

# Lecture 4

Classes and Objects

# Review

# Solutions 1

```
public static int getMinIndex(int[] values) {  
  
    int minValue = Integer.MAX_VALUE;  
    int minIndex = -1;  
  
    for(int i=0; i<values.length; i++)  
        if (values[i] < minValue) {  
            minValue = values[i];  
            minIndex = i;  
        }  
  
    return minIndex;  
}
```

# Solutions 2

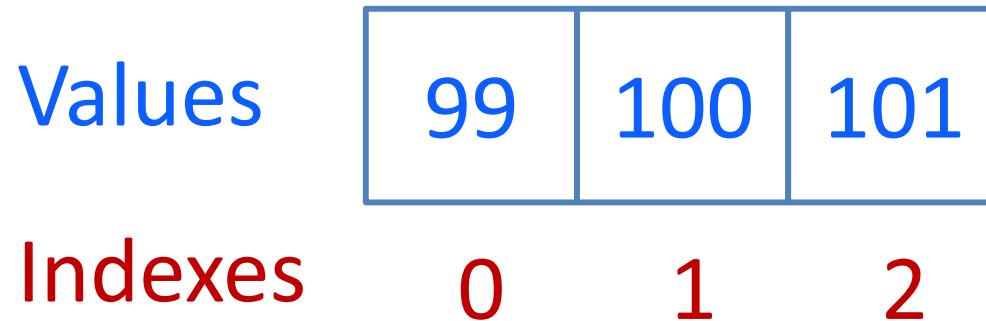
```
public static int getSecondMinIndex(int[] values) {  
    int secondIdx = -1;  
    int minIdx= getMinIndex(values);  
  
    for(int i=0; i<values.length; i++) {  
        if (i == minIdx)  
            continue;  
        if (secondIdx == -1 ||  
            values[i] < values[secondIdx])  
            secondIdx = i;  
    }  
    return secondIdx;  
}
```

- What happens if  $\text{values} = \{0\}$ ?  $\text{values} = \{0, 0\}$ ?  $\text{values} = \{0, 1\}$ ?

# Popular Issues 1

- Array **Index** vs Array **Value**

```
int [] values = { 99, 100, 101 };  
System.out.println(values[0] ); // 99
```



# Popular Issues 2

- Curly braces { ... } after **if/else**, **for/while**

```
for (int i = 0; i < 5; i++)  
    System.out.println("Hi");  
    System.out.println("Bye");
```

- What does this print?

# Popular Issues 3

- Variable initialization

```
int minValue(int[] vals) {  
    int min = 0;  
    for (int i = 0; i < vals.length; i++) {  
        if (vals[i] < min) {  
            min = vals[i]  
        }  
    }  
}
```

- What if `vals = {1, 2, 3}`? ← Problem?
- Set `min = Integer.MAX_VALUE` or `vals[0]`

# Popular Issues 4

- Variable Initialization – secondMinIndex

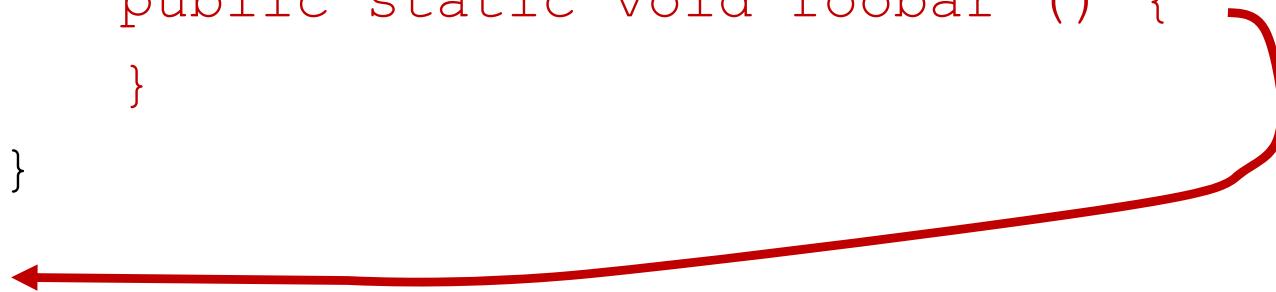
```
int minIdx = getMin(vals)
int secondIdx = 0;
for (int i = 0; i < vals.length; i++) {
    if (i == minIdx) continue;
    if (vals[i] < vals[secondIdx])
        secondIdx = i;
}
```

- What if `vals` = {0, 1, 2}?
- See solutions

# Popular Issues 5

## Defining a method inside a method

```
public static void main(String[] arguments) {  
    public static void foobar () {  
    }  
}
```



