OPERATOR OVERLOADING RULE OF THREE

Problem Solving with Computers-II

Will this code compile?

```
int main(){
  Complex p;
  p.conjugate();
  p.print();
}
```

A. Yes
B. No
C. I am not sure . . .

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

Will this code compile?

```
int main(){
  Complex p;
  Complex w(1, 2);
  p = w;
  p.conjugate();
  p.print();
}
```

A. Yes
B. No
C. I am not sure . . .

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

Will this code compile?

```
int main(){
  Complex p;
  Complex w(1, 2);
  p = w;
  p.conjugate();
  p.print();
}
```

A. Yes
B. No
C. I am not sure . . .

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

Operator Overloading

We would like to be able to perform operations on two objects of the class using the following operators:

<<

==

!=

+

-

and possibly others

Handout activity 1A

```
cout << w;
```

Select the equivalent function call:

```
w.operator<<(cout);
```

A

```
cout.operator<<(w);
```

B

```
operator<<(cout, w);
```

C

Overloading the << operator

```
int main(){
  Complex w(10, -5);
  w.conjugate();
  w.print();
}
```

```
int main(){
  Complex w(10, -5);
  w.conjugate();
  cout << w;
}
```

```
Before overloading the << operator
```

```
After overloading the << operator
```

```
operator<<(cout, w);
```

Select the function declaration that matches the above call

A
```
void operator<<(ostream &out,
                const Complex &c);
```

B
```
void Complex::operator<<(ostream &out);
```

Overloading the + operator

```
p = q + w;
```

Goal: We want to apply the + operator to Complex type objects

New method: add()

```
int main(){
  Complex p;
  Complex q(2, 3);
  Complex w(10, -5);
  p = _______________;
  p.print();
}
```

Approach 1

```
int main(){
  Complex p;
  Complex q(2, 3);
  Complex w(10, -5);
  p = _______________;
  p.print()
}
```

Approach 2

New method: add()

```
int main(){
  Complex p;
  Complex q(2, 3);
  Complex w(10, -5);
  p = add(q, w);
  p.print();
}
```

Approach 1

```
int main(){
  Complex p;
  Complex q(2, 3);
  Complex w(10, -5);
  p = q.add(w);
  p.print()
}
```

Approach 2

Overloading the + operator for Complex objects

```
p = add(q, w);
```

```
p = q.add(w);
```

```
p = q + w;
```

Goal: We want to apply the + operator to Complex type objects

Handout Activity 1B:

Implement operator+ for Complex objects as a non-member function

```
Complex operator+(const Complex& lhs, const Complex& rhs) {
    // YOUR CODE:




}
```

Overloading Operators for IntList

In lab01 you will overload operators for the IntList ADT

==

!=

+ (list concatenation)

<< (overloaded stream operation to print the sequence)

RULE OF THREE

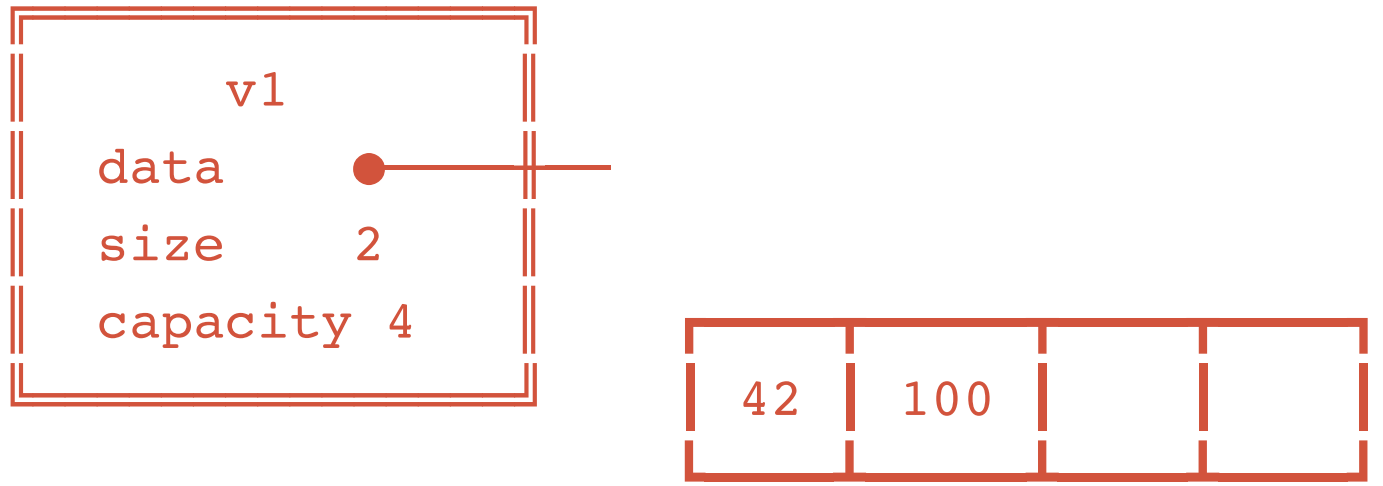
If a class defines one (or more) of the following it should probably explicitly define all three:

