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 values = {0}? values = {0, 0}? values = {0,1}?

Popular Issues 1

- Array Index vs Array Value

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

Values	99	100	101
Indexes	0	1	2

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 getMinValue(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

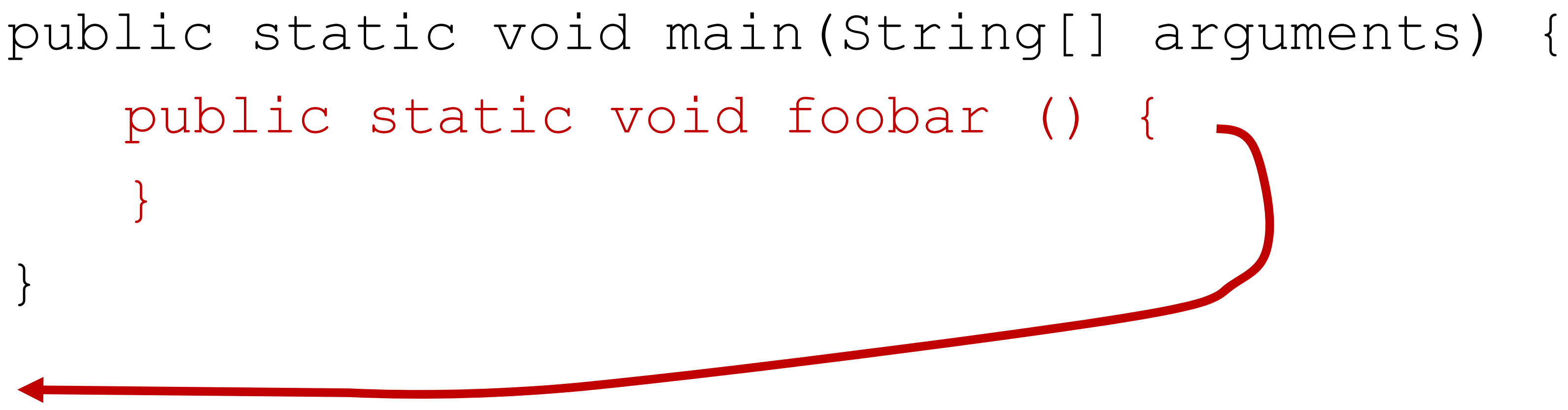
- Variable Initialization – secondMinIndex

```
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?

Name

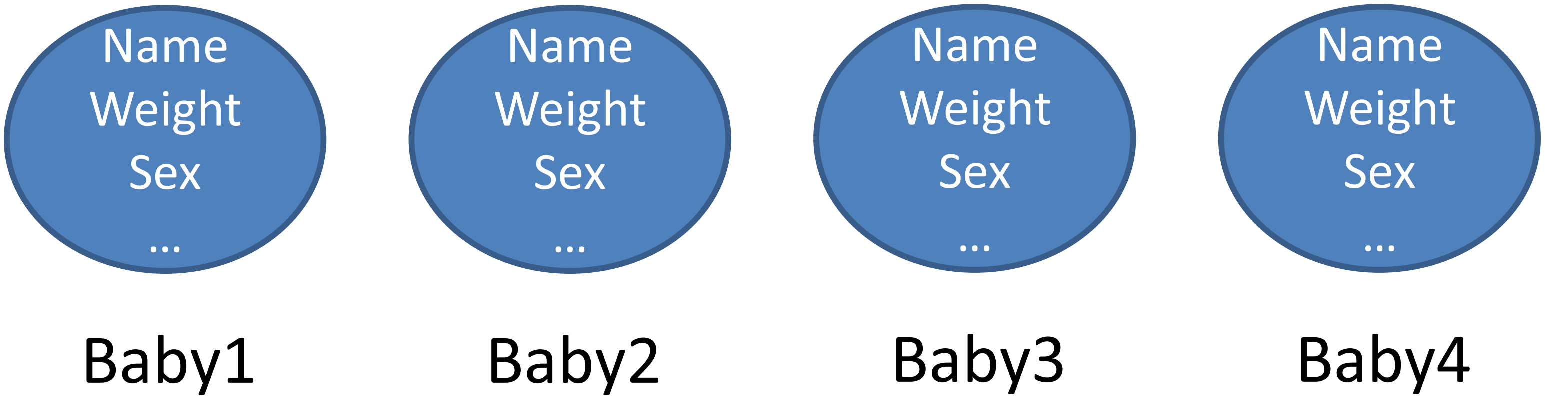
Weight

Sex

…

Baby1

Why use classes?