# Debugging Notes 1

- Use `System.out.println` throughout your code to see what it's doing

```
for ( int i=0; i< vals.length; i++) {  
    if ( vals[i] < minVal) {  
        System.out.println("cur min: " + minVal);  
        System.out.println("new min: " + vals[i]);  
        minVal = vals[i];  
    }  
}
```

# Debugging Notes 2

- Formatting
- Ctrl-shift-f is your friend

```
for (int i = 0; i < vals.length; i++) {  
    if (vals[i] < vals[minIdx]) {  
        minIdx=i;  
    }  
    return minIdx; }
```

- Is there a bug? Who knows! Hard to read

# Today's Topics

Object oriented programming

Defining Classes

Using Classes

References vs Values

Static types and methods

# Today's Topics

Object oriented programming

Defining Classes

Using Classes

References vs Values

Static types and methods

Whew!  
That's a lot!

# Object oriented programming

- Represent the real world

Baby

# Object oriented programming

- Represent the real world

Baby

Name

Sex

Weight

Decibels

# poops so far

# Object Oriented Programming

- Objects group together
  - Primitives (int, double, char, etc..)
  - Objects (String, etc...)

Baby

```
String name  
boolean isMale  
double weight  
double decibels  
int numPoops
```

# Why use **classes**?

- Why not just primitives?

```
// little baby alex  
String nameAlex;  
double weightAlex;  
// little baby david  
String nameDavid;  
double weightDavid;
```

# Why use **classes**?

- Why not just primitives?

```
// little baby alex  
String nameAlex;  
  
double weightAlex;  
  
// little baby david  
String nameDavid;  
  
double weightDavid;  
  
// little baby david  
String nameDavid2;  
  
double weightDavid2;
```



David2?  
Terrible ☹

# Why use **classes**?

- Why not just primitives?

```
// little baby alex  
String nameAlex;  
  
double weightAlex;  
  
// little baby david  
String nameDavid;  
  
double weightDavid;  
  
// little baby david  
String nameDavid2;  
  
double weightDavid2;
```



David2?  
Terrible ☹

500 Babies? That Sucks!

# Why use **classes**?



Baby1

# Why use **classes**?



Baby1



Baby2



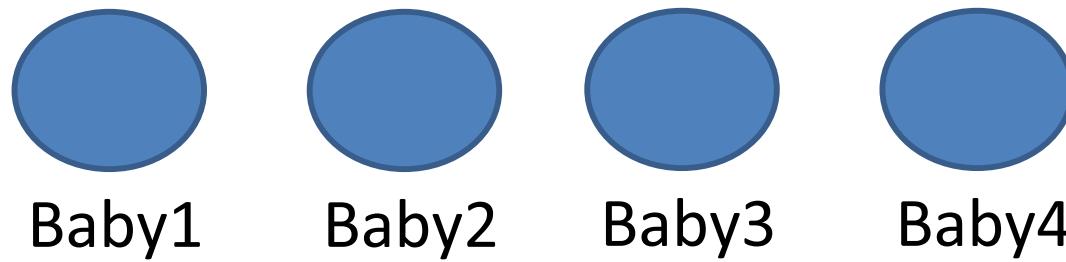
Baby3



Baby4

496  
more  
Babies  
...

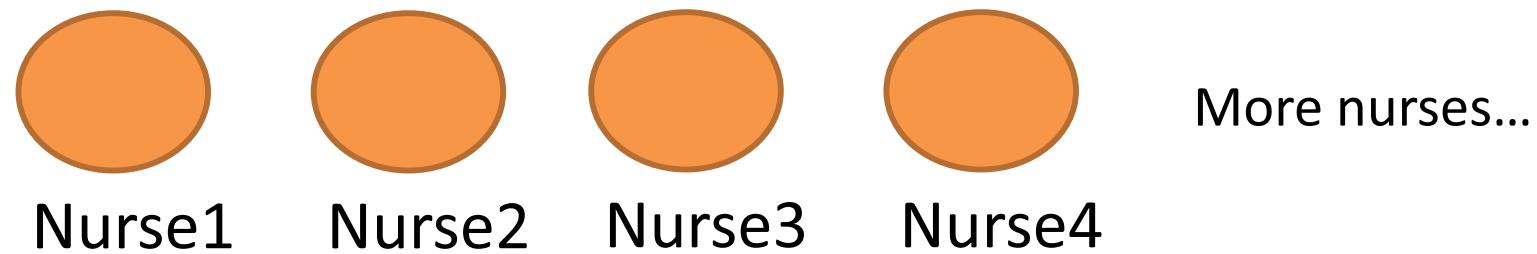
# Why use **classes**?



496 more  
Babies ...

