

See the Assessment Guide for information on how to interpret this report.

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ASSESSMENT SUMMARY

Compilation: PASSED
API: PASSED

SpotBugs: PASSED
PMD: PASSED
Checkstyle: PASSED

Correctness: 38/38 tests passed
Memory: 8/8 tests passed
Timing: 20/20 tests passed

Aggregate score: 100.00%

[Compilation: 5%, API: 5%, Style: 0%, Correctness: 60%, Timing: 10%, Memory: 20%]

ASSESSMENT DETAILS

The following files were submitted:

6.7K Apr 1 17:27 Percolation.java
2.9K Apr 1 17:27 PercolationStats.java

```
*****
*   COMPILING
*****
```

```
% javac Percolation.java
*-----
```

```
% javac PercolationStats.java
*-----
```

=====

```
Checking the APIs of your programs.
*-----
```

Percolation:

PercolationStats:

=====

```
*****
```

* CHECKING STYLE AND COMMON BUG PATTERNS

% spotbugs *.class

*-----

=====

% pmd .

*-----

=====

% checkstyle *.java

*-----

% custom checkstyle checks for Percolation.java

*-----

% custom checkstyle checks for PercolationStats.java

*-----

=====

* TESTING CORRECTNESS

Testing correctness of Percolation

*-----

Running 21 total tests.

Tests 1 through 7 create a Percolation object using your code, then repeatedly open sites by calling open(). After each call to open(), it checks the return values of isOpen(), percolates(), numberOfOpenSites(), and isFull() in that order. Tests 12 through 15 create a Percolation object using your code, then repeatedly call the methods open(), isOpen(), isFull(), percolates(), and, numberOfOpenSites() in random order with probabilities $p = (p_1, p_2, p_3, p_4, p_5)$. The tests stop immediately after the system percolates.

Tests 18 through 21 test backwash.

Except as noted, a site is opened at most once.

Test 1: open predetermined list of sites using file inputs

- * filename = input6.txt
- * filename = input8.txt
- * filename = input8-no.txt
- * filename = input10-no.txt
- * filename = greeting57.txt
- * filename = heart25.txt

=> passed

Test 2: open random sites until the system percolates

- * n = 3
- * n = 5
- * n = 10
- * n = 10

```
* n = 20
* n = 20
* n = 50
* n = 50
==> passed
```

Test 3: open predetermined sites for n = 1 and n = 2 (corner case test)

```
* filename = input1.txt
* filename = input1-no.txt
* filename = input2.txt
* filename = input2-no.txt
==> passed
```

Test 4: check predetermined sites with long percolating path

```
* filename = snake13.txt
* filename = snake101.txt
==> passed
```

Test 5: open every site

```
* filename = input5.txt
==> passed
```

Test 6: open random sites until the system percolates,
allowing open() to be called on a site more than once

```
* n = 3
* n = 5
* n = 10
* n = 10
* n = 20
* n = 20
* n = 50
* n = 50
==> passed
```

Test 7: open random sites with large n

```
* n = 250
* n = 500
* n = 1000
* n = 2000
==> passed
```

Test 8: call methods with invalid arguments

```
* n = 10, (row, col) = (-1, 5)
* n = 10, (row, col) = (11, 5)
* n = 10, (row, col) = (0, 5)
* n = 10, (row, col) = (5, -1)
* n = 10, (row, col) = (5, 11)
* n = 10, (row, col) = (5, 0)
* n = 10, (row, col) = (-2147483648, -2147483648)
* n = 10, (row, col) = (2147483647, 2147483647)
==> passed
```

Test 9: call constructor with invalid argument

```
* n = -10
* n = -1
* n = 0
==> passed
```

Test 10: create multiple Percolation objects at the same time
(to make sure you didn't store data in static variables)

```
==> passed
```

Test 11: open predetermined list of sites using file inputs,
but permute the order in which methods are called

```
* filename = input8.txt; order = isFull(), isOpen(), percolates()
```

```

* filename = input8.txt; order = isFull(), percolates(), isOpen()
* filename = input8.txt; order = isOpen(), isFull(), percolates()
* filename = input8.txt; order = isOpen(), percolates(), isFull()
* filename = input8.txt; order = percolates(), isOpen(), isFull()
* filename = input8.txt; order = percolates(), isFull(), isOpen()
==> passed