Name
Weight
Sex
…

Baby1

Name
Weight
Sex
…

Baby2

Name
Weight
Sex
…

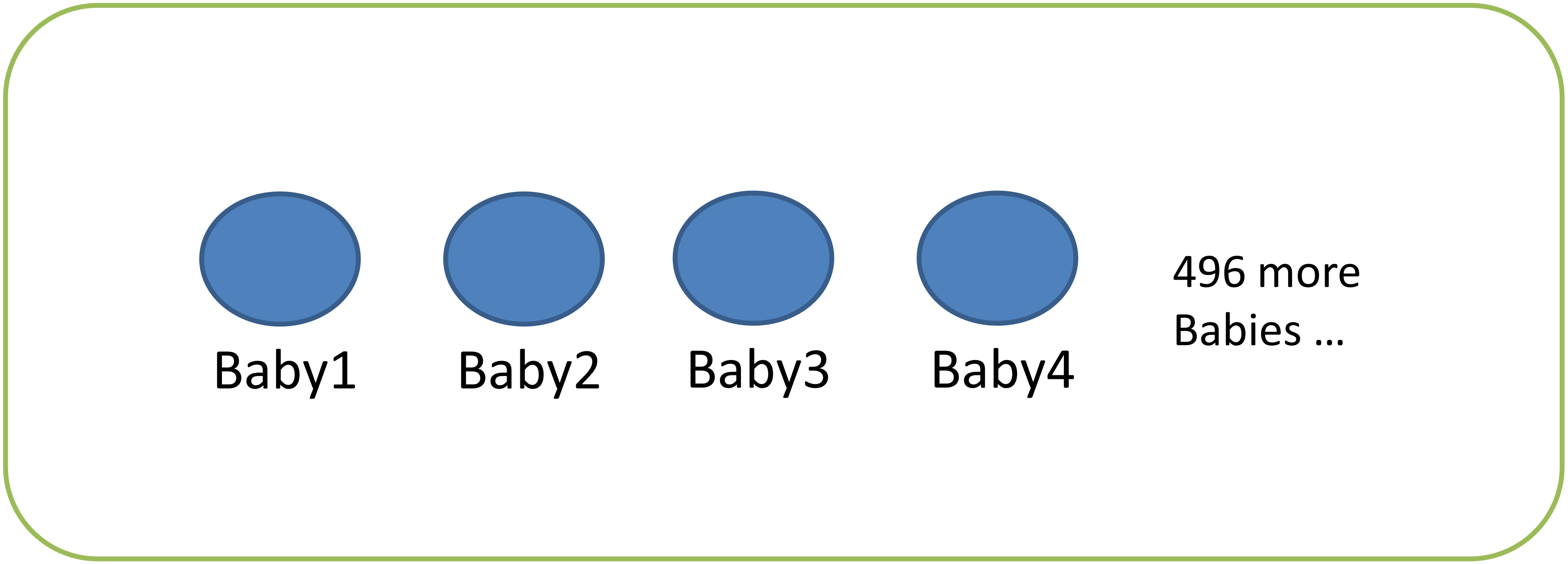
Baby3

Name
Weight
Sex
…

Baby4

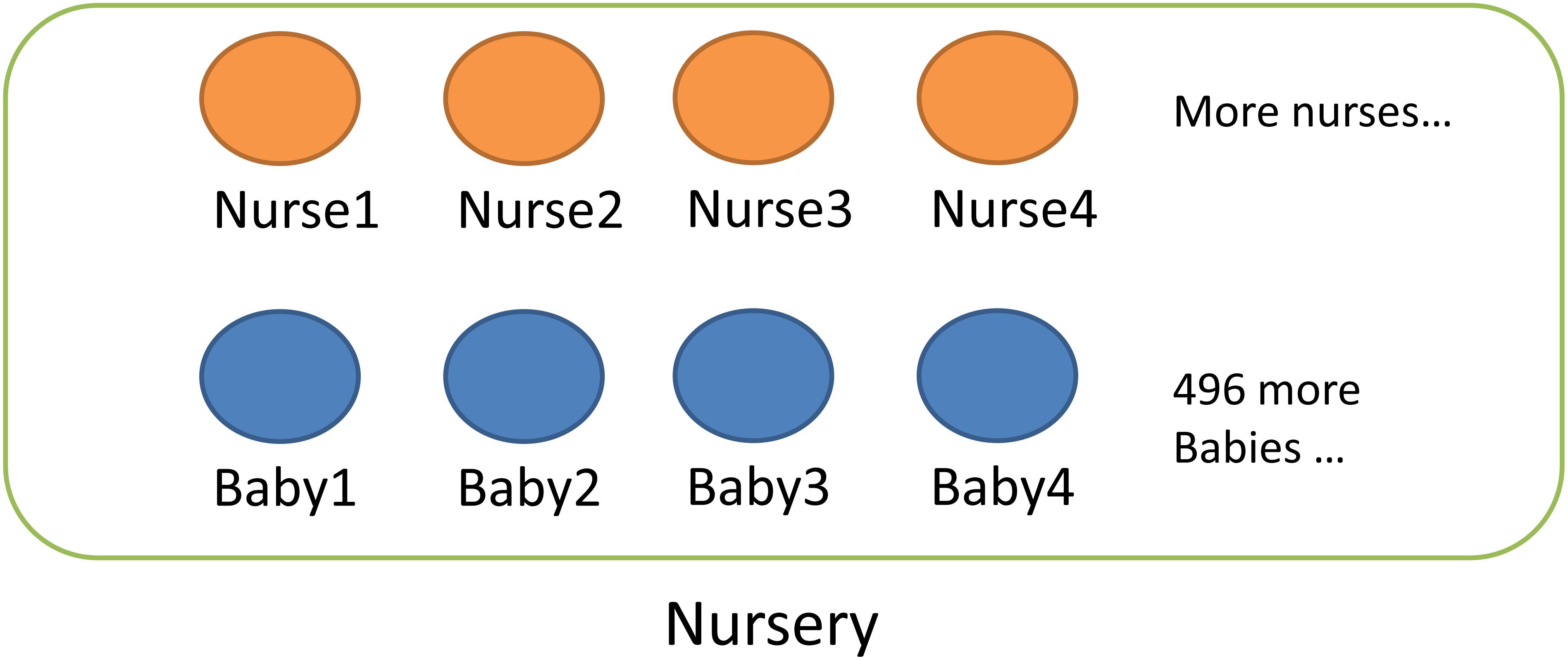
496
more
Babies
…

Why use classes?

