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The Song of Ducks and Dragons [2025]

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Part I

Story section

Thanks to the study of family connections based on scales received from Thaddeus, you now know that you most likely come from the dragonduck clan residing in the distant Kingdom of Algorithmia. The ability of the local families for solving complex problems is very well known throughout the world.

However, these dragonducks are also known for their care of their offspring and never abandon their young. If you ended up at the blacksmith in such a distant village, there must have been a very good reason for that. Before you can think further, a breathless nerdmaster bursts into the chamber, nearly tripping over his scrolls.

- Thaddeus, it's time! The Dragon Chess Tournament is about to begin!

You look questioningly at Veronica, who quickly explains that this is a crucial event in the Sanctuary - a match where the sharpest minds among all the nerdmasters compete. You also learn that the tournament winner will get to speak with the Grand Bytefather. He is the most important figure in the entire Sanctuary. He personally receives all incoming messages and determines the community's next course of action.

Talking to such a great figure is the greatest honor for nerdmasters. However, you see this as an opportunity to learn more about the current situation in the Kingdom of Algorithmia.

You rush to the room where the competition is about to take place. On the way, Veronica explains the rules of the game.

Dragon Chess is played on a rectangular chessboard. The size of this chessboard can vary depending on the game.

There is one dragon figurine and a lot of sheep figurines on the board. If at any moment the dragon and the sheep end up on the same square of the board, the sheep figurine is removed from the board as eaten by the dragon.

It is very important to understand how the dragon moves. The simplest way to explain it would be that the dragon moves exactly like a knight in classic chess, but you have no idea what classic chess is, so Veronica explains it to you as best as she can.

In a single move, the dragon must move exactly 2 squares in any of the 4 directions: up, down, right, or left, and then exactly one square in a direction perpendicular to the chosen one. The shape defined by such a move resembles the letter L. The dragon can usually move to 8 squares, but if it's near the edge, the number of possible squares is smaller.

Below are several examples of chessboards, marking the dragon D and the squares it can move to in its next move X.

.....	...X...D
.X.X..	.D.....X..X.X
.X...X.	...X....X.X....
..D...	X.X....D..
.X...X.X.X..X...
..X.X..X...X.X.X
.....D...

You decide to practice the dragon's moves a bit. You imagine a chessboard, in the centre of which you place a single dragon figurine D and many sheep figurines around it S (your notes). Then you check how many sheep are within the range of 4 moves of the dragon.

Example based on the following notes:

```
....SSS.....  
.S.....S.SS.  
..S....S...S.  
.....SSS..  
..SSSS...S...  
....SS..S..S  
SS....D.S....  
S.S...S...S...  
....S.....S  
.SSS..SS....  
.....S...S...  
SS....S...S...
```

For the sake of the example, we check only 3 moves of the dragon instead of 4. Below you can find the squares marked with X that are reachable in a certain number of moves. The sheep have been omitted for better readability:

moves: 0	moves: 1	moves: 2	moves: 3
.....X.X.X.X...
.....X.X.X.X.X..
.....X.X.X...	.X.XXXXXXX.X.
.....X.X.X.X...	X.XXXXXXXXXX.X
.....	...X.X....	..X..XXX..X..	.XXX.XXX.XXX.
.....	...X...X....XXX.XXX...	X.XXXXXXXXXX.X
....X....X....	...X.X.X.X.X..	.XXXXXXXXXXXX.
.....X...X....XXX.XXX...	X.XXXXXXXXXX.X
.....X.X....	...X..XXX..X..	.XXX.XXX.XXX.
.....X.X.X.X...	X.XXXXXXXXXX.X
.....X.X.X....	.X.XXXXXXX.X.
.....X.X.X.X.X..
.....X.X.X.X....

Now all you need to do is count how many squares within the dragon's range have sheep: X.

```
...XSX.....  
.S.....X.XS.  
..S....X...X.  
.....XS.  
..XXSX...X...  
....XX...X..X  
SX....D.X....  
X.X...X...X...  
....S.....S  
.SXX..XX....  
.....X...  
.....S....S  
SS....X...S...
```

In the above example, there are 27 sheep within the range of 3 dragon moves.

