The first page of your homework submission must be a cover sheet answering the following questions. Do not leave it until the last minute; it's fine to fill out the cover sheet before you have completely finished the assignment. Assignments submitted without a cover sheet, or with a cover sheet obviously dashed off without much thought at the last minute, will not be graded.

- How many hours would you estimate that you spent on this assignment?

- Explain (in one or two sentences) one thing you learned through doing this assignment.

- What is one thing you think you need to review or study more? What do you plan to do about it?

```
Percolating on 25x25 grid...
  .     . .       X .   . .   . . .       .
  .   . .       . X .           . . . .     .
  . .     .   . . X X . . .     . . .         .
            .     . X X . .       . .     .
.   .     . . .     . X       .     .     . . . .
    . .     .   .     X . . .       . . . . . . .
    . .   .   . .   . X .   .     . .   .       .
.       . .   . .     X .     . .         .     .
.   . .   .     .   . X X X .   . . X X X   . .
. . . . .     .   . . . . X .     X X . X . . .
.     .   . . .     . .   X X . . X . . X .   .
. . .     . . . . .       . X X X X .   X .   .
            . .     .   . . . . .   . .   X
.   . .   . . .     .   . . . .   .     . X X .
. . . . . . . .       .     . .       . . X
      .     . . .   .           .     .   X
.                   . .   .   . .   . . X X .
. . . .   . . .             . . . X X X X .
        .     .       .     .     X .         . .
. .     .     . .   . . . .     . X .           .
    . .         .     .     .   . X .     .   . .
  .   .   . . . . .   .   .       X .   . . .   .
  .   .   .   . . .     .     . . X X . .
        .   .   .     . .   . . . . X       . .
.   .       . .     .   . .         X           .
Percolation achieved with 352 cells opened (56.32%)
Shortest path length = 48
```

It is a curious fact that on average, the grid will percolate after 59.2% of the cells are opened—no matter what size the grid is. (The larger the grid, the more precise the percentage will be.) Moreover, this percentage is a sort of "phase transition": if you take a large grid and randomly open *fewer* than 59.2% of its cells, then it probably will not percolate; open any *more* than 59.2%, and it probably will.

Note that in the given sample output shown to the left, open cells are displayed as a space, blocked cells as a dot, and open cells through which the shortest percolating path passes as an `X`. Alternate columns are left blank just to make the grid look relatively square. Your output does not have to look exactly like this.

Imagine an $n \times n$ square grid, where each cell is connected to its four neighbors to the north, east, south, and west. Each cell can be either "open" or "blocked". Paths through the grid can only travel through open cells. We say the grid *percolates* if there is a path from some open cell in the top row all the way to some open cell in the bottom row.

Now, carry out the following process: the cells all start out blocked; at each iteration, randomly pick a blocked cell and open it. Keep iterating until the grid percolates.

You should write a program (using a language of your choice) which will explore this percolation model, producing output like the above. That is, your program should carry out the above random cell-opening procedure until the grid percolates, and then display the resulting grid along with the shortest percolating path. For full credit, your program must be able to complete relatively quickly (within a few seconds) for a 500×500 grid.