CONTAINER CLASSES

Problem Solving with Computers-II

https://ucsb-cs24-sp17.github.io/

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

CLICKERS OUT – FREQUENCY AB

Container Classes

- A **container class** is a data type that is capable of holding a collection of items.
- In C++, container classes can be implemented as a class, along with member functions to add, remove, and examine items.

Bags

- For the first example, think about a bag.

Bags

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- Inside the bag are some numbers.

Initial State of a Bag

- When you first begin to use a bag, the bag will be empty.
- We count on this to be the **initial state** of any bag that we use.

What questions should we ask to define the bag container class?

Defining the bag container class

- What questions should we ask to help define the bag container class?
- What can a user do with a bag of numbers

Inserting Numbers into a Bag

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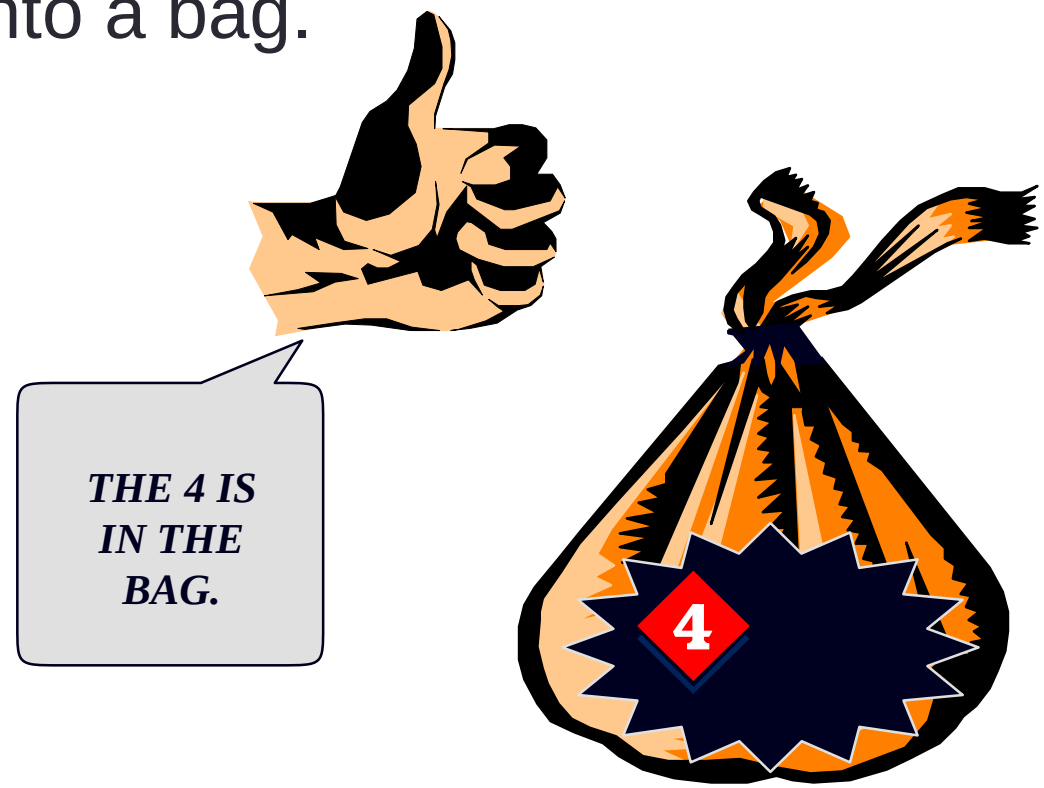

