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

ASSESSMENT SUMMARY

```
Compilation:  PASSED
API:          PASSED

SpotBugs:     PASSED
PMD:          FAILED (1 warning)
Checkstyle:   PASSED

Correctness:  51/51 tests passed
Memory:       22/22 tests passed
Timing:       125/125 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:
----------------------------------
4.1K Feb 13 02:35 Board.java
3.3K Feb 13 02:35 Solver.java


================================================================================
*  COMPILING
================================================================================


% javac Board.java
*---------------------------------------------------------

% javac Solver.java
*---------------------------------------------------------


================================================================


Checking the APIs of your programs.
*---------------------------------------------------------
Board:

Solver:

================================================================


================================================================================
*  CHECKING STYLE AND COMMON BUG PATTERNS
================================================================================


% spotbugs *.class
*---------------------------------------------------------


================================================================


% pmd .
*---------------------------------------------------------
Board.java:129: The method body is empty. If this is your intent, document it with a comment. [UncommentedEmptyMethodBody]
PMD ends with 1 warning.
```

```
================================================================


% checkstyle *.java
*-----------------------------------------------------------

% custom checkstyle checks for Board.java
*-----------------------------------------------------------

% custom checkstyle checks for Solver.java
*-----------------------------------------------------------


================================================================


********************************************************************************
*  TESTING CORRECTNESS
********************************************************************************

Testing correctness of Board
*-----------------------------------------------------------
Running 26 total tests.

Tests 4-7 and 14-17 rely upon toString() returning results in prescribed format.

Test 1a: check hamming() with file inputs
  * puzzle04.txt
  * puzzle00.txt
  * puzzle07.txt
  * puzzle17.txt
  * puzzle27.txt
  * puzzle2x2-unsolvable1.txt
==> passed

Test 1b: check hamming() with random n-by-n boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 9-by-9
  * 10-by-10
  * 127-by-127
==> passed

Test 2a: check manhattan() with file inputs
  * puzzle04.txt
  * puzzle00.txt
  * puzzle07.txt
  * puzzle17.txt
  * puzzle27.txt
  * puzzle2x2-unsolvable1.txt
==> passed

Test 2b: check manhattan() with random n-by-n boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 9-by-9
  * 10-by-10
  * 127-by-127
==> passed

Test 3: check dimension() with random n-by-n boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 6-by-6
==> passed

Test 4a: check toString() with file inputs
  * puzzle04.txt
  * puzzle00.txt
  * puzzle06.txt
```

```
  * puzzle09.txt
  * puzzle23.txt
  * puzzle2x2-unsolvable1.txt
==> passed

Test 4b: check toString() with random n-by-n boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 9-by-9
  * 10-by-10
  * 127-by-127
==> passed

Test 5a: check neighbors() with file inputs
  * puzzle04.txt
  * puzzle00.txt
  * puzzle06.txt
  * puzzle09.txt
  * puzzle23.txt
  * puzzle2x2-unsolvable1.txt
==> passed

Test 5b: check neighbors() with random n-by-n boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 9-by-9
  * 10-by-10
  * 127-by-127
==> passed

Test 6a: check neighbors() of neighbors() with file inputs
  * puzzle04.txt
  * puzzle00.txt
  * puzzle06.txt
  * puzzle09.txt
  * puzzle23.txt
  * puzzle2x2-unsolvable1.txt
==> passed

Test 6b: check neighbors() of neighbors() with random n-by-n boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 9-by-9
  * 10-by-10
==> passed

Test 7a: check twin() with file inputs
  * puzzle04.txt
  * puzzle00.txt
  * puzzle06.txt
  * puzzle09.txt
  * puzzle23.txt
  * puzzle2x2-unsolvable1.txt
==> passed

Test 7b: check twin() with random n-by-n boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 9-by-9
  * 10-by-10
==> passed

Test 8a: check isGoal() with file inputs
  * puzzle00.txt
  * puzzle04.txt
  * puzzle16.txt
  * puzzle06.txt
