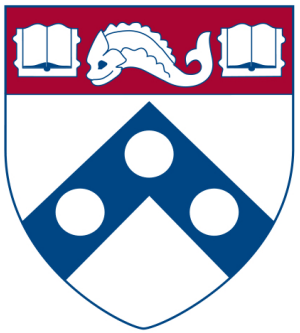

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Video 3.1

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ArrayList

- Used when the size of the data collection is unknown.
- The indexing operations are still quick
- Adding an element is quick on average.
  - ArrayList works by dynamically resizing an array behind the scenes.

Syntax for ArrayList

- Remember to import java.util.*
- ArrayList<object datatype>;
- An arraylist can only be made of objects. Primitive datatypes are not allowed.

ArrayList of Strings

- Declaration

```
ArrayList<String> names;
```

- Initialize the list

```
names = new ArrayList<String>();
```

- Declare and initialize

```
ArrayList<String> names =
                        new ArrayList<String>();
```

ArrayList methods

```
names = new ArrayList<String>();
```

- `names.add("John Doe")` - add the element to the end of the arraylist
- `names.get(i)` - get the element at the i^{th} index.
- `names.contains("John Doe")` – returns a boolean saying whether the names arraylist contains John Doe
- `names.remove(i)` – remove the element at the i^{th} index.

Java wrapper classes for primitives

- Java has classes that ”wrap around” the primitive datatypes.
- Instead of using the primitive datatype int you can replace it with java’s Integer class.
- To make an arraylist containing integers (in the mathematical sense)

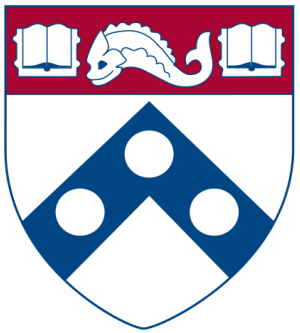
```
ArrayList<Integer> attendance =
      new ArrayList<Integer>();
```

Example – using ArrayList to simulate cards

```
public Card {
    char suit;// d, s, c, h
    int rank; // Jack is 11, Queen is 12, King is 13
}
//creating a deck of cards
ArrayList<Card> deck = new ArrayList<Card>();
suits = new char[] {'d', 's', 'c', 'h'};
for (int i = 1; i < = 13; i++) {
   Card c = new Card();
   for (int j = 0; j <= 4; j++) {
      c.suit = suits[j]; c.rank = i;
      deck.add(c);
   }
}
```

Shuffling an ArrayList

```
Collections.shuffle(deck);
//pick the 10th card
Card tenthCard = deck.get(9);
System.out.println(tenthCard.rank + " " +
                                    tenthCard.suit);
```



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Enhanced for loop

- For any collection of data the following syntax loops through every element

```
for( datatype variable : collection) {
      // variable name can be used in this loop
        // variable takes each value in the
       //collection one by one
}
```

Example: find longest name in a list

Assume we have an arraylist of strings called names

```
int max = 0;
String longest = “”;
for (String name : names) {
    int current = name.length();
    if (current > max) {
        max = current;
        longest = name;
    }
}
```

Looping through arrays

The enhanced for loop can work for arrays as well

```
int[] scores = //an array of integer scores;
double total = 0;

for (double element : scores) {
  total = total + element;
}
```

Modifying an array in a loop

- The enhanced for loop is best used for reading elements
- Not suitable for initializing values or modifying existing values

```
for (double element : values) {
    element = 0;
}
```

The above loop does not make all the values in the collection called values to be 0.

Modifying an array(the corrent way)

```
for (int i = 0; i < values.length; i++) {
    values[i] = 0;
}
```

Modifying an arraylist

```
for (int i = 0; i < values.size(); i++) {
    values.set(i, 0);
}
```

ConcurrentModificationException

```
for (Card ca : deck) {
    if (ca.suit == 'c') {
            deck.remove(ca);
       }
}
```

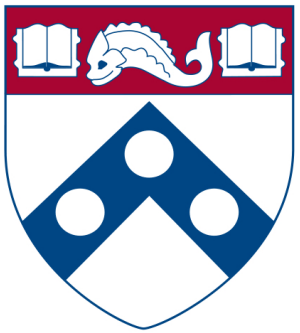
- Removing elements while iterating through the list at the same time is not allowed in the enhanced for loop.

Solving the ConcurrentModificationException

```
ArrayList<Card> clubs = new ArrayList<Card>();

for (int i = 0 ; i < deck.size(); i++) {
   Card ca = deck.get(i);
   if (ca.suit == 'c') {
      clubs.add(ca);
   }
}

deck.removeAll(clubs);
```



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Documentation

- In order to get someone to use the classes that you develop it is important to communicate to them
- No one wants to read every single line of your code
- The best way is to have good documentation

Javadoc creation

- Provide documentation for every method
- In Eclipse just type in /** before a method and hit enter

```
public int getNumerator() {
    return 5;
}
```

Javadoc creation

```
/**
public int getNumerator() {
    return 5;
}
```

Javadoc creation

```
/**
 *
 * @return
 */
public int getNumerator() {
    return 5;
}
```

Tags in documentation

- Eclipse auto generates a block of documentation for you
- Fill in general documentation about what the method does. Remember that there are tags to provide more detail about components of the method.
- @param - provide helpful documentation for each parameter
- @return – clearly specify what the method returns
- One additional tag is
  - @see – if you want the reader of your documentation to look up a different class

Using Eclipse to generate documentation

- Project - > Generate Javadoc
- Remember to write your javadocs completely before clicking this
  - every public method must have some javadocs.