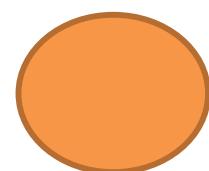
Nursery

# Why use **classes**?



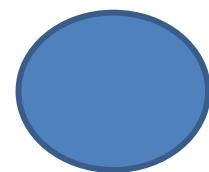
Nursery

# Why use **classes**?



[ ]

Nurse

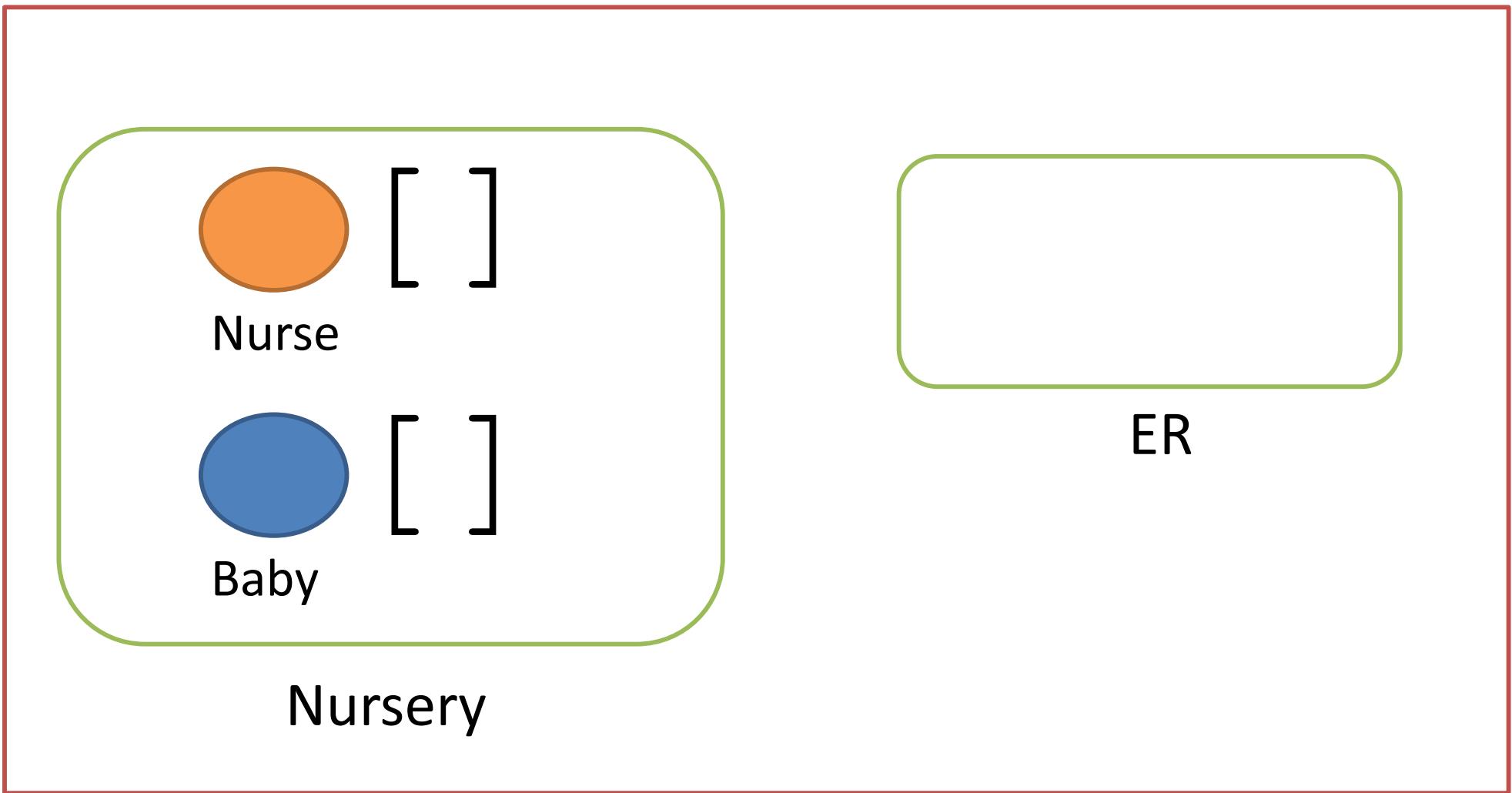


[ ]

Baby

Nursery

# Why use **classes**?



Hospital

# Defining classes

# Class - overview

```
public class Baby {  
    String name;  
    boolean isMale;  
    double weight;  
    double decibels;  
    int numPoops = 0;  
  
    void poop() {  
        numPoops += 1;  
        System.out.println("Dear mother, "+  
            "I have pooped. Ready the diaper.");  
    }  
}
```