  * puzzle09.txt
  * puzzle23.txt
```

```
  * puzzle2x2-unsolvable1.txt
  * puzzle3x3-unsolvable1.txt
  * puzzle3x3-00.txt
  * puzzle4x4-00.txt
==> passed

Test 8b: check isGoal() on n-by-n goal boards
  * 2-by-2
  * 3-by-3
  * 4-by-4
  * 5-by-5
  * 6-by-6
  * 100-by-100
==> passed

Test 9: check that two Board objects can be created at the same time
  * random 3-by-3 and 3-by-3 boards
  * random 4-by-4 and 4-by-4 boards
  * random 2-by-2 and 2-by-2 boards
  * random 3-by-3 and 4-by-4 boards
  * random 4-by-4 and 3-by-3 boards
==> passed

Test 10a: check equals()
  * reflexive
  * symmetric
  * transitive
  * argument is null
  * argument is of type String
  * argument is of type UncastableString
  * Board object stored in a variable of type Object
==> passed

Test 10b: check correctness of equals() on random n-by-n boards
  * n = 2
  * n = 3
  * n = 4
  * 5 <= n < 10
==> passed

Test 10c: check equals() when board sizes m and n are different
  * m = 4, n = 5
  * m = 2, n = 5
  * m = 5, n = 3
  * m = 2, n = 3
  * m = 3, n = 2
==> passed

Test 11: check that Board is immutable by changing argument array after
         construction and making sure Board does not mutate
==> passed

Test 12: check that Board is immutable by testing whether methods
         return the same value, regardless of order in which called
  * puzzle10.txt
  * puzzle20.txt
  * puzzle30.txt
  * 2-by-2
  * 3-by-3
  * 4-by-4
==> passed

Test 13: check dimension() on a board that is kth neighbor of a board
  * 0th neighbor of puzzle27.txt
  * 1st neighbor of puzzle27.txt
  * 2nd neighbor of puzzle27.txt
  * 13th neighbor of puzzle27.txt
  * 13th neighbor of puzzle00.txt
  * 13th neighbor of puzzle2x2-unsolvable1.txt
==> passed

Test 14: check hamming() on a board that is kth neighbor of a board
  * 0th neighbor of puzzle27.txt
  * 1st neighbor of puzzle27.txt
  * 2nd neighbor of puzzle27.txt
  * 13th neighbor of puzzle27.txt
  * 13th neighbor of puzzle00.txt
```

```
  * 13th neighbor of puzzle2x2-unsolvable1.txt
==> passed

Test 15: check manhattan() on a board that is a kth neighbor of a board
  * 0th neighbor of puzzle27.txt
  * 1st neighbor of puzzle27.txt
  * 2nd neighbor of puzzle27.txt
  * 13th neighbor of puzzle27.txt
  * 13th neighbor of puzzle00.txt
  * 13th neighbor of puzzle2x2-unsolvable1.txt
==> passed

Test 16: check hamming() on a board that is a kth twin of a board
  * 0th twin of puzzle27.txt
  * 1st twin of puzzle27.txt
  * 2nd twin of puzzle27.txt
  * 13th twin of puzzle27.txt
  * 13th twin of puzzle00.txt
  * 13th twin of puzzle2x2-unsolvable1.txt
==> passed

Test 17: check manhattan() on a board that is a kth twin of a board
  * 0th twin of puzzle27.txt
  * 1st twin of puzzle27.txt
  * 2nd twin of puzzle27.txt
  * 13th twin of puzzle27.txt
  * 13th twin of puzzle00.txt
  * 13th twin of puzzle2x2-unsolvable1.txt
==> passed


Total: 26/26 tests passed!


================================================================
********************************************************************************
*  MEMORY
********************************************************************************

Analyzing memory of Board
*-----------------------------------------------------------
Running 10 total tests.

Memory usage of an n-by-n board
[ must be at most 4n^2 + 32n + 64 bytes ]


              n       student (bytes)    reference (bytes)
---------------------------------------------------------
=> passed     2           144                  128
=> passed     3           208                  192
=> passed     4           256                  240
=> passed     8           576                  560
=> passed    12          1024                 1008
=> passed    16          1600                 1584
=> passed    20          2304                 2288
=> passed    37          6872                 6856
=> passed    72         23104                23088
=> passed   120         61504                61488
==> 10/10 tests passed

Total: 10/10 tests passed!

Student   memory = 4.00 n^2 + 32.00 n + 64.00   (R^2 = 1.000)
Reference memory = 4.00 n^2 + 32.00 n + 48.00   (R^2 = 1.000)


================================================================



********************************************************************************
*  TESTING CORRECTNESS (substituting reference Board)
********************************************************************************

Testing correctness of Solver
*-----------------------------------------------------------
```

```
Running 25 total tests.