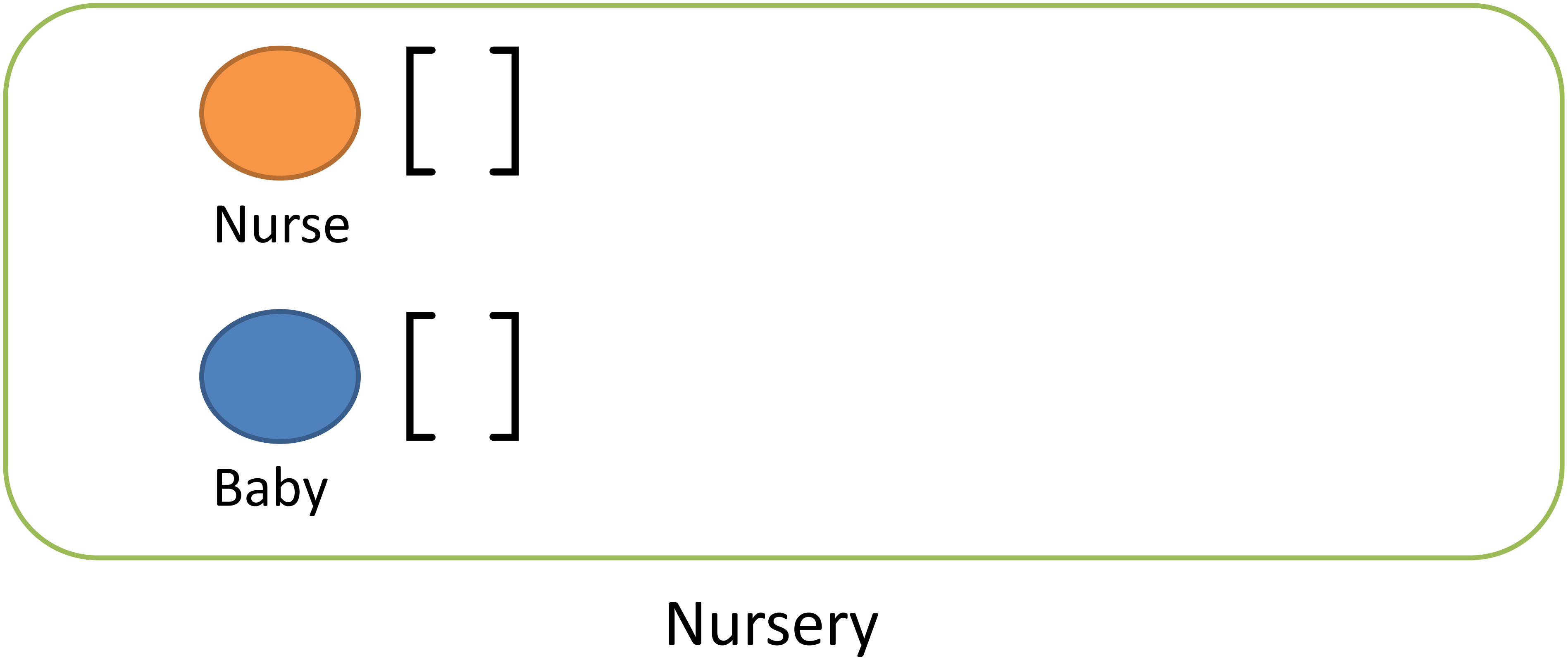


Nursery

Why use classes?



Why use classes?

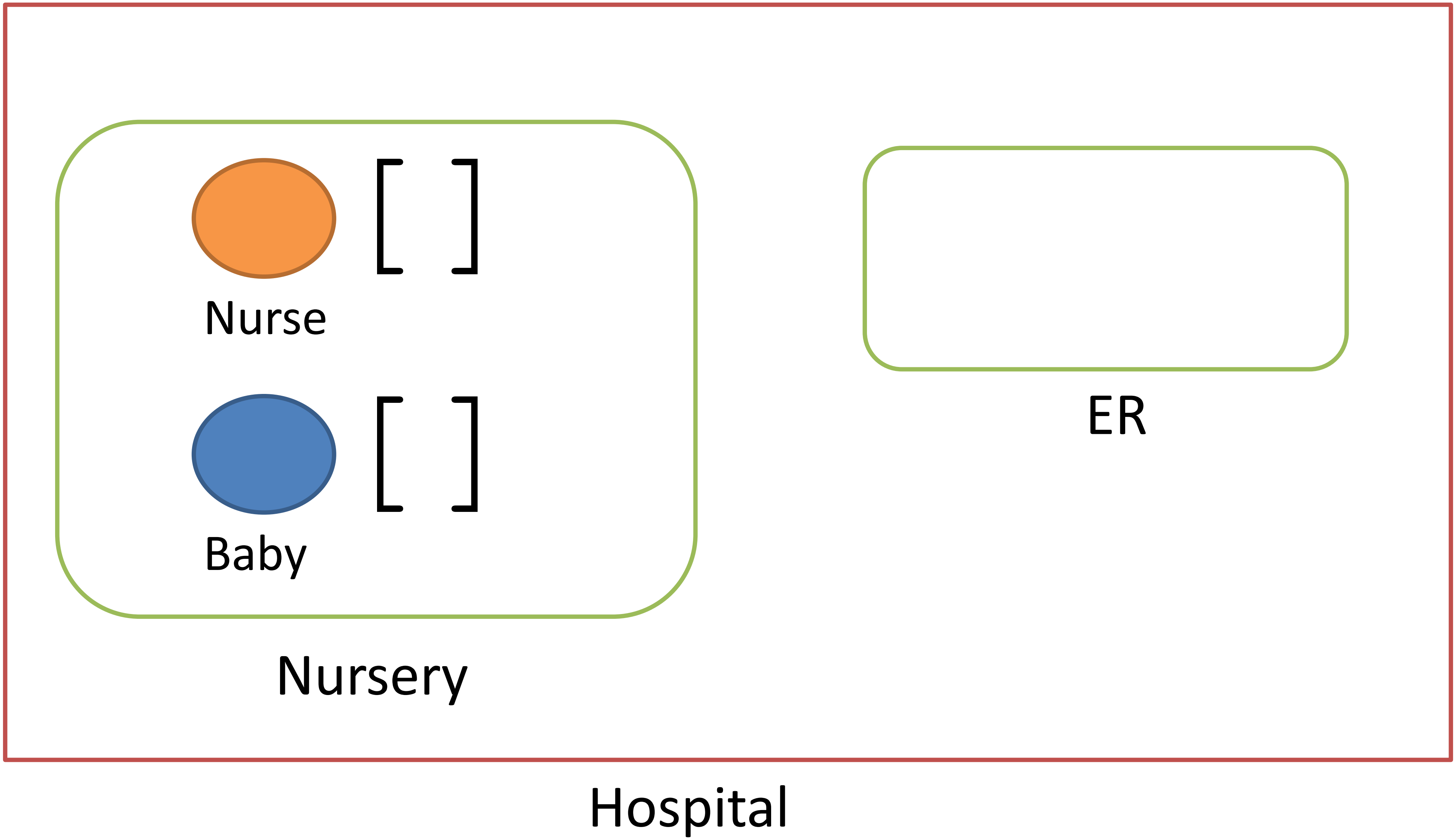


Nurse [ ]

Baby [ ]

Nursery

Why use classes?



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

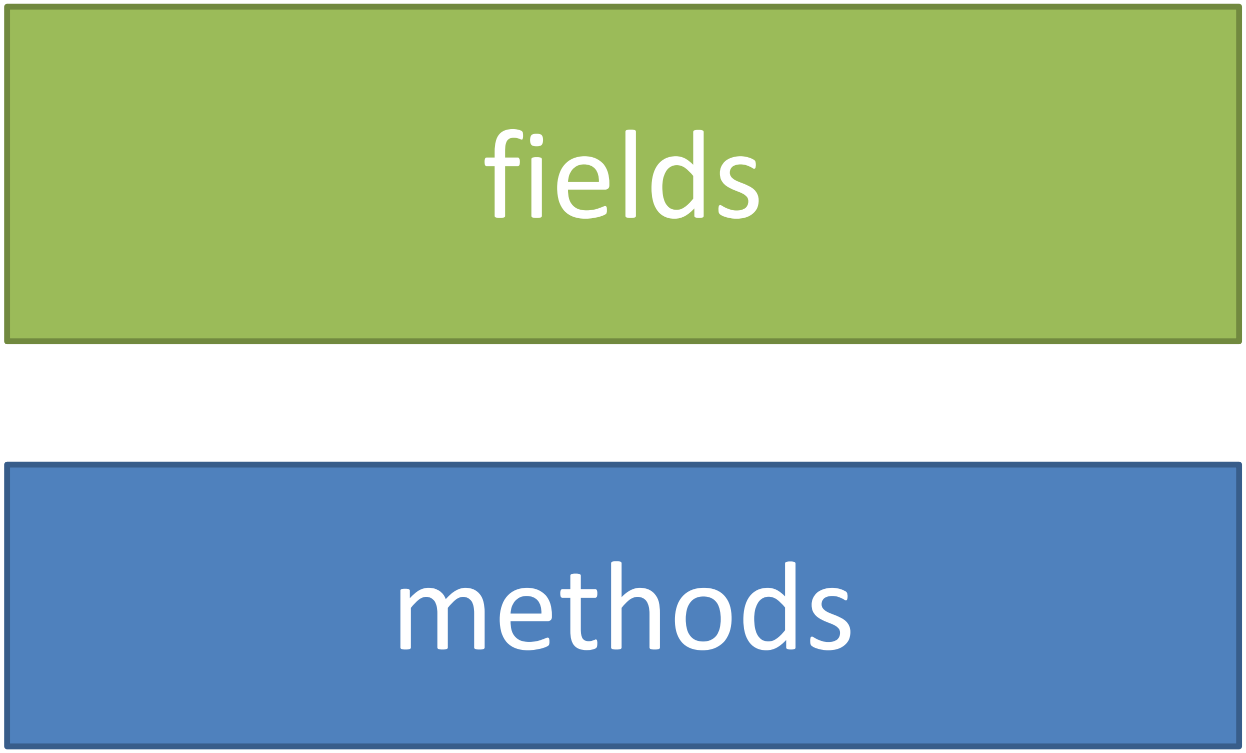