```

Test 12: call open(), isOpen(), and numberOfOpenSites()
in random order until just before system percolates

```

* n = 3, trials = 40, p = (0.4, 0.4, 0.0, 0.0, 0.3)
* n = 5, trials = 20, p = (0.4, 0.4, 0.0, 0.0, 0.3)
* n = 7, trials = 10, p = (0.4, 0.4, 0.0, 0.0, 0.3)
* n = 10, trials = 5, p = (0.4, 0.4, 0.0, 0.0, 0.3)
* n = 20, trials = 2, p = (0.4, 0.4, 0.0, 0.0, 0.3)
* n = 50, trials = 1, p = (0.4, 0.4, 0.0, 0.0, 0.3)
==> passed

```

Test 13: call open() and percolates() in random order until just before system percolates

```

* n = 3, trials = 40, p = (0.5, 0.0, 0.0, 0.5, 0.0)
* n = 5, trials = 20, p = (0.5, 0.0, 0.0, 0.5, 0.0)
* n = 7, trials = 10, p = (0.5, 0.0, 0.0, 0.5, 0.0)
* n = 10, trials = 5, p = (0.5, 0.0, 0.0, 0.5, 0.0)
* n = 20, trials = 2, p = (0.5, 0.0, 0.0, 0.5, 0.0)
* n = 50, trials = 1, p = (0.5, 0.0, 0.0, 0.5, 0.0)
==> passed

```

Test 14: call open() and isFull() in random order until just before system percolates

```

* n = 3, trials = 40, p = (0.5, 0.0, 0.5, 0.0, 0.0)
* n = 5, trials = 20, p = (0.5, 0.0, 0.5, 0.0, 0.0)
* n = 7, trials = 10, p = (0.5, 0.0, 0.5, 0.0, 0.0)
* n = 10, trials = 5, p = (0.5, 0.0, 0.5, 0.0, 0.0)
* n = 20, trials = 2, p = (0.5, 0.0, 0.5, 0.0, 0.0)
* n = 50, trials = 1, p = (0.5, 0.0, 0.5, 0.0, 0.0)
==> passed

```

Test 15: call all methods in random order until just before system percolates

```

* n = 3, trials = 40, p = (0.2, 0.2, 0.2, 0.2, 0.2)
* n = 5, trials = 20, p = (0.2, 0.2, 0.2, 0.2, 0.2)
* n = 7, trials = 10, p = (0.2, 0.2, 0.2, 0.2, 0.2)
* n = 10, trials = 5, p = (0.2, 0.2, 0.2, 0.2, 0.2)
* n = 20, trials = 2, p = (0.2, 0.2, 0.2, 0.2, 0.2)
* n = 50, trials = 1, p = (0.2, 0.2, 0.2, 0.2, 0.2)
==> passed

```

Test 16: call all methods in random order until almost all sites are open
(with inputs not prone to backwash)

```

* n = 3
* n = 5
* n = 7
* n = 10
* n = 20
* n = 50
==> passed

```

Test 17: substitute the WeightedQuickUnionUF implementation with one that
picks the leader nondeterministically after each call to union();
call all methods in random order until almost all sites are open
(with inputs not prone to backwash)

```

* n = 3
* n = 5
* n = 7
* n = 10
* n = 20
* n = 50
==> passed

```

Test 18: check for backwash with predetermined sites

```
* filename = input20.txt
* filename = input10.txt
* filename = input50.txt
* filename = jerry47.txt
* filename = sedgewick60.txt
* filename = wayne98.txt
==> passed
```

Test 19: check for backwash with predetermined sites that have multiple percolating paths

```
* filename = input3.txt
* filename = input4.txt
* filename = input7.txt
==> passed
```

Test 20: call all methods in random order until all sites are open (these inputs are prone to backwash)

```
* n = 3
* n = 5
* n = 7
* n = 10
* n = 20
* n = 50
==> passed
```

Test 21: substitute WeightedQuickUnionUF data type that picks leader nondeterministically; call all methods in random order until all sites are open (these inputs are prone to backwash)

```
* n = 3
* n = 5
* n = 7
* n = 10
* n = 20
* n = 50
==> passed
```