Test 1a: check moves() with file inputs
  * puzzle00.txt
  * puzzle01.txt
  * puzzle02.txt
  * puzzle03.txt
  * puzzle04.txt
  * puzzle05.txt
  * puzzle06.txt
  * puzzle07.txt
  * puzzle08.txt
  * puzzle09.txt
  * puzzle10.txt
  * puzzle11.txt
  * puzzle12.txt
  * puzzle13.txt
==> passed

Test 1b: check solution() with file inputs
  * puzzle00.txt
  * puzzle01.txt
  * puzzle02.txt
  * puzzle03.txt
  * puzzle04.txt
  * puzzle05.txt
  * puzzle06.txt
  * puzzle07.txt
  * puzzle08.txt
  * puzzle09.txt
  * puzzle10.txt
  * puzzle11.txt
  * puzzle12.txt
  * puzzle13.txt
==> passed

Test 2a: check moves() with more file inputs
  * puzzle14.txt
  * puzzle15.txt
  * puzzle16.txt
  * puzzle17.txt
  * puzzle18.txt
  * puzzle19.txt
  * puzzle20.txt
  * puzzle21.txt
  * puzzle22.txt
  * puzzle23.txt
  * puzzle24.txt
  * puzzle25.txt
  * puzzle26.txt
  * puzzle27.txt
  * puzzle28.txt
  * puzzle29.txt
  * puzzle30.txt
  * puzzle31.txt
==> passed

Test 2b: check solution() with more file inputs
  * puzzle14.txt
  * puzzle15.txt
  * puzzle16.txt
  * puzzle17.txt
  * puzzle18.txt
  * puzzle19.txt
  * puzzle20.txt
  * puzzle21.txt
  * puzzle22.txt
  * puzzle23.txt
  * puzzle24.txt
  * puzzle25.txt
  * puzzle26.txt
  * puzzle27.txt
  * puzzle28.txt
  * puzzle29.txt
  * puzzle30.txt
  * puzzle31.txt
==> passed
```

```
Test 3a: check moves() with random solvable n-by-n boards
  * 1000 random 3-by-3 boards that are exactly 1 move from goal
  * 1000 random 3-by-3 boards that are exactly 2 moves from goal
  * 1000 random 3-by-3 boards that are exactly 3 moves from goal
  * 1000 random 3-by-3 boards that are exactly 4 moves from goal
  * 1000 random 3-by-3 boards that are exactly 5 moves from goal
  * 1000 random 3-by-3 boards that are exactly 6 moves from goal
  * 1000 random 3-by-3 boards that are exactly 7 moves from goal
  * 1000 random 3-by-3 boards that are exactly 8 moves from goal
  * 1000 random 3-by-3 boards that are exactly 9 moves from goal
  * 1000 random 3-by-3 boards that are exactly 10 moves from goal
  * 1000 random 3-by-3 boards that are exactly 11 moves from goal
  * 1000 random 3-by-3 boards that are exactly 12 moves from goal
==> passed

Test 3b: check solution() with random solvable n-by-n boards
  * 1000 random 3-by-3 boards that are exactly 1 move from goal
  * 1000 random 3-by-3 boards that are exactly 2 moves from goal
  * 1000 random 3-by-3 boards that are exactly 3 moves from goal
  * 1000 random 3-by-3 boards that are exactly 4 moves from goal
  * 1000 random 3-by-3 boards that are exactly 5 moves from goal
  * 1000 random 3-by-3 boards that are exactly 6 moves from goal
  * 1000 random 3-by-3 boards that are exactly 7 moves from goal
  * 1000 random 3-by-3 boards that are exactly 8 moves from goal
  * 1000 random 3-by-3 boards that are exactly 9 moves from goal
  * 1000 random 3-by-3 boards that are exactly 10 moves from goal
  * 1000 random 3-by-3 boards that are exactly 11 moves from goal
  * 1000 random 3-by-3 boards that are exactly 12 moves from goal
==> passed

Test 4: create two Solver objects at the same time
  * puzzle04.txt and puzzle04.txt
  * puzzle00.txt and puzzle04.txt
