BAPC 2022

Solutions presentation

October 22, 2022

E: Equalising Audio

Problem Author: Abe Wits

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  Then, output $\sqrt{x/x'} \cdot a_1, \ldots, \sqrt{x/x'} \cdot a_n$ with sufficient precision.

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- Verification:

$$\frac{1}{n}\sum_{i=1}^{n}(\sqrt{x/x'}a_i)^2 = \frac{x}{x'} \cdot \frac{1}{n}\sum_{i=1}^{n} a_i^2 = \frac{x}{x'} \cdot x' = x.$$

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Statistics: 127 submissions, 50 accepted, 6 unknown

B: Bellevue

Problem Author: Ragnar Groot Koerkamp

- **Problem:** Given the profile of an island, find the point with the largest viewing angle of the sea.

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- **Observation:** If point P is blocking the view of the edge of the island from point Q, you can see more sea in P than Q.
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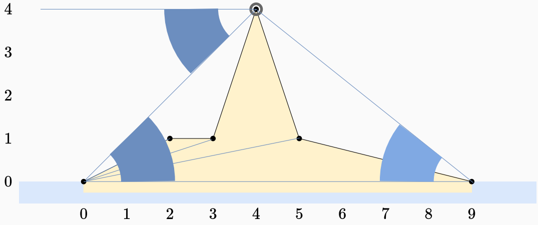
- **Solution:** take the maximum angle around the start/end.



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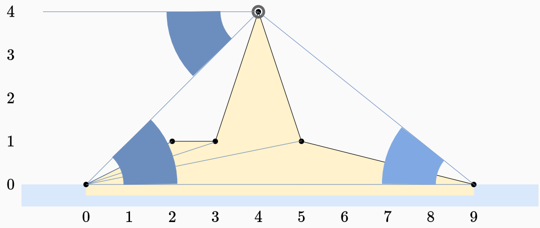

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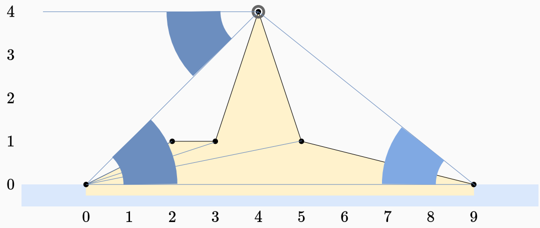

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F: Failing Flagship

Problem Author: Ruben Brokkelkamp

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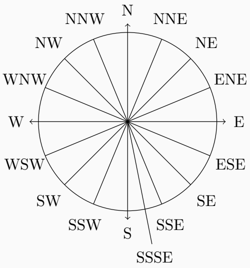

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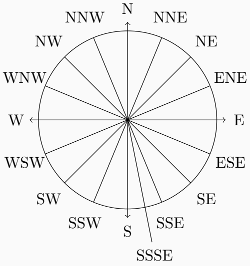

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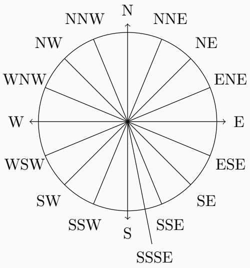

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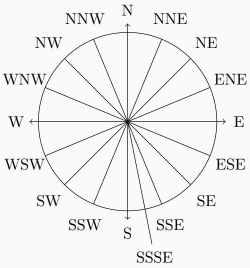

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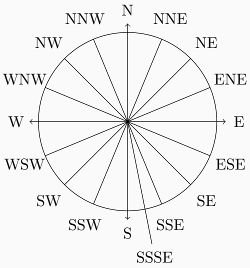

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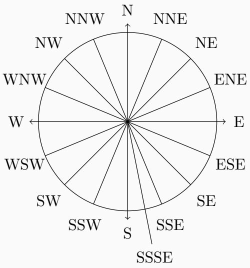

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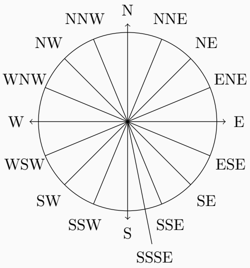

Statistics: 144 submissions, 39 accepted, 21 unknown

I: Imperfect Imperial Units

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Statistics: 32 submissions, 10 accepted, 17 unknown

C: Crashing Competition Computer

Problem Author: Jorke de Vlas

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- **Solution:** Dynamic programming over the length of the code.
- Time to code any x consecutive characters (without saving) =

  time to write $x - 1$ characters $+$ 1 $+$ expected time needed to recover from crashing:

$$T(x) = T(x-1) + 1 + p \cdot (r + T(x)) = \frac{T(x-1) + 1 + p \cdot r}{1-p} \quad \textbf{or} \quad T(x) = \frac{r+1}{p} \cdot ((1-p)^{-x} - 1)$$

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- Calculate time to code all characters between position 0 and x,
  minimising the total time by trying to click "Save" after character k:

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Statistics: 56 submissions, 10 accepted, 35 unknown

K: Kiosk Construction

Problem Author: Reinier Schmiermann

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- **Solution:** Find the shortest path from every kiosk location k to every plot p ($d(k, p)$), then calculate $\min_k(\max_p(d(k, p)))$.
  - But, doing n^2 times BFS/DFS from every possible kiosk location to every plot is too slow ($\mathcal{O}(n^3)$).