Instance

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  YYYYY;

}
```

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

```java
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

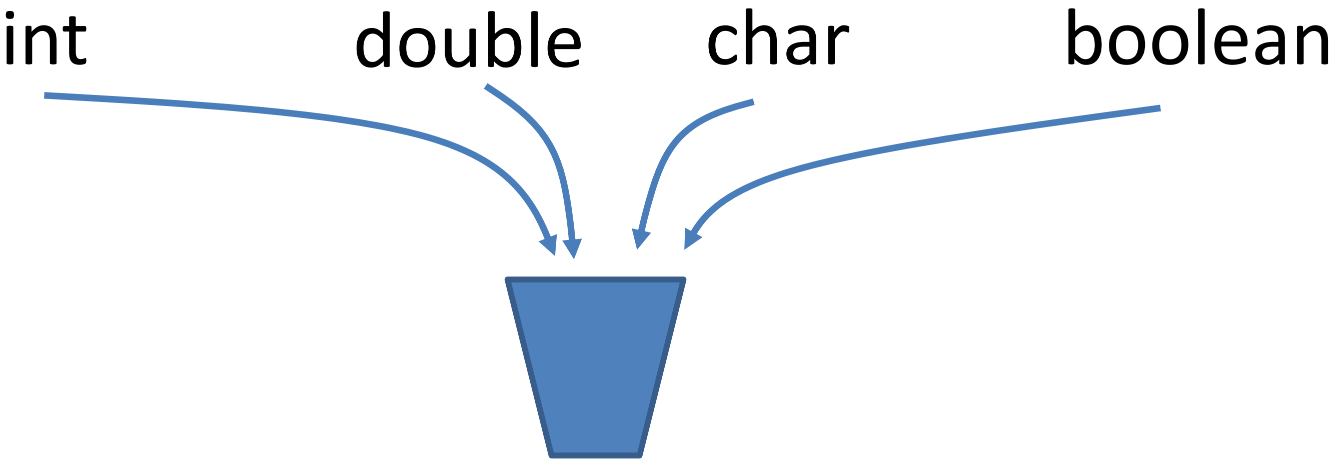