  * puzzle04.txt and puzzle00.txt
==> passed

Test 5a: call isSolvable() with file inputs
  * puzzle01.txt
  * puzzle03.txt
  * puzzle04.txt
  * puzzle17.txt
  * puzzle3x3-unsolvable1.txt
  * puzzle3x3-unsolvable2.txt
  * puzzle4x4-unsolvable.txt
==> passed

Test 5b: call isSolvable() on random n-by-n boards
  * 100 random 2-by-2 boards
==> passed

Test 6: check moves() on unsolvable puzzles
  * puzzle2x2-unsolvable1.txt
  * puzzle2x2-unsolvable2.txt
  * puzzle3x3-unsolvable1.txt
  * puzzle3x3-unsolvable2.txt
  * puzzle4x4-unsolvable.txt
==> passed

Test 7: check solution() on unsolvable puzzles
  * puzzle2x2-unsolvable1.txt
  * puzzle2x2-unsolvable2.txt
  * puzzle3x3-unsolvable1.txt
  * puzzle3x3-unsolvable2.txt
  * puzzle4x4-unsolvable.txt
==> passed

Test 8a: check that Solver is immutable by testing whether methods
         return the same value, regardless of order in which called
  * puzzle3x3-00.txt
  * puzzle3x3-01.txt
  * puzzle3x3-05.txt
  * puzzle3x3-10.txt
  * random 2-by-2 solvable boards
==> passed

Test 8b: check that Solver is immutable by testing whether methods
```

```
         return the same value, regardless of order in which called
  * puzzle3x3-unsolvable1.txt
  * puzzle3x3-unsolvable2.txt
  * puzzle4x4-unsolvable.txt
  * random 2-by-2 unsolvable boards
==> passed

Test 9a: check that equals() method in Board is called
  * puzzle04.txt
  * puzzle05.txt
  * puzzle10.txt
==> passed

Test 9b: check that equals() method in Board is called only
         with an argument of type Board
  * puzzle00.txt
  * puzzle04.txt
  * puzzle05.txt
  * puzzle10.txt
==> passed

Test 9c: check that equals() method in Board is called only
         with a neighbor of a neighbor as an argument
  * puzzle00.txt
  * puzzle04.txt
  * puzzle05.txt
  * puzzle10.txt
  * puzzle27.txt
==> passed

Test 10: check that constructor throws exception if board is null
==> passed

Test 11a: check moves() with 2-by-2 file inputs
  * puzzle2x2-00.txt
  * puzzle2x2-01.txt
  * puzzle2x2-02.txt
  * puzzle2x2-03.txt
  * puzzle2x2-04.txt
  * puzzle2x2-05.txt
  * puzzle2x2-06.txt
==> passed

Test 11b: check solution() with 2-by-2 file inputs
  * puzzle2x2-00.txt
  * puzzle2x2-01.txt
  * puzzle2x2-02.txt
  * puzzle2x2-03.txt
  * puzzle2x2-04.txt
  * puzzle2x2-05.txt
  * puzzle2x2-06.txt
==> passed

Test 12a: check moves() with 3-by-3 file inputs
  * puzzle3x3-00.txt
  * puzzle3x3-01.txt
  * puzzle3x3-02.txt
  * puzzle3x3-03.txt
  * puzzle3x3-04.txt
  * puzzle3x3-05.txt
  * puzzle3x3-06.txt
  * puzzle3x3-07.txt
  * puzzle3x3-08.txt
  * puzzle3x3-09.txt
  * puzzle3x3-10.txt
  * puzzle3x3-11.txt
  * puzzle3x3-12.txt
  * puzzle3x3-13.txt
  * puzzle3x3-14.txt
  * puzzle3x3-15.txt
  * puzzle3x3-16.txt
  * puzzle3x3-17.txt
  * puzzle3x3-18.txt
  * puzzle3x3-19.txt
  * puzzle3x3-20.txt
  * puzzle3x3-21.txt
  * puzzle3x3-22.txt
```

```
  * puzzle3x3-23.txt
  * puzzle3x3-24.txt
  * puzzle3x3-25.txt
  * puzzle3x3-26.txt
  * puzzle3x3-27.txt
  * puzzle3x3-28.txt
  * puzzle3x3-29.txt
  * puzzle3x3-30.txt
==> passed

Test 12b: check solution() with 3-by-3 file inputs
  * puzzle3x3-00.txt
  * puzzle3x3-01.txt
  * puzzle3x3-02.txt
  * puzzle3x3-03.txt
