Quiz Answers

2. What is an object?
   - Java-specific answers:
     • What you get when you invoke a class constructor
     • An instance of a class
   - General answers
     • An entity that includes both state and procedures for manipulating that state
   - Really general answers
     • "Something intelligible or perceptible by the mind." (Philosophy dictionary answer)

Mystery Method

```java
public void f(String s) {
    char c = s.charAt(0);
    if (c == '-') {
        s.concat("negative");
    }
}
```

Mode Specification

```java
public int mode(int[] a) {
    // MODIFIES: a
    // EFFECTS: Returns the value that appears most often in a.
}
```

If something is listed in MODIFIES, how it can change must be described in EFFECTS. Recall that MODIFIES means everything not listed is unchanged.
Mode Specification

public int mode (int [] a)
// REQUIRES: a has at least one element
// EFFECTS: Returns the value that
// appears most often in a.

Note this is misleading. There may be multiple values.

Implementing Mode

static public int mode (int[] a) {
    int best = a[0];
    int bestcount = 1;
    for (int i = 0; i < a.length; i++) {
        int val = a[i];
        int count = 0;
        for (int j = 0; j < a.length; j++) {
            if (a[j] == val) { count++; }
        }
        if (count > bestcount) {
            best = val; bestcount = count;
        }
    }
    return best; }

Violating Requires

- In C/C++: can lead to anything
  - Machine crash
  - Security compromise
  - Strange results
- In Java: often leads to runtime exception

Use Exceptions to Remove Requires

static public int mode (int [] a)
// REQUIRES: a has at least one element
// EFFECTS: Returns the value that
// appears most often in a.

static public int mode (int [] a)
throws NoModeException
// EFFECTS: If a is empty throws NoModeException.
// Otherwise, returns the value that appears most
// often in a.

Throwing Exceptions

static public int mode (int [] a) throws NoModeException
{
    if (a == null || size () == 0)
        throw new NoModeException ();
    ...

What is NoModeException?
Exceptions are Objects

```java
public class NoModeException extends Exception {
    public NoModeException () {
        super ();
    }
}
```

Exception extends Exception means EmptyException inherits from the Exception type (in the Java API).

We will cover subtyping and inheritance later.

Compiler Checking

```java
static public void main(String[] args) {
    int[] tarray1 = { 1, 2, 2, 3, 2, 5 };
    int[] tarray2 = {};
    System.out.println("Mode tarray1: " + mode(tarray1));
    System.out.println("Mode tarray2: " + mode(tarray2));
}
```

Unhandled exception type NoModeException

Catching Exceptions

```java
static public void main(String[] args) {
    int[] tarray1 = { 1, 2, 2, 3, 2, 5 };
    int[] tarray2 = {};
    try {
        System.out.println("Mode tarray1: " + mode(tarray1));
    } catch (NoModeException nme) {
        System.err.println("Error: " + nme);
    }
    try {
        System.out.println("Mode tarray2: " + mode(tarray2));
    } catch (NoModeException nme) {
        System.err.println("Error: " + nme);
    }
}
```

Charge

- PS2 is due Friday
- Next class:
  - Lots more issues with Exceptions
  - Data abstraction