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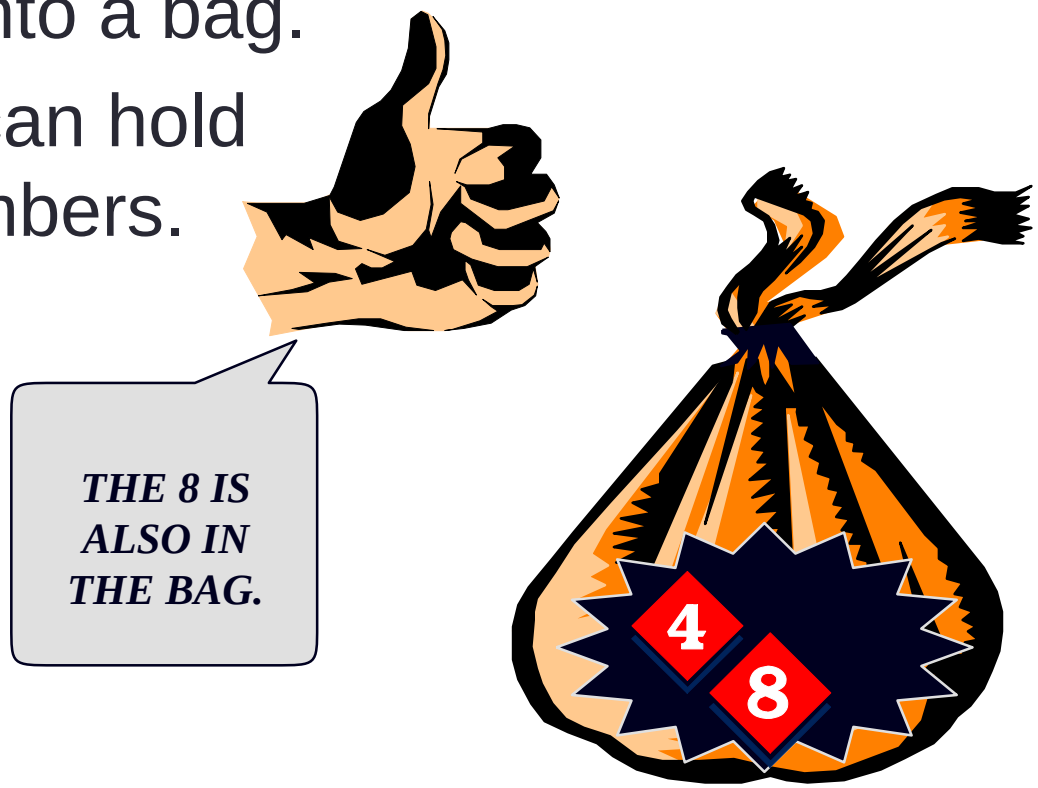

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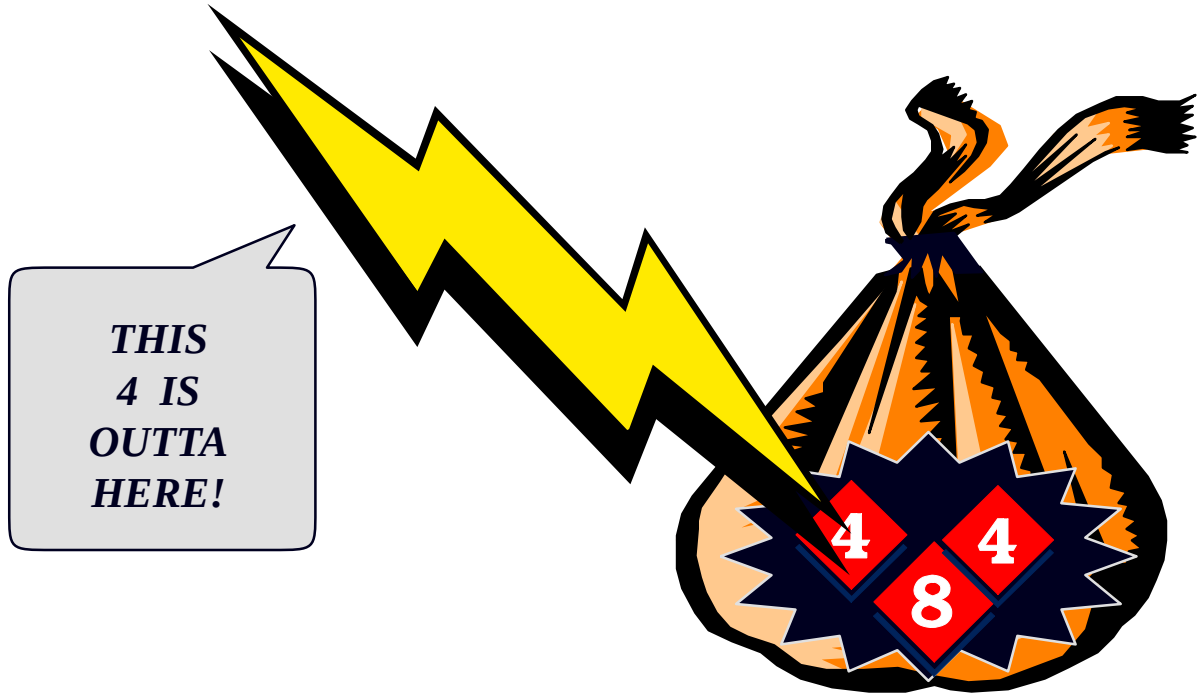
Examining a Bag

- We may ask about the contents of the bag.