Class  
Definition

# Class - overview

```
Baby myBaby = new Baby();
```

Class  
Instance

# Let's declare a baby!

```
public class Baby {
```

```
}
```

# Let's declare a baby!

```
public class Baby {
```

fields

methods

```
}
```

# Note

- Class names are Capitalized
- 1 Class = 1 file
- Having a main method means the class can be run

# Baby fields

```
public class Baby {  
  
    TYPE var_name;  
    TYPE var_name = some_value;  
  
}
```

# Baby fields

```
public class Baby {  
    String name;  
    double weight = 5.0;  
    boolean isMale;  
    int numPoops = 0;  
}
```

# Baby Siblings?

```
public class Baby {  
    String name;  
    double weight = 5.0;  
    boolean isMale;  
    int numPoops = 0;  
XXXXX    YYYY;  
}
```

# Baby Siblings?

```
public class Baby {  
    String name;  
    double weight = 5.0;  
    boolean isMale;  
    int numPoops = 0;  
Baby[] siblings;  
}
```

# Ok, let's make this baby!

```
Baby ourBaby = new Baby();
```

But what about it's name? it's sex?

# Constructors

```
public class CLASSNAME {  
    CLASSNAME ( ) {  
    }  
  
    CLASSNAME ( [ARGUMENTS] ) {  
    }  
}  
  
CLASSNAME obj1 = new CLASSNAME () ;  
CLASSNAME obj2 = new CLASSNAME ( [ARGUMENTS] )
```

# Constructors

- Constructor name == the class name
- No return type – never returns anything
- Usually initialize fields
- All classes need at least one constructor
  - If you don't write one, defaults to

```
CLASSNAME () {  
}
```

# Baby constructor

```
public class Baby {  
    String name;  
    boolean isMale;  
    Baby(String myname, boolean maleBaby) {  
        name = myname;  
        isMale = maleBaby;  
    }  
}
```

# Baby methods

```
public class Baby {  
    String name = "Slim Shady";  
    ...  
    void sayHi() {  
        System.out.println(  
            "Hi, my name is.. " + name);  
    }  
}
```

# Baby methods

```
public class Baby {  
    String weight = 5.0;  
  
    void eat(double foodWeight) {  
        if (foodWeight >= 0 &&  
            foodWeight < weight) {  
            weight = weight + foodWeight;  
        }  
    }  
}
```

# Baby class

```
public class Baby {  
    String name;  
    double weight = 5.0;  
    boolean isMale;  
    int numPoops = 0;  
    Baby[] siblings;  
  
    void sayHi() {...}  
    void eat(double foodWeight) {...}  
}
```

# Using classes

# Classes and Instances

```
// class Definition  
public class Baby { ... }
```

```
// class Instances  
Baby shiloh = new Baby("Shiloh Jolie-Pitt", true);  
Baby knox   = new Baby("Knox Jolie-Pitt", true);
```

# Accessing fields

- Object.**FIELDNAME**

```
Baby shiloh = new Baby("Shiloh Jolie-Pitt",
                      true)

System.out.println(shiloh.name);
System.out.println(shiloh.numPoops);
```

# Calling Methods

- Object.**METHODNAME([ARGUMENTS])**

```
Baby shiloh = new Baby("Shiloh Jolie-Pitt",
                      true)
shiloh.sayHi();      // "Hi, my name is ..."
shiloh.eat(1);
```