How many sheep are within the range of 4 dragon moves?

Your notes for this part:

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Part 1 solved with answer: 147

 Check your progress

Part II

You're running through the corridors, so it's hard to tell all the rules precisely, but you're not giving up. Veronica further explains that the sheep, in their turn, simply move one square, always towards the bottom of the chessboard. During the game, the moves alternate: dragon, sheep, dragon, sheep, ... etc.

Additionally, there are hideouts on the board marked as #, which protect the sheep from the dragon. Both the dragon and the sheep can move over them in the usual way, but if the dragon and the sheep end up on such a square at the same time, the sheep is not eaten and can move in the next turn.

The goal of each sheep is to escape the board before the dragon eats it. If the sheep reaches the lowest row on the chessboard and moves again in the next turn, it can be removed from the board as a survivor.

You imagine a large chessboard with plenty of sheep and hiding spots (your notes), and you try to simulate the game. You decide to play 20 rounds to see how many sheep can be eaten in all possible variants of dragon moves overall. All hideouts are empty at the beginning of the game. You assume that the sheep are not very smart, and in their turn, they might run into a square where

the dragon stands, giving him a free meal.

Example based on the following notes:

```
...SSS#....  
.S.#..$#SS.  
..S.#.,S#..S.  
.#.:#$##..SS.  
..SSS.,#..S#.  
.##..SS..$#S  
SS##..#D.S.#..  
S..S..S..$##.  
.##..S#..#...S  
.SSS..#SS..##.  
..#..##...S##.  
.#...#..S#...S  
SS...#..S..#S..
```

For the sake of this example, we check only 3 rounds of the game instead of 20. Below you can see the boards showing where the dragon can be at the end of each turn.

turn: 0	after turn: 1	after turn: 2	after turn: 3
.....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.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.X.X.X
.....X.X...X...	.X.X.X.X.X.X.
.....X.X.X.X.X..
.....X.X.X.X...

Each sheep can only move down the chessboard, so it is easy to simulate what the arrangement of the sheep looks like after each round. Hiding spots have been omitted for better readability.

turn: 0	after turn: 1	after turn: 2	after turn: 3
...SSS.....
.S.....S.SS.SSS.....
..S...S..S.	.S.....S.SS.SSS.....
....S....SS.	.S.....S...S.S.....S.SS.	...SSS.....
...SSSS...S...S.....SS.S.....S...S.	.S.....S.SS.
....SS..S..SSSSS...S...S.....SS.S.....S...
SS.....S....SS..S..SSSSS...S...S.....SS.
S..S..S..S....	SS.....S....SS..S..S	...SSSS...S...
....S.....S	S..S..S..S....	SS.....S....SS..S..S
.SSS..SS....S.....S	S..S..S..S....	SS.....S....
....S....SSS..SS....S.....S	S..S..S..S....
....S....SS....SSS..SS....S.....S
SS.....S..S..S....SS.....SSS..SS....

Dragon moves first. In its first move, it can go to one of the eight squares around it. Then all the sheep move one square towards the bottom. Sheep that can be eaten are marked as X and are immediately removed from the board to avoid counting them again in subsequent rounds.

In the first round of the game, there are 6 sheep within the dragon's reach, of which 5 can be eaten X and one is safe in the hideout S.

dragon turn: 1	sheeps turn: 0	sheeps turn: 1	hides
.....	...SSS.....##....
.....	.S.....S.SS.SSS.....	..#.##...#...
.....	.S.....S...S.	.S.....S.SS.##..#....
.....S....SS.S.....S...S.	.#.##.###....
....X.X....SSSX...S...X....SS.##...#..
....X..X....SSS..S..SSSX....S...	.##....##...#.
.....	SS.....S....SS..S..S	..##.##....#..
....X..X....	S..S..S..X....	SS.....X....##...##..
....X..X....S.....S	S..S..S.....	.##..##..#....
.....SS..SS....S.....S#...##..#.
.....S....SSS..SS....	..#.##....##.
.....	SS.....S..S..S.....S	.#....#..#....
.....	SS.....S..S..S.....S#....#....