Removing a Number from a Bag

- We may remove a number from a bag.



Removing a Number from a Bag

- We may remove a number from a bag.
- But we remove only one number at a time.

Which operations were defined so far on a “bag”

A. Insert (possibly multiple instances of the same number)
B. Count the number of occurrences of a number
C. Remove a single occurrence of a number
D. Some of the above
E. All of the above

One more operation: Count how many numbers are in the bag in total

- Another operation is to determine how many numbers are in a bag.

Summary of the Bag Operations

- A bag can be put in its **initial state**, which is an empty bag.
- Numbers can be **inserted** into the bag.
- You may check how many **occurrences** of a certain number are in the bag.
- Numbers can be **removed** from the bag.
- You can check **how many** numbers are in the bag.

Activity 1: Write the definition of the class

Operations defined so far -

- Create an **initial state**, which is an empty bag.
- **Insert** a number
- Count **occurrences** of a certain number
- **Remove** a number from the bag.
- Count **how many** numbers are in the bag.

- With your peer group write the definition of the bag class
- Hints:
  1. What are the private data members?
  2. What are the methods?

Demo

- Definition of the simple bag class: simple_bag.cpp
- Understand the use of static member variables by considering other options

Key take away: We used a static array to store the elements of a bag, why?

```
class bag
{
public:
      ...
private:
     int  data[20];
     unsigned int count;
};
```

This limits the maximum number of elements!

We used a static const member variable for the capacity, why?

```
class bag
{
public:
    static const unsigned int CAPACITY = 20;
    ...
private:
    int  data[CAPACITY];
    unsigned int count;
};
```

Don’t forget to define CAPACITY in the implementation file!

bag b1, b2, b3;

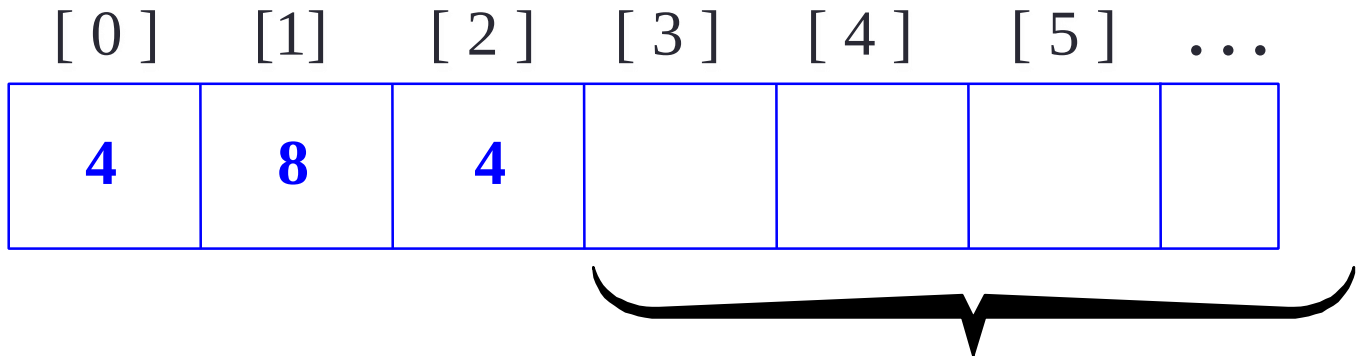
How many copies of CAPACITY are created in memory by the above C++ statement?

```
class bag
{
public:
    static const unsigned int CAPACITY = 20;
    ...
private:
    int  data[CAPACITY];
    size_t count;
};
```

