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--- Day 20: Donut Maze ---

You notice a strange pattern on the surface of Pluto and land nearby to get a closer look. Upon closer inspection, you realize you've come across one of the famous space-warping mazes of the long-lost Pluto civilization!

Because there isn't much space on Pluto, the civilization that used to live here thrived by inventing a method for folding spacetime. Although the technology is no longer understood, mazes like this one provide a small glimpse into the daily life of an ancient Pluto citizen.

This maze is shaped like a **donut**. Portals along the inner and outer edge of the donut can instantly teleport you from one side to the other. For example:

```

      A
      A
#####.#####
#####.....#
#####.#####.
#####.#####.
#####.#####.
##### B   ###.
BC...## C   ###.
##.##   ###.
##...DE F   ###.
##### G   ###.
#####.#####.
DE..#####...###.
#.#####.###.
FG..#####.....#
#####.#####
      Z
      Z
  
```

This map of the maze shows solid walls (**#**) and open passages (**.**). Every maze on Pluto has a start (the open tile next to **AA**) and an end (the open tile next to **ZZ**). Mazes on Pluto also have portals; this maze has three pairs of portals: **BC**, **DE**, and **FG**. When on an open tile next to one of these labels, a single step can take you to the other tile with the same label. (You can only walk on **.** tiles; labels and empty space are not traversable.)

One path through the maze doesn't require any portals. Starting at **AA**, you could go down 1, right 8, down 12, left 4, and down 1 to reach **ZZ**, a total of 26 steps.

However, there is a shorter path: You could walk from **AA** to the inner **BC** portal (4 steps), warp to the outer **BC** portal (1 step), walk to the inner **DE** (6 steps), warp to the outer **DE** (1 step), walk to the outer **FG** (4 steps), warp to the inner **FG** (1 step), and finally walk to **ZZ** (6 steps). In total, this is only 23 steps.

Here is a larger example:

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```

      A
      A
#####
#.#...#.....#.#.#
#.#.#.###.###.###.###.###
#.#.#.....#...#.....#.#.#
#.#.#####.###.#####.###.###
#.....#.#.....#.....#
###.#####.###.#####.###.###
#.....#      A   C   #.#.#.#
#####      S   P   #####.#
#.#...#                      #.....VT
#.#.#.#                      #.#####
#...#.#                      YN....#.#
#.###.#                      #####.#
DI....#.#                    #.....#
#####.#                    #.###.#
ZZ.....#                    QG....#..AS
###.###                    #####
JO..#.#.#                    #.....#
#.#.#.#                    ###.#.#
#...#..DI                    BU....#..LF
#####.#                    #.#####
YN.....#                    VT..#....QG
#.#.###.#                    #.###.#
#.#...#                      #.....#
###.###      J L      J      #.#.###
#.....#      O F      P      #.#...#
#.#.###.#####.#.#####.#####.###.#
#...#.#.#...#.....#.....#.#...#
#.#.#####.###.###.#.#.#####.###.#
#...#.#.....#...#.#.#.#.....#.#
#.#.#####.###.###.#.#.#####
#.#.....#...#.....#.....#
#####.#.###.###.#####
      B   J   C
      U   P   P

```

Here, `AA` has no direct path to `ZZ`, but it does connect to `AS` and `CP`. By passing through `AS`, `QG`, `BU`, and `JO`, you can reach `ZZ` in 58 steps.

In your maze, how many steps does it take to get from the open tile marked `AA` to the open tile marked `ZZ`?

Your puzzle answer was `602`.

--- Part Two ---

Strangely, the exit isn't open when you reach it. Then, you remember: the ancient Plutonians were famous for building **recursive spaces**.

The marked connections in the maze aren't portals: they **physically connect** to a larger or smaller copy of the maze. Specifically, the labeled tiles around the inside edge actually connect to a smaller copy of the same maze, and the smaller copy's inner labeled tiles connect to yet a **smaller** copy, and so on.

When you enter the maze, you are at the outermost level; when at the outermost level, only the outer labels `AA` and `ZZ` function (as the start and end, respectively); all other outer labeled tiles are effectively walls. At any other level, `AA` and `ZZ` count as walls, but the other outer labeled tiles bring you one level outward.

Your goal is to find a path through the maze that brings you back to `ZZ` at the outermost level of the maze.

In the first example above, the shortest path is now the loop around the right side. If the starting level is `0`, then taking the previously-shortest path would pass through `BC` (to level `1`), `DE` (to level `2`), and `FG` (back to level `1`). Because this is not the outermost level, `ZZ` is a wall, and the only option is to go back around to `BC`, which would only send you even deeper into the recursive maze.

In the second example above, there is no path that brings you to `ZZ` at the outermost level.

Here is a more interesting example:

```

      Z L X W      C
      Z P Q B      K
#####.###.#####.#####
#...#.....#.#.....#.#.....#.#...#
###.###.###.###.###.#####.###.###
#.#...#.#.#...#.#.#...#...#.#.....#
#.###.#####.###.###.###.###.#####
#...#.....#.#...#...#.....#...#
#.#####.#####.#####.#####.###
#...#.#      F      R I      Z      #.###.
#.###.#      D      E C      H      #.###.
#.#...#                                #...#.#
#.###.#                                #.###.#
#.#....OA                                WB...#.ZH
#.###.#                                #.###.#
CJ.....#                                #.....#
#####                                #####
#.#....CK                                #.....IC
#.#...#                                #.###.#
#.....#                                #...#.#
###.###                                #.###.#
XF....#.#                                RF...#.#
#####                                #####
#.....CJ                                NM...#...#
###.###                                #.###.#
RE....#.#                                #.....RF
###.###      X  X      L      #.###.#
#.....#      F  Q      P      #.###.#
###.#####.###.#####.#####.###
#.....#...#.....#.....#...#...#...#
#####.###.#####.#####.###.###.###
#.....#.....#.#.#.#...#...#...#...#
#####.###.#####.###.###.###.###.###
#.....#.....#.#...#.....#...#...#
#####.###.#####.###.###.###.###.###
#.....#.....#.#...#.....#...#...#
#####.###.#####.#####.#####
      A O F      N
      A A D      M

```

One shortest path through the maze is the following:

- Walk from `AA` to `XF` (16 steps)
- Recurse into level 1 through `XF` (1 step)
- Walk from `XF` to `CK` (10 steps)
- Recurse into level 2 through `CK` (1 step)
- Walk from `CK` to `ZH` (14 steps)
- Recurse into level 3 through `ZH` (1 step)
- Walk from `ZH` to `WB` (10 steps)
- Recurse into level 4 through `WB` (1 step)
- Walk from `WB` to `IC` (10 steps)
- Recurse into level 5 through `IC` (1 step)

```

- Walk from IC to RF (10 steps)
- Recurse into level 6 through RF (1 step)
- Walk from RF to NM (8 steps)
- Recurse into level 7 through NM (1 step)
- Walk from NM to LP (12 steps)
- Recurse into level 8 through LP (1 step)
- Walk from LP to FD (24 steps)
- Recurse into level 9 through FD (1 step)
- Walk from FD to XQ (8 steps)
- Recurse into level 10 through XQ (1 step)
- Walk from XQ to WB (4 steps)
- Return to level 9 through WB (1 step)
- Walk from WB to ZH (10 steps)
- Return to level 8 through ZH (1 step)
- Walk from ZH to CK (14 steps)
- Return to level 7 through CK (1 step)
- Walk from CK to XF (10 steps)
- Return to level 6 through XF (1 step)
- Walk from XF to OA (14 steps)
- Return to level 5 through OA (1 step)
- Walk from OA to CJ (8 steps)
- Return to level 4 through CJ (1 step)
- Walk from CJ to RE (8 steps)
- Return to level 3 through RE (1 step)
- Walk from RE to IC (4 steps)
- Recurse into level 4 through IC (1 step)
- Walk from IC to RF (10 steps)
- Recurse into level 5 through RF (1 step)
- Walk from RF to NM (8 steps)
- Recurse into level 6 through NM (1 step)
- Walk from NM to LP (12 steps)
- Recurse into level 7 through LP (1 step)
- Walk from LP to FD (24 steps)
- Recurse into level 8 through FD (1 step)
- Walk from FD to XQ (8 steps)
- Recurse into level 9 through XQ (1 step)
- Walk from XQ to WB (4 steps)
- Return to level 8 through WB (1 step)
- Walk from WB to ZH (10 steps)
- Return to level 7 through ZH (1 step)
- Walk from ZH to CK (14 steps)
- Return to level 6 through CK (1 step)
- Walk from CK to XF (10 steps)
- Return to level 5 through XF (1 step)
- Walk from XF to OA (14 steps)
- Return to level 4 through OA (1 step)
- Walk from OA to CJ (8 steps)
- Return to level 3 through CJ (1 step)
- Walk from CJ to RE (8 steps)
- Return to level 2 through RE (1 step)
- Walk from RE to XQ (14 steps)
- Return to level 1 through XQ (1 step)
- Walk from XQ to FD (8 steps)
- Return to level 0 through FD (1 step)
- Walk from FD to ZZ (18 steps)

```

This path takes a total of 396 steps to move from AA at the outermost layer to ZZ at the outermost layer.

In your maze, when accounting for recursion, how many steps does it take to get from the open tile marked AA to the open tile marked ZZ, both at the outermost layer?

Your puzzle answer was `6986`.

Both parts of this puzzle are complete! They provide two gold stars: **

At this point, you should [return to your Advent calendar](#) and try another puzzle.

If you still want to see it, you can [get your puzzle input](#).

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