## Frequently Asked Questions (General)

**What are the goals of this assignment?**

- Set up a Java programming environment.
- Use our input and output libraries.
- Learn about a scientific application of the union–find data structure.
- Measure the running time of a program and use the doubling hypothesis to make predictions.

**Should I implement the union–find data structures from scratch?** No, use the versions in `algs4.jar`. On some assignments (such as this one), you will *apply* classic algorithms and data structures (from the textbook) to solve interesting problems. On other assignments (such as the next one), you will *implement* fundamental algorithms and data structures from scratch. Both are important skills.

**Can I add (or remove) methods to (or from) the `Percolation` or `PercolationStats` APIs?** No. You must implement the APIs exactly as specified, with the identical set of public methods and signatures (or you will receive a substantial deduction). However, you are encouraged to add *private* methods that enhance the readability, maintainability, and modularity of your program.

**Why is it so important to implement the prescribed API?** It is an essential component of modular programming, whether you are developing software by yourself or as part of a team. When you properly implement an API, others can write software to use your module or to test it. We do this regularly when grading your programs. For example, your `PercolationStats` client should work with our `Percolation` and vice versa. If you add an extra public method to `Percolation` and call it from `PercolationStats`, then your client won't work with our `Percolation`. Conversely, our `PercolationStats` client may not work with your `Percolation` if you remove a public method.

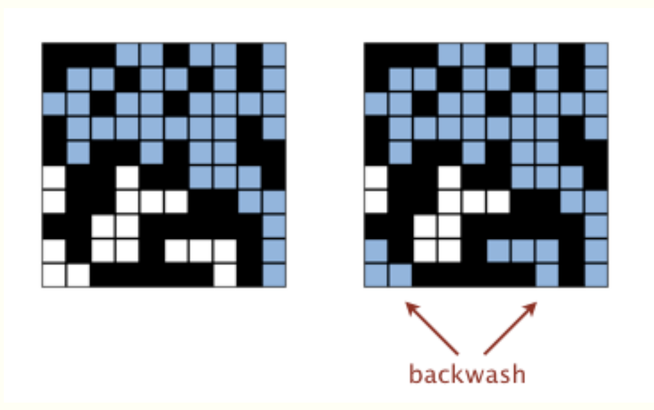
**How thoroughly must I test my code?** For each program, you must include a `main()` method that unit tests the class. At a minimum, the `main()` method must not only call each public constructor and method directly, but it must also help verify that they work as prescribed (e.g., by printing results to standard output).

**How many lines of code should my program be?** You should strive for clarity and efficiency. Our reference solution for `Percolation.java` is about 80 lines, plus a test client. Our `PercolationStats.java` client is about 60 lines.

## Frequently Asked Questions (Percolation)

**Can I use a depth-first search based approach instead of using union–find?** The percolation problem is discussed in Section 2.4 of *Computer Science: An Interdisciplinary Approach* (the course textbook for COS 126) and it uses depth-first search to solve a related problem. However, depth-first search will not meet the performance requirements of this assignment.

**After the system has percolated, `PercolationVisualizer` colors in light blue all sites connected to open sites on the bottom (in addition to those connected to open sites on the top). Is this "backwash" acceptable?** Yes. While allowing backwash does not strictly conform to the `Percolation` API, it requires a bit of ingenuity to fix. It is extra credit if you are able to implement a solution that meets the performance requirements and has no backwash.




```
% java-algs4 PercolationVisualizer input10.txt
```

## Frequently Asked Questions (PercolationStats)

**What should `stddev()` return if $T$ equals 1?** The sample standard deviation is undefined. We recommend returning `Double.NaN` but we will not test this case.

**How do I generate a site uniformly at random among all blocked sites?** Pick a site at random—use `StdRandom` to generate two integers between 0 (inclusive) and $n$ (exclusive)—and use this site if it is blocked; if not, try again and repeat until you find a blocked site.

**I don't get reliable timing information when $n = 200$. What should I do?** Increase the size of $n$ (say to 400, 800, and 1,600), until the average running time exceeds its standard deviation.