Primitives vs References

- 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, …

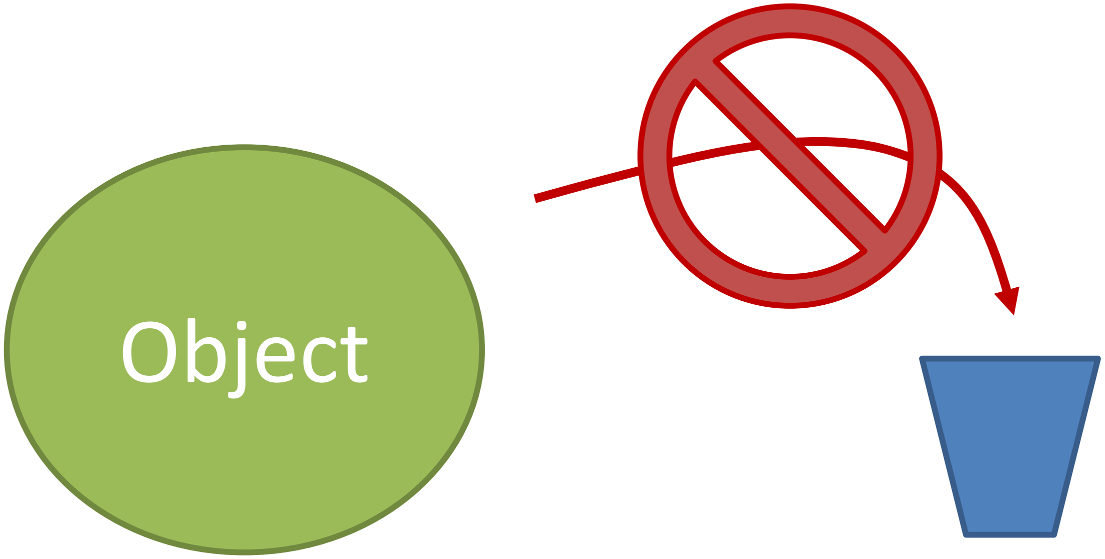
How java stores primitives

- 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
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