  * puzzle3x3-04.txt
  * puzzle3x3-05.txt
  * puzzle3x3-06.txt
  * puzzle3x3-07.txt
  * puzzle3x3-08.txt
  * puzzle3x3-09.txt
  * puzzle3x3-10.txt
  * puzzle3x3-11.txt
  * puzzle3x3-12.txt
  * puzzle3x3-13.txt
  * puzzle3x3-14.txt
  * puzzle3x3-15.txt
  * puzzle3x3-16.txt
  * puzzle3x3-17.txt
  * puzzle3x3-18.txt
  * puzzle3x3-19.txt
  * puzzle3x3-20.txt
  * puzzle3x3-21.txt
  * puzzle3x3-22.txt
  * puzzle3x3-23.txt
  * puzzle3x3-24.txt
  * puzzle3x3-25.txt
  * puzzle3x3-26.txt
  * puzzle3x3-27.txt
  * puzzle3x3-28.txt
  * puzzle3x3-29.txt
  * puzzle3x3-30.txt
==> passed

Test 13a: check moves() with 4-by-4 file inputs
  * puzzle4x4-00.txt
  * puzzle4x4-01.txt
  * puzzle4x4-02.txt
  * puzzle4x4-03.txt
  * puzzle4x4-04.txt
  * puzzle4x4-05.txt
  * puzzle4x4-06.txt
  * puzzle4x4-07.txt
  * puzzle4x4-08.txt
  * puzzle4x4-09.txt
  * puzzle4x4-10.txt
  * puzzle4x4-11.txt
  * puzzle4x4-12.txt
  * puzzle4x4-13.txt
  * puzzle4x4-14.txt
  * puzzle4x4-15.txt
  * puzzle4x4-16.txt
  * puzzle4x4-17.txt
  * puzzle4x4-18.txt
  * puzzle4x4-19.txt
  * puzzle4x4-20.txt
  * puzzle4x4-21.txt
  * puzzle4x4-22.txt
  * puzzle4x4-23.txt
  * puzzle4x4-24.txt
  * puzzle4x4-25.txt
  * puzzle4x4-26.txt
  * puzzle4x4-27.txt
  * puzzle4x4-28.txt
  * puzzle4x4-29.txt
  * puzzle4x4-30.txt
==> passed
```

```
Test 13b: check solution() with 4-by-4 file inputs
  * puzzle4x4-00.txt
  * puzzle4x4-01.txt
  * puzzle4x4-02.txt
  * puzzle4x4-03.txt
  * puzzle4x4-04.txt
  * puzzle4x4-05.txt
  * puzzle4x4-06.txt
  * puzzle4x4-07.txt
  * puzzle4x4-08.txt
  * puzzle4x4-09.txt
  * puzzle4x4-10.txt
  * puzzle4x4-11.txt
  * puzzle4x4-12.txt
  * puzzle4x4-13.txt
  * puzzle4x4-14.txt
  * puzzle4x4-15.txt
  * puzzle4x4-16.txt
  * puzzle4x4-17.txt
  * puzzle4x4-18.txt
  * puzzle4x4-19.txt
  * puzzle4x4-20.txt
  * puzzle4x4-21.txt
  * puzzle4x4-22.txt
  * puzzle4x4-23.txt
  * puzzle4x4-24.txt
  * puzzle4x4-25.txt
  * puzzle4x4-26.txt
  * puzzle4x4-27.txt
  * puzzle4x4-28.txt
  * puzzle4x4-29.txt
  * puzzle4x4-30.txt
==> passed

Test 14a: check moves() with random solvable n-by-n boards
  * 100 random 2-by-2 boards that are <= 6 moves from goal
  * 200 random 3-by-3 boards that are <= 20 moves from goal
  * 200 random 4-by-4 boards that are <= 20 moves from goal
  * 200 random 5-by-5 boards that are <= 20 moves from goal
==> passed

Test 14b: check solution() with random solvable n-by-n boards
  * 100 random 2-by-2 boards that are <= 6 moves from goal
  * 200 random 3-by-3 boards that are <= 20 moves from goal
  * 200 random 4-by-4 boards that are <= 20 moves from goal
  * 200 random 5-by-5 boards that are <= 20 moves from goal
==> passed


Total: 25/25 tests passed!


================================================================
********************************************************************************
*  MEMORY (substituting reference Board)
********************************************************************************

Analyzing memory of Solver
*-----------------------------------------------------------
Running 12 total tests.

Maximum allowed time per puzzle is 5.0 seconds.
Maximum allowed memory per puzzle = 200000000 bytes.

