C++: copy, assign, convert

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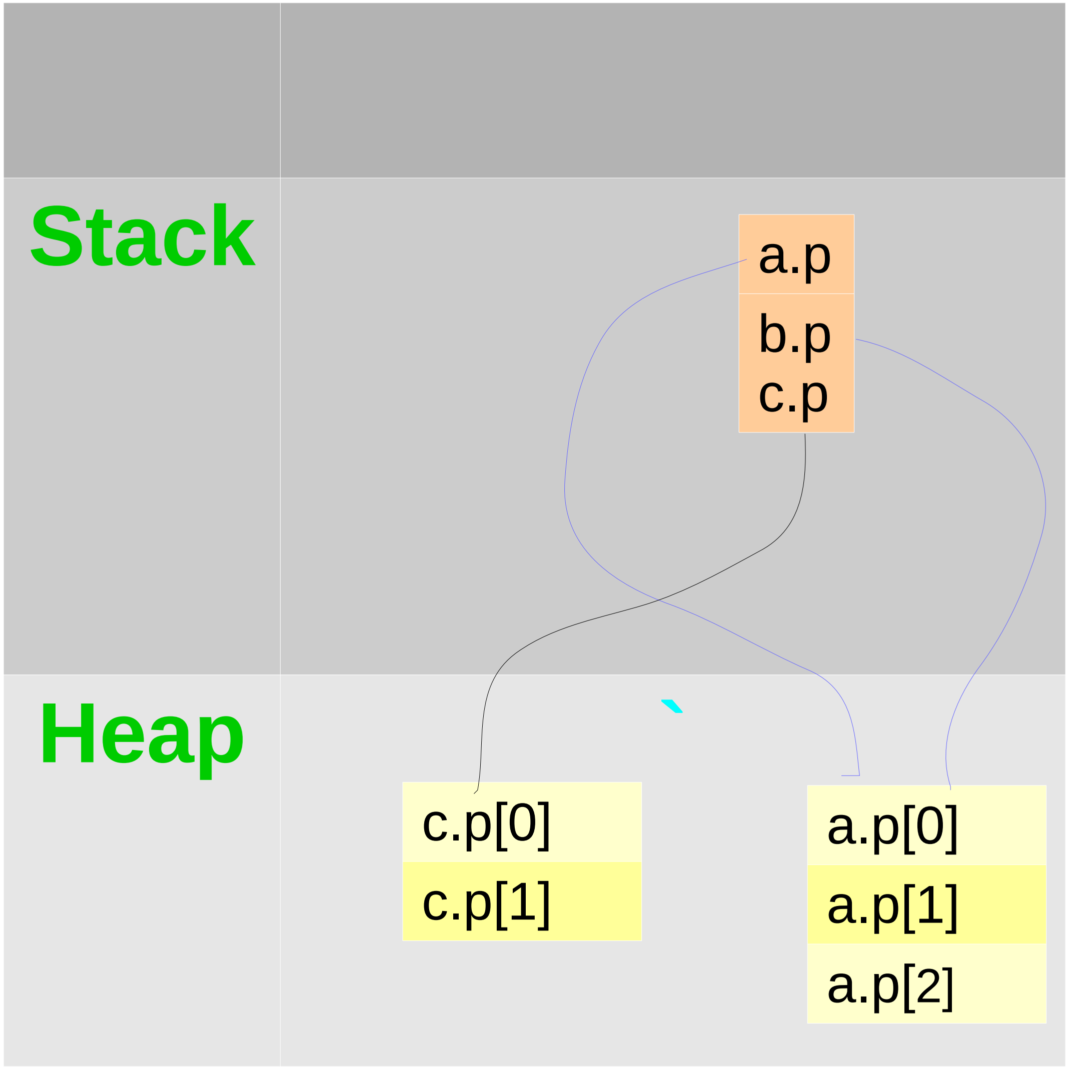
Shallow vs. Deep Copy *(folder 1)*

```
class IntList {
  int* p;
public:
  IntList(uint n):
    p(new int[n]) {  }
  ~IntList() {
    delete[] p;  }
};

int main() {
  IntList a(3);
  IntList b=a;
  IntList c(2);
}
```



Stack

a.p

b.p

c.p

Heap

c.p[0]

c.p[1]

a.p[0]

a.p[1]

a.p[2]

