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The Song of Ducks and Dragons [2025]

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Quest 9: Encoded in the Scales

‹ Quest 8   Quest 10 ›

Part I

> **Story section**
>
> You finally reach the grand centre of knowledge filled with countless scrolls, books, and artifacts - the Stacktrace Sanctuary. Mysterious symbols adorn the stone walls of the building, while the aroma of ancient parchment and ink permeates the interior.
>
> Many nerdmasters live inside, each specialising in a particular field. Some devote their lives to studying ancient runes; others delve into the laws of nature; and others analyse complex structures and algorithms. The corridors of the Sanctuary are filled with their conversations, inscribed tablets, and experimental projects.
>
> Veronica leads you to the office of her master - the Great Nedrmaster Thaddeus, who has dedicated his life to dragonducks. You find him at his desk, surrounded by piles of books and notes. Thaddeus lifts his gaze from the books and looks at you with curiosity for a moment. His piercing eyes shine as if he immediately noticed something extraordinary. He smiles and nods his head, as if confirming his suspicions.
>
> - Ah, I see it right away! - he says with enthusiasm. - Your talent is solving puzzles. It is an extremely rare gift. That's perfect timing! - Thaddeus turns the page of one of his books. - I am currently working on the family tree of the dragonducks from this area. Your skills might be extremely useful here, and by the way, we can check which dynasty you belong to. That's why you came here, right?
>
> You nod with a slight disbelief at how quickly and accurately nerdmaster recognised the whole situation. Your heart beats a little faster. You have wondered many times where you come from. Now you have the chance to discover it!

Thaddeus discusses the remarkable characteristic shared by all dragonducks. It turns out that each individual has its unique DNA identifier (Distinct Name Algorithm) recorded on each of its scales! You haven't noticed it until now because it is located on the under-side of the scales.

The identifier consists of a long sequence of four symbols `A, T, C, G`. At first glance, each sequence looks completely random, but if we start comparing the sequences of children and parents, we observe a very interesting relationship between them.

Every DNA symbol of a child always comes from one of the parents. That means, for example, if both parents have the symbol `A` in the first position, all their children will also have symbol `A` in the first position. If one of the parents has the symbol `T` in the first position and the other parent has `C` in that position, then all the children will have one of these two symbols in that position.

Based on this mechanism, you can calculate the degree of similarity of the child to the parents. To achieve this, you must count how many child DNA symbols match with each parent and multiply these two numbers together.

Thaddeus shows you the DNA of three scales (your notes). They are numbered in order: 1, 2, 3, for easier reference. You can ignore those numbers for now. These are scales of two parents and their child. Your first task is to find the child's scale and calculate the degree of similarity of this child to the parents.

Example based on the following notes:

```
1:CAAGCGCTAAGTTCGCTGGATGTGTGCCCGCG
2:CTTGAATTGGGCCGTTTACCTGGTTTAACCAT
3:CTAGCGCTGAGCTGGCTGCCTGGTTGACCGCG
```

For the purposes of this example, the DNA sequences are shorter than in the actual data.

Assuming that the scale with the number 1 is the child, we already have a problem with the second symbol, [A]. The two remaining scales have the symbol [T] in the second position, so it would not be possible to inherit the symbol [A].

A similar problem arises in the third position if we assume that the scale labelled with the number 2 represents the child. The symbol [T] can not be inherited from the other two scales.

If we look at all the symbols on scale 3, each position matches the symbol at the same position on scale 1 or 2. That means scale 3 must be the child.

Comparing the child's DNA with parent number 1, [23] matching symbols can be found (marked with [+] below):

```
1:CAAGCGCTAAGTTCGCTGGATGTGTGCCCGCG
3:CTAGCGCTGAGCTGGCTGCCTGGTTGACCGCG
   +  ++++++  ++  +  ++++    ++    ++  +++++
```

Comparing the child's DNA with parent number 2, [18] matching symbols can be found (marked with [+] below):

```
2:CTTGAATTGGGCCGTTTACCTGGTTTAACCAT
3:CTAGCGCTGAGCTGGCTGCCTGGTTGACCGCG
   ++  +     ++  ++  +   +  +++++++  +  +
```

Multiplying these two numbers gives the degree of similarity: 23 * 18 = [414].

Find the child's scale and calculate its degree of similarity.

Your notes for this part:

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Part II

Thaddeus confirms your answer, so it seems you understand the rules of DNA inheritance. The next section of the study involves organising the list of one hundred dragonduck scales (your notes). Thaddeus is still uncertain about their potential linkage. He is sure, however, that DNA ensures each child matches only one pair of parents.

