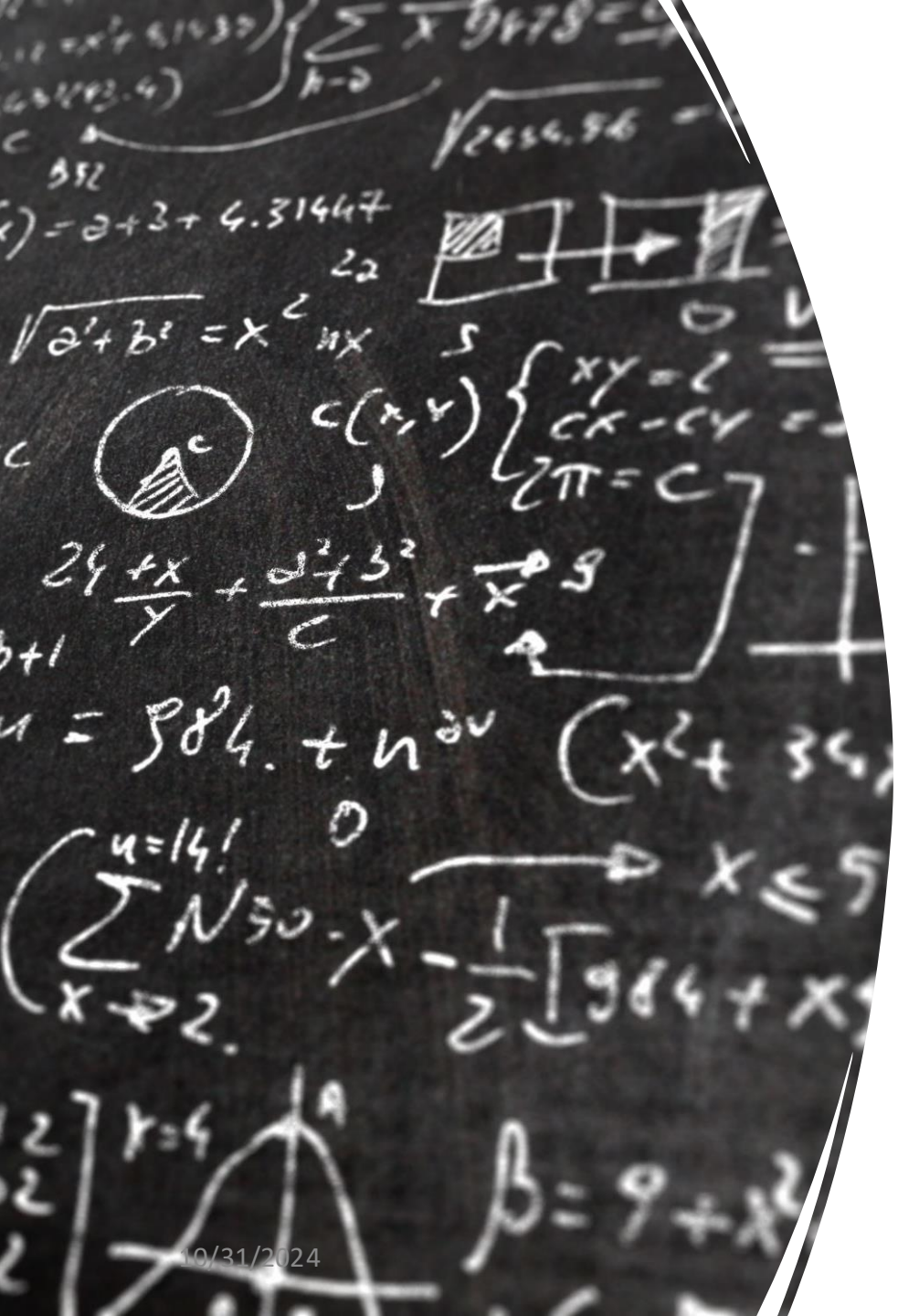


CS 113 – Computer Science I

Lecture 14 – Arrays, Classes & Objects

Tuesday 10/31/2024

Announcements

HW 06 – Due Monday 11/04

- Loops

HW 07 – Due Monday 11/11

Agenda

- Arrays
- Mutability
- Objects & Classes

Bank example

Keep track of account balances

Use an array:

- Each index represents another account
- The value represents the account's balance

Determine how many accounts we can hold:

- Create a new array of fixed size

Bank example

Over time our bank becomes successful, lots of new clients

No more space for new customers

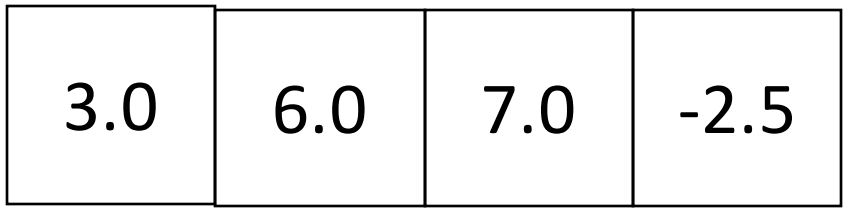
Implementation issue: running out of space in our array

Solution: build a bigger bank!