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- **Optimisation:** Calculate distances the other way around: from every plot to every kiosk location.
  - The rules of walking between plots are fixed given a destination plot p, so do floodfill (BFS/DFS) starting from every destination plot p.
  - From a plot a, walk to neighbouring plots b if, according to the procedure, you can walk from b to a given the destination plot p.

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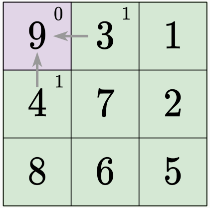

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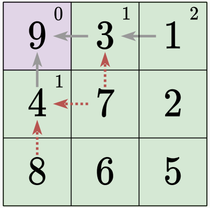

K: Kiosk Construction

Problem Author: Reinier Schmiermann

- **Problem:** Find the optimal kiosk position for a given camping layout.
- **Solution:** Find the shortest path from every kiosk location k to every plot p ($d(k, p)$), then calculate $\min_k(\max_p(d(k, p)))$.
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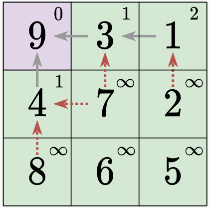

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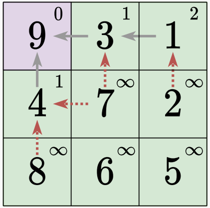

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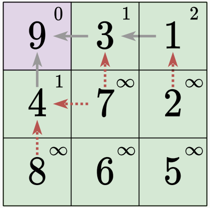

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Statistics: 31 submissions, 8 accepted, 15 unknown

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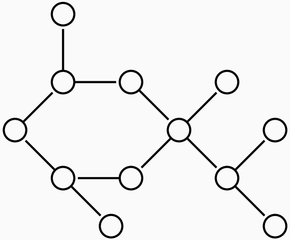

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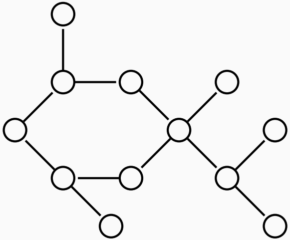

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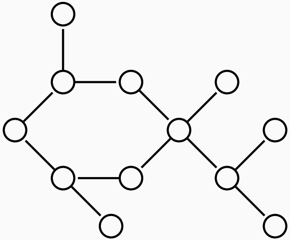

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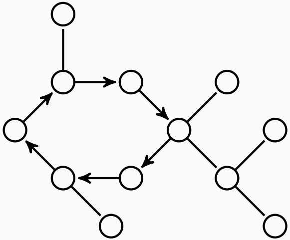

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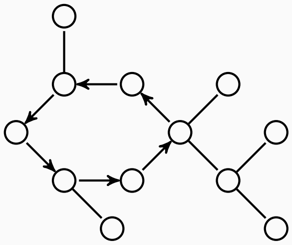

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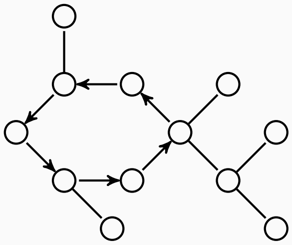

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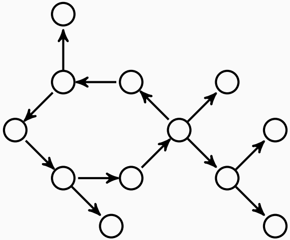

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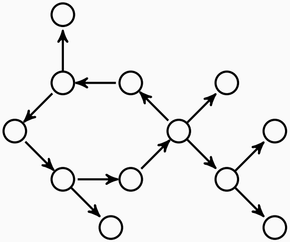

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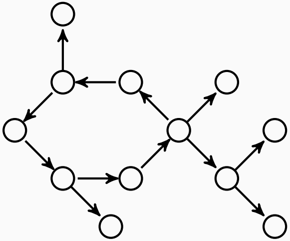

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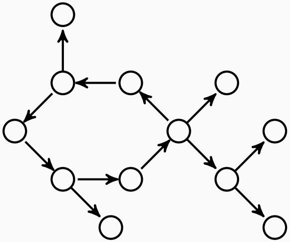

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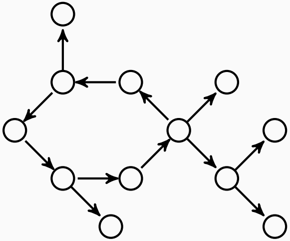

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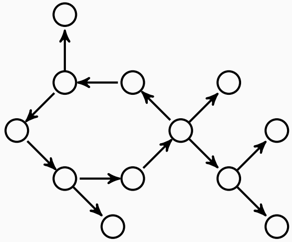

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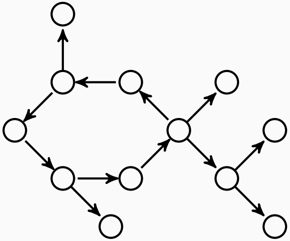

Statistics: 31 submissions, 5 accepted, 15 unknown

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Problem Author: Reinier Schmiermann

- **Problem:** Given $w \leq 10\,000$ integers $0 \leq h_i \leq 10^{18}$, find the maximum in at most $12\,000$ queries: "`