C++ BIG THREE

Problem Solving with Computers-II

Read the syllabus. Know what's required. Know how to get help.

Today's learning goals:

We want to understand the what, why, and how of the Big Three:

- Destructor
- Copy constructor
- Copy assignment operator

→ special functions

C++ compiler generates default versions

Constructor and Destructor

Every class has the following special methods:

- Constructor: Called right AFTER an object is created in memory
- Destructor: Called right BEFORE an object is deleted from memory

The compiler automatically generates default versions, but you can provide user-defined implementations

```
void foo(){
    Complex p(1, 2);
    Complex *q = new Complex(3, 4);
}
```

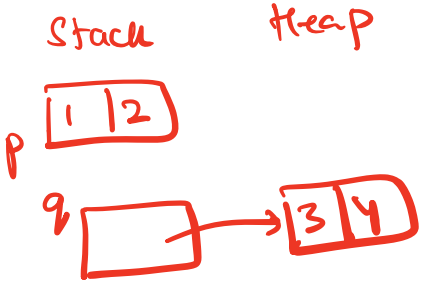
What is the output?

A. 1 + 2j

B. 3 + 4j

C. 1 + 2j
3 + 4j

D. None of the above




```
class Complex
{
private:
    double real;
    double imag;
public:
    Complex(double re = 0, double im = 0);
    ~Complex(){ print();}
    double getMagnitude() const;
    double getReal() const;
    double getImaginary() const;
    void print() const;
    void conjugate();
    void setReal(double r);
    void setImag(double r);
};
```

Copy constructor

- Parameterized constructor whose first argument is a class object
- Default behavior: **initializes a (new) object using an existing object**

Usage: `Complex c(x);`

Declaration: `Complex(const Complex& other);`

In which of the following cases is the copy constructor called?

```
A.  Complex p1;
    Complex p2(1, 2);

B.  Complex p1(1, 2);
    Complex p2(p1);

C.  Complex *p1 = new Complex(1, 2);
    Complex p2 = *p1;

D.  B&C
E.  A, B & C
```

// calls copy constructor

Complex p2(*p1);

Complex p2;
p2 = *p1;
copy assignment

Copy assignment (operator=)

- For existing objects x, y, this statement calls the operator= function:

  x = y;

- Default behavior: Copies the member variables of rhs object (y) to lhs object (x)

```
Complex x(1, 2);
Complex y;
y = x; // function call!
cout << y;
```

1 + 2j

Operator = ( ) is called

Aside:
Different ways of storing an array in a class.

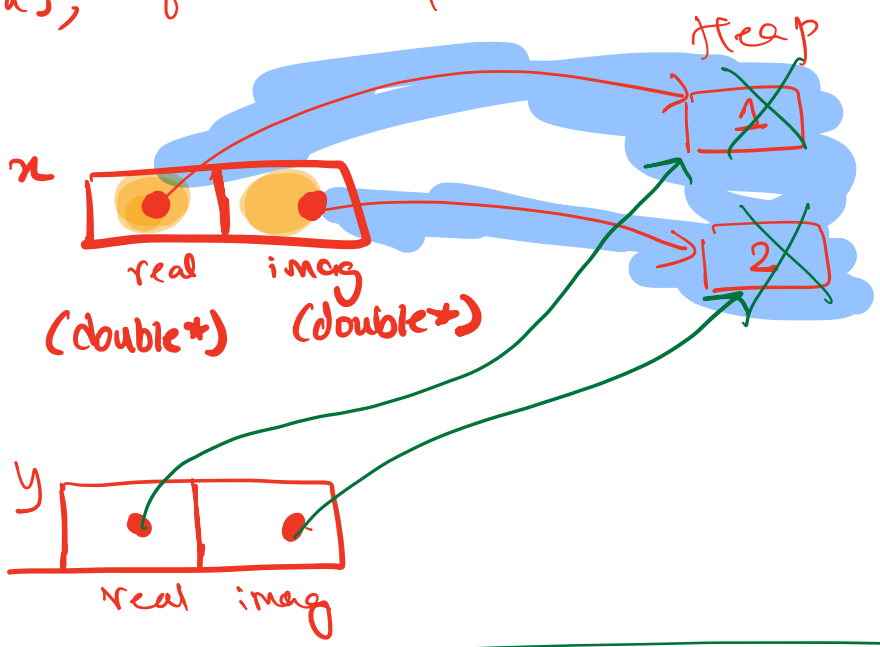
class A {
private:
① int arr[10];
② int *arr;
}

```
double foo(Complex p){
    return p.getMagnitude();
}
int main(){
     Complex q(1, 2);
     foo(q);
}
```