Building a bigger bank

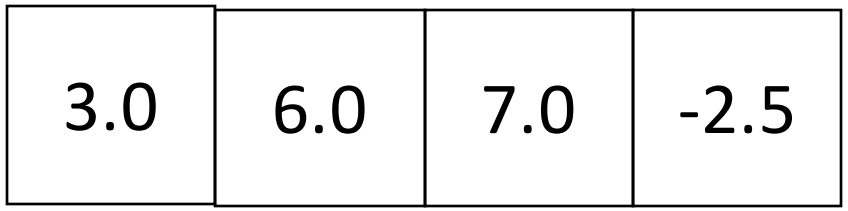
Copying arrays

Old bank

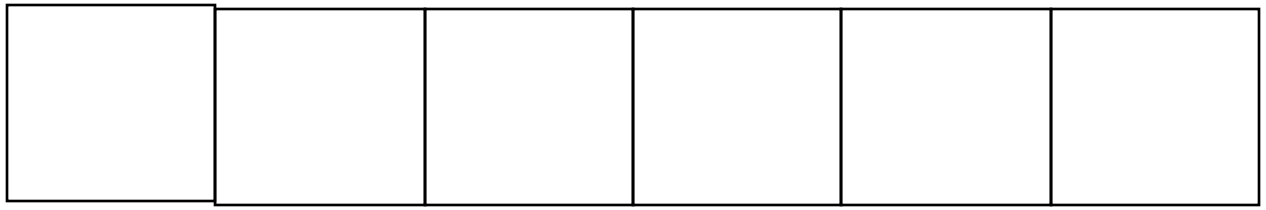


Copying arrays – build the new bank/array

