

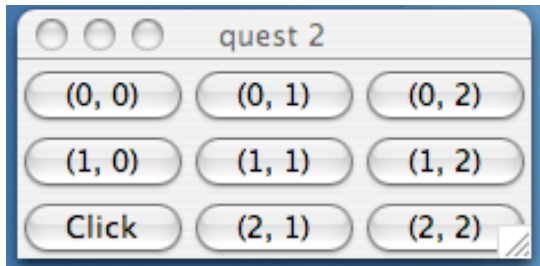
1.

```
public static int numberAncestors(Rhino r) {
    int num= 0;
    if (r.father != null)
        num= num + 1 + numberAncestors(r.father);
    if (r.mother != null)
        num= num + 1 + numberAncestors(r.mother);
    return num;
}
```

2a. 5 instances of Box are created: 4 horizontal ones and 1 vertical one.

2b. 4*4 buttons are created.

2c.



3.

```
public static boolean isTridiagonal(int[][] m) {
    for (int k= 0; k != m.length; k= k+1) {
        // return false if row k contains a non-zero
        // where it should have a 0.
        for (int i= 0; i != m.length; i= i+1) {
            if (i != k-1 && i != k &&
                i != k+1 && m[k][i] != 0) {
                return false;
            }
        }
    }
    return true;
}
```

4a.

```
/** Constructor: integer i in Mod n arithmetic
    Precondition: n > 1. There are no restrictions on i.*/
public Mod(int i, int modulus) {
    this.i= i;
    this.modulus= modulus;
    modularize();
}
```

```
/** If r1 and r2 do not have the same modulus,
    return null; otherwise return r1 + r2 */
```

```
public static Mod add(Mod r1, Mod r2) {
    if (r1.modulus != r2.modulus)
        return null;
    return new Mod(r1.i + r2.i, r1.modulus);
}
```

```
/** = r is a non-null Mod with the same modulus
    and integer as this one */
```

```
public boolean equals(Object ob) {
    return ob != null &&
        ob instanceof Mod &&
        i == ((ob)r).i &&
        modulus == ((ob)r).modulus;
}
```

4b1. Make a class abstract so that it cannot be instantiated (one cannot create objects of the class).

```
public abstract class Example {
```

```
...
}
```

4b2. Page 148 of the text says this: The first statement of a subclass constructor *must* be a call on a superclass constructor. If you do not put one in, Java inserts this one: **super();** .” This is done to enforce the principle that fields in the superclass should be initialized before those in the subclass.

4b3. A local variable of a method is created when the frame for the method call is drawn (or created inside the computer).

4b4. A static variable goes in the file drawer of the class in which it is declared, and it has to be there throughout execution. Hence, it is created just before execution of a program begins.

```
5. /** = index i that satisfies  $b[0..i] \leq x < b[i+1..]$ 
    */
```

```
public static int bsearch(int[] b, int x) {
    int i= -1; int j= b.length;
    // invariant:  $b[0..i] \leq x$  and  $x < b[j..]$ 
    while (i+1 != j) {
        int e= (i+j)/2;
        //  $\{-1 \leq i < e < j \leq b.length\}$ 
        if (b[e] <= x) i= e;
        else j= e;
    }
    return i;
}
```