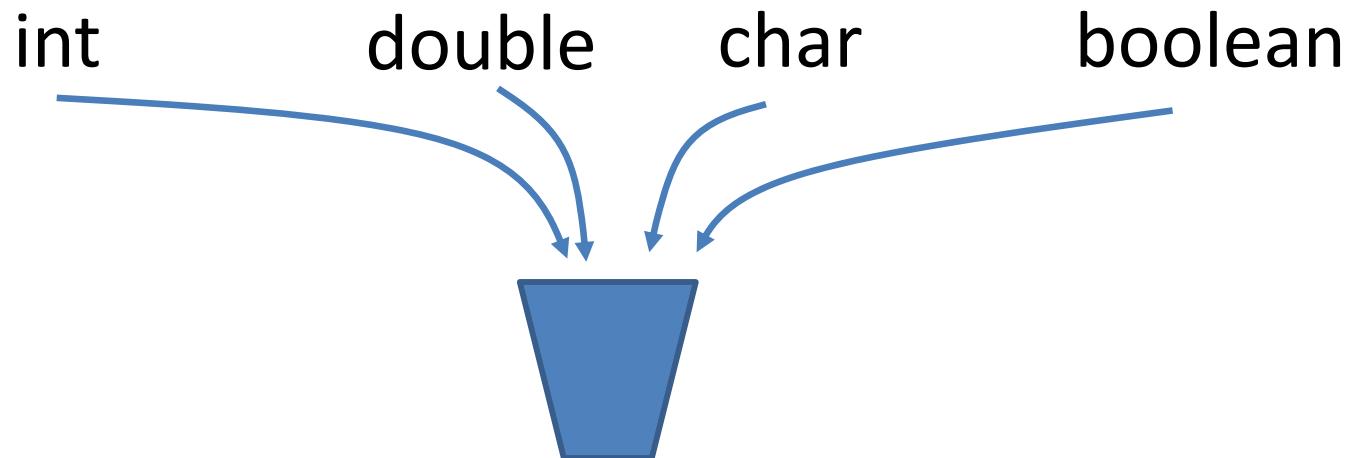
# References vs Values

# Primitives vs References

- Primitive types are basic java types
  - int, long, double, boolean, char, short, byte, float
  - The actual values are stored in the variable
- Reference types are arrays and objects
  - String, int[], Baby, ...

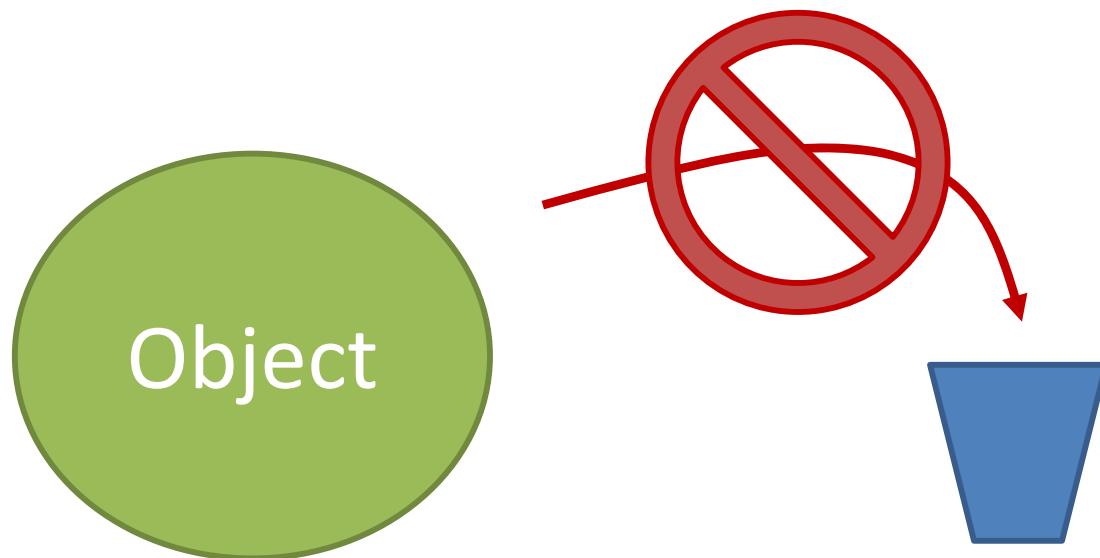
# How java stores primitives

- Variables are like fixed size cups
- Primitives are small enough that they just fit into the cup



