", int newAge=18){
studentName = std::move(newName);
studentAge = newAge;
std::cout << "Constructor Called." << std::endl;
};

//deconstructor
~Student(){
std::cout << "Destructor Called." << std::endl;
}
//Copy Constructor
Student(const Student &copyStudent){
std::cout << "Copy Constructor Called" << std::endl;
studentName = copyStudent.studentName;
studentAge = copyStudent.studentAge;
}
//Display Attributes
void printDetails(){
std::cout << this->studentName << " " << this->studentAge << std::endl;
}
};
```

```
int main() {
const size_t j = 5;
Student studentList[j] = {};
std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
int ageList[j] = {15, 16, 18, 19, 16};
for(int i = 0; i < j; i++){ //loop A
Student *ptr = new Student(namesList[i], ageList[i]);
studentList[i] = *ptr;
}
for(int i = 0; i < j; i++){ //loop B
studentList[i].printDetails();
}
return 0;
}
```

Table 2 - 3 (Loop A):

```
#include <iostream>
#include <string.h>

class Student{
private:
std::string studentName;
int studentAge;

public:
//constructor
Student(std::string newName ="John Doe", int newAge=18){
studentName = std::move(newName);
studentAge = newAge;
std::cout << "Constructor Called." << std::endl;
};

//deconstructor
```

```
~Student(){
std::cout << "Destructor Called." << std::endl;
}
//Copy Constructor
Student(const Student &copyStudent){
std::cout << "Copy Constructor Called" << std::endl;
studentName = copyStudent.studentName;
studentAge = copyStudent.studentAge;
}
//Display Attributes
void printDetails(){
std::cout << this->studentName << " " << this->studentAge << std::endl;
}
};

int main() {
const size_t j = 5;
Student studentList[j] = {};
std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
int ageList[j] = {15, 16, 18, 19, 16};
for(int i = 0; i < j; i++){ //loop A
Student *ptr = new Student(namesList[i], ageList[i]);
studentList[i] = *ptr;
}
/*for(int i = 0; i < j; i++){ //loop B
studentList[i].printDetails();
}*/
return 0;
}
```

Table 2 - 3 (Loop B):

```
#include <iostream>
#include <string.h>
```

```
class Student{
private:
std::string studentName;
int studentAge;

public:
//constructor
Student(std::string newName ="John Doe", int newAge=18){
studentName = std::move(newName);
studentAge = newAge;
std::cout << "Constructor Called." << std::endl;
};

//deconstructor
~Student(){
std::cout << "Destructor Called." << std::endl;
}
//Copy Constructor
Student(const Student &copyStudent){
std::cout << "Copy Constructor Called" << std::endl;
studentName = copyStudent.studentName;
studentAge = copyStudent.studentAge;
}
//Display Attributes
void printDetails(){
std::cout << this->studentName << " " << this->studentAge << std::endl;
}
};

int main() {
const size_t j = 5;
Student studentList[j] = {};
```

```
std::string namesList[j] = {"Carly", "Freddy", "Sam", "Zack", "Cody"};
int ageList[j] = {15, 16, 18, 19, 16};
/*for(int i = 0; i < j; i++){ //loop A
Student *ptr = new Student(namesList[i], ageList[i]);
studentList[i] = *ptr;
}*/
for(int i = 0; i < j; i++){ //loop B
studentList[i].printDetails();
}
return 0;
}
```

Supplementary Activity:

```
#include <iomanip>
#include <iostream>
#include <vector>
#include <string>
using namespace std;

class GroceryItem {
private:
    string name;
    int price;
    int quantity;

public:
    // The constructor
    GroceryItem(const string & name, int price, int quantity)
        : name(name), price(price), quantity(quantity) {}

    // The destructor
    virtual ~GroceryItem() {}
```

```
    // The copy constructor
    GroceryItem(const GroceryItem & other)
        : name(other.name), price(other.price), quantity(other.quantity) {}

    // The copy assignment operator
    GroceryItem & operator = (const GroceryItem & other) {
        if (this != &other) {
            name = other.name;
            price = other.price;
            quantity = other.quantity;
        }
        return *this;
    }

    int calculateSum() const {
        return price * quantity;
    }

    void display() const {
        cout << left << setw(10) << name << "PHP " << setw(4) << price << "x" << setw(2) << quantity << endl;
    }

    const string & getName() const {
        return name;
    }
};

// Class for Fruit
class Fruit : public GroceryItem {
public:
    Fruit(const string & name, int price, int quantity)
        : GroceryItem(name, price, quantity) {}
```

```
    ~Fruit() {}
};

// Class for Vegetable
class Vegetable : public GroceryItem {
public:
    Vegetable(const string & name, int price, int quantity)
        : GroceryItem(name, price, quantity) {}

    ~Vegetable() {}
};

// Function to display all items in the list
void displayGroceryList(const vector <GroceryItem*> & groceryList) {
    for (const auto & item : groceryList) {
        item -> display();
    }
}

// Function to calculate the total sum of all items in the list
int totalSum(const vector <GroceryItem*> & groceryList) {
    int sum = 0;
    for (const auto & item : groceryList) {
        sum += item -> calculateSum();
    }
    return sum;
}

// Function to delete an item from the list
void deleteItem(vector <GroceryItem*> & groceryList, const string& itemName) {
    for (auto it = groceryList.begin(); it != groceryList.end(); ++it) {
        if ((*it) -> getName() == itemName) {
            delete *it;
```

```
            groceryList.erase(it);
            break;
        }
    }
}

int main() {
    // Problem 2: Create an array GroceryList
    vector <GroceryItem*> groceryList = {
        new Fruit("Apple", 10, 7),
        new Fruit("Banana", 10, 8),
        new Vegetable("Broccoli", 60, 12),
        new Vegetable("Lettuce", 50, 10)
    };
    cout << "Grocery List:\n";
    displayGroceryList(groceryList);

    // Problem 3: Calculate the total sum
    cout << "\nTotal Sum: PHP " << totalSum(groceryList) << endl;

    // Problem 4: Delete Lettuce and deallocate memory
    deleteItem(groceryList, "Lettuce");
    cout << "\nGrocery List (After the deletion of Lettuce):\n";
    displayGroceryList(groceryList);
    cout << "\nTotal Sum: PHP " << totalSum(groceryList) << endl;
    for (auto & item : groceryList) {
        delete item;
    }
    return 0;
}
```