In the second round, there are 15 sheep within the dragon's reach, of which 7 can be eaten and 8 are safe in the hideouts.

dragon turn: 2	sheeps turn: 1	sheeps turn: 2	hides
.....#.....
.....	...SS.....#.##...#...
....X.X.X....	.S.....\$..SS.SSS.....##...#....
....X.X.X.X...	.S.....\$...S.	.S.....S.SS.	.#.##.##.....
...X...X...X...XS.	...X...S...S.##...#...
...X.X.X.X...	.SX.....X...S.	##...##...#...
...X.X.X.X.X...SX...S.S	...S.....	..##.##...##..
...X.X.X.X...	SS.....X...S..S####..
...X...X...X...	S.\$...S.....	SS.....	.##..#.##...
...X.X.X.X...S...S	S.S...S.....##...##..
...X.X.X.X...S...SS...S	..#.##...##..
....X.X.X...S...SS...S	.#...##...#...
.....S...SSSS...S...	##...##...#...
.....S...SS...##...#...

In the third round, there are 23 sheep within the dragon's reach, of which 15 can be eaten.

dragon turn: 3	sheeps turn: 2	sheeps turn: 3	hides
...X.X.X.X...##.....
...X.X.X.X.X...#.##...#...
.X.X.X.X.X.X.	...X\$...##...#...
X.X.X.X.X.X.X	.S.....XS.SS.....	.##..#.##.....
.X.X.X.X.X.X.S...S	.X.....S.##...#...
X.X.X.X.X.X.XS...S...S.	.##...##...#...
.X.X.X.X.X.X.	.S.....X.	..##.##...#...
X.X.X.X.X.X.XS...X	...X.....####..
.X.X.X.X.X.X.	SS.....X...	.##..#.##...
X.X.X.X.X.X.X	X.X...S.....	XS.....##...##..
.X.X.X.X.X.X.S...SS.....	..#.##...##..
..X.X.X.X.X...	.SXS...S...X...S...	.#...##...#...
...X.X.X.X...S...SS.X...X...##...#...

Considering 3 rounds of gameplay, the dragon can eat $5 + 7 + 15 = \boxed{27}$ sheep (in all possible variants of dragon moves).

How many sheep can the dragon eat in 20 rounds of the game in all possible variants of dragon moves?

Your notes for this part:

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Part 2 solved with answer: 1789

 Check your progress 

Part III

You arrive at the grand hall where the competition has already begun. To your surprise, the game board is very small compared to your imaginations. What is even stranger, everyone is sitting by their own chessboard alone, making some notes.

You sit at one of the few remaining free spots together with Veronica. You notice that all the rows of the chessboard are numbered: 1, 2, 3, ... etc., starting from the top row. Each column has a letter: A, B, C, ... etc., starting from the left. Veronica explains that this system is used for recording the moves in the game; for example, if the dragon moves to a square with a row marked as 1 and column as A, it is enough to note such a move as D>A1. The sheep would record a similar move as S>A1.

While you largely understand the game rules, there have been a few misunderstandings that require clarification:

- In the played variant, the game begins with the sheep's move.
- Each column can contain at most one sheep.
- In a single turn, only one sheep can move, not all of them at once as you assumed before (a singular form of the word sheep would help to explain).
- The sheep are smart enough to not move to a square occupied by the dragon (unless there is a hiding place there).
- If at least one sheep can make a move (including escaping when it is on the lowest row of the chessboard), then a move by the sheep must be made. Otherwise, the sheep's turn is completely skipped and the dragon takes the turn again.
- The dragon must always make a move on its turn.

The Dragon Chess Tournament is not about playing games against each other. Each participant receives a chessboard with the initial arrangement of the dragon, sheep, and hiding places ([your notes](#)). All hideouts are empty at the beginning of the game. The competition is about finding such sequences of moves in which the dragon eats all the sheep. Whoever finds the highest number of unique sequences of such games within two days wins the tournament. To ensure your victory, you decide to find all possible sequences.

Example based on the following notes:

```
SSS
..#
..#
#.#
#D.
```

If we add the row and column symbols, the example chessboard looks as follows:

	A	B	C
1	S	S	S
2	.	.	#
3	#	.	#
4	#	D	.

