

[Events](#)[Stories](#)[Support](#)[Shop](#)[Sponsors](#)[FAQ](#)[Profile](#)

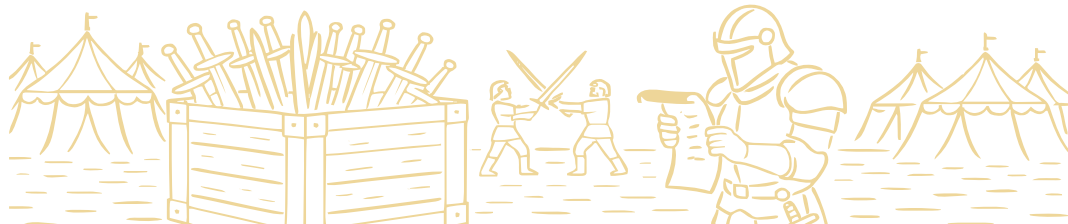
Julian Williams

9 / 93

The Song of Ducks and Dragons [2025]

[Quests](#)[Leaderboards](#)[Stats](#)[Head to Head](#)[Your times](#)

Quest 5: Fishbone Order

[← Quest 4](#) [Quest 6 →](#)

Part I

Story section

You arrive at the garrison shortly after sunset. Upon arrival, you discover towering stone walls encircling a spacious courtyard, illuminated by the torches strategically placed around, where knights, despite the late hour, are engaged in sword fighting. Around the square, hundreds, if not thousands, of tents have been set up. The captain assigns you one of them so you can rest after the journey.

The next day, as you stroll through the square, the captain approaches you to exchange a few words.

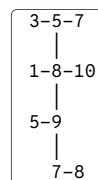
- Hello, friend. Sir Mandelbrot told me what brings you to us. In a few days, we will be escorting a group of nerdmasters to the Stacktrace Sanctuary. You can join this expedition if you want.
- That's excellent news! Thank you very much! Might there be a way for me to express my gratitude?
- Hmm... I've heard that you have an extraordinary talent for solving problems. We have a few matters to attend to here that require a sharp mind, but don't take this as any expectation of you. If you want to learn more details, go to the armourer. You will find him in the middle of the square, by the large chest. We received a delivery of new swords for the garrison early this morning.

Excited, you almost run to the square, unable to wait for the next puzzle to solve. You feel that with each solved problem, you grow stronger, and it brings you immense satisfaction!

You find the armourer copying the numbers on the sword's hilts into a book. Noticing your interest, he explains to you the meaning of the numbers. Each sword is marked with a unique identifier, followed by numbers that allow to determine its quality. The numbers are separated with commas, but it is a simplified representation of a structure called "fishbone".

To determine the sword's quality, you need to build a fishbone from the given list and combine the digits written on the spine into a single number, starting from the highest segment.

An example fishbone looks as follows:



The central part, connected vertically by pipe characters, is the spine. In the example above, the spine consists of 4 segments:

5, 8, 9, 7, so its quality is simply 5897.

Each segment can have one (or none) number on the left side, which must be less than the value recorded on the connected spine segment, and one (or none) number on the right side, which must be greater than the value recorded on the connected spine segment. These numbers determine certain special characteristics of the sword that are only significant for very skilled knights.

To construct a fishbone from the listed numbers, the first element from the list should be placed as the first segment of the spine. Next, we add the subsequent numbers one by one, according to the following rules:

- Check all segments of the spine, starting from the top.
- If your number is less than the one on the spine segment and the left side of the segment is free - place it on the left.
- If your number is greater than the one on the spine segment and the right side of the segment is free - place it on the right.
- If no suitable place is found at any segment, create a new spine segment from your number and place it as the last one.