Total: 21/21 tests passed!

```
=====
*****
* TESTING CORRECTNESS (substituting reference Percolation)
*****
```

Testing correctness of PercolationStats

```
*-----
Running 17 total tests.
```

Test 1: check formatting of output of main()

```
% java-algs4 PercolationStats 20 10
mean          = 0.56075
stddev        = 0.05392960947177144
95% confidence interval = [0.5273240817461792, 0.5941759182538208]

% java-algs4 PercolationStats 200 100
mean          = 0.5928985000000001
stddev        = 0.00973958315589046
95% confidence interval = [0.5909895417014456, 0.5948074582985546]
```

==> passed

Test 2: check that methods in PercolationStats do not print to standard output

```
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 3: check that mean() returns value in expected range

```
* n = 2, trials = 10000
* n = 5, trials = 10000
* n = 10, trials = 10000
* n = 25, trials = 10000
==> passed
```

Test 4: check that stddev() returns value in expected range

```
* n = 2, trials = 10000
* n = 5, trials = 10000
* n = 10, trials = 10000
* n = 25, trials = 10000
==> passed
```

Test 5: check that PercolationStats constructor creates
trials Percolation objects, each of size n-by-n

```
* n = 15, trials = 15
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 6: check that PercolationStats.main() creates
trials Percolation objects, each of size n-by-n

```
* n = 15, trials = 15
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 7: check that PercolationStats calls open() until system percolates

```
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 8: check that PercolationStats does not call open() after system percolates

```
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 9: check that mean() is consistent with the number of intercepted calls to open()
on blocked sites

```
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 10: check that stddev() is consistent with the number of intercepted calls to open()
on blocked sites

```
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
```

```
* n = 64, trials = 150
==> passed
```

Test 11: check that `confidenceLo()` and `confidenceHigh()` are consistent with `mean()` and `stddev()`

```
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 12: check that exception is thrown if either `n` or `trials` is out of bounds

```
* n = -23, trials = 42
* n = 23, trials = 0
* n = -42, trials = 0
* n = 42, trials = -1
* n = -2147483648, trials = -2147483648
==> passed
```

Test 13: create two `PercolationStats` objects at the same time and check `mean()`
(to make sure you didn't store data in static variables)

```
* n1 = 50, trials1 = 10, n2 = 50, trials2 = 5
* n1 = 50, trials1 = 5, n2 = 50, trials2 = 10
* n1 = 50, trials1 = 10, n2 = 25, trials2 = 10
* n1 = 25, trials1 = 10, n2 = 50, trials2 = 10
* n1 = 50, trials1 = 10, n2 = 15, trials2 = 100
* n1 = 15, trials1 = 100, n2 = 50, trials2 = 10
==> passed
```

Test 14: check that the methods return the same value, regardless of
the order in which they are called

```
* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed
```

Test 15: check that no calls to `StdRandom.setSeed()`

```
* n = 20, trials = 10
* n = 20, trials = 10
* n = 40, trials = 10
* n = 80, trials = 10
==> passed
```

Test 16: check distribution of number of sites opened until percolation

```
* n = 2, trials = 100000
* n = 3, trials = 100000
* n = 4, trials = 100000
==> passed
```

Test 17: check that each site is opened the expected number of times

```
* n = 2, trials = 100000
* n = 3, trials = 100000
* n = 4, trials = 100000
==> passed
```

Total: 17/17 tests passed!

