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The Song of Ducks and Dragons [2025]

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Quest 6: Mentorship Matrix

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Part I

> **Story section**
>
> Another morning in the garrison greets everyone with a pleasant chill. The shouts of training knights pierce the air. On the training ground stands the captain, closely observing his men. As soon as he sees you, he invites you over with a hand gesture.
>
> - I was just looking for you. This afternoon, the escort to Stacktrace Sanctuary is setting off, so be ready for the journey. Thank you for your invaluable help recently. I hope you find the answers to your questions. Can I get one more favour from you before our paths diverge?
> - Of course, captain. I would love to help.
> - Great! Look over there. - The captain points to a group of young novices practicing with wooden swords; their movements are chaotic and uncertain. - To become real knights, they have a long way to go. I have an idea to make their journey easier. Instead of pairing them with one mentor as a squire, the mentor will change from time to time. More mentors means more opportunities to learn. I even have a plan on how to pair novices with mentors over time.

You receive a note consisting of a list of uppercase and lowercase letters (your notes). Capital letters represent mentors (knights). Lowercase letters represent novices.

Each letter means a different profession: `A a` means sword fighting, `B b` means archery and `C c` specialises in magic. Any knight who matches the novice's letter and appears earlier in the list can mentor them. The captain explains that this procedure is just a draft method, and first, he wants to check only the sword fighting category. For each novice in this profession `a`, determine the total number of possible mentors `A`, and calculate the overall number of possible novice-mentor pairs in this category.

> Example based on the following notes:
>
> `ABabACacBCbca`
>
> To analyse the example, let's leave only the letters in the sword fighting category and skip the rest:
>
> `AaAaa`
>
> The first novice `a` has only one mentor `A` on the list, who is at earlier position than he is. Each of the two novices at the end of the list has two mentors at earlier positions. The total number of possible novice-mentor pairs is: 1 + 2 + 2 = `5` :
>
> `AaAaa`
> `AaAaa`
> `AaAaa`
> `AaAaa`
> `AaAaa`

What is the total number of possible novice-mentor pairs in the sword fighting category?

Your notes for this part:

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Part 1 solved with answer: 185
Check your progress

Part II

The captain seems unsure about his idea, so he asks for a similar analysis of a slightly longer list (your notes). This time, however, it is about providing the total number of novice-mentor pairs for all categories.

Example based on the following notes:

`ABabACacBCbca`

For the same example as in Part I, we can perform similar filtering by each category:

```
AaAaa
BbBb
CcCc
```

Category `a` novices still have a total of `5` options for assigning them a mentor.
Category `b` novices have a total of `3` such options.
Category `c` novices also have a total of `3` options for mentoring.

After adding the numbers obtained for each category, we get the final result: 5 + 3 + 3 = `11`

What is the total number of possible novice-mentor pairs?

Your notes for this part:

📋 **Copy**   ⤢ **Open**   ⬇ **Download**

Part 2 solved with answer: 4046

⚙ **Check your progress** ⚙

Part III

Together with the captain, you agree that this assignment method is impractical. It will be far more effective to pair novices with mentors based on the distance between their tents. The final list contains all mentors and novices currently stationed in the garrison, and its order reflects the actual layout of the tents. However, you have noticed that this layout follows a repeating pattern, so you have recorded only the unique segment (your notes). This segment should be repeated `1000` times to represent the full arrangement of tents.

You propose a method, which allows the novices to switch mentors without wasting time on relocation. To achieve this, the novice can only be mentored by knights who are on the list no further than `1000` tents to the left or right of the novice.

Example based on the following notes:

`AABCBABCABCabcabcABCCBAACBCa`

For the sake of the example, we assume for now the distance limit between the mentor and the novice is only `10` instead of `1000`, and the pattern repeats `1` time instead of `1000` times.

All of the mentors `M` who are close enough to each novice `N` have been marked below. For even better readability, the range limit of the current novice being verified is marked with `.`.

```
                  N
AABCBABCABCabcabcABCCBAACBCa
   M...M..M........M....          = 4

                  N
AABCBABCABCabcabcABCCBAACBCa
   M.M.M..M........M..M.          = 6

                 N
AABCBABCABCabcabcABCCBAACBCa
    M...M..M........MM...         = 5

                 N
AABCBABCABCabcabcABCCBAACBCa
     .M..M........M....MM.        = 5

                 N
AABCBABCABCabcabcABCCBAACBCa
     .M..M........M..M...M        = 5

                 N
AABCBABCABCabcabcABCCBAACBCa
      .M..M........MM...M.M       = 6

                          N
AABCBABCABCabcabcABCCBAACBCa
              M....MM....         = 3
```

To calculate the final result, simply add the number of possible mentors for each novice.

4 + 6 + 5 + 5 + 5 + 6 + 3 = [34]

[AABCBABCABCabcabcABCCBAACBCa]

For the same example, if we repeat the pattern [2] times, and still use the distance limit of [10], we get following list of tents:

[AABCBABCABCabcabcABCCBAACBCaAABCBABCABCabcabcABCCBAACBCa]

with [72] novice-mentor pairs.

[AABCBABCABCabcabcABCCBAACBCa]

For the same example, if we repeat that pattern [1000] times, and use the distance limit of [1000], we get [3442321] novice-mentor pairs.

What is the total number of possible novice-mentor pairs?

Your notes for this part:

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Part 3 solved with answer: 1668256394

⚙ Check your progress ⚙

Puzzle solved! Don't stop now!

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