Test 1: Measure memory of Solver.

               filename   moves   memory
---------------------------------------------
=> passed  puzzle10.txt      10     4784
=> passed  puzzle15.txt      15     5792
=> passed  puzzle20.txt      20     3056
=> passed  puzzle25.txt      25     3776
=> passed  puzzle30.txt      30     4496
=> passed  puzzle35.txt      35     6080
==> 6/6 tests passed
```

Test 2: Measure memory of MinPQ.

```
                              deep              max           ending
               filename     memory             size             size
-------------------------------------------------------------------
=> passed  puzzle10.txt      28784               34               33
=> passed  puzzle15.txt      35984               52               51
=> passed  puzzle20.txt     218624              587              586
=> passed  puzzle25.txt    1554976             4214             4213
=> passed  puzzle30.txt    6471888            17038            17037
=> passed  puzzle35.txt   92935480           271122           271121
==> 6/6 tests passed


Total: 12/12 tests passed!


================================================================
```

```
********************************************************************************
*  TIMING (substituting reference Board)
********************************************************************************

Timing Solver
*-----------------------------------------------------------
Running 125 total tests.

Maximum allowed time per puzzle is 5.0 seconds.

Test 1: Measure CPU time and check correctness

               filename   moves    n  seconds
-----------------------------------------------
=> passed  puzzle20.txt      20    3     0.02
=> passed  puzzle22.txt      22    3     0.01
=> passed  puzzle21.txt      21    3     0.01
=> passed  puzzle23.txt      23    3     0.01
=> passed  puzzle24.txt      24    3     0.01
=> passed  puzzle25.txt      25    3     0.02
=> passed  puzzle27.txt      27    3     0.02
=> passed  puzzle29.txt      29    3     0.02
=> passed  puzzle26.txt      26    3     0.01
=> passed  puzzle28.txt      28    3     0.03
=> passed  puzzle30.txt      30    3     0.04
=> passed  puzzle31.txt      31    3     0.03
=> passed  puzzle39.txt      39    4     0.04
=> passed  puzzle41.txt      41    5     0.07
=> passed  puzzle34.txt      34    4     0.10
=> passed  puzzle37.txt      37    4     0.09
=> passed  puzzle44.txt      44    5     0.17
=> passed  puzzle32.txt      32    4     0.30
=> passed  puzzle35.txt      35    4     0.33
=> passed  puzzle33.txt      33    4     0.34
=> passed  puzzle43.txt      43    4     0.58
=> passed  puzzle46.txt      46    4     0.58
=> passed  puzzle40.txt      40    4     0.64
=> passed  puzzle36.txt      36    4     1.21
=> passed  puzzle45.txt      45    4     1.44
==> 25/25 tests passed



Test 2: Count MinPQ operations

               filename   insert()         delMin()
-------------------------------------------------
=> passed  puzzle20.txt       1439              853
=> passed  puzzle22.txt       3481             2071
=> passed  puzzle21.txt       3541             2081
=> passed  puzzle23.txt       5299             3149
=> passed  puzzle24.txt       5427             3259
=> passed  puzzle25.txt      10316             6103
=> passed  puzzle27.txt      11209             6741
```

```
=> passed  puzzle29.txt      11637             7077
=> passed  puzzle26.txt      11894             7099
=> passed  puzzle28.txt      26974            16231
=> passed  puzzle30.txt      43094            26057
=> passed  puzzle31.txt      46007            27805
=> passed  puzzle39.txt      71417            35045
=> passed  puzzle41.txt     116491            50009
=> passed  puzzle34.txt     151673            73159
=> passed  puzzle37.txt     166811            80085
=> passed  puzzle44.txt     275661           123165
=> passed  puzzle32.txt     521596           249495
=> passed  puzzle35.txt     528418           257297
=> passed  puzzle33.txt     622352           298883
=> passed  puzzle43.txt    1056805           508833
=> passed  puzzle46.txt    1032320           516741
=> passed  puzzle40.txt    1108443           541467
=> passed  puzzle36.txt    2086331          1011485
=> passed  puzzle45.txt    2418079          1189753
==> 25/25 tests passed


Test 3: Count Board operations (that should not get called)

               filename    hamming()   toString()
------------------------------------------------
=> passed  puzzle20.txt            0            0
=> passed  puzzle22.txt            0            0
=> passed  puzzle21.txt            0            0
=> passed  puzzle23.txt            0            0
=> passed  puzzle24.txt            0            0
=> passed  puzzle25.txt            0            0
=> passed  puzzle27.txt            0            0
=> passed  puzzle29.txt            0            0
=> passed  puzzle26.txt            0            0
=> passed  puzzle28.txt            0            0
=> passed  puzzle30.txt            0            0
=> passed  puzzle31.txt            0            0