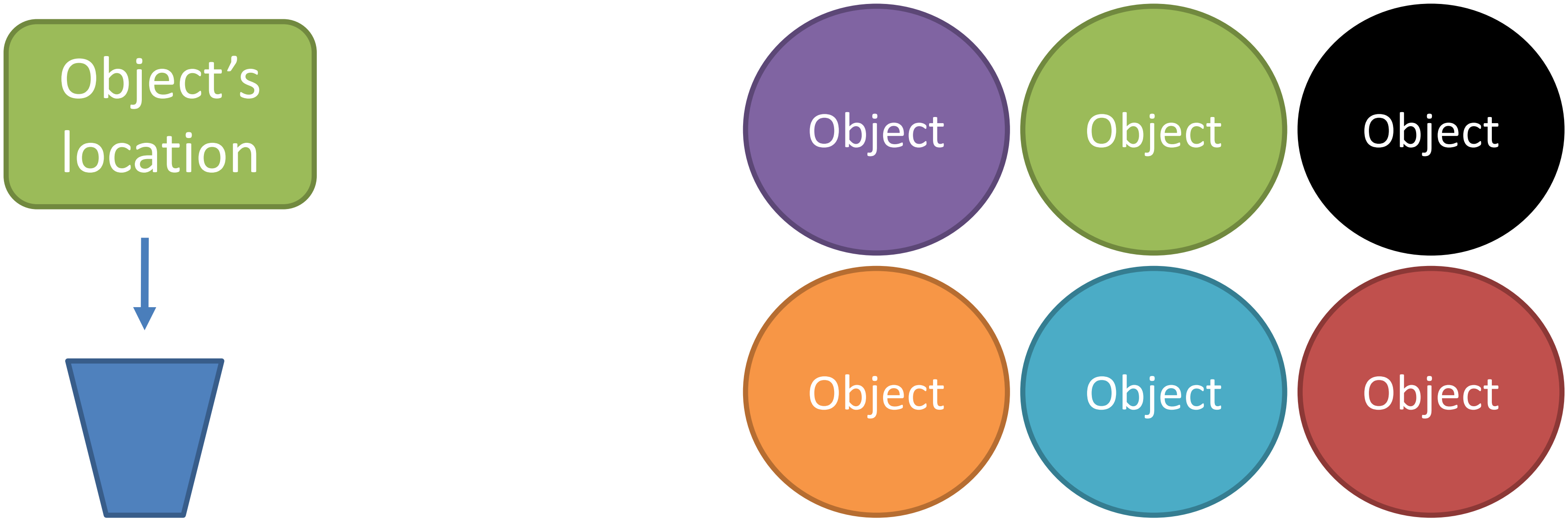


References

- 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

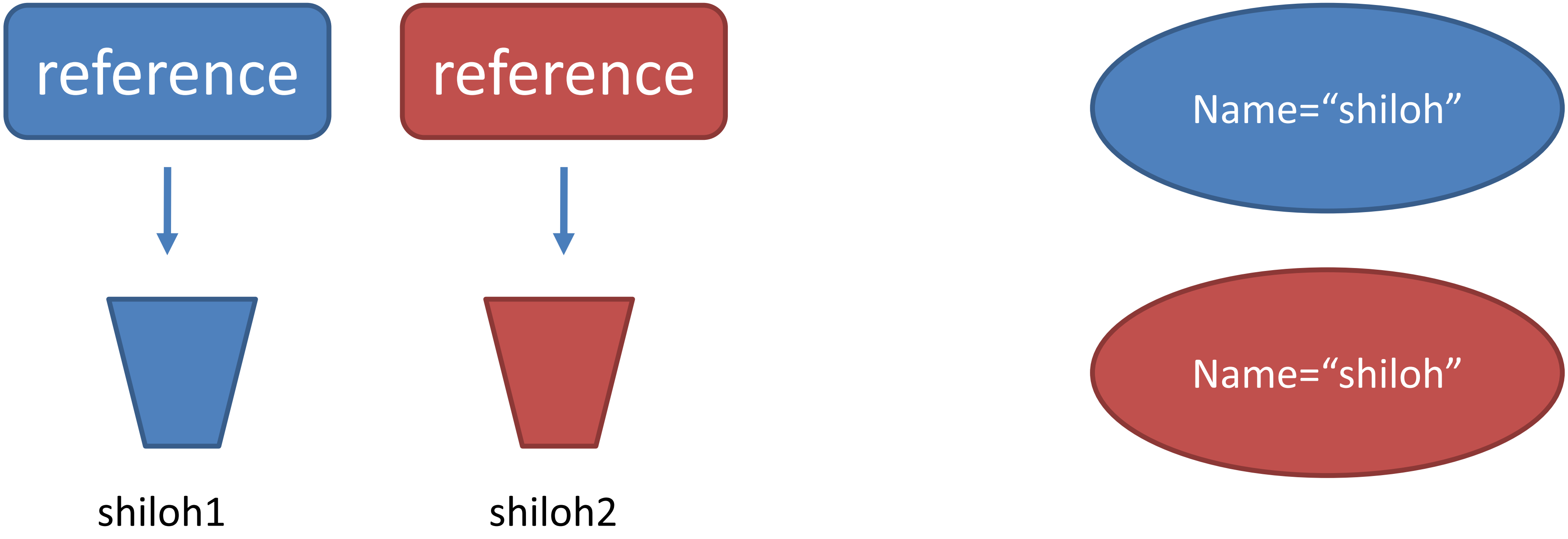
```
Baby shiloh1 = new Baby(“shiloh”);
Baby shiloh2 = new Baby(“shiloh”);
```

Does `shiloh1 == shiloh2`?