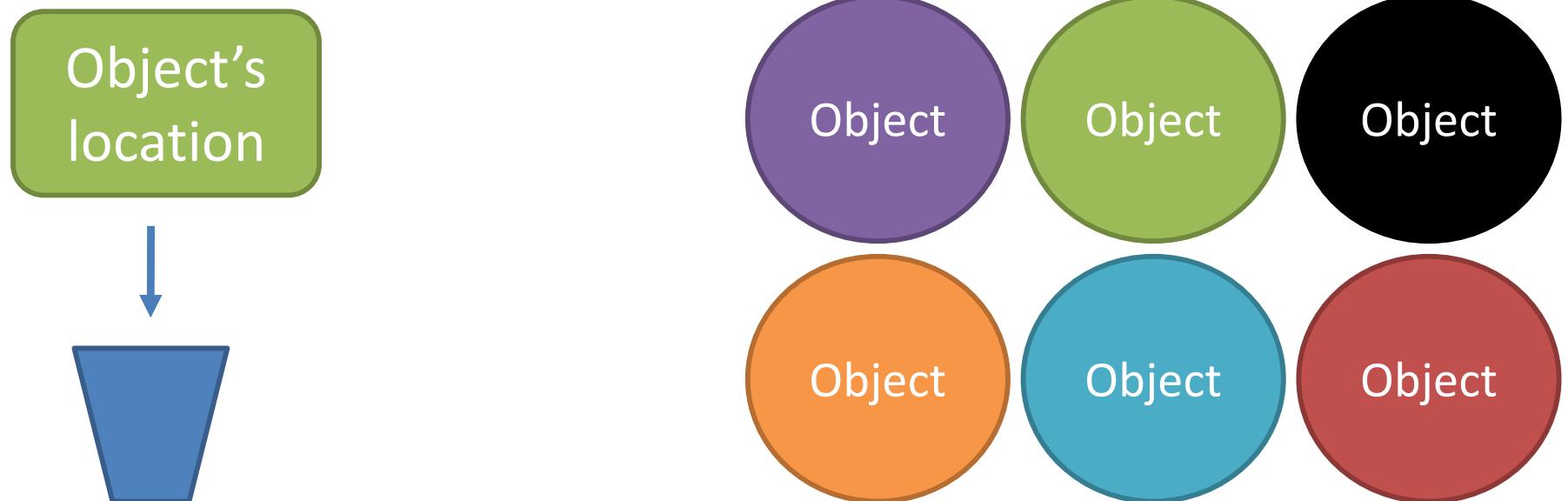
# How java stores objects

- Objects are too big to fit in a variable
  - Stored somewhere else
  - Variable stores a number that locates the object



# How java stores objects

- Objects are too big to fit in a variable
  - Stored somewhere else
  - Variable stores a number that locates the object



# References

- The object's location is called a **reference**
- **==** compares the references

```
Baby shiloh1 = new Baby("shiloh");
```

```
Baby shiloh2 = new Baby("shiloh");
```

Does shiloh1 == shiloh2?

# References

- The object's location is called a **reference**
- **==** compares the references

```
Baby shiloh1 = new Baby("shiloh");
```

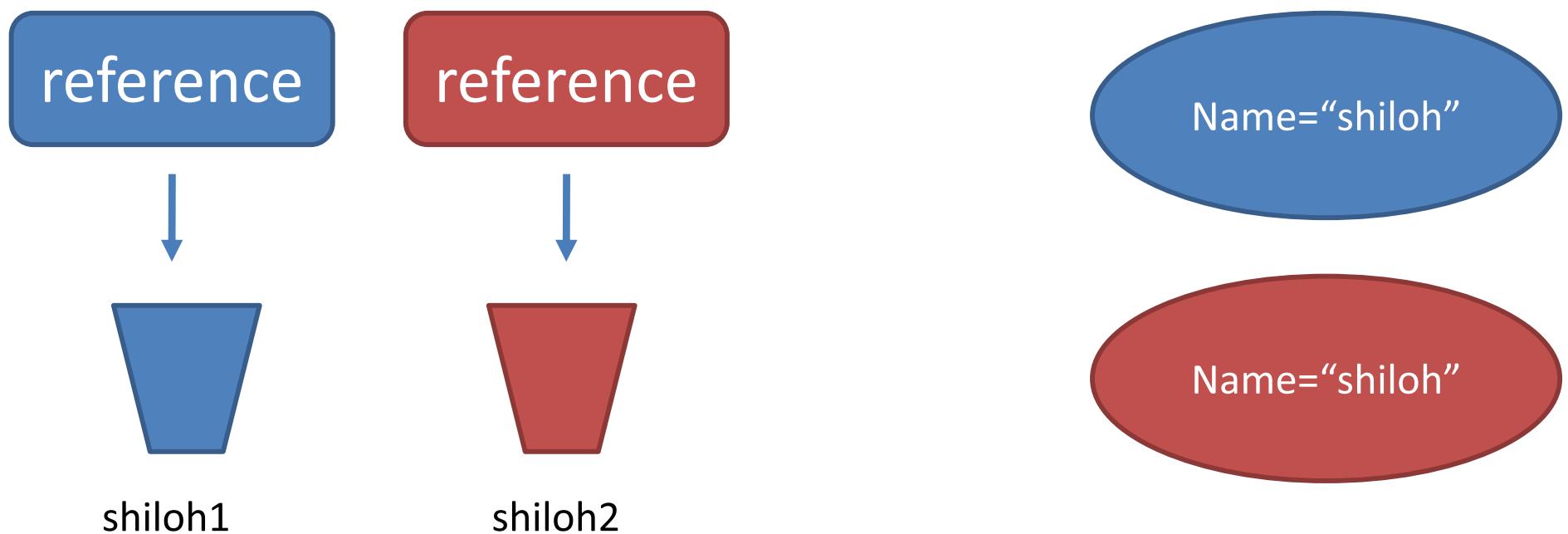
```
Baby shiloh2 = new Baby("shiloh");
```

Does shiloh1 == shiloh2?