Old bank

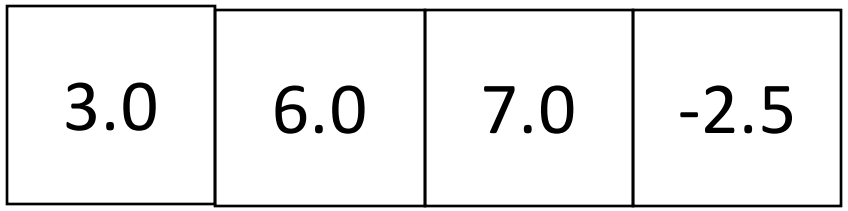


new bank

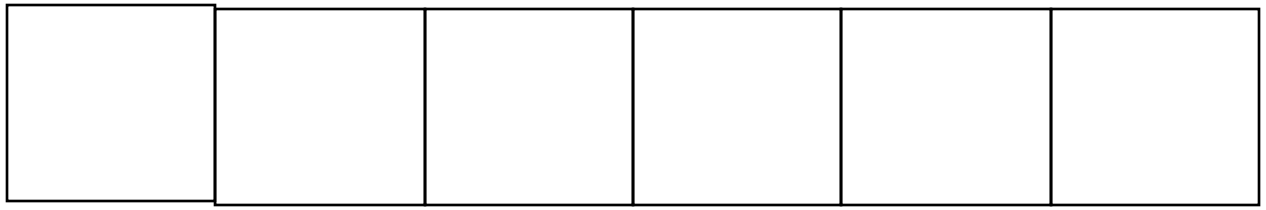


Copying arrays – copy over values/customers