no

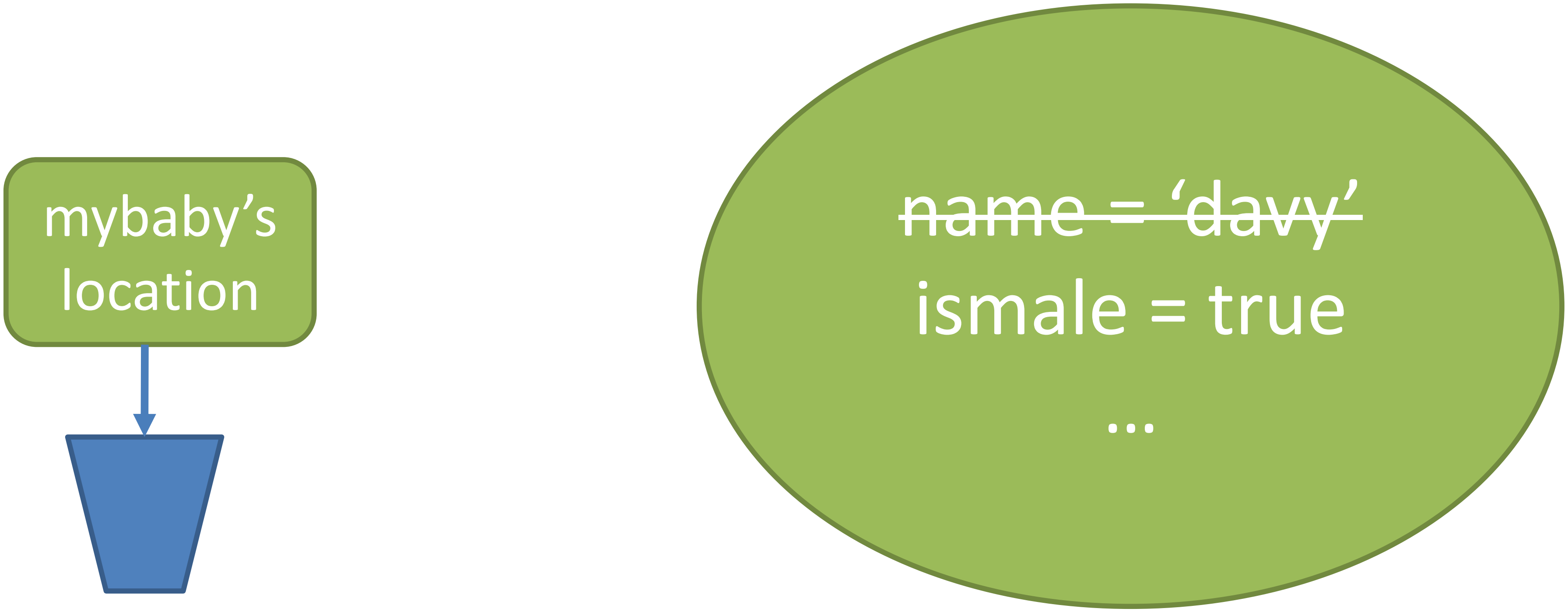
References

```
Baby shiloh1 = new Baby(“shiloh”);
Baby shiloh2 = new Baby(“shiloh”);
```



References

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



mybaby’s location

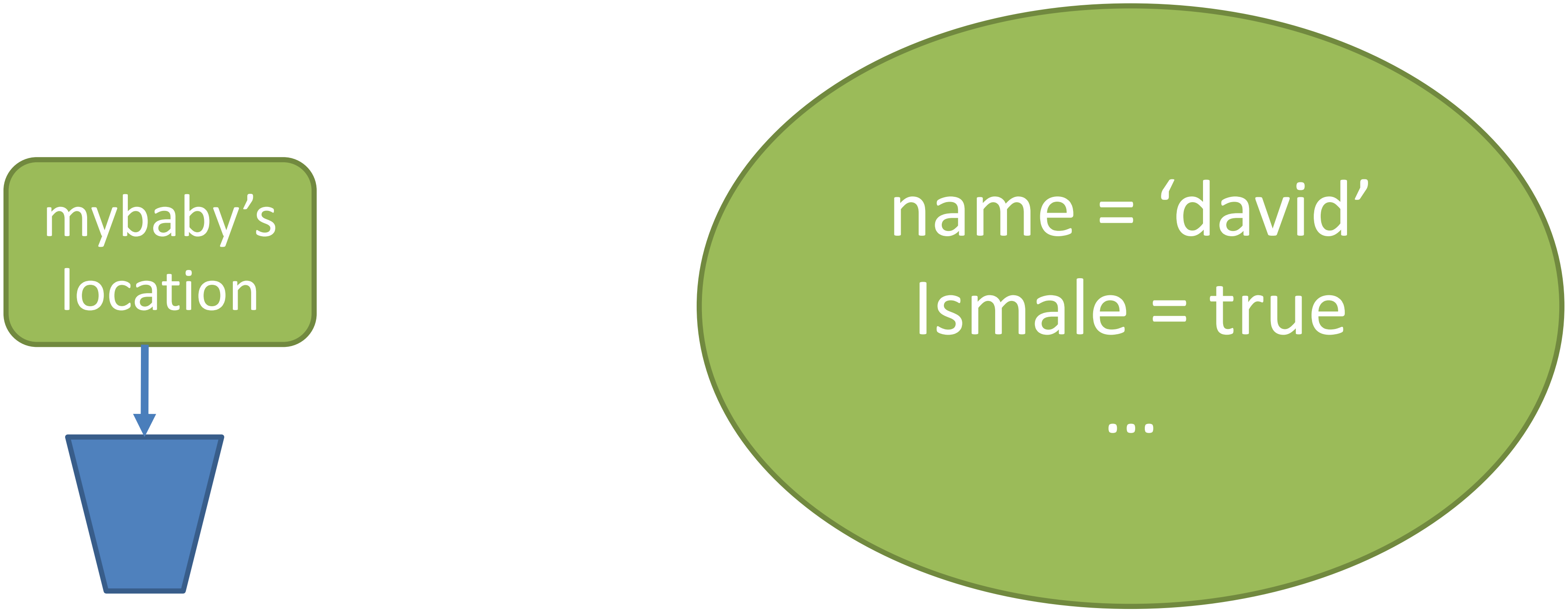
~~name = ‘davy’~~

ismale = true

…

References

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



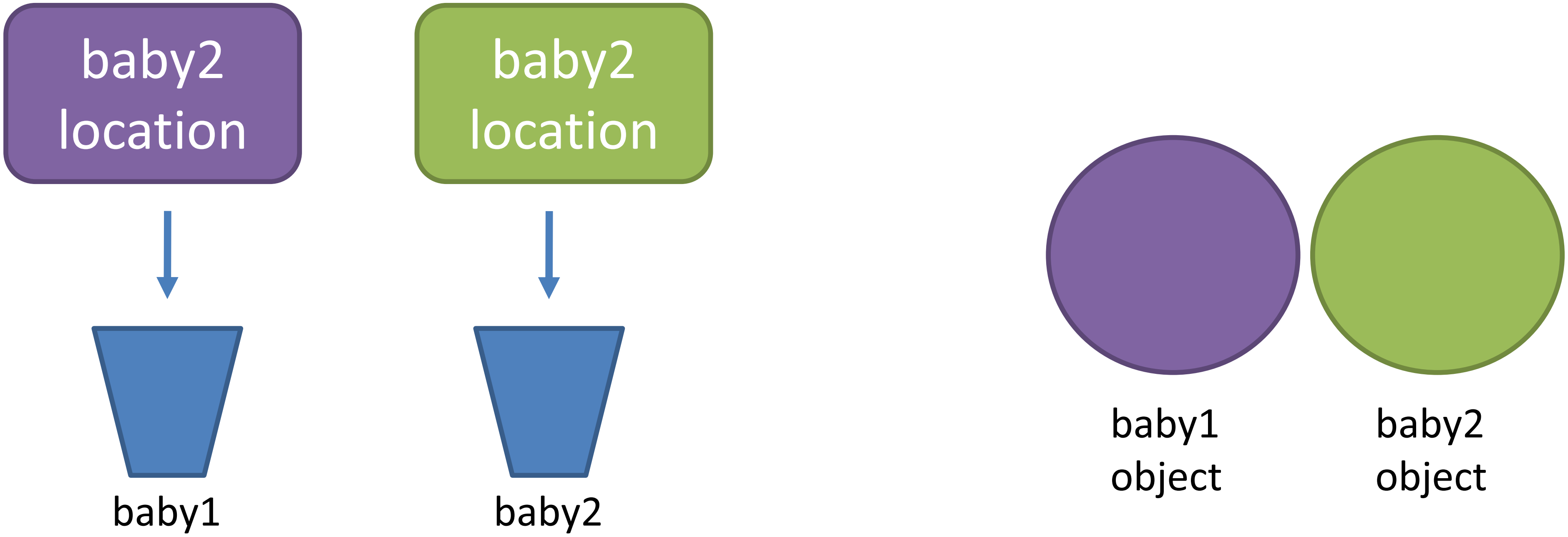