Shallow vs. Deep Copy

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int main() {
  IntList a(3);
  IntList b=a;
  IntList c(2); c=a;
}
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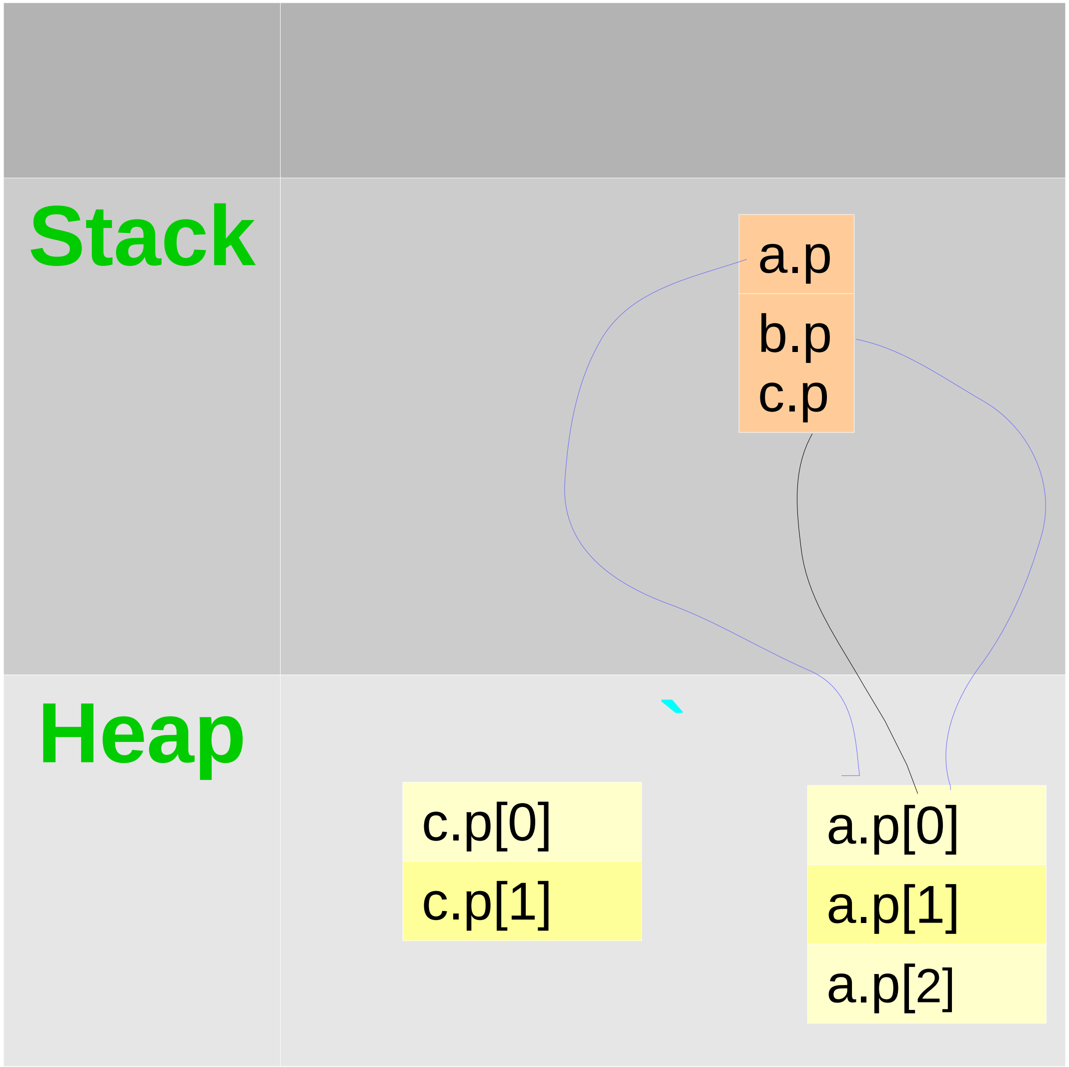

Stack

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Copying

An object is copied when:

1. Constructing new object from existing;
2. Passing parameter by value;
3. Returning by value;
4. Assigning existing to existing.

Cases 1-3 are handled by

copy constructor;

Case 4 is handled by

assignment operator.

By default, both do **shallow copy**.

Rule of Three

A rule of thumb:

- When you need to make a deep copy of an object, you need to define all of these:
  1. Copy constructor
  2. Destructor
  3. Operator =
- Or in other words:

  when you need one, you need all.

A skeleton for deep copy (folder 1)

```
// Copy constructor
A (const A& other) : init {
    copy_other(other);
}
```

```
// Destructor
~A() {
    clear();
}
```

```
// Operator =
A& operator=(const A& other) {
    if (this!=&other) { // preventing problems in a=a
      clear(); init // or recycle
      copy_other(other);
    } return *this; } // allows a= b= c= …
```

Conversions of types

done in two cases:

1. Explicit casting;
2. When a function gets **X** type while it was expecting to get **Y** type, and there is a casting from **X** to **Y**:

```
void foo(Y y)
...
X x;
foo(x); // a conversion from X to Y is done
```

User defined conversion (folders 5,6)

```
class Fraction {
    ...
    // double --> Fraction conversion
    Fraction (const double& d) {
        ...
    }
    ...
    // Fraction --> double conversion
    operator double() const {
        ...
    }
```

Conversions danger: unexpected behavior

```
Vector(size_t length) // ctor
…
int sum(const Vector& v) // function
...
int i=3;
sum(i); // Equivalent to: sum(Vector(i))
// Did the user really wanted this?
```

The Vector and the size_t objects are not logically the same objects!

The `explicit` keyword (folder 4)

```
explicit Vector(size_t length) // ctor
…
int sum(const Vector& v) // function
...
int i=3;
sum(i); // Won’t compile
```