Flow of Control Statements

- Comparing objects for equality
  - Example from Assignment 3
- Simple for loops
  - Iterated execution
- More on if statements
  - Blocks within ifs
  - Break statement

How to do value comparisons?

- **For primitive types we use == to check if two values are equivalent**

```
int a, b; ... if (a == b)
```

- **For objects, we define an *equals()* method in each class which will check that all corresponding pairs of instance variables of the two objects have the same value**

```
String p1;...if (p1.equals(“inches”))...
```

Objects must be instance of the same class to be equal.

Equals versus ==

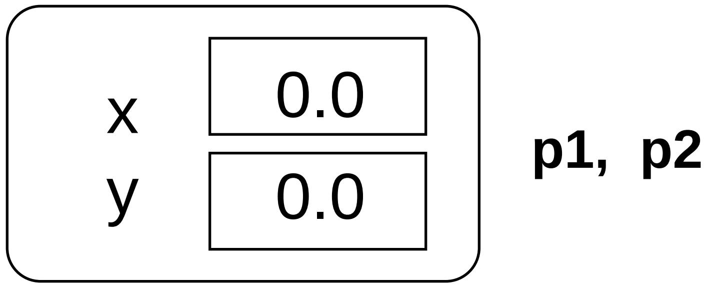
- Identical twins:
  - equal (they look alike) but not = = (they are not the same person)
- Two lectures in cs111 taught by same instructor: equal (same lecture notes) but not == (can’t do same delivery each time)
- MORAL:
  - Use == for comparing primitive values
  - Use *equals()* for comparing objects when you want a comparison of values

Assumptions

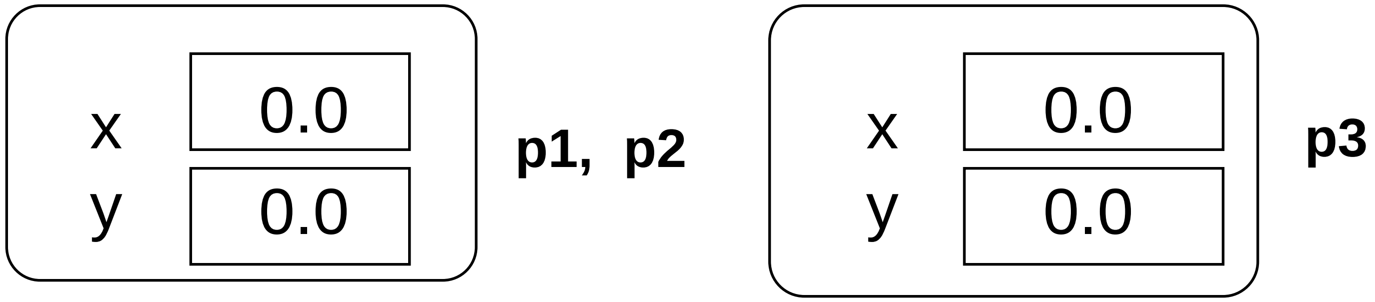
- Have a class called Point
  - Instance variables: double x, double y
- Constructor
  - Point(double x, double y)
    - Creates new point with these x and y coordinates
- Need to tell if two Point objects are really the same point, meaning they represent the same (x,y) coordinate on the plane.

Example - Points in a Plane

```
Point p1 = new Point(0.,0.);
//make reference p2 refer to same object as p1
Point p2 = p1;
```