=> passed  puzzle39.txt            0            0
=> passed  puzzle41.txt            0            0
=> passed  puzzle34.txt            0            0
=> passed  puzzle37.txt            0            0
=> passed  puzzle44.txt            0            0
=> passed  puzzle32.txt            0            0
=> passed  puzzle35.txt            0            0
=> passed  puzzle33.txt            0            0
=> passed  puzzle43.txt            0            0
=> passed  puzzle46.txt            0            0
=> passed  puzzle40.txt            0            0
=> passed  puzzle36.txt            0            0
=> passed  puzzle45.txt            0            0
==> 25/25 tests passed


Test 4a: Count Board operations (that should get called)

               filename    Board()            equals()         manhattan()
--------------------------------------------------------------------------
=> passed  puzzle20.txt       2289                2279                2292
=> passed  puzzle22.txt       5549                5543                5552
=> passed  puzzle21.txt       5619                5611                5622
=> passed  puzzle23.txt       8445                8437                8448
=> passed  puzzle24.txt       8683                8673                8686
=> passed  puzzle25.txt      16416               16408               16419
=> passed  puzzle27.txt      17947               17939               17950
=> passed  puzzle29.txt      18711               18703               18714
=> passed  puzzle26.txt      18990               18984               18993
=> passed  puzzle28.txt      43202               43192               43205
=> passed  puzzle30.txt      69148               69142               69151
=> passed  puzzle31.txt      73809               73801               73812
=> passed  puzzle39.txt     106459              106451              106462
=> passed  puzzle41.txt     166497              166487              166500
=> passed  puzzle34.txt     224829              224823              224832
=> passed  puzzle37.txt     246893              246885              246896
=> passed  puzzle44.txt     398823              398813              398826
=> passed  puzzle32.txt     771088              771078              771091
```

```
=> passed  puzzle35.txt     785712              785702              785715
=> passed  puzzle33.txt     921232              921224              921235
=> passed  puzzle43.txt    1565635             1565627             1565638
=> passed  puzzle46.txt    1549058             1549050             1549061
=> passed  puzzle40.txt    1649907             1649901             1649910
=> passed  puzzle36.txt    3097813             3097803             3097816
=> passed  puzzle45.txt    3607829             3607821             3607832
==> 25/25 tests passed


Test 4b: count Board operations (that should get called),
         rejecting if doesn't adhere to stricter caching limits

               filename    Board()            equals()         manhattan()
--------------------------------------------------------------------------------
=> passed  puzzle20.txt       2289                2279                2292
=> passed  puzzle22.txt       5549                5543                5552
=> passed  puzzle21.txt       5619                5611                5622
=> passed  puzzle23.txt       8445                8437                8448
=> passed  puzzle24.txt       8683                8673                8686
=> passed  puzzle25.txt      16416               16408               16419
=> passed  puzzle27.txt      17947               17939               17950
=> passed  puzzle29.txt      18711               18703               18714
=> passed  puzzle26.txt      18990               18984               18993
=> passed  puzzle28.txt      43202               43192               43205
=> passed  puzzle30.txt      69148               69142               69151
=> passed  puzzle31.txt      73809               73801               73812
=> passed  puzzle39.txt     106459              106451              106462
=> passed  puzzle41.txt     166497              166487              166500
=> passed  puzzle34.txt     224829              224823              224832
=> passed  puzzle37.txt     246893              246885              246896
=> passed  puzzle44.txt     398823              398813              398826
=> passed  puzzle32.txt     771088              771078              771091
=> passed  puzzle35.txt     785712              785702              785715
=> passed  puzzle33.txt     921232              921224              921235
=> passed  puzzle43.txt    1565635             1565627             1565638
=> passed  puzzle46.txt    1549058             1549050             1549061
=> passed  puzzle40.txt    1649907             1649901             1649910
=> passed  puzzle36.txt    3097813             3097803             3097816
=> passed  puzzle45.txt    3607829             3607821             3607832
==> 25/25 tests passed


Total: 125/125 tests passed!


================================================================
```