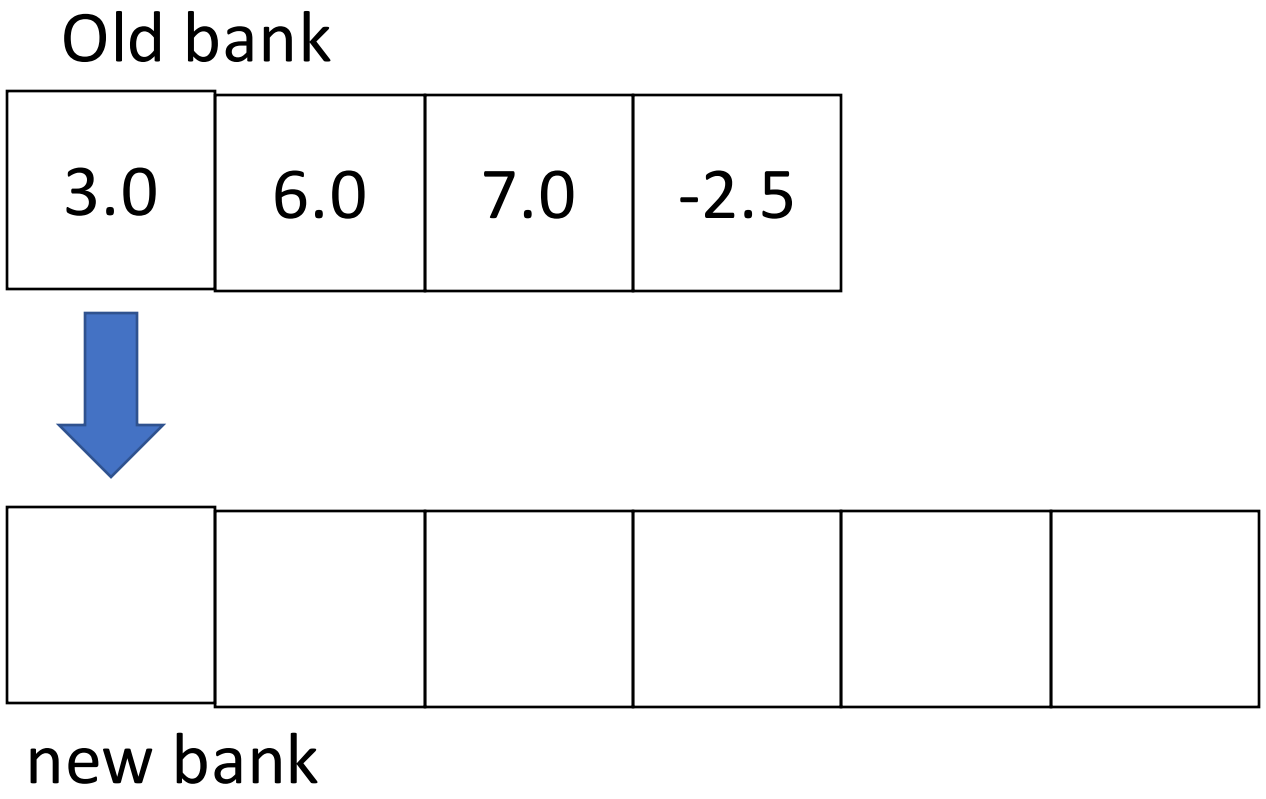
Old bank



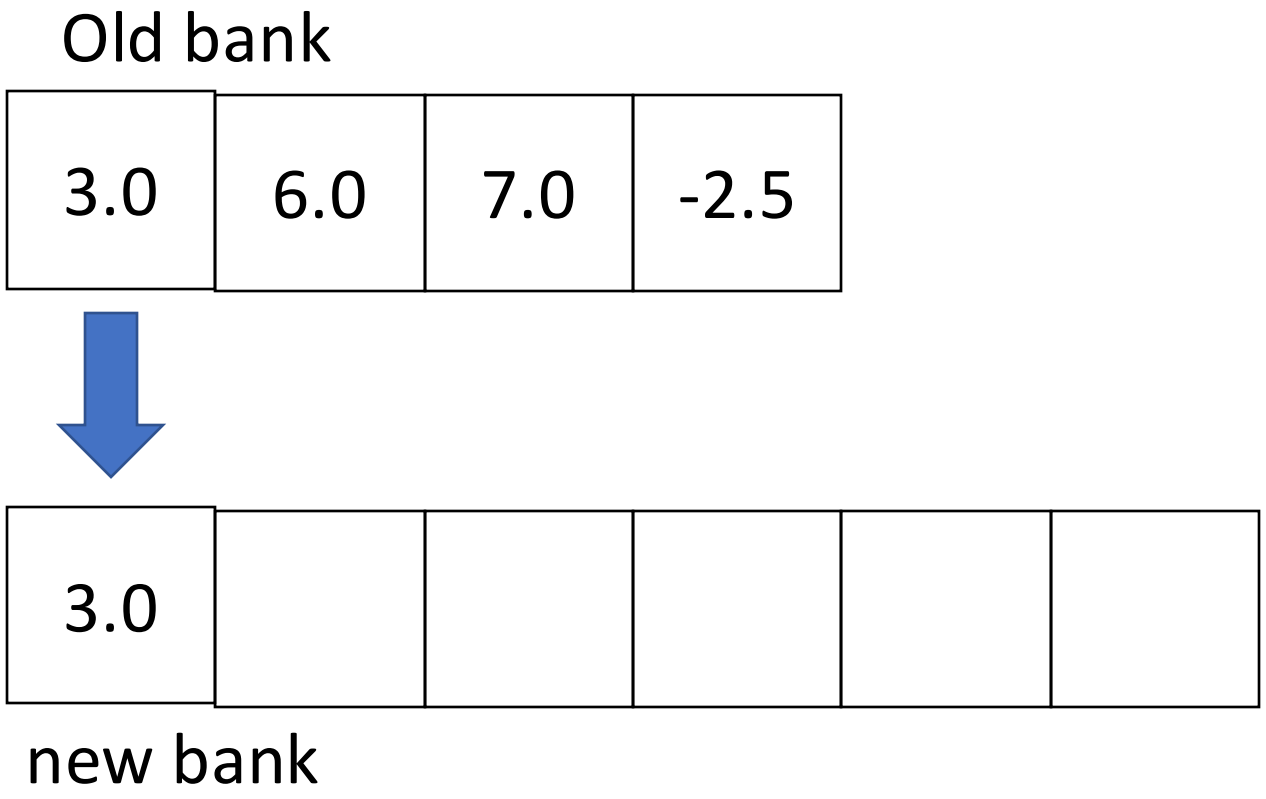
new bank



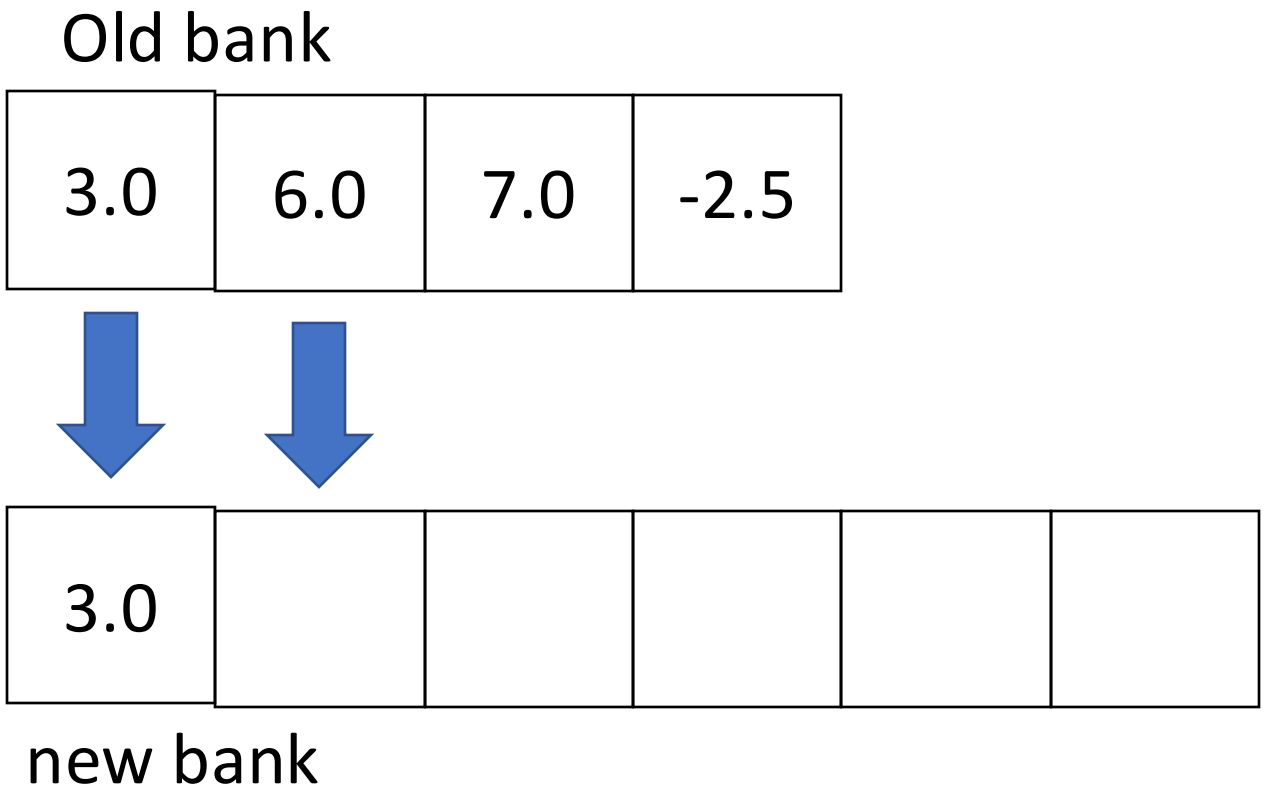
Copying arrays – copy over values/customers