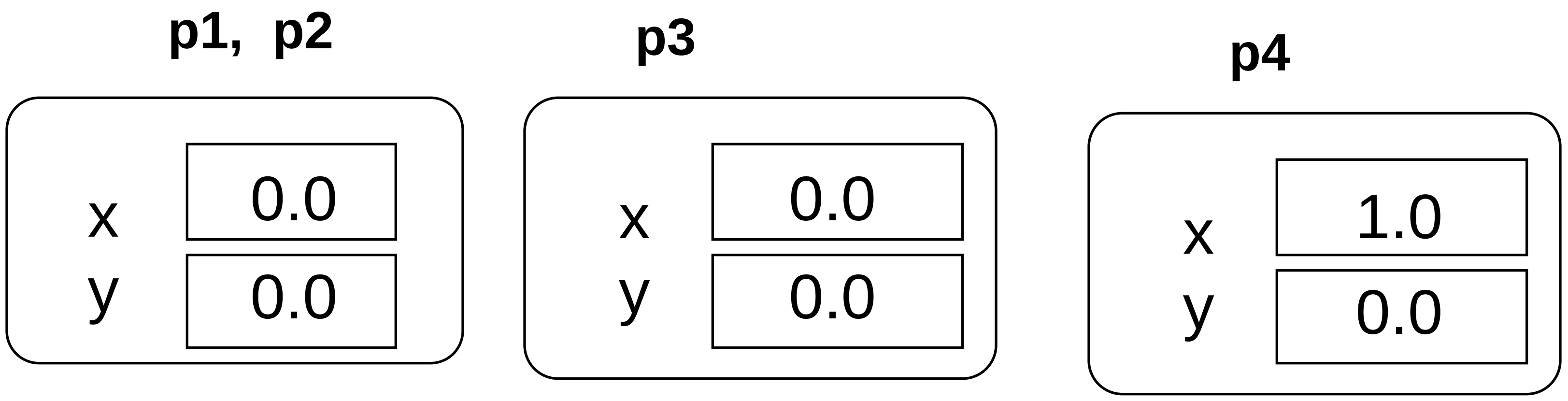


```
//create second object with same x,y
//coordinates as p1
Point p3 = new Point(0.,0.);
```



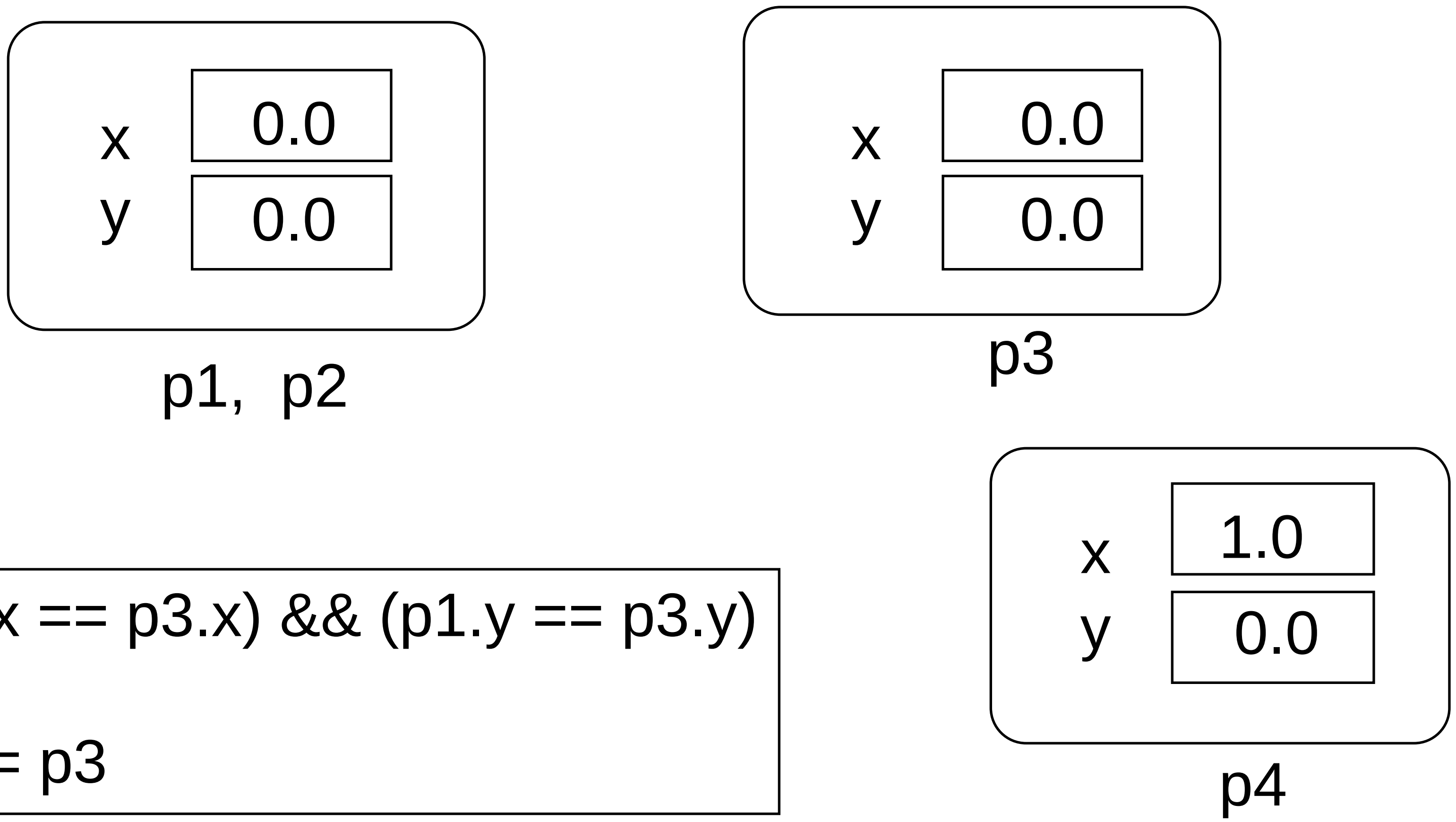
Example

```
Point p4 = new Point(1.0,0.);
```



```
if (p1 == p3).../references to different objects;false
if (p1.equals(p3).../instance var value check; true
if (p1 == p2).../references to same object; true
if (p1 == p4).../references to different objects; false
if (p1.equals(p4))//instance var value check; false
```