1. Destructor
2. Copy constructor
3. Copy assignment

THE CODE:

```
CustomVector v1;
v1.push_back(42);
v1.push_back(100);
```

MEMORY AFTER v1.push_back(100):



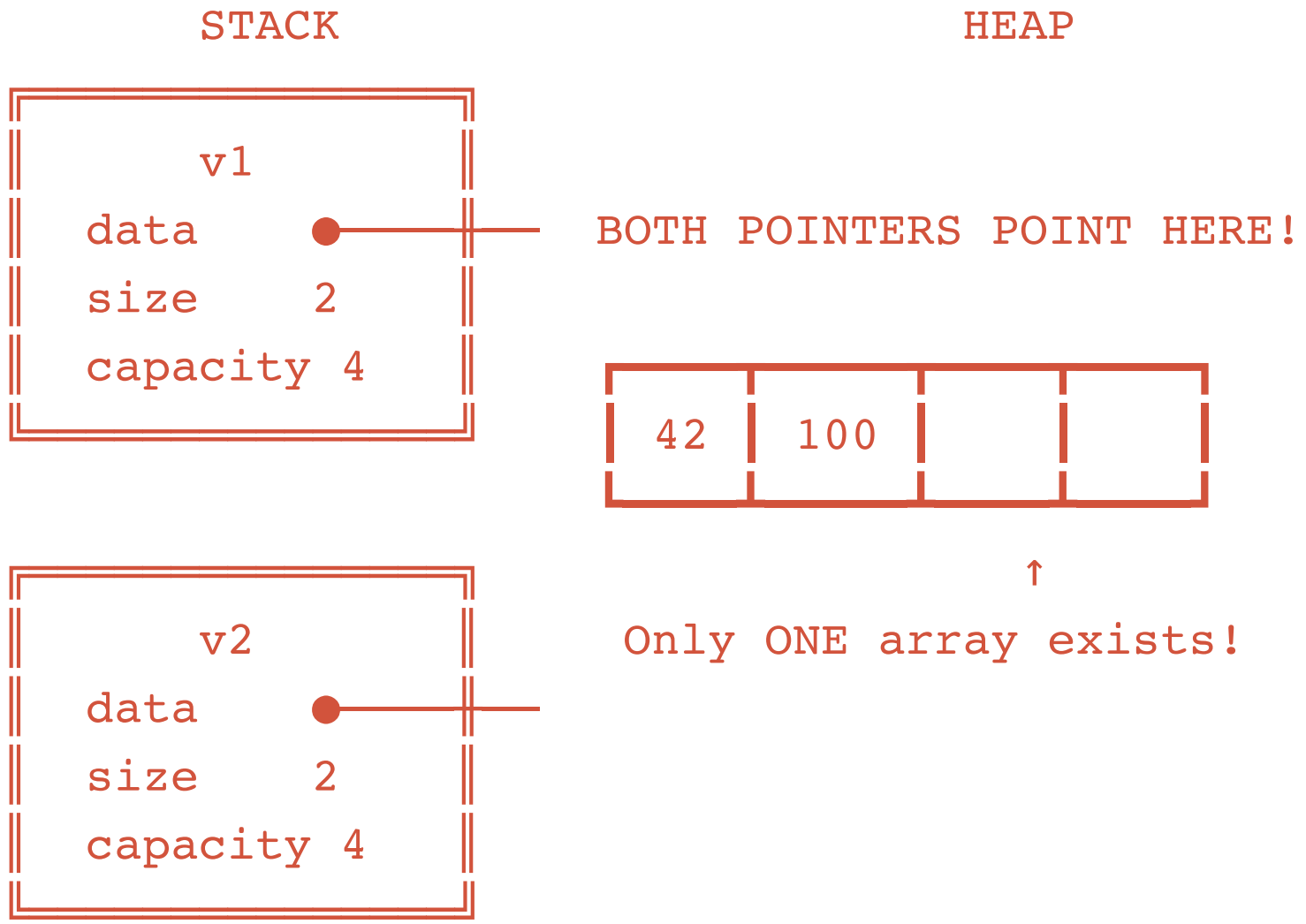
THE PROBLEM: SHALLOW COPY WITH DYNAMIC MEMORY

THE CODE:

```
CustomVector v1;
v1.push_back(42);
v1.push_back(100);
CustomVector v2 = v1;
```

Default copy = SHALLOW
Copies pointers,
NOT the data!