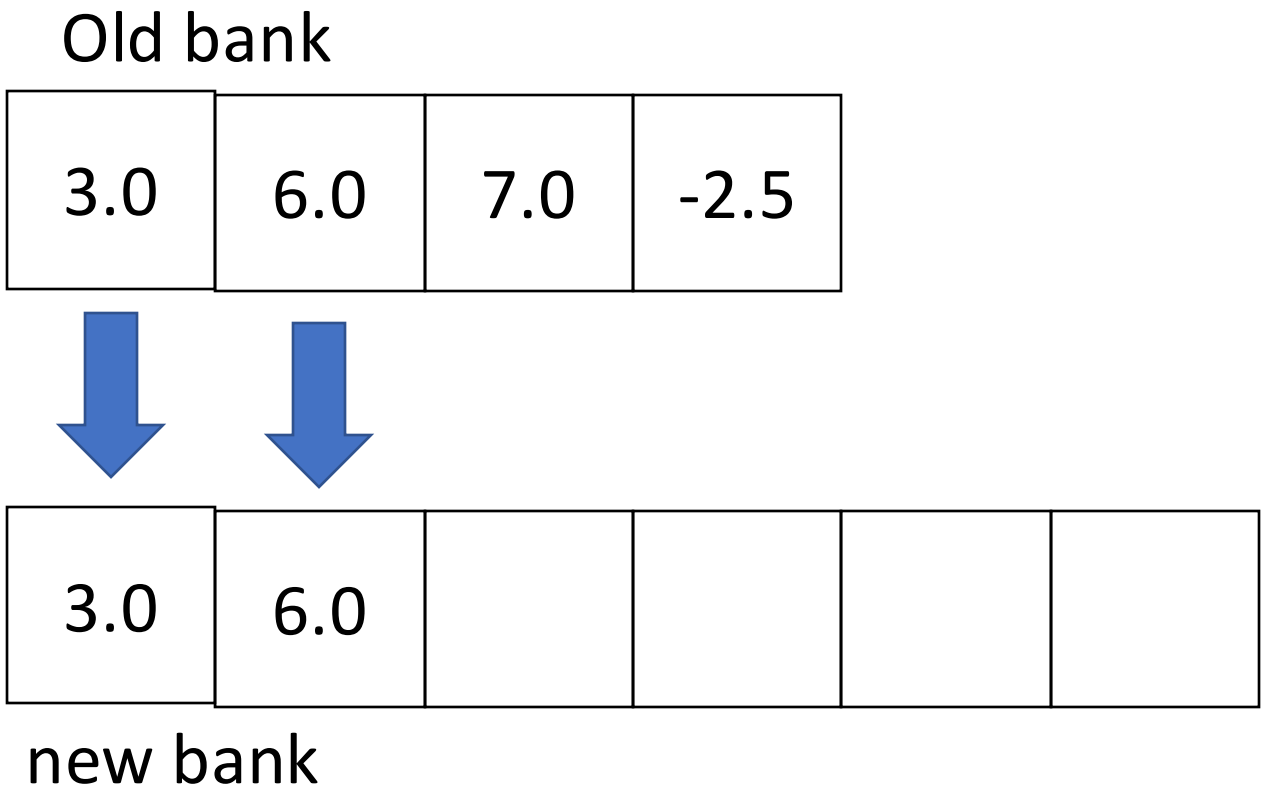
Copying arrays – copy over values/customers