Everybody Codes is possible thanks to:

IICPC

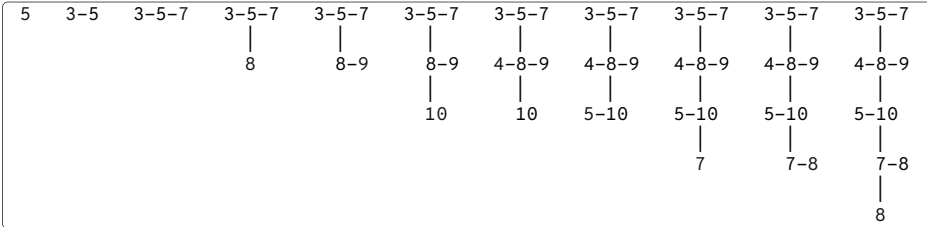
IICPC fosters Competitive Programming through a series of events like Camps, Hackathons and Contests. Reach out to us at our Youtube channel and website for upcoming events.

You are looking at the numbers being recorded by the armourer (*your notes*) to see if you can construct a fishbone from them and determine the quality of the associated sword.

Example based on the following notes:

58: 5, 3, 7, 8, 9, 10, 4, 5, 7, 8, 8

Below are the steps for building a fishbone from the specified list, number after number. The first number (58) is the identifier of the sword, and for now, we simply skip it.



The quality of the sword in this example is equal to 581078.

What is the quality of the sword currently being recorded by the armourer?

Your notes for this part:

[Copy](#) [Open](#) [Download](#)

Part 1 solved with answer: 7265385435

[Check your progress](#)

Part II

You provide the correct quality value immediately after the armourer finishes writing down the last digit on the list, which leaves him stunned. You explain that you came to help him with his work on the captain's orders. The armourer is delighted and states that, with your skills, the task will definitely go much faster.

You receive a list of swords designated for the best squires as a reward for their service (*your notes*). The armourer must check how much their qualities differ by finding the best and the weakest sword and calculating the difference between them.

You glance at the list and see how the written numbers arrange themselves into fishbones, which begin to glow with a faint light visible only to you.

Example based on the following notes:

1: 2, 4, 1, 1, 8, 2, 7, 9, 8, 6
2: 7, 9, 9, 3, 8, 3, 8, 8, 6, 8
3: 4, 7, 6, 9, 1, 8, 3, 7, 2, 2
4: 6, 4, 2, 1, 7, 4, 5, 5, 5, 8
5: 2, 9, 3, 8, 3, 9, 5, 2, 1, 4
6: 2, 4, 9, 6, 7, 4, 1, 7, 6, 8
7: 2, 3, 7, 6, 2, 2, 4, 1, 4, 2
8: 5, 1, 5, 6, 8, 3, 1, 8, 3, 9
9: 5, 7, 7, 3, 7, 2, 3, 8, 6, 7
10: 4, 1, 9, 3, 8, 5, 4, 3, 5, 5

The qualities of the swords, assigned to their identifiers, are as follows:

1: 21296
2: 79388
3: 46822
4: 62555
5: 2335
6: 2977
7: 27222
8: 5513
9: 5776
10: 43535

The weakest sword in this example has a quality rating of 2335, and the best one, 79388. The difference between these qualities equals $79388 - 2335 = 77053$.

What is the quality difference between the best and the weakest sword on the given list?

Your notes for this part:

Copy

Open

Download

Part 2 solved with answer: 8808957594576

Check your progress

Part III

Without delay, you provide the result and point out the best and weakest sword to the armourer so he can verify it himself. It looks like you are correct, so the knight hands you another, slightly longer list of swords (your notes).

This is a list of all the swords intended for knights. The swords should be sorted from the best to the weakest, but unfortunately, they got mixed up during transport. However, a checksum of the sorted swords is included in the package, so after restoring the correct order, it will be possible to verify if nothing got lost.

The rules determining which of the two swords is better are as follows:

- If two swords have different qualities, a higher quality score means a better sword.
- If the quality of both swords is the same, the numbers resulting from the subsequent levels of the fishbone should be compared, starting from the top. A higher score on the first level, which differs between swords, indicates a better sword.
- If the above conditions are not met, the swords must have identical fishbones. For such swords, the sword with the higher identifier is considered better.