Below are all the unique sequences of moves in which the dragon eats all the sheep.

```
S>A2 D>A2 S>B2 D>C1 S>B3 D>B3
S>A2 D>A2 S>B2 D>C1 S>B3 D>A2 S>B4 D>B4
S>B2 D>A2 S>B3 D>C1 S>A2 D>A2 S>B4 D>B4
S>A2 D>A2 S>B2 D>C3 S>C2 D>A4 S>C3 D>B2 S>C4 D>C4
S>A2 D>A2 S>C2 D>C3 S>B2 D>A4 S>C3 D>B2 S>C4 D>C4
S>A2 D>A2 S>C2 D>C3 S>C3 D>A4 S>B2 D>B2 S>C4 D>C4
S>A2 D>A2 S>B2 D>B4 S>B3 D>A2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>A2 D>A2 S>B2 D>B4 S>B3 D>C2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>A2 D>A2 S>B2 D>C3 S>B3 D>A2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>A2 D>C2 S>B2 D>B4 S>B3 D>A2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>B2 D>A2 S>B3 D>B4 S>A2 D>A2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>B2 D>A2 S>B3 D>C3 S>A2 D>A2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>B2 D>C2 S>A2 D>B4 S>B3 D>A2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>B2 D>C2 S>B3 D>B4 S>A2 D>A2 S>B4 D>B4 S>C2 D>C2 S>C3 D>A3 S>C4 D>C4
S>C2 D>C2 S>C3 D>A3 S>C4 D>C4 S>B2 D>A3 S>B3 D>C2 S>B4 D>B4 S>A2 D>A2
```

The number of all unique sequences for this example is .

```
SSS
..#
..#
.##
.D#
```

The next example has only unique sequences, but some of them might be useful as they cover the case when the dragon has to move two times in a row.

```
S>A2 D>C3 S>A3 D>A2 S>A4 D>C1 S>A5 D>B3 S>B2 D>A5 S>B3 D>B3
S>A2 D>C3 S>A3 D>A2 S>A4 D>C1 S>B2 D>B3 S>A5 D>A5 S>B3 D>B3
S>A2 D>C3 S>A3 D>A2 S>B2 D>C1 S>A4 D>B3 S>A5 D>A5 S>B3 D>B3
S>A2 D>C3 S>A3 D>A2 S>B2 D>C1 S>B3 D>B3 S>A4 D>A5 D>B3 S>A5 D>A5
S>A2 D>C3 S>A3 D>A2 S>B2 D>C1 S>B3 D>B3 S>A4 D>A5 D>C4 S>A5 D>A5
S>A2 D>C3 S>A3 D>A2 S>A4 D>C1 S>A5 D>B3 S>B2 D>A5 S>B3 D>C4 S>B4 D>A3 S>B5 D>B5
S>A2 D>C3 S>A3 D>A2 S>A4 D>C1 S>B2 D>B3 S>A5 D>A5 S>B3 D>C4 S>B4 D>A3 S>B5 D>B5
S>A2 D>C3 S>A3 D>A2 S>B2 D>C1 S>A4 D>B3 S>A5 D>A5 S>B3 D>C4 S>B4 D>A3 S>B5 D>B5
```

```
...S...
.....
..#..
.....
..D..
```