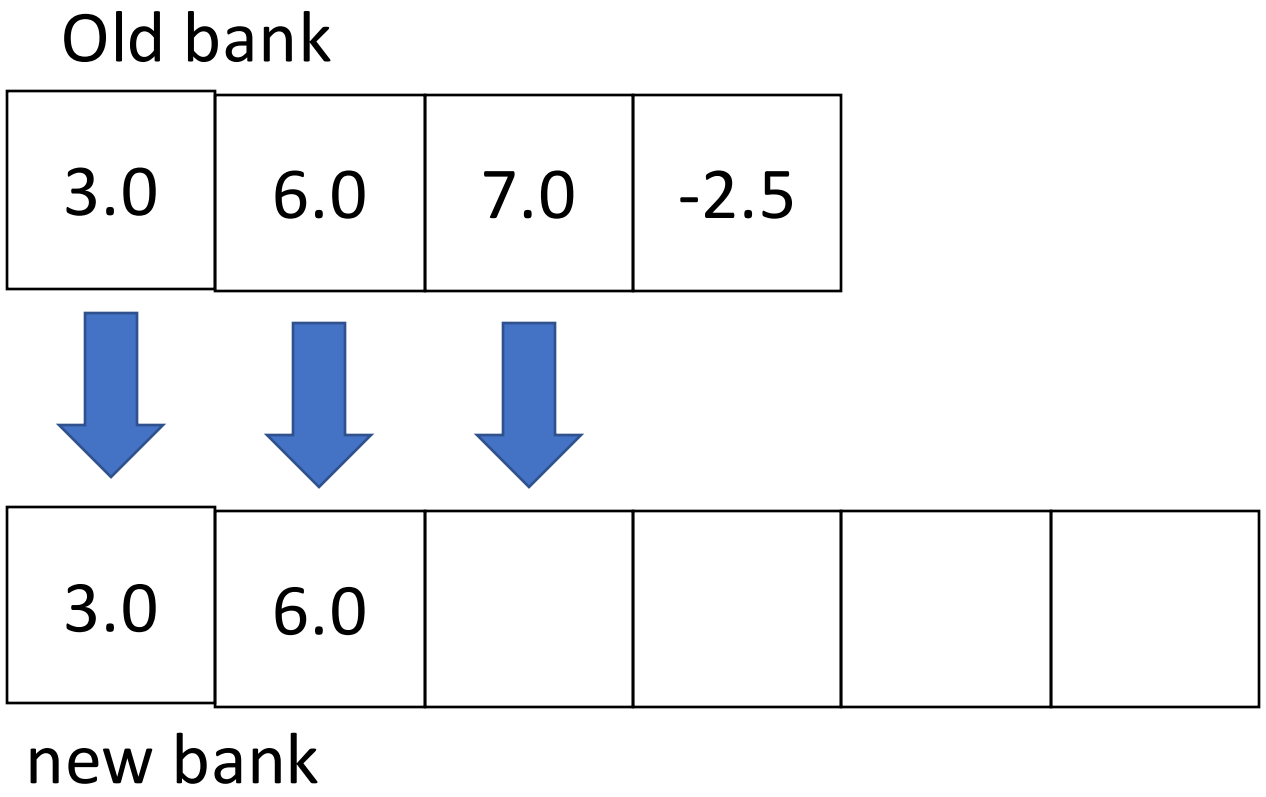
Copying arrays – copy over values/customers



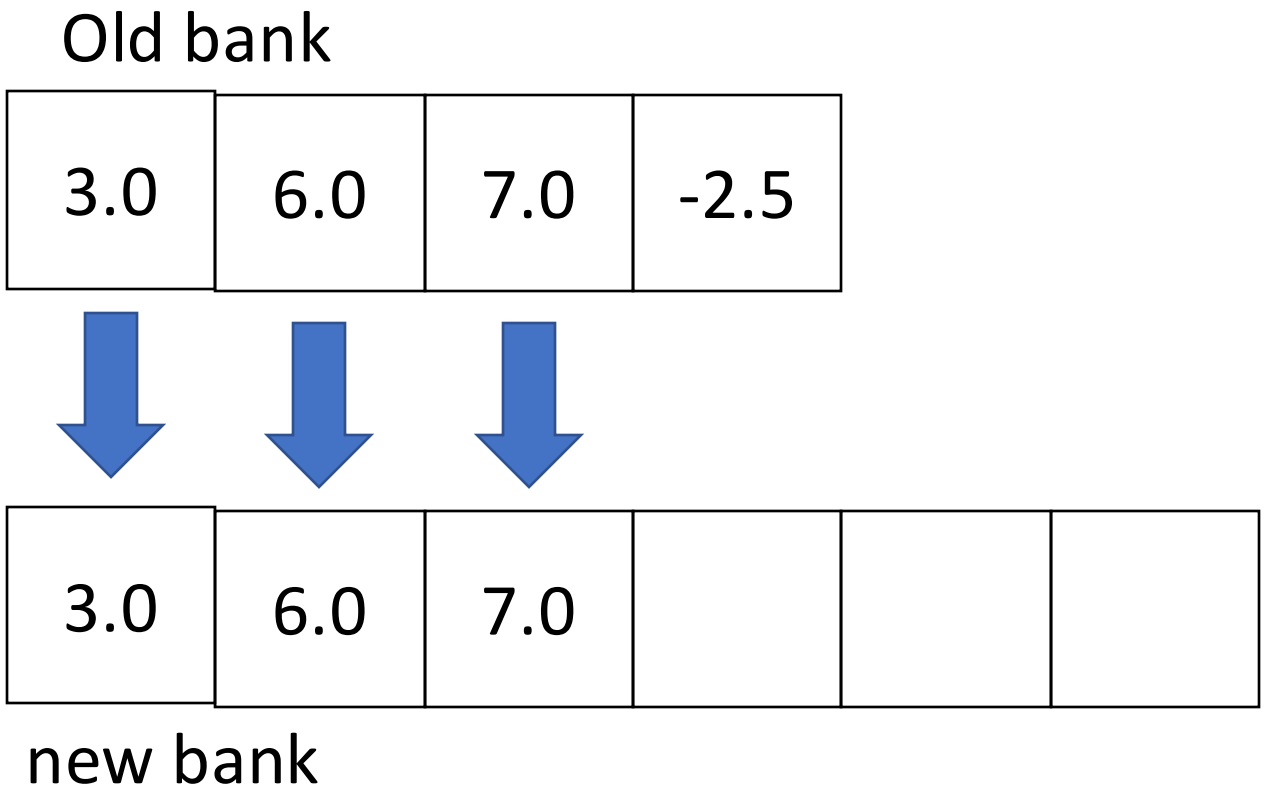
Copying arrays – copy over values/customers