```
=====
*****
* MEMORY (substituting reference Percolation)
*****
```

Analyzing memory of `PercolationStats`

*-----

Running 4 total tests.

Test 1a-1d: check memory usage as a function of T trials for n = 100
(max allowed: 8*T + 128 bytes)

	T	bytes
=> passed	16	176
=> passed	32	304
=> passed	64	560
=> passed	128	1072
==> 4/4 tests passed		

Estimated student memory = 8.00 T + 48.00 (R^2 = 1.000)

Total: 4/4 tests passed!

=====

* TIMING (substituting reference Percolation)

Timing PercolationStats

*-----

Running 4 total tests.

Test 1: Call PercolationStats constructor and instance methods and
count calls to StdStats.mean() and StdStats.stddev().

* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed

Test 2: Call PercolationStats constructor and instance methods and
count calls to methods in StdRandom.

* n = 20, trials = 10
* n = 20, trials = 10
* n = 40, trials = 10
* n = 80, trials = 10
==> passed

Test 3: Call PercolationStats constructor and instance methods and
count calls to methods in Percolation.

* n = 20, trials = 10
* n = 50, trials = 20
* n = 100, trials = 50
* n = 64, trials = 150
==> passed

Test 4: Call PercolationStats constructor and instance methods with trials = 3
and values of n that go up by a multiplicative factor of sqrt(2).
The test passes when n reaches 2,896.

The approximate order-of-growth is $n^{\log \text{ratio}}$

n	seconds	log ratio
724	0.15	2.6

1024	0.39	2.6
1448	1.16	3.2
2048	2.69	2.4
2896	6.68	2.6

==> passed

Total: 4/4 tests passed!

=====

 * MEMORY

Analyzing memory of Percolation

*-----

Running 4 total tests.

Test 1a-1d: check that total memory $\leq 17 n^2 + 128 n + 1024$ bytes

	n	bytes
=> passed	64	71984
=> passed	256	1122608
=> passed	512	4473136
=> passed	1024	17858864

==> 4/4 tests passed

Estimated student memory = $17.00 n^2 + 32.00 n + 304.00$ ($R^2 = 1.000$)

Test 2 (bonus): check that total memory $\leq 11 n^2 + 128 n + 1024$ bytes

- failed memory test for n = 64

==> **FAILED**

Total: 4/4 tests passed!

=====

 * TIMING

Timing Percolation

*-----

Running 16 total tests.

Test 1a-1e: Creates an n-by-n percolation system; open sites at random until the system percolates, interleaving calls to percolates() and open(). Count calls to connected(), union() and find().

	n	union()	2 * connected() + find()	constructor
=> passed	16	367	308	2
=> passed	32	1512	1246	2

```

=> passed      64      5555      4778      2
=> passed     128     21763     18828      2
=> passed     256     86168     75116      2
=> passed     512    380734    315732      2
=> passed    1024   1491637   1250574      2
==> 7/7 tests passed

```

If one of the values in the table violates the performance limits the factor by which you failed the test appears in parentheses. For example, (9.6x) in the union() column indicates that it uses 9.6x too many calls.

Tests 2a-2f: Check whether the number of calls to union(), connected(), and find() is a constant per call to open(), isOpen(), isFull(), and percolates(). The table shows the maximum number of union() and find() calls made during a single call to open(), isOpen(), isFull(), and percolates(). One call to connected() counts as two calls to find().

	n	per open()	per isOpen()	per isFull()	per percolates()
=> passed	16	8	0	2	2
=> passed	32	8	0	2	2
=> passed	64	8	0	2	2
=> passed	128	8	0	2	2
=> passed	256	8	0	2	2
=> passed	512	8	0	2	2
=> passed	1024	8	0	2	2

```

==> 7/7 tests passed

```

Running time (in seconds) depends on the machine on which the script runs.

Test 3: Create an n-by-n percolation system; interleave calls to percolates() and open() until the system percolates. The values of n go up by a factor of sqrt(2). The test is passed if n >= 4096 in under 10 seconds.

The approximate order-of-growth is $n^{(\log \text{ ratio})}$

n	seconds	log ratio	union-find operations	log ratio
1024	0.15	2.9	4255274	2.1
1448	0.37	2.6	8312200	1.9
2048	0.94	2.7	16627292	2.0
2896	2.34	2.6	33501410	2.0
4096	5.21	2.3	67102054	2.0

```

==> passed

```

Test 4: Create an n-by-n percolation system; interleave calls to open(), percolates(), isOpen(), isFull(), and numberOfOpenSites() until the system percolates. The values of n go up by a factor of sqrt(2). The test is passed if n >= 4096 in under 10 seconds.

n	seconds	log ratio	union-find operations	log ratio
1024	0.17	2.7	5414726	2.0
1448	0.43	2.7	10802502	2.0
2048	1.15	2.9	21768634	2.0

2896	2.68	2.4	43530982	2.0
4096	5.65	2.2	87069772	2.0

==> passed

Total: 16/16 tests passed!

=====