

Express Riddler

29 May 2020

Riddle:

While spending more time at home in recent weeks, I've had the chance to revisit one of my favorite video games from recent years — The Legend of Zelda: Breath of the Wild. Within the game, there are hundreds of hidden “Korok Seeds”, which I'm having an increasingly difficult time finding.

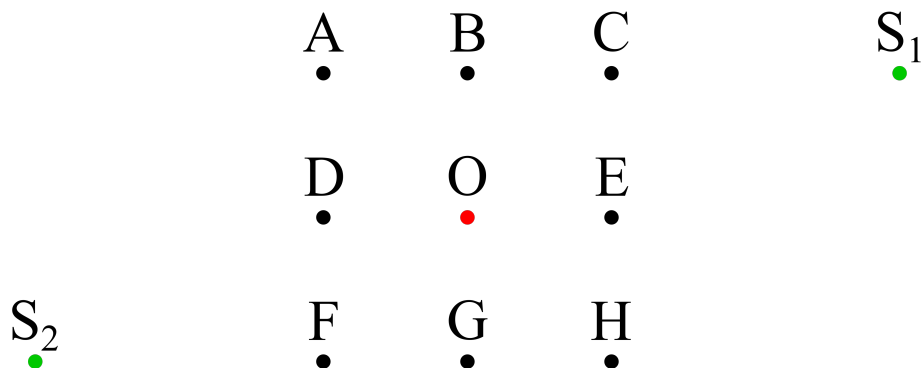
Fortunately, there's a special mask you can acquire in the game that makes a sound any time you're within a certain distance of a Korok Seed. While playing, I marked nine distinct locations on the game map, forming the 3-by-3 grid shown below:



Each leaf symbol is within range of a Korok Seed, while the point in the middle is *not* within range of a Korok Seed. Given this arrangement, what is the minimum possible number of Korok Seeds I could have detected?

Solution:

Surprisingly, it is possible for this arrangement to occur from only two seeds. The only condition necessary for a solution is that the distance from the center point to either seed is greater than the distance from any other point to the nearest seed, regardless of the particular detection range. I will illustrate a solution with the diagram below:



I have labeled each of the detection points A–H, the non-detection point O, and the two seed points S_1 and S_2 .

To quantify the problem, suppose that O is at the origin, and the surrounding detection points are located at $(-1, 1)$, $(0, 1)$, $(1, 1)$, etc. Also suppose S_1 is located at $(3, 1)$ and S_2 at $(-3, -1)$. Then, we have $\overline{BS_1} = 3$, $\overline{CS_1} = 2$, $\overline{ES_1} = \sqrt{5}$, $\overline{HS_1} = \sqrt{8}$, and $\overline{OS_1} = \sqrt{10}$. The situation is the same for S_2 by symmetry. Because the distance from the origin to the seeds is larger than the other distances ($\sqrt{10} > 3 > \sqrt{8} > \sqrt{5} > 2$), the necessary condition is met. Thus as long as the detection range is larger than 3 times the unit distance, but less than $\sqrt{10}$ times, we can construct the above grid.