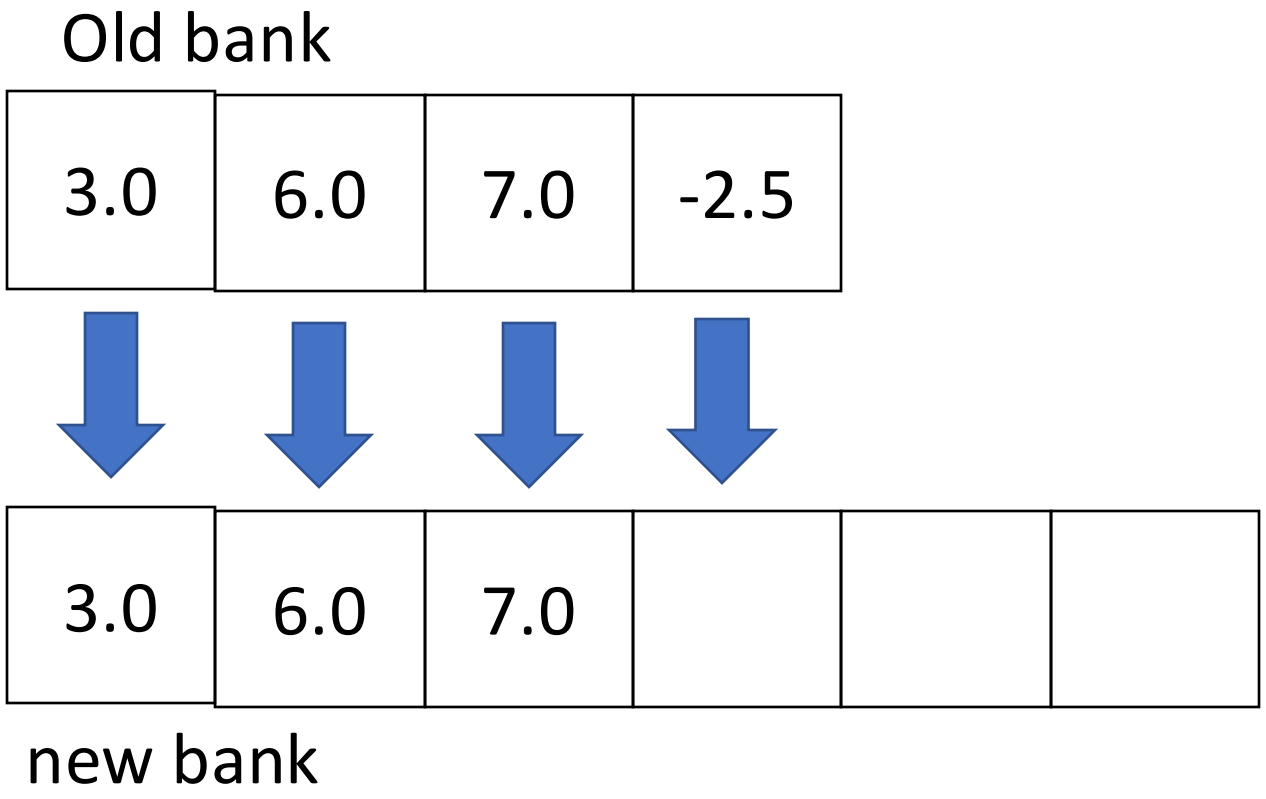
Copying arrays – copy over values/customers



Copying arrays – copy over values/customers



Copying arrays – copy over values/customers



Copying arrays – copy over values/customers

Algorithm

When we run out of space in an array

- Create a new array (that's a bit bigger)
- Copy over all elements from the older array to the new array

How many steps do we take in this algorithm?

- Creating a new array – 1 step
- Copying *n* elements from the old array to the new array – *n* steps

How big should the new array be?

Previous size plus 1

- Pro: not making too much space
- Con: might have to create new arrays a lot of times

As big as possible

- Pro: rarely have to create a new array
- Con: wasted space

Typical solution – previous size x 2

Agenda

- Arrays
- **Mutability**
- Objects & Classes

Mutable vs Immutable

Mutable:

Values can change

Immutable:

Values cannot change

Strings and Integers are immutable

Agenda

- Arrays
- Mutability
- **Objects & Classes**

Data types revisited

What are some examples of built-in types in Java?