MEMORY AFTER v2 = v1:



THE PROBLEM: SHALLOW COPY WITH DYNAMIC MEMORY

WHEN BOTH GO OUT OF SCOPE:

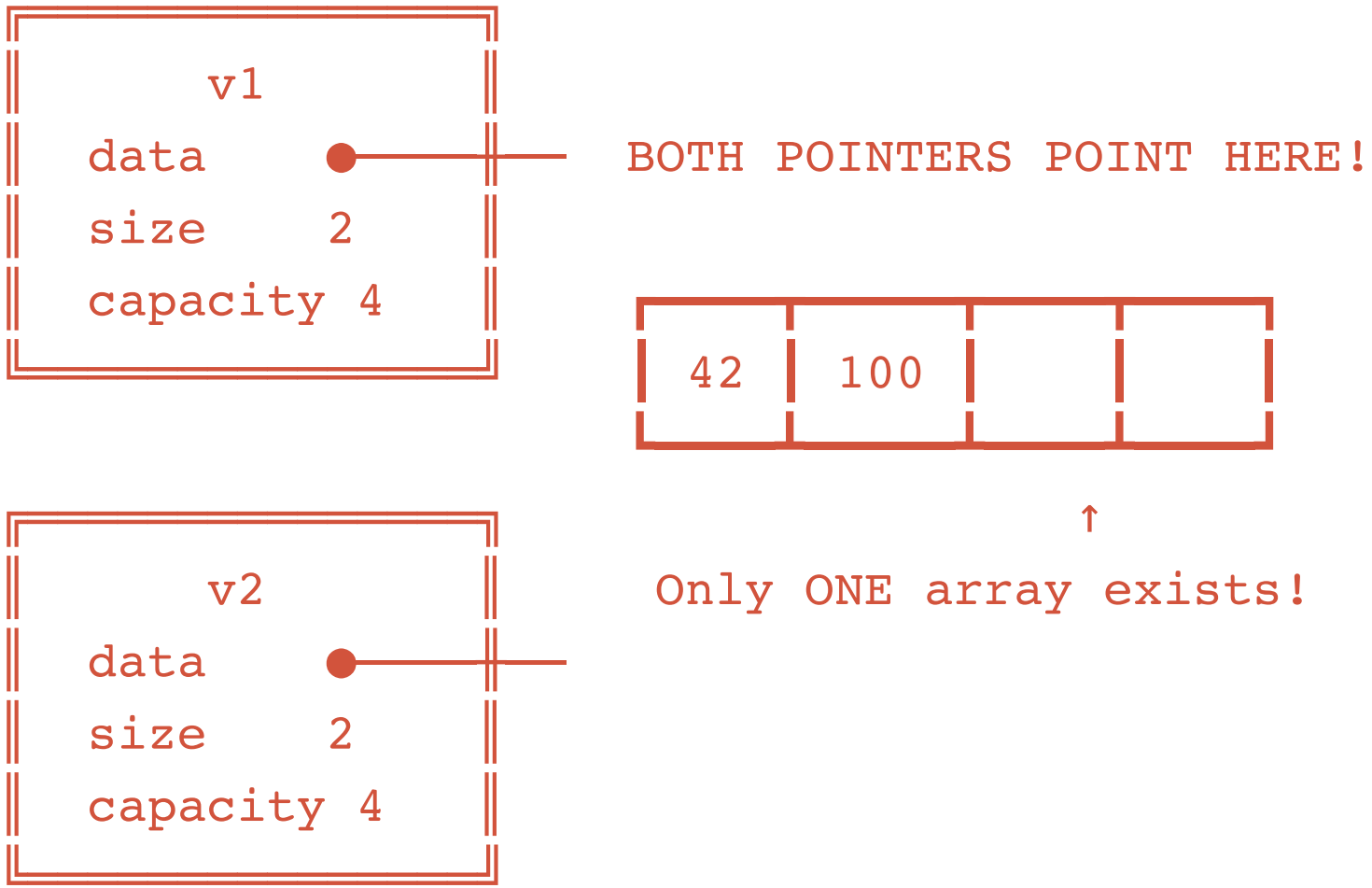
Step 1: v2's destructor runs → delete[] data; ✓
Frees the array

Step 2: v1's destructor runs → delete[] data; ✗
CRASH!