no

# References

```
Baby shiloh1 = new Baby("shiloh");  
Baby shiloh2 = new Baby("shiloh");
```



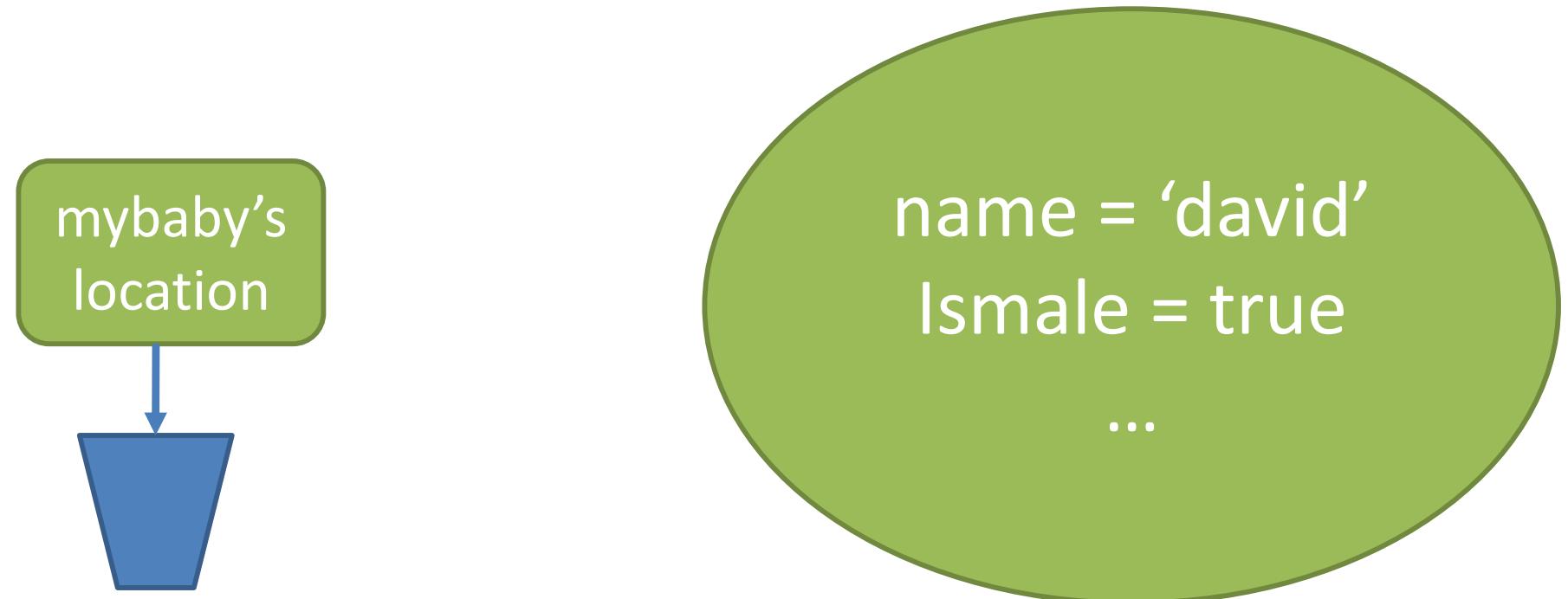
# References

```
Baby mybaby = new Baby("davy", true)  
mybaby.name = "david"
```



# References

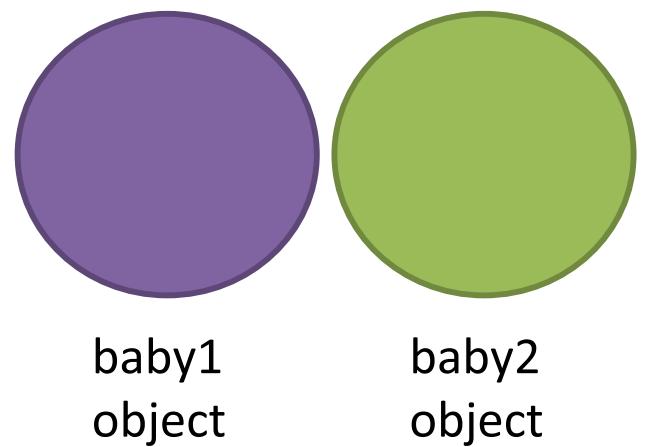
```
Baby mybaby = new Baby('davy', true)  
mybaby.name = 'david'
```



# References

- Using = updates the reference.