Example



(p1.x == p3.x) && (p1.y == p3.y)
but
p1 != p3

Iterated Execution

- Need for repeating a sequence of statements
  - – e.g., in Nim game to explore all Nim(2) games which start with 1 - 14 stones

<for-loop> →

for (<start> ; <check> ; <update>) <block>

<block> →{ <statements> } | <statement>

<statements> → <statement> |

<statements> <statement>

```
for (i=0; i<10; i++) sum += i;
for (j =15;  j>0; j--){
  squares += j*j;
}
```

For Loop

- Loop variable
  - Value initialized in <start>
  - Value changed on each iteration in <update>
  - Value checked for stopping iteration in <check>

```
for(int i = 1; i < n;  i++)
```

- Loop execution

  <start> <check> <block> <update>

  <check> <block> <update>

  <check> <block> <update> ... <check>

Nim Loop Example

```
public static void main (String[ ] arg) {
  // play game with each of 14 piles of stones
  // need to repeat what did before for each pile
  // for loop - (initialization; test; increment)
  for (int i=1;  i < 15; i++) {
  //create new game object initialized with i stones
      NimState st = new NimState(i);
      System.out.print(i +": ");
      //test if game is winnable by first player
      if(st.win()) System.out.println ("win, remove " +
                  st.move());
      else System.out.println("lose, remove " +
                  st.move());
  }
}
```

see NimState-loop.java

UStime Loop Example

```
public static void main(String[] args){
for (int h = 1; h < 13; h++) {
   UStime z = new UStime (h, 0);
   System.out.print(z +“ in NYC is “);
   System.out.println(
            (z.cvrtCentral( )) +
            “ in Chicago” );
}
```

from main method in UStime-loop.java

- Compare to temp conversion program in Bishop, p 61.

