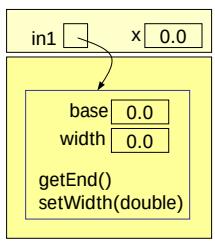
- Previous Lecture:
  - OO thinking
  - Defining a class:
    - Instance variables
    - Instance methods, getters and setters
- Today's Lecture:
  - Defining a class:
    - Constructors
    - Keyword this
    - Method toString
- Reading: Sec 4.4
- Announcement: P5 on its way...


```
/* An Interval is [base, base+width] */
class Interval {
   private double base;  // low end
   private double width; // interval width

   /* =Get right end of interval */
   public double getEnd() {
     return base + width;
   }
   /* set width to w */
   public void setWidth(double w) {
     width= w;
   }
}
```

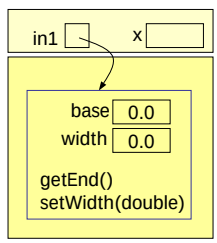

Calling an instance method

```
public class Client {
  public static void main(String[] args){

    Interval in1;
    in1= new Interval();
    double x;
    x= in1.getEnd();

  }
}
```



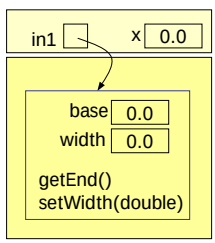
Calling an instance method

```
public class Client {
  public static void main(String[] args){

    Interval in1;
    in1= new Interval();
    double x;
    x= in1.base +
       in1.width;
  }
}
```

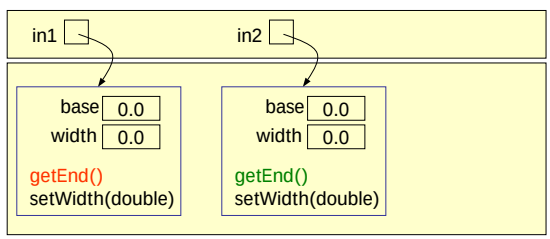


Calling an instance method

```
public class Client {
  public static void main(String[] args){

    Interval in1;
    in1= new Interval();
    double x;
    x= in1.getEnd();
    in1.setWidth(4);
  }
}
```




```
Interval in1= new Interval();
Interval in2= new Interval();
if ( in1.getEnd() > in2.getEnd() )
  System.out.println("blah...");
```



Class Definition

```
public class class-name {

   declaration (and initialization)

   constructor

   methods

}
```


Constructor

- A *constructor* is used to create objects
- Each class has a default constructor
- You can define your own constructor:

```
modifier class-name ( parameter-list ) {
    statements-list
}
```

- Use `public` as the modifier for now
- an instance method that has *no* return type


```
class Interval {
  private double base;  // low end
  private double width; // interval width

  /* An Interval with base b, width w */
  public Interval(double b, double w) {
    base= b;
    width= w;
  }

  public double getEnd() {
    return base + width;
  }
}
```



```
class Interval {
  private double base;  // low end
  private double width; // interval width

  /* Default constructor */
  public Interval() {}

  public double getEnd() {
    return base + width;
  }
}
```

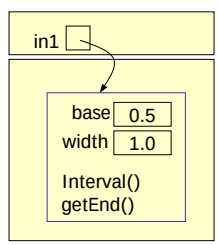

Constructor invocation

```
new class-name ( expression-list )
```

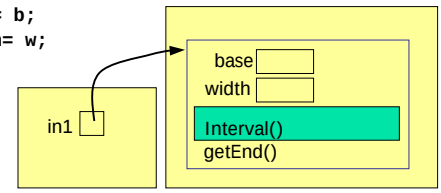
- The value of above expression is a reference to a *new* object of the given *class-name*
- The defined (or default) constructor is invoked on the new object created by **new**

Creating an object

```
public class Client {
  public static void main(String[] args){

    Interval in1;
    in1= new Interval(
                  0.5,1);

  }
}
```



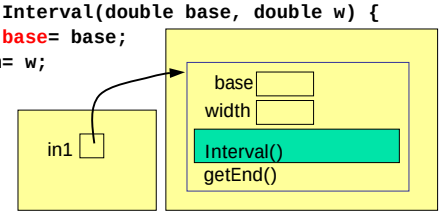
```
public class IntervalClient {
  public static void main(String() args) {
    Interval in1= new Interval(3,1);
  }
}
class Interval {
  ...
  public Interval(double b, double w) {
    base= b;
    width= w;
  }
  ...
}
```




```
public Interval(double b, double w) {
    this.base= b;
    this.width= w;
}
```

- Keyword **this** returns a reference to the object itself, so **this.base** is the field **base** inside "this" object
- Use keyword **this** only when it is necessary. (It is not necessary in the example above.)


```
public class IntervalClient {
  public static void main(String() args) {
    Interval in1= new Interval(3,1);
  }
}
class Interval {
  ...
  public Interval(double base, double w) {
    this.base= base;
    width= w;
  }
  ...
}
```



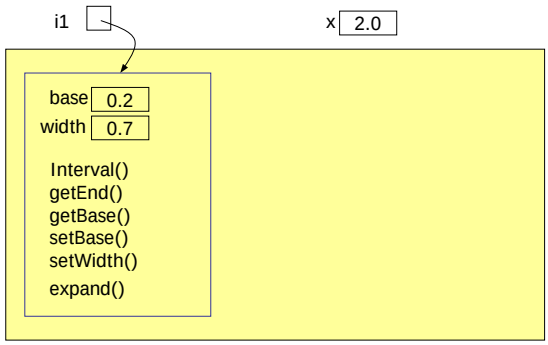
More instance methods with input parameters