A. Zero
B. One
C. Two
D. Three
E. Depends

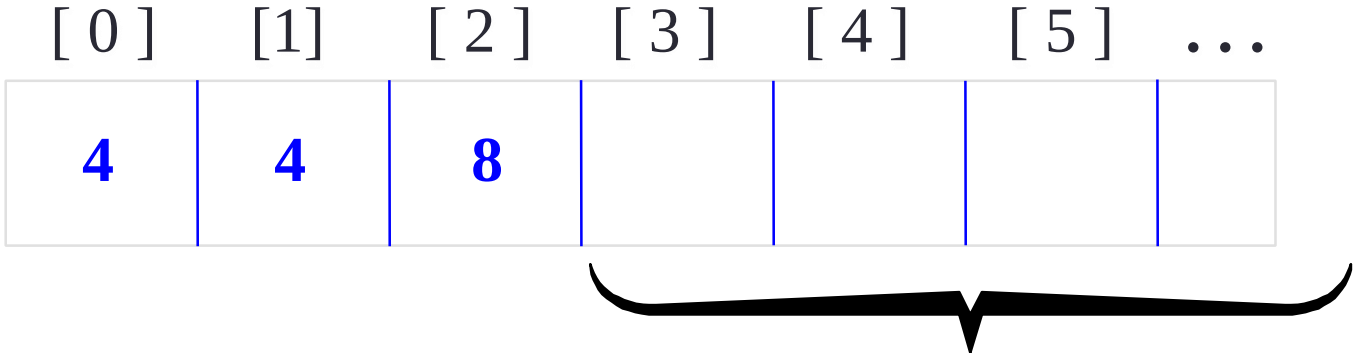
Implementation Details

- The entries of a bag will be stored in the front part of an array, as shown in this example.



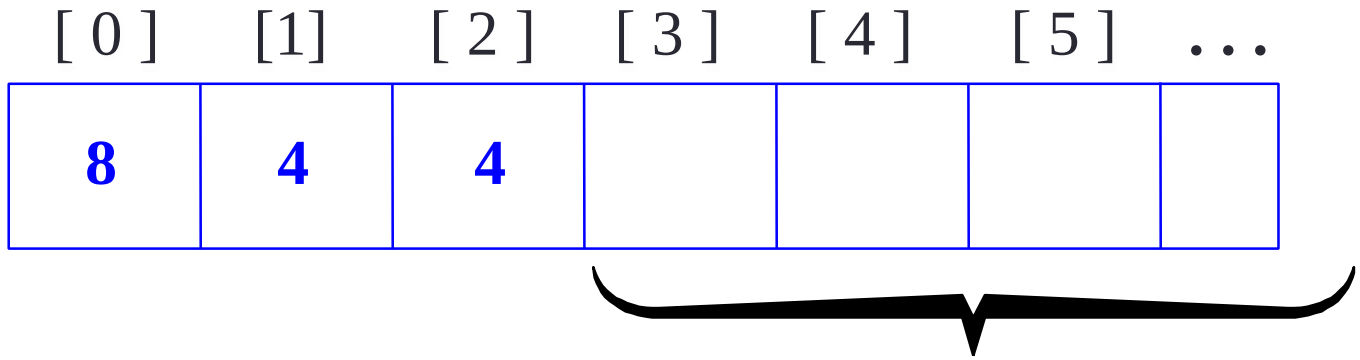
Implementation Details

- The entries may appear in any order. This represents the same bag as the previous one. . .



Implementation Details

- . . . and this also represents the same bag.



Implementation Details

- We also need to keep track of how many numbers are in the bag.

3

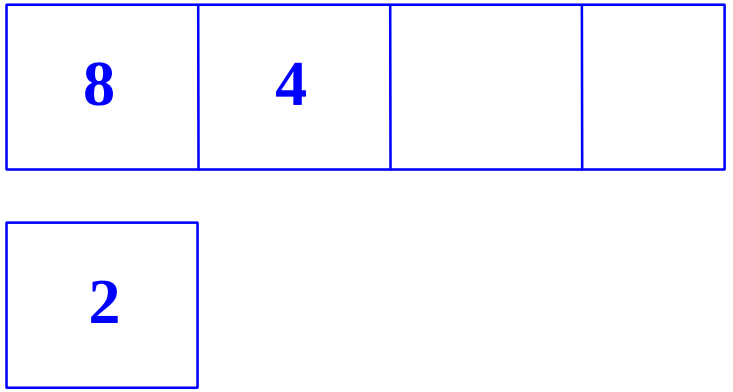
[0]	[1]	[2]	[3]	[4]	[5]	...
8	4	4				

Note: This is a key difference between the bag class and the sequence class (PA02) is that the for the sequence class, the order of elements is maintained after each deletion

An Example of Calling Insert

```
void bag::insert(int new_entry)
```

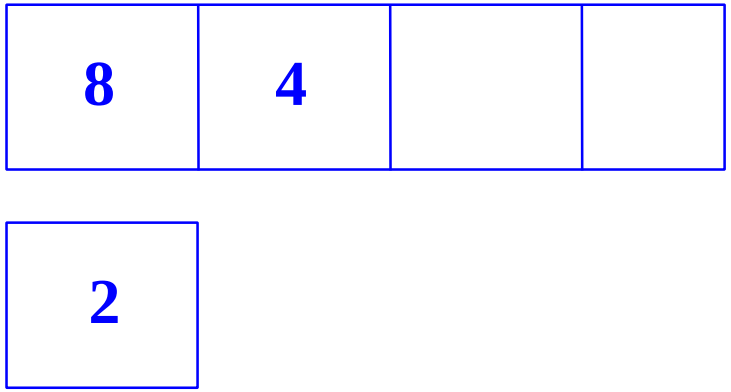
Before calling insert, we might have this bag b:



An Example of Calling Insert

```
void bag::insert(int new_entry)
```

b.insert(17);



What values will be in b.data and b.count after the member function finishes ?

