

Not All Instances of Hard Problems are Difficult[†]

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[†]and they can be a lot of fun

In this talk, we explore some problems from Advent of Code 2023 and the techniques that make these problems simpler than they first appear.

We will also look at some problems just for fun.

What is AoC?

Advent of Code is an annual series of small programming puzzles for a variety of skill sets and skill levels in any programming language you like.

It runs from December 1st to December 25th each year (since 2015).

Here are the current completion statistics for each day. Gold indicates users that have completed both parts of a puzzle, while silver indicates users that have completed only the first half. Each * or * star represents up to 7755 users.

| | | | |
|----|--------|-------|-------|
| 25 | 11188 | 3070 | *** |
| 24 | 12504 | 5014 | *** |
| 23 | 15233 | 2992 | *** |
| 22 | 16484 | 1001 | **** |
| 21 | 14936 | 10316 | **** |
| 20 | 18964 | 4486 | **** |
| 19 | 23210 | 7295 | **** |
| 18 | 25496 | 4988 | ***** |
| 17 | 24701 | 1128 | ***** |
| 16 | 36168 | 1061 | ***** |
| 15 | 41723 | 4250 | ***** |
| 14 | 37274 | 7582 | ***** |
| 13 | 38957 | 5309 | ***** |
| 12 | 31750 | 14617 | ***** |
| 11 | 58390 | 2438 | ***** |
| 10 | 49160 | 17346 | ***** |
| 9 | 77739 | 1283 | ***** |
| 8 | 75250 | 14948 | ***** |
| 7 | 83178 | 7468 | ***** |
| 6 | 104874 | 1985 | ***** |
| 5 | 81386 | 31578 | ***** |
| 4 | 132136 | 18012 | ***** |
| 3 | 132321 | 20318 | ***** |
| 2 | 199469 | 9535 | ***** |
| 1 | 234418 | 75774 | ***** |

adventofcode.com/2023/stats

Private Leaderboard

This is the private leaderboard of Will for Advent of Code 2023. You can use a different [Ordering], manage your [Private Leaderboards], use an [API], or switch to another [Event].
















Gold indicates the user got both stars for that day, silver means just the first star, and gray means none.

| | | | |
|-----|-----|---------------------------|---------------------------|
| | | 1111111111222222 | |
| | | 1234567890123456789012345 | |
| 1) | 478 | ***** | ZeroTau (AoC++) |
| 2) | 420 | ***** | Will (AoC++) |
| 3) | 352 | ***** | Sgr A8 |
| 4) | 182 | ***** | one-reader |
| 5) | 53 | ***** | Austin Stortzum |
| 6) | 37 | ***** | zemkat |
| 7) | 25 | ***** | Jack Schmidt |
| 8) | 7 | ***** | Abby Gamboa |
| 9) | 2 | ***** | Guyfee |
| 10) | 0 | ***** | (anonymous user #3280719) |

Global Leaderboard

Below is the Advent of Code 2023 overall leaderboard; these are the 100 users with the highest total score. Getting a star first is worth 100 points, second is 99, and so on down to 1 point at 100th place.

You can change how you appear here on the [\[Settings\]](#) page. You can also view your own [\[Personal Times\]](#) or use a [\[Private Leaderboard\]](#).

| | | | |
|-----|------|---|----------------------------------|
| 1) | 3257 |  | xiaowucl |
| 2) | 3174 |  | tckmn |
| 3) | 2909 |  | 5space (AoC++) |
| 4) | 2486 |  | nthistle (AoC++) (Sponsor) |
| 5) | 2484 |  | jonathanpaulson (AoC++) |
| 6) | 2476 |  | Antonio Molina (AoC++) (Sponsor) |
| 7) | 2404 |  | dan-simon |
| 8) | 2370 |  | bluepichu |
| 9) | 2285 |  | leijurv (AoC++) |
| 10) | 2241 |  | boboquack |
| 11) | 2226 |  | hyper-neutrino |
| 12) | 2198 |  | D. Salgado |
| 13) | 2092 |  | Ian DeHaan |
| 14) | 2046 |  | Noble Mushtak |
| 15) | 2034 |  | Anish Singhani (AoC++) |

adventofcode.com/2023/leaderboard

Why do contests?

- Fun
- Learning
- Community
- Profit?

Once you see it...



Day 1: Sum of Digits

This problem asks us to parse lines of input to find the first and last digits contained within.

Then combine the first digit and the last digit to form a single two-digit number, and sum all such numbers.

The catch is the digits could be spelled out or written as numbers.

Day 1: Example

two|nine
eightwo|three
abc|one2three|xyz
xtwo|one3four
4nine|eightseven2
zone|eight234
7pqr|stsixteen

Yields the sum $29 + 83 + 13 + 24 + 42 + 14 + 76 = 281$.

Day 1: Possible Approaches

- Use a regular expression
- Build our own parser
- Use tools like sed or awk
- Use a parser generator like ANTLR

Note the input is small (around 22KB).

While we can find the digits with only one pass over the input. Even if we take multiple passes, we can still solve the problem quickly for input this small.

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Day 1: Solutions

- Python
- Bash pipeline
- Circuit

Day 16: Light Propagation

This problem asks us to illuminate as many cells of a room as possible by shining a light from any cell on an outer edge.

This is complicated by the fact that there are mirrors and beam splitters in the room.

Day 16: Rules

If the beam encounters empty space (.), it continues in the same direction.

If the beam encounters a mirror (/ or \), the beam is reflected 90 degrees depending on the angle of the mirror.

If the beam encounters the pointy end of a splitter (| or -), the beam passes as if the splitter were empty space.

If the beam encounters the flat side of a splitter (| or -), the beam is split into two beams going in each of the two directions the splitter's pointy ends are pointing.

Beams do not interact with other beams

Day 16: Example

| | |
|---------------------|---------------------|
| \ | > < < < \ |
| . - . \ | v - . \ ^ |
| - . . . | . v . . . - > > > |
| | . v . . . v ^ . . |
| | . v . . . v ^ . . . |
| \ | . v . . . v ^ . . \ |
| / . \ \ . . | . v . . / 2 \ \ . . |
| . - . - / | < - > - / v v . . |
| - . \ | . < < < 2 - . \ |
| . . / / | . v / / . . v . . |

In this example, 46 cells are *illuminated* when light shines in from the left in the top left cell.

Day 16: Instance Size

Our problem input is a room with 110 rows and 110 columns.

So there are 12100 cells.

Our instance has 1191 objects in the room.

What are the challenges of this problem?

Let's look at a solution.

Questions?

This talk available at github.com/ZeroTau/AoC2023Talk

Thank You!