mybaby’s location

name = ‘david’
Ismale = true
…

References

- Using = updates the reference.

```
baby1 = baby2
```



baby2 location

baby2 location

baby1

baby2

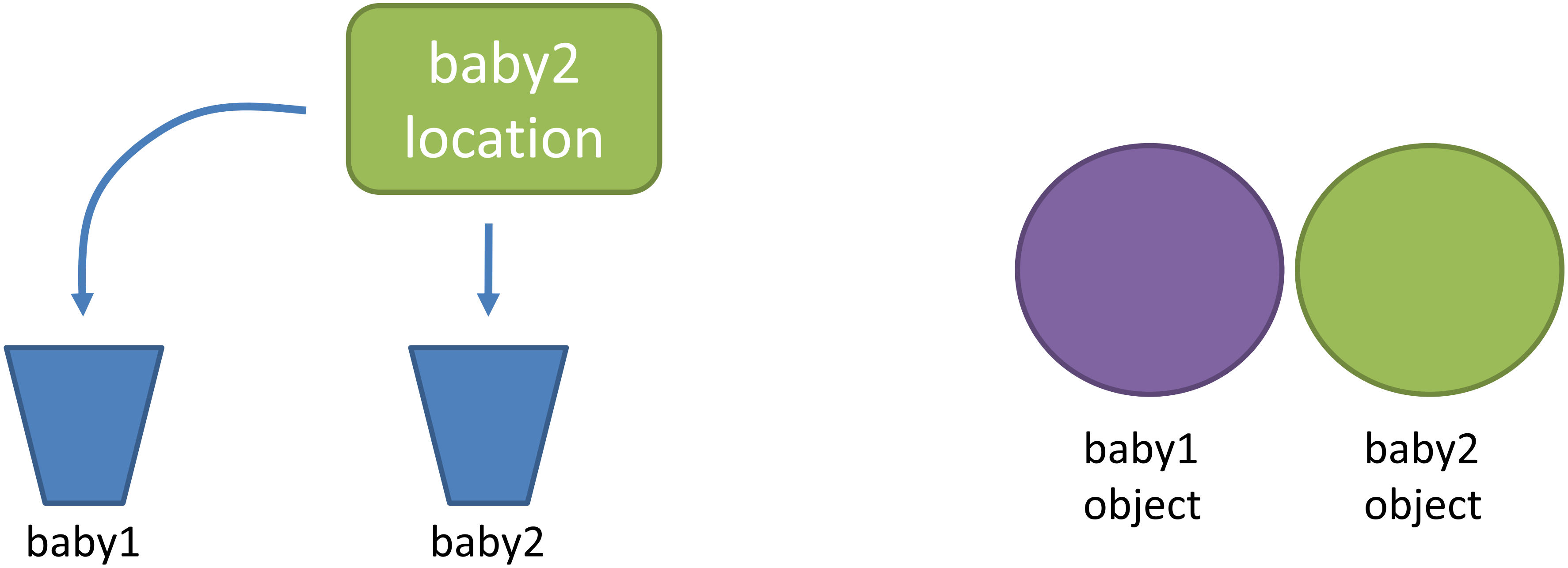
baby1 object

baby2 object

References

- Using = updates the reference.

```
baby1 = baby2
```



baby2 location

baby1

baby2

baby1 object

baby2 object

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[]