What is printed?

```
1 hours and 0 minutes in NYC is 12 hours and 0 minutes in Chicago
2 hours and 0 minutes in NYC is 1 hours and 0 minutes in Chicago
3 hours and 0 minutes in NYC is 2 hours and 0 minutes in Chicago
4 hours and 0 minutes in NYC is 3 hours and 0 minutes in Chicago
5 hours and 0 minutes in NYC is 4 hours and 0 minutes in Chicago
6 hours and 0 minutes in NYC is 5 hours and 0 minutes in Chicago
7 hours and 0 minutes in NYC is 6 hours and 0 minutes in Chicago
8 hours and 0 minutes in NYC is 7 hours and 0 minutes in Chicago
9 hours and 0 minutes in NYC is 8 hours and 0 minutes in Chicago
10 hours and 0 minutes in NYC is 9 hours and 0 minutes in Chicago
11 hours and 0 minutes in NYC is 10 hours and 0 minutes in Chicago
12 hours and 0 minutes in NYC is 11 hours and 0 minutes in Chicago
```

For Loops

- Loop variable usually changes value by simple increment or decrement

```
 for (int i = 10; i > 0; i -= 2 ){ }
```

- Often used to iterate loop variable over a range of values

Nested Loop Example

```
for (int h = 1; h < 13; h++) {
  for ( int m = 0; m < 60; m++) {
    UStime z = new UStime (h, m);
    System.out.print(z +
            " in NYC is ");
    System.out.println(
            (z.cvrtCentral( )) +
            " in Chicago" );
   }
}
```

from UStime-nestloop.java

loops through all minutes for all possible hours

If Statement as Selection

- If statement allows selection between two alternative directions for flow of control in program - true (then clause) and false (else clause)
- Often used in conjunction with a loop
- Can nest if statements for more complex conditions
- Can group sequence of statements to be performed conditionally in a block

Example - If in a Loop

```
class Summation extends Object{
   static final int limit = 30;//Java constant class var
   public static void main(String[] args) {
   int sumeven=0;
   int sumodd =0;
   for (int i=0; i<=limit; i++)
      if ((i%2)==0) sumeven += i;
            else sumodd += i;
  System.out.println("sum of even numbers from 0 to”  +
  limit + " is " + sumeven);
  System.out.println("sum of odd numbers from 0 to”  +
  limit + " is " + sumodd);
  }
}
```

Example - Blocks in If Stmts

```
class Summation extends Object{
static final int limit = 30;
public static void main(String[] args) {
// sums all even nos and odd nos  <= limit,
// separately
        int sumeven=0; int sumodd =0;
        int evencnt = 0; int oddcnt = 0;
        for (int i=0; i<=limit; i++)
        if ((i%2)==0){sumeven += i;
                      evencnt +=1;}
                 else {sumodd += i;
                      oddcnt +=1;}
        System.out.println("sum of” + evencnt +
 “ even numbers from 0 to " + limit + " is " +
  sumeven);
        System.out.println("sum of” + oddcnt +
“ odd numbers from 0 to " +limit+ " is " + sumodd);
}
}
```

from sum.java

Blocks in If Statements

<block> → { <statements> } | <statement>

- Old if statement BNF:

<if_stmt> → if (<condition>) <statement>
[else <statement> *]*

- Replaced by new if statement BNF:

<if_stmt> → if (<condition>) <block>
[else <block> *]*

Nested If Statements

- Check on related conditions or membership in a range of values

```
if (<cond1>) <block> // <cond1> is true
    else if (<cond2>)  <block>
                                  //!<cond1>&&<cond2> is true
    else if (<cond3>) <block>
                                   // !<cond1> && !<cond2> && <cond3>
                                  // is true
    else  <block>  //!<cond1> && !<cond2> && !<cond3>
                          // is true
```

Possible Ambiguity in Meaning

```
if (x>0) if (y<-1) y += 2; else y +=3;
```

is this generated by this rule?

<if_stmt> → if (<condition>) <statement>

or this rule?

<if_stmt> → if (<condition>) <statement>
else <statement>

Under what conditions is y incremented by 3, when `x<=0` OR when `x>0 && y>=-1` ?

Possible Ambiguity -2

`if (x>0) if (y<-1) y += 2; else y +=3;`

`in Java means:` **if (<condition>) <statement>**

where <statement> matches the "inner" <if-stmt>:

`if (y<-1) y += 2; else y += 3;` **matches**

if (<condition>) <statement> else <statement>

where these expand to <assign-stmt> and <assign-stmt>, respectively