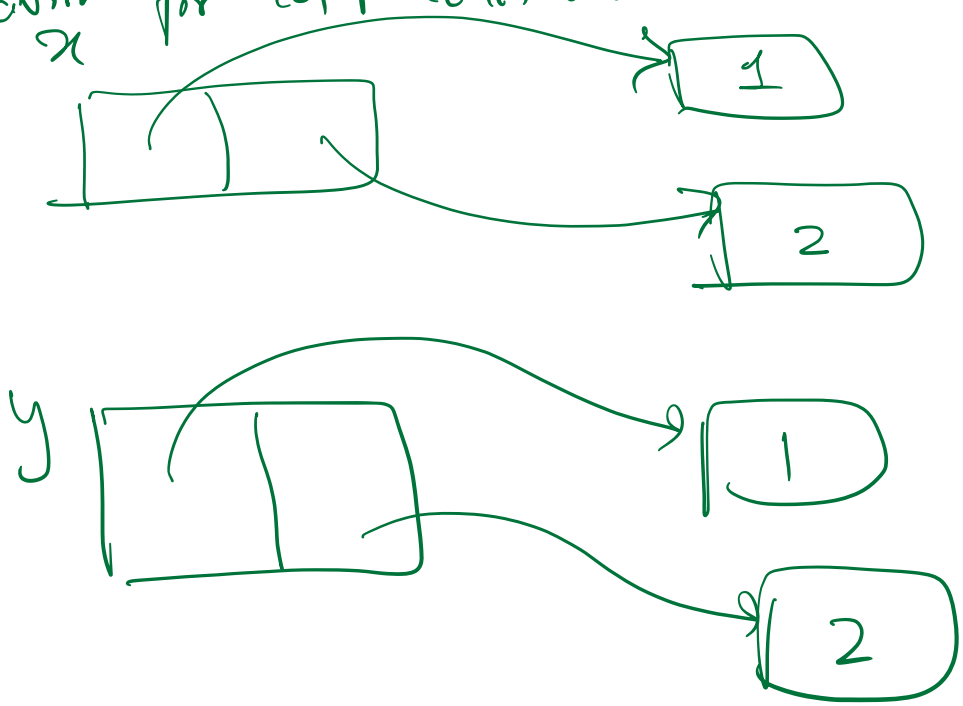
Which special method(s) is/are called as a result of calling `foo()`?

A. Parameterized constructor with integer parameters
B. Destructor
C. Copy constructor
D. Copy assignment
E. All of the above

Complex y(x); If we use default implementation of copy constructor



Desired behaviour for copy constructor



Constant pointers and pointers to constants

```
const char* p1;
char* const p2;
const char* const p3;
```

Summary

- Classes have member variables and member functions (method). An object is a variable where the data type is a class.
- You should know how to declare a new class type, how to implement its member functions, how to use the class type.
- Frequently, the member functions of an class type place information in the member variables, or use information that's already in the member variables.
- New functionality may be added using non-member functions, friend functions, and operator overloading
- If a class allocates data on the heap, then a user-defined destructor must be implemented to perform a clean-up procedure (de-allocate heap memory)

Next time

- Linked Lists and the rule of three