**I don't get reliable timing information even when $n$ is large. What should I do?** Try executing with the `-Xint` flag.

```
% java-algs4 -Xint PercolationStats 200 100
...
```

The `-Xint` flag turns off various compiler optimizations, which helps normalize and stabilize the timing data that you collect (albeit, at the expense of making your program substantially slower).

**I can't squeeze 5 data points so that they all fit between 0.25 seconds and 30 seconds. What should I do?** Try using a smaller multiplicative factor in the "doubling" test. If you use a non-integral multiplicative factor, round the resulting values of $n$ or $T$ to the nearest integer.

## Testing

**Testing.** We provide two clients that serve as large-scale visual traces. Use them for testing and debugging your `Percolation` implementation.

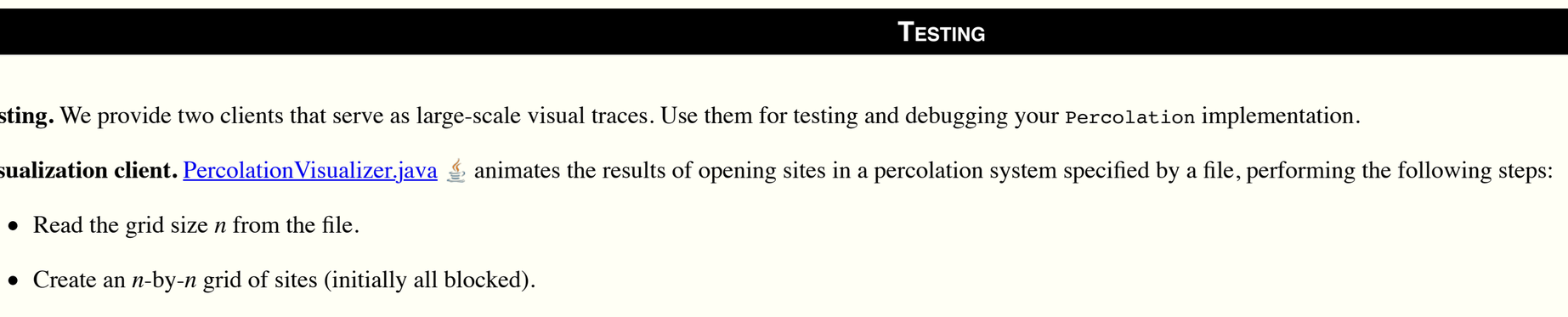
**Visualization client.** PercolationVisualizer.java animates the results of opening sites in a percolation system specified by a file, performing the following steps:

- Read the grid size $n$ from the file.
- Create an $n$-by-$n$ grid of sites (initially all blocked).
- Read in a sequence of sites ($row$, $col$) to open from the file. After each site is opened, draw full sites in light blue, open sites (that aren't full) in white, and blocked sites in black using *standard drawing*, with site $(0, 0)$ in the upper left-hand corner.

The program should behave as in this movie and the following snapshots when used with input20.txt.

```
% more input20.txt
20
 6 10
17 10
11  4
 8  4
 4  8
 0  0
...

% java-algs4 PercolationVisualizer input20.txt
```



*50 open sites* *100 open sites* *150 open sites* *204 open sites* *250 open sites*

**Sample data files.** The file percolation.zip contains sample data files for use with the visualization client. Associated with most input `.txt` files is an output `.png` file that contains the desired graphical output at the end of the visualization.

**InteractiveVisualization client.** InteractivePercolationVisualizer.java is similar to the first test client except that the input comes from a mouse (instead of from a file). It takes a command-line integer $n$ that specifies the grid size. As a bonus, it writes to standard output the sequence of sites opened in the same format used by `PercolationVisualizer`, so you can use it to prepare interesting files for testing. If you design an interesting data file, feel free to share it with us and your classmates by posting it in the discussion forums.

## Possible Progress Steps

**These are purely suggestions for how you might make progress. You do not have to follow these steps.**