Using Eclipse to generate documentation

```
public class Rational {

    int num; // the numerator
    int den; // the denominator

    /**
     * Given a numerator and a denominator
     * make a rational number of the form
     * <br>
     * numerator
     * <br>
     * ---------
     * <br>
     * denominator.
     *
     * <br>
     * Initialize the rational number.
     * This throws an ArithmeticException if the denominator is 0.
     * @param numerator - the numerator of the fraction
     * @param denominator - the denominator of the fraction.
     */
    public Rational(int numerator, int denominator) {
```

Using Eclipse to generate documentation

Constructor Detail

Rational

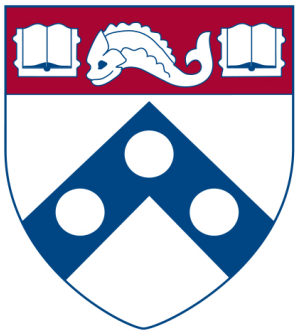
```
public Rational(int numerator,
                int denominator)
```

Given a numerator and a denominator make a rational number of the form
numerator
---
denominator.
Initialize the rational number. This throws an ArithmeticException if the denominator is 0.

Parameters:

`numerator - - the numerator of the fraction`

`denominator - - the denominator of the fraction.`



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Topics

- What does static mean?
- Static instance variables
- Static methods

What does static mean?

Think of static as belonging to the class and not to the individual instances of the class.

A static method means the method exists at the class level and is not specific to the instance.

The one static method that you have in a lot of your classes is **main.**

Used when you do not need an instance of the object.

Math.sqrt is a method that computes the square root of a number. You do not need an instance of mathematics before you know how to compute the square root.

Using static methods

- To use a static method called method1 in a class called Class1 the code is
  `Class1.method1(parameters…)`
- You do not have to create an instance of the class in order to invoke the method
- Many java utility functions are static methods. Almost all math function are static methods in the **Math** class.

Static versus non static

Consider the Rational number class

To reduce 2/4 to 1/2 a common thing to do is to compute the greatest common divisor. To compute the gcd you do not need an instance of a fraction.

```
public static int gcd (int a, int b)
public Rational add(Rational otherRational)
```

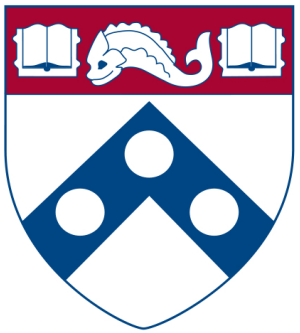
Static instance variables

- Static instance variables are used if you want some information to be shared by every instance of a class
- A common use case is constants
- For constants you also get to see the keyword **final.** Final meaning you do not get to override this value in any manner.
- `public static final int MAXSCORE = 100;`

Example of static variable used to keep count

- Bank account and bank account numbering

- Demo



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Topics

- Access Modifiers
- What is private, public?
- What if we don't write any modifier?

Access modifier

- Every instance variable and every method can be given one of 4 access modifiers
  - public
  - protected
  - private
  - default – no modifier provided at all

- We will discuss what protected means later (after we have covered inheritance)

public instance variables

- With an access modifier being public the instance variable or method can be directly accessed, even outside the class

- In the example below, the Spy class can go and change the id of a Human object because the id has a public access modifier

```
public class Human {
    public int id;
    public String name;
}

public class Spy() {
    public static void main(String[] args) {
        Human h = new Human();
        h.id = 45;
    }
}
```

private instance variables

- For the same example (Human, Spy), if the id is made private then it cannot be accessed in the Spy class.
- It can still be accessed within the Human class

```
public class Human {
    private int id;
    public String name;
    public void sayHello() {
      System.out.println("Hello there " + id); // same class.
Works fine.
    }
}

public class Spy() {
    public static void main(String[] args) {
        Human h = new Human();
        h.id = 45; // this line of code will not work anymore
    }
}
```

Default access modifier

- What happens if you leave out the private/public?
- The default access is for every class inside the same package to be able to access the instance variable while classes in different packages cannot do so.
- This is quite uncommon in the actual software industry. Avoid it unless there is a very specific need.

Best practice for instance variables

- The first preference for any instance variable is to make it private
- You still want to be able to access these instance variables. The correct way of doing so is via accessors and mutators
- Accessors and mutators
  - Also called getters and setters

```
public class Student {
    private String name;
    public getName() {
         return name;
    }
    public setName(String name) {
        this.name = name;
    }
}
```

Best practice for instance variables

```
public class Student {
    private String name;
    public getName() {
         return name;
    }
    public setName(String name) {
        this.name = name;
    }
}

public class School {
  private Student[] students;
  public void printStudentNames() {
     for (int i = 0; i < students.length; i++) {
        System.out.println(students[i].getName());
     }
  }
}
```

public methods

- The method can be accessed from any other class.
- Public methods are the primary manner in which two classes communicate with each other.
- Think of a public method as a service that one class is providing to another.

private methods

- A private method can only be accessed within the class
- Common use case – Helper methods

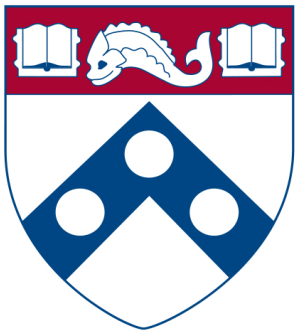
```
public class Student {
    private int age;
    public void setAge(int age) {
        if (verifyAge(age))
            this.age = age;
    }
    private verifyAge(int age) {
         return age >= 1;
    }
}
```

Summary

Modifier	Class	Package	World
public	Y	Y	Y
default	Y	Y	N
private	Y	N	N

https://docs.oracle.com/javase/tutorial/java/javaOO/accesscontrol.html

World means any class that is outside the package



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Topics

- Hands on example of cars being parked in a parking garage.
- We will design a car object and a parking garage object in Eclipse.