- 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
    - Static variables and methods
- Reading: Sec 4.4, start reading Sec 5.1

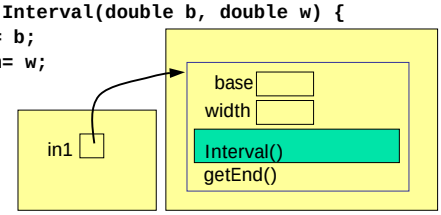
Constructor

- 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

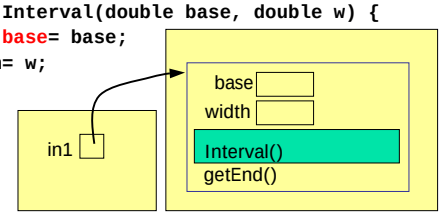

```
public class IntervalClient {
  public static void main(String() args) {
    Interval in1= new Interval(3,1);
  }
}
class Interval {
  ...
  public Interval(double b, double w) {
    base= b;
    width= w;
  }
  ...
}
```




```
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

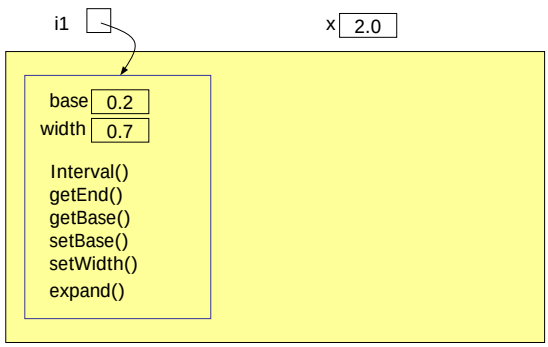
  expand(double f)

  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

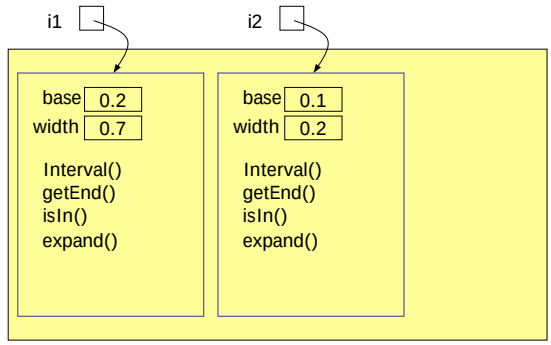
- Write an instance method
  `isIn(Interval i)`
- that returns the **`boolean`** value **`true`** if the instance is in **`Interval i`**. Return **`false`** otherwise.
- Parameter of non-primitive type: pass-by-reference
  I.e., Reference is copied; object itself is not copied


```
/** ="this Interval is in 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!!

```
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.");
  }
}
```

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);
  }
}
```

Static Variables & Methods

- *Shared* by all instances of a class
- Only one copy no matter how many objects have been instantiated
- Keyword: **`static`**
- Examples:
  - A constant used by the whole class
  - A variable to keep track of how many Intervals have been created
  - A method that doesn't need to reference fields

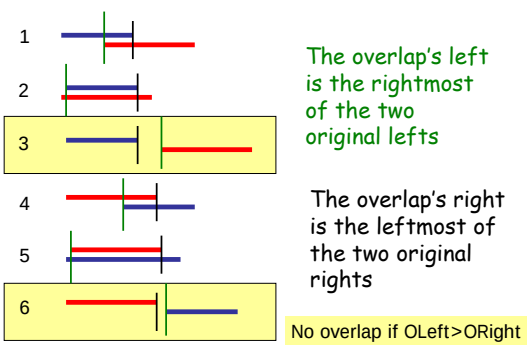
Class (`static`) method

Write a class method

`overlap(Interval a, Interval b)`

that returns a new **`Interval`** representing the overlap between **`Interval`**s **`a`** and **`b`**. (Return **`null`** if there's no overlap)

What is the method header?



The overlap's left is the rightmost of the two original lefts

The overlap's right is the leftmost of the two original rights

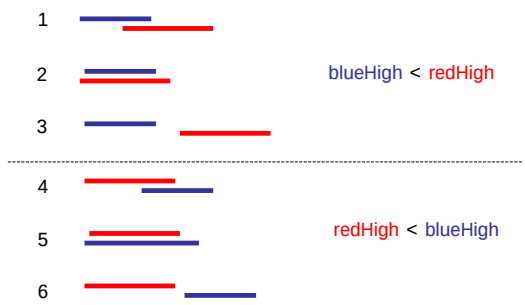
No overlap if OLeft>ORight


```
class Interval {
  private double base;  // low end
  private double width; // interval width
  public static final double MAXwidth= 5; //...

  public Interval(double b, double w) {
    setBase(b);
    setWidth(w);
  }

  public void setBase(double base) {
    this.base= base;
  }

  /* Set width to w, w<=MAXwidth */
  public void setWidth(double w) {
    width= Math.min(w,MAXwidth);
  }
}
```


```
/* =the overlapped Interval between
   Intervals a and b */
public static Interval overlap(Interval a,
                               Interval b) {
  Interval olap;      // overlapped interval
  double left, right; // olap's left & right

  left = Math.max(a.getBase(),b.getBase());
  right = Math.min(a.getEnd(),b.getEnd());
  if ( (right-left) <= 0 )
      olap= null;
  else
      olap= new Interval(left, right-left);
  return olap;
}
```