re #10: OOP Mechanisms and Class Design

Review: A Puzzle

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Answer to Puzzle

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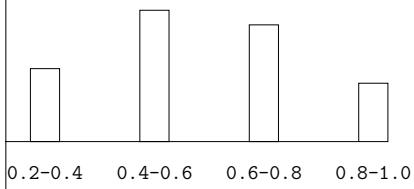
Example: Designing a Class

t a class that represents histograms, like this one:



t do we need from it? At least:

kets and limits.

counts of values.

nts of values.

bers of buckets and other initial parameters.

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t defined in A, we'd see a compile-time error

Histogram Specification and Use

```
of floating-point values */
 Histogram {
 of buckets in THIS. */


d of bucket #K. Pre: 0<=K<size(). */
 k);

s in bucket #K. Pre: 0<=K<size(). */
k);

 the histogram. */
e val);
```

Sample output:

```
>=  0.00 |   10
>= 10.25 |   80
>= 20.50 |  120
>= 30.75 |   50
```

```
am(Histogram H,
    Scanner in)

sNextDouble())
nextDouble());
```

```
void printHistogram(Histogram H) {
    for (int i = 0; i < H.size(); i += 1)
        System.out.printf
            (">=%5.2f | %4d%n",
             H.low(i), H.count(i));
}
```


Specification Seen by Clients

of a module (class, program, etc.) are the programs or t *use* that module's exported definitions.

ntion is that exported definitions are designated **public**.

ntended to rely on *specifications,* (*aka* APIs) not code.

ecification: method and constructor headers—syntax e.

ecification: what they do. No formal notation, so use

specification is a *contract.*

s client must satisfy (*preconditions*, marked "Pre:" in below).

results (*postconditions*).

ese to be *all the client needs!*

s communicate errors, specifically failure to meet pre- s.

Let's Make a Tiny Change

priori **bounds:**

```
Histogram implements Histogram {
w histogram with SIZE buckets. */
lexHistogram(int size) {


needs to change?
```

u do this? Profoundly changes implementation.

ike printHistogram and fillHistogram) still work with

he power of *separation of concerns*.

An Implementation

```
edHistogram implements Histogram {
 _low, _high; /* From constructor*/
_count; /* Value counts */

ogram with SIZE buckets of values >= LOW and < HIGH. */
stogram(int size, double low, double high)

igh || size <= 0) throw new IllegalArgumentException();
_high = high;
 int[size];


e() { return _count.length; }
low(int k) { return _low + k*(_high-_low)/_count.length; }

nt(int k) { return _count[k]; }

d(double val) {
_low && val < _high)
int) ((val-_low)/(_high-_low) * _count.length)] += 1;
```

of Procedural Interface over Visible Fields

method for `count` instead of making the array `_count` change" is transparent to clients:

to write `myHist._count[k]`, it would mean

ber of items currently in the k^{th} bucket of histogram hich, by the way, is stored in an array called `_count` that always holds the up-to-date count)."

l comment *worse than useless* to the client.

ray had been visible, after "tiny change," *every use* of nt program would have to change.

method for the public `count` method decreases what know, and (therefore) has to change.

Implementing the Tiny Change

pre-allocate the `_count` array.

ounds, so must save arguments to `add`.

ute `_count` array "lazily" when `_count(···)` called.

ount array whenever histogram changes.

```
togram implements Histogram {
rayList<Double> _values = new ArrayList<>();

t[] _count;

xHistogram(int size) { _size = size; _count = null;  }

d add(double x) { _count = null; _values.add(x); }

 count(int k) {
nt == null) { compute _count from _values here.  }
count[k];
```