Example sword, `1:5,3,7,8,1,10,9,5,7,8`, has 4 levels, one for each segment of the spine. The number at each level is obtained by concatenating all the digits at that level from left to right.

	level	number
3-5-7	1	357
1-8-10	2	1810
5-9	3	59
7-8	4	78

Second example sword: `2:5,3,7,8,1,10,9,4,7,9` has the same quality (5897), so to determine which one is better, you need to find the first differing level starting from the top.

	level	number
3-5-7	1	357
1-8-10	2	1810
4-9	3	49
7-9	4	79

The numbers on the first two levels are the same in both swords. At the third level, the second sword achieved a score of 49, while the first achieved 59, so the first sword is better than the second.

Sort all the swords from the best to the weakest and provide the resulting checksum. To calculate the checksum, you need to multiply the sword identifiers by their position on the sorted list, starting from 1, and sum the resulting values.

Example based on the following notes:

```
1:7,1,9,1,6,9,8,3,7,2
2:6,1,9,2,9,8,8,4,3,1
3:7,1,9,1,6,9,8,3,8,3
4:6,1,9,2,8,8,8,4,3,1
5:7,1,9,1,6,9,8,3,7,3
6:6,1,9,2,8,8,8,4,3,5
7:3,7,2,2,7,4,4,6,3,1
8:3,7,2,2,7,4,4,6,3,7
9:3,7,2,2,7,4,1,6,3,7
```

The constructed fishbones for this sample list look as follows:

id: 1	id: 2	id: 3	id: 4	id: 5	id: 6	id: 7	id: 8	id: 9
1-7-9	1-6-9	1-7-9	1-6-9	1-7-9	1-6-9	2-3-7	2-3-7	2-3-7
1-6	1-2-9	1-6	1-2-8	1-6	2-8	1-2-7	2-7	1-2-7
8-9	4-8	8-9	4-8	8-9	4-8	3-4-6	3-4-6	3-4-6
2-3-7	3-8	3-8	3-8	3-7	3-8	4	4-7	7
		3		3	5			

After sorting the list according to the rules presented by the armourer, you get the following order:

id: 3	id: 5	id: 6	id: 1	id: 2	id: 4	id: 9	id: 7	id: 8
1-7-9	1-7-9	1-6-9	1-7-9	1-6-9	1-6-9	2-3-7	2-3-7	2-3-7
1-6	1-6	2-8	1-6	1-2-9	1-2-8	1-2-7	1-2-7	2-7
8-9	8-9	4-8	8-9	4-8	4-8	3-4-6	3-4-6	3-4-6
3-8	3-7	3-8	2-3-7	3-8	3-8	7	4	4-7
3	3	5						

Thereafter, we can calculate the checksum by multiplying the identifiers by their position on the list:

$$1 * 3 + 2 * 5 + 3 * 6 + 4 * 1 + 5 * 2 + 6 * 4 + 7 * 9 + 8 * 7 + 9 * 8 = 260$$

1: 7, 1, 9, 1, 6, 9, 8, 3, 7, 2
 2: 7, 1, 9, 1, 6, 9, 8, 3, 7, 2

In this short example, the two swords are identical, so you have to compare their identifiers. A higher identifier is considered better, so the checksum is: $1 * 2 + 2 * 1 = 4$

Sort the swords from the best to the weakest. What is the checksum of the sorted list?


Your notes for this part:

 Copy  Open  Download

Part 3 solved with answer: 31705644

 Check your progress 

Puzzle solved! Don't stop now!

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

© 2024-2025 Everybody Codes. All right reserved.

[Terms of Use](#), [Privacy Policy](#), [Cookies and Tracking Policy](#)

By using this website, you agree to these terms.