Already freed!

⚠ DOUBLE DELETION = UNDEFINED BEHAVIOR
(crash or corruption)

MEMORY AFTER v2 = v1:



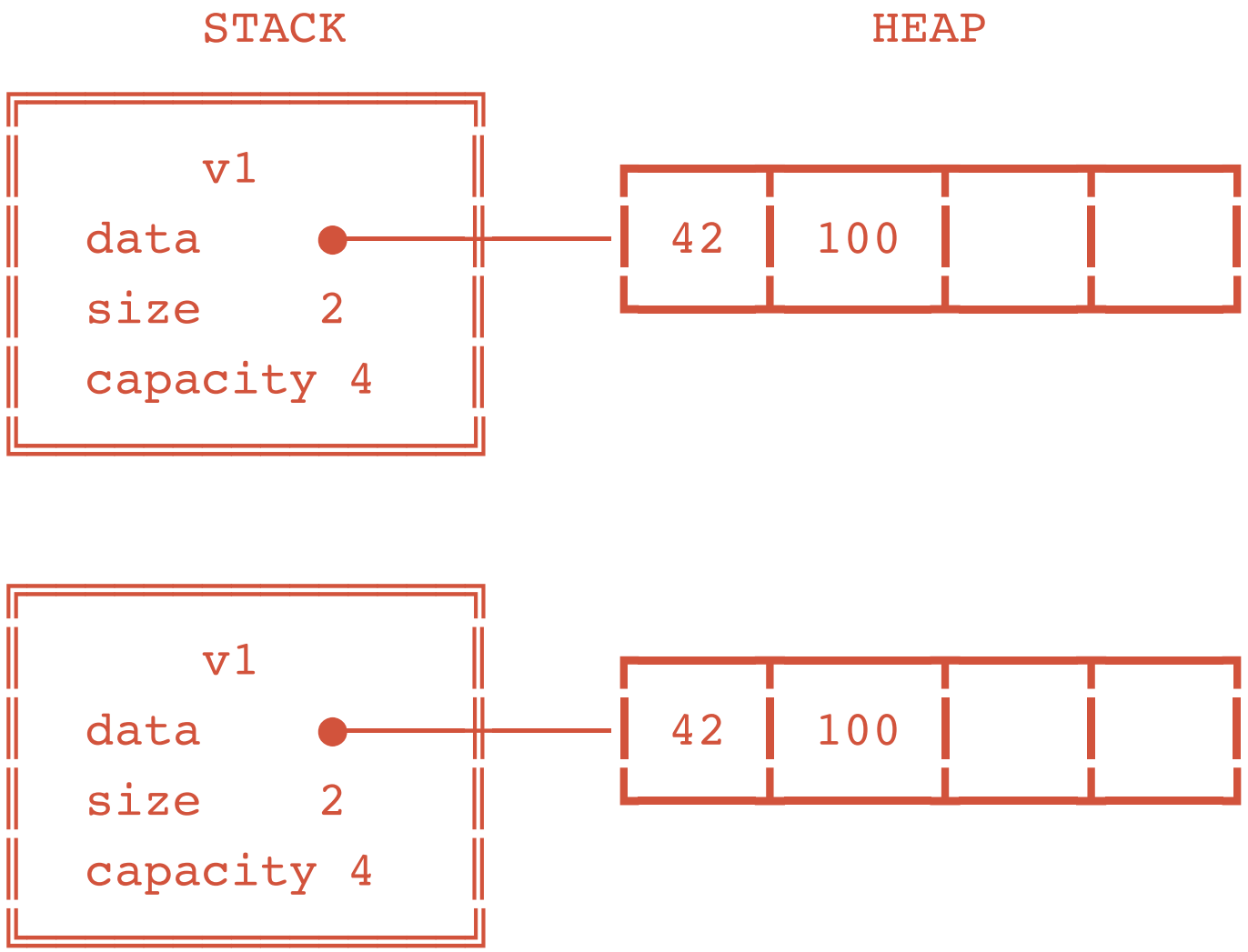
THE PROBLEM: SHALLOW COPY WITH DYNAMIC MEMORY

THE SOLUTION:

THE BIG THREE:
1. Destructor
2. Copy Constructor
3. Copy Assignment

(Deep copy needed!)

MEMORY AFTER v2 = v1:



Handout Activity Part 3:

Now apply the Rule of Three to CustomList!

This is in preparation for the upcoming lab