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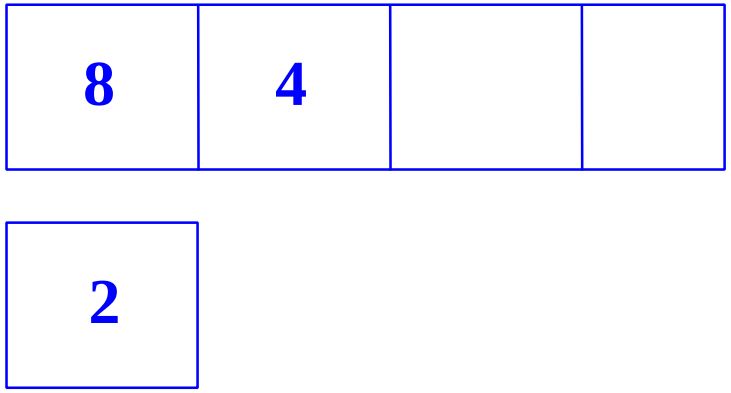

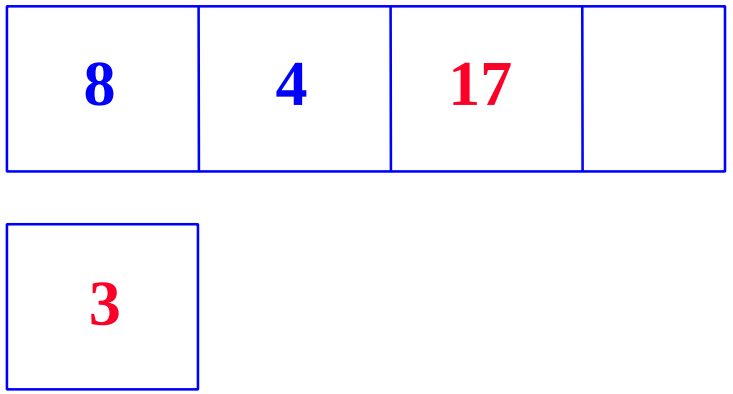

Pseudocode for bag::insert

- assert(size( ) < CAPACITY);
- Place new_entry in the appropriate location of the data array.
- Add one to the member variable count.

What is the "appropriate location" of the data array ?

Pseudocode for bag::insert

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```
data[count]  = new_entry;
count++;
```

Pseudocode for bag::insert

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```
data[ count++]  = new_entry;
```

Demo: Implementation of bag

- Definition of the simple bag class: simple_bag.cpp
- Implement the insert, erase_one and count methods
- Test with simple_bag_test.cpp
- Use the bag class to store the ages of members of a family, find each age and delete them (bag_demo.cxx)
- Consider the changes you have to make to the current code if we were to store a bag of elements of a different datatype.
- Compare with the other implementation (bag1.cxx) that uses a “flexible” data type for the elements of the bag.

What's new?

```
class bag
    {
    public:
        typedef int value_type;
        typedef std::size_t size_type;
        static const size_type CAPACITY = 30;
        bag( );
        bool erase_one(const value_type& target);
        void insert(const value_type& entry);
         size_type size( ) const { return used; }
        size_type count(const value_type& target) const;
    private:
        value_type data[CAPACITY];
        size_type used;
    };
```

Other types of bags

- In the simple_bag.cpp example, we implemented a bag containing **integers**.
- The implementation in bag1.cxx allowed us to easily create a bag of **float numbers**, a bag of **characters**, a bag of **strings** . . .
- What was the key technique that allowed us to create a more flexible implementation?

Demo expected behaviour of pa02

Summary

- A container class is a class that can hold a collection of items.
- Container classes can be implemented with a C++ class.
- The class is implemented with a header file (containing documentation and the class definition) and an implementation file (containing the implementations of the member functions).
- Other details are given in Section 3.1, which you should read.

Next time

- Chapter 4: Pointers and dynamic arrays