The next example has unique sequences.

```
S>C2 D>A4 S>C3 D>B2 S>C4 D>C4
S>C2 D>B3 S>C3 D>A5 S>C4 D>C4
S>C2 D>B3 S>C3 D>D2 S>C4 D>C4
S>C2 D>D3 S>C3 D>B2 S>C4 D>C4
S>C2 D>D3 S>C3 D>E5 S>C4 D>C4
S>C2 D>E4 S>C3 D>D2 S>C4 D>C4
S>C2 D>A4 S>C3 D>B2 S>C4 D>A4 S>C5 D>C5
S>C2 D>A4 S>C3 D>B2 S>C4 D>D3 S>C5 D>C5
S>C2 D>A4 S>C3 D>C3 S>C4 D>A4 S>C5 D>C5
S>C2 D>A4 S>C3 D>C3 S>C4 D>E4 S>C5 D>C5
S>C2 D>A4 S>C3 D>C5 S>C4 D>A4 S>C5 D>C5
S>C2 D>A4 S>C3 D>C5 S>C4 D>B3 S>C5 D>C5
S>C2 D>A4 S>C3 D>C5 S>C4 D>D3 S>C5 D>C5
S>C2 D>A4 S>C3 D>C5 S>C4 D>E4 S>C5 D>C5
S>C2 D>B3 S>C3 D>A1 S>C4 D>B3 S>C5 D>C5
S>C2 D>B3 S>C3 D>A5 S>C4 D>B3 S>C5 D>C5
S>C2 D>B3 S>C3 D>C1 S>C4 D>B3 S>C5 D>C5
S>C2 D>B3 S>C3 D>C1 S>C4 D>D3 S>C5 D>C5
S>C2 D>B3 S>C3 D>C5 S>C4 D>A4 S>C5 D>C5
S>C2 D>B3 S>C3 D>C5 S>C4 D>B3 S>C5 D>C5
S>C2 D>B3 S>C3 D>C5 S>C4 D>D3 S>C5 D>C5
S>C2 D>B3 S>C3 D>C5 S>C4 D>E4 S>C5 D>C5
S>C2 D>B3 S>C3 D>D2 S>C4 D>B3 S>C5 D>C5
S>C2 D>B3 S>C3 D>D4 S>C4 D>B3 S>C5 D>C5
S>C2 D>D3 S>C3 D>B2 S>C4 D>A4 S>C5 D>C5
S>C2 D>D3 S>C3 D>B2 S>C4 D>D3 S>C5 D>C5
S>C2 D>D3 S>C3 D>B4 S>C4 D>D3 S>C5 D>C5
S>C2 D>D3 S>C3 D>C1 S>C4 D>B3 S>C5 D>C5
S>C2 D>D3 S>C3 D>C1 S>C4 D>D3 S>C5 D>C5
S>C2 D>D3 S>C3 D>C5 S>C4 D>A4 S>C5 D>C5
S>C2 D>D3 S>C3 D>C5 S>C4 D>B3 S>C5 D>C5
S>C2 D>D3 S>C3 D>C5 S>C4 D>B3 S>C5 D>C5
S>C2 D>D3 S>C3 D>C5 S>C4 D>D3 S>C5 D>C5
S>C2 D>D3 S>C3 D>C5 S>C4 D>E4 S>C5 D>C5
S>C2 D>D3 S>C3 D>C5 S>C4 D>E1 S>C4 D>D3 S>C5 D>C5
S>C2 D>D3 S>C3 D>E5 S>C4 D>D3 S>C5 D>C5
S>C2 D>E4 S>C3 D>C3 S>C4 D>A4 S>C5 D>C5
S>C2 D>E4 S>C3 D>C3 S>C4 D>E4 S>C5 D>C5
S>C2 D>E4 S>C3 D>C5 S>C4 D>A4 S>C5 D>C5
S>C2 D>E4 S>C3 D>C5 S>C4 D>B3 S>C5 D>C5
S>C2 D>E4 S>C3 D>C5 S>C4 D>D3 S>C5 D>C5
S>C2 D>E4 S>C3 D>C5 S>C4 D>E4 S>C5 D>C5
S>C2 D>E4 S>C3 D>D2 S>C4 D>B3 S>C5 D>C5
S>C2 D>E4 S>C3 D>D2 S>C4 D>E4 S>C5 D>C5
```

```
.SS.S
#...#
...#
##..#
.#####
##D.#
```

Another example has 4406 unique sequences.

```
SSS.S
.....
#.#.#
.#.#
#.D.#
```

The last example has as many as 13033988838 unique sequences when all the sheep are eaten.

How many unique sequences of moves are there in which the dragon manages to eat all of the sheep?

Your notes for this part:

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Part 3 solved with answer: 1399694636022

 Check your progress 

Puzzle solved! Don't stop now!

Post your solution, compare ideas, and help others grow on Reddit 

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