- Write an instance method
  expand(double f)
  that expands the **Interval** by a factor of **f**.
- What should be the method header?
- Parameter of primitive type


```
/** Expand this Interval by a
 *  factor of f
 */
public void expand(double f) {
  width *= f;
}
```



```
public class Client {
  public static void main(String[] args){
    Interval i1= new Interval(0.2,0.7);
    double x= 2;
    i1.expand(x);
    System.out.println(i1.getEnd());
  }
}
```




```
/** Expand this Interval by a
 *  factor of f
 */
public void expand(double f) {
  setWidth(width*f);
}
```

Use available methods when possible!

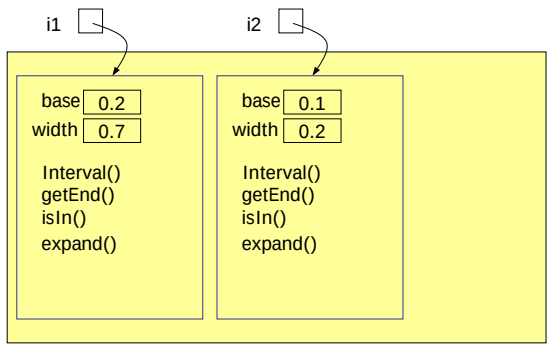
Non-primitive input parameter

- Write an instance method
  `isIn(Interval i)`
- that returns the `boolean` value `true` if the instance is in `Interval i`. Return `false` otherwise.
- Parameter of non-primitive type: pass-by-reference
  I.e., Reference is copied; object itself is not copied


```
/** ={this Interval is in Interval i} */
public boolean isIn(Interval i) {
  return (     getBase()>=i.getBase() &&
               getEnd()<=i.getEnd() );
}
```



```
public class Client {
  public static void main(String[] args){
    Interval i1= new Interval(0.2,0.7);
    Interval i2= new Interval(
                      Math.random(),0.2);
    if (i2.isIn(i1))
      System.out.println("Interval i2 "
                  + "is in Interval i1.");
    else
      System.out.println("Interval i2 "
             + "is not in Interval i1.");
  }
}
```

```
/** ="this Interval is in i" */
public boolean isIn(Interval i) {
  return ( getBase()>=i.getBase() &&
           getEnd()<=i.getEnd() );
}
```

```
public boolean isIn(Interval i) {
  boolean in = getBase()>=i.getBase() &&
               getEnd()<=i.getEnd();
  return in;
}
```

Not concise!!


```
/** ="this Interval is in i" */
public boolean isIn(Interval i) {
 return ( getBase()>=i.getBase() &&
          getEnd()<=i.getEnd() );
}
```

```
public boolean isIn(Interval i) {
  if ( getBase()>=i.getBase() &&
       getEnd()<=i.getEnd()
       == true )
    return true;
  else
    return false;
}
```

Not concise!!

Method `toString()`

- Every object has default method `toString`
- *Automatically* invoked by `print`, `println`

```
Interval a = new Interval(1,2);
System.out.println(a);
```

- Some default text will be printed unless you define a `toString` method

Method `toString()`

- Usually defined to give a *useful* description of an instance of a class
- E.g., useful description of an instance of `Interval` would be the mathematical notation for an Interval, e.g.,

  `[3,7.5]`

  for an `Interval` object with `base` 3 and `width` 4.5.


```
class Interval {
  private double base;  // low end
  private double width; // interval width

  public Interval(double base, double w){
    this.base= base;
    width= w;
  }

  /** =String description of Interval */
  public String toString() {
    return "[" + getBase() + "," + getEnd() +
           "]";
  }
}
```



```
public class Client {
  public static void main(String[] args){
    Interval i1= new Interval(0.2,0.7);
    Interval i2= new Interval(
                      Math.random(),0.2);
    if (i2.isIn(i1))
      System.out.println(i2 + "is in" +
                         i1);
    else
      System.out.println(i2 + "is not in"
                         + i1);
  }
}
```

```
/** Numeric interval -- closed intervals
 */
class Interval {

  private double base;  // low end
  private double width; // interval width

  /** Constructor: An Interval has a specified base and width w */
  public Interval(double base, double w) {
    this.base= base;
    setWidth(w);
  }

  /** =Get right end of this Interval */
  public double getEnd() { return base + width; }

  /** =Get base of this Interval */
  public double getBase() { return base; }

  /** Set width of this Interval to w */
  public void setWidth(double w) { width= w; }

  /** Expand this Interval by a factor of f (expand to the right) */
  public void expand(double f) {
    setWidth(width*f);
  }

  /** ={This Interval is in Interval i}
   *  If the ends of this Interval and i are exactly equal, consider
   *  this Interval to be in i.
   */
  public boolean isIn(Interval i) {
    return ( getBase()>=i.getBase() && getEnd()<=i.getEnd() );
  }

  /** =String description of this Interval */
  public String toString(){
    return "[" + getBase() + "," + getEnd() + "]";
  }

} //class Interval
```