To help the nerdmaster with his research, find all the connections between the children and parents on the given list and calculate the sum of all the degrees of similarity found.
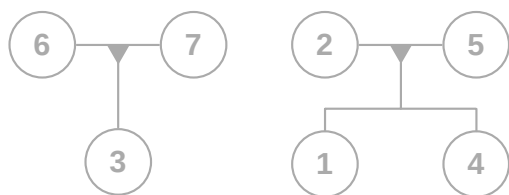
Example based on the following notes:

```
1:GCAGGCGAGTATGATACCCGGCTAGCCACCCC
2:TCTCGCGAGGATATTACTGGGCCAGACCCCCC
3:GGTGGAACATTCGAAAGTTGCATAGGGTGGTG
4:GCTCGCGAGTATATTACCGAACCAGCCCCTCA
5:GCAGCTTAGTATGACCGCCAAATCGCGACTCA
6:AGTGGAACCTTGGATAGTCTCATATAGCGGCA
7:GGCGTAATAATCGGATGCTGCAGAGGCTGCTG
```

On the sample list, you can find three children along with their parents.

The scale marked with the number 3 can be matched with the scales of parents 6 and 7, with a degree of similarity equal to 21 * 22 = [462].

Scales marked with numbers 1 and 4 can be matched to the scales of parents 2 and 5,with similarity scores of 21 * 19 = [399], and 24 * 16 = [384].

Based on this, you can even develop a family trees for these dragonducks:

The sum of all similarity degrees is equal to: 462 + 399 + 384 = [1245].

What is the sum of the degrees of similarity of all the children found on the list?

Part 2 solved with answer: 314260
⚙ Check your progress ⚙

Part III

Nerdmaster can't contain his joy at how quickly you are able to find all the connections. It will save him many days of tedious searching. The final stage of research that Thaddeus planned is an even longer list of scales.
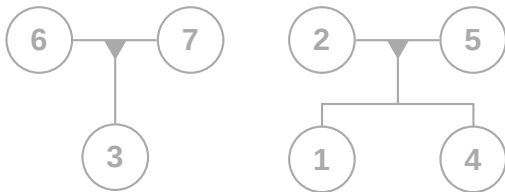
Analyse all the connections between the dragonducks in this list and construct their family trees. A single family includes all dragonducks linked by any chain of connections. As a result, a single egg may unite two great houses into a single family. Since dragonducks live for centuries, children may have parents from entirely different generations. Moreover, even siblings can lay eggs, so there are no limits to how the family lines may intertwine.

Once you've discovered all the links, you need to find the biggest family and calculate the sum of all the dragonducks' scale numbers from that family.

Example based on the following notes:

```
1:GCAGGCGAGTATGATACCCGGCTAGCCACCCC
2:TCTCGCGAGGATATTACTGGGCCAGACCCCCC
3:GGTGGAACATTCGAAAGTTGCATAGGGTGGTG
4:GCTCGCGAGTATATTACCGAACCAGCCCCTCA
5:GCAGCTTAGTATGACCGCCAAATCGCGACTCA
6:AGTGGAACCTTGGATAGTCTCATATAGCGGCA
7:GGCGTAATAATCGGATGCTGCAGAGGCTGCTG
```

For the same example as in Part II, we get two families:

The first family consists of [3] members, parents 6 and 7, and their child number 3.
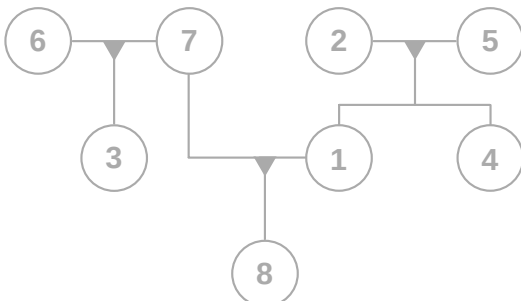
The second family consists of [4] members, parents 2 and 5, and their children numbered 1 and 4.

The second family has more members and the sum of their scale numbers is:
1 + 2 + 4 + 5 = [12].

```
1:GCAGGCGAGTATGATACCCGGCTAGCCACCCC
2:TCTCGCGAGGATATTACTGGGCCAGACCCCCC
3:GGTGGAACATTCGAAAGTTGCATAGGGTGGTG
4:GCTCGCGAGTATATTACCGAACCAGCCCCTCA
5:GCAGCTTAGTATGACCGCCAAATCGCGACTCA
6:AGTGGAACCTTGGATAGTCTCATATAGCGGCA
7:GGCGTAATAATCGGATGCTGCAGAGGCTGCTG
8:GGCGTAAAGTATGGATGCTGGCTAGGCACCCG
```

The second example is almost identical, but the child marked with scale 8 connected all dragonducks from this list to one family with a total scale sum of [36].

Find the largest family and calculate the sum of the scale numbers of all members in this family.

Your notes for this part:

Part 3 solved with answer: 41986

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Puzzle solved! Don't stop now!

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

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