What is a data type?

Examples

Type	Valid values	Operations

Examples

Type	Valid values	Operations
int		

Examples

Type	Valid values	Operations
int	1, 10, 999	%, +, -, / …

Examples

Type	Valid values	Operations
int	1, 10, 999	%, +, -, / …
boolean	true, false	==, &&, ||, !=
String	Anything between “”	.compareTo(), .charAt(), concatentation, …

Class

A blueprint for a custom data type

A template for how data/information is stored

Contains a set of methods for how to interact/operate on the stored data

Classes and objects

An **object** is an ***instance*** of a **class**

An **object** is to a **class** as a

cat is to an **animal**

tulip is to an **flower**

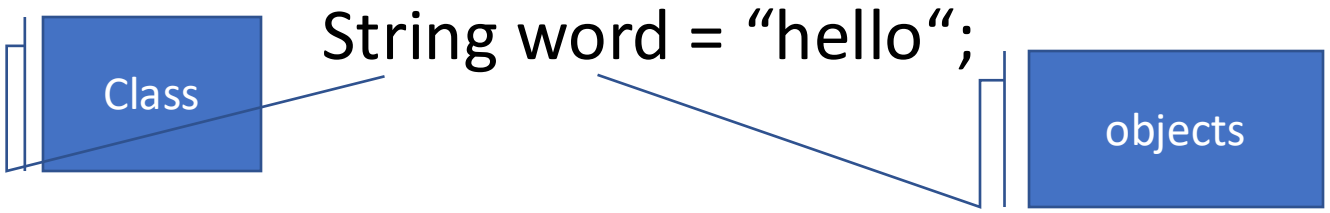
cookie it to a **snack**

Socrates is to a **human**

Classes and objects

A **class** defines the characteristics of a type (data and methods)

An **object** is a particular example/instance of a class



Java is a strict object-oriented programming language, meaning all code must be inside a class!

Creating objects

Declare variables in the same way!

Create using `new`

Using objects

The methods you are allowed to call on an object is called an **API**

Recall: API = Application Programming Interface

Example: The *String API* has over 60 methods!

Objects can have either *static* or *instance* methods

static methods use syntax <ClassName>.<methodName>

instance methods use syntax <object>.<methodName>

Example: String API

boolean	**endsWith**(**String** suffix) Tests if this string ends with the specified suffix.
boolean	**equals**(**Object** anObject) Compares this string to the specified object.
boolean	**equalsIgnoreCase**(**String** anotherString) Compares this `String` to another `String`, ignoring case considerations.
static **String**	**format**(**Locale** l, **String** format, **Object**... args) Returns a formatted string using the specified locale, format string, and arguments.
static **String**	**format**(**String** format, **Object**... args) Returns a formatted string using the specified format string and arguments.

Using objects: some special methods

The **constructor method** is called when you do a `new`

accesors (aka getters)
return the values of instance variables

mutators (aka setters)
set the values of instance variables

toString()
returns a string representation of an object

Defining classes

By defining our own classes, we can create our own data types

A class definition contains

- the data contained by the new type (**instance variables**)

- the operations supported by the new type (**instance methods**)

OOP Example & Design: Bank

Defining the Bank class

```
public class Bank {
    private int size;
    private String name;
    private String[] clients;
    private double[] accounts;

    public Bank(String bankName, int numClients) {
        name = bankName;
        size = numClients;
        clients = new String[size];
        accounts = new double[size];

    }
    public String getName() {
        return name;
    }

}
```

Bank Actions

How can we find out how much money the bank is holding at once?

How can we find out which account is currently overdraft?

What other questions might the bank want to know?

Object-oriented programming (OOP)

Method for designing programs in terms of objects

Recall: Top-down design

- the “nouns” in your feature list correspond to classes/data
- the “verbs” correspond to methods

Testing the Bank class

```
public static void main(String args[])
{
    Bank boa = new Bank(”Bank of America", 10);
    System.out.println(”Bank: "+boa.getName());
}
```

Objects: Stack diagrams revisited

```
public static void main(String args[])
{
    Bank boa = new Bank(”Bank of America", 10); //call constructor
    System.out.println(”Bank: "+boa.getName());
}
```

Exercise: draw a stack diagram for this program

Exercise: Define a class BankAccount

BankAccount should have the following data:

- Name
- Amount

BankAccount should have the following operations:

- currentBalance() // returns current amount in the bank account
- withdraw(float amt) // withdraw the given amount from the account
- deposit(float amt) // deposit the given amount to the account