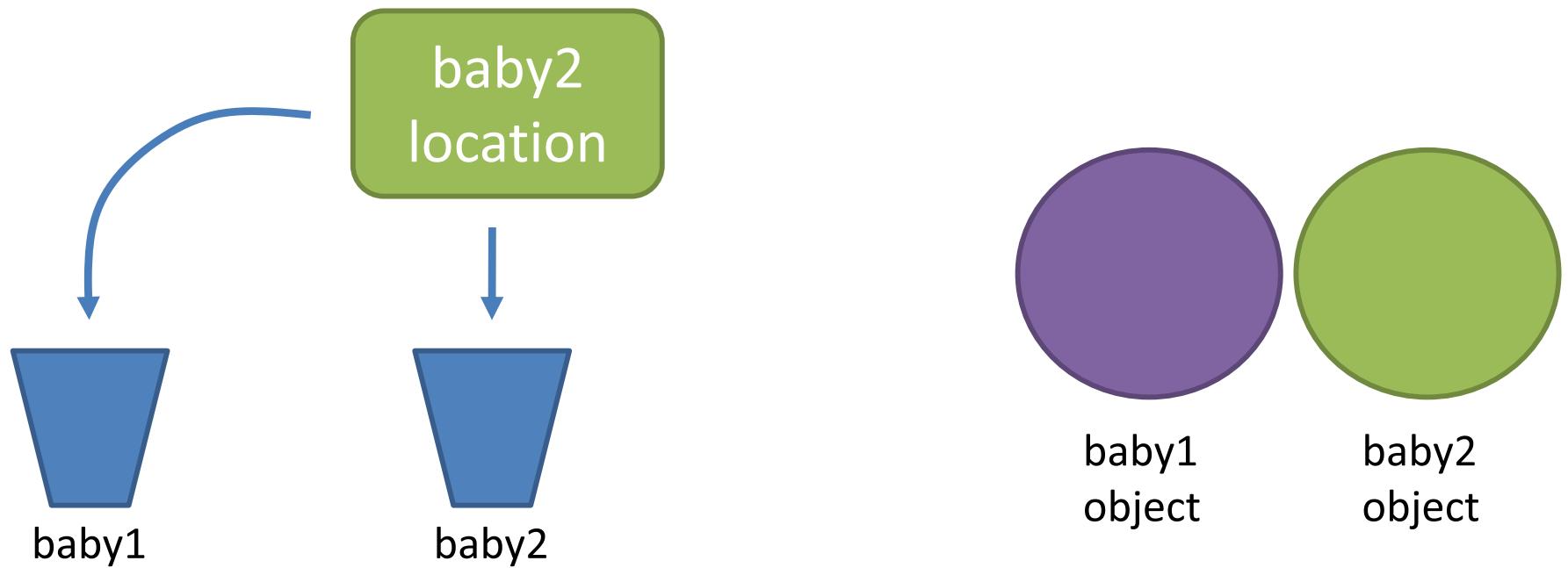
`baby1 = baby2`



# References

- Using = updates the reference.

`baby1 = baby2`



# References

- using [ ] or •
  - Follows the reference to the object
  - May modify the object, but never the reference
- Imagine
  - Following directions to a house
  - Moving the furniture around
- Analogous to
  - Following the reference to an object
  - Changing fields in the object

# Methods and references

```
void doSomething(int x, int[] ys, Baby b) {  
    x = 99;  
    ys[0] = 99;  
    b.name = "99";  
}
```

...

```
int i = 0;  
int[] j = {0};  
Baby k = new Baby("50", true);  
doSomething(i, j, k);
```

i=? j=? k=?

# static types and methods

# static

- Applies to fields and methods
- Means the field/method
  - Is **defined for the class declaration**,
  - Is **not** unique for each instance

# static

```
public class Baby {  
    static int numBabiesMade = 0;  
}  
  
Baby.numBabiesMade = 100;  
Baby b1 = new Baby();  
Baby b2 = new Baby();  
Baby.numBabiesMade = 2;
```

What is

b1.numBabiesMade?

b2.numBabiesMade?

# static example

- Keep track of the number of babies that have been made.

```
public class Baby {  
    int numBabiesMade = 0;  
    Baby() {  
        numBabiesMade += 1;  
    }  
}
```

# static field

- Keep track of the number of babies that have been made.

```
public class Baby {  
    static int numBabiesMade = 0;  
    Baby() {  
        numBabiesMade += 1;  
    }  
}
```

# static method

```
public class Baby {  
    static void cry(Baby thebaby) {  
        System.out.println(thebaby.name + "cries");  
    }  
}
```

Or

```
public class Baby {  
    void cry() {  
        System.out.println(name + "cries");  
    }  
}
```

# static notes

- Non-static methods can reference static methods, but not the other way around
  - Why?

```
public class Baby {  
    String name = "DMX";  
    static void whoami() {  
        System.out.println(name);  
    }  
}
```

# main

- Why is main static?

```
public static void main(String[] arguments) {  
}
```

# Assignment 4

- Modeling Book and Libraries
  - class Book {}
  - class Library{}
- Books can be
  - Borrowed
  - Returned
- Library
  - Keeps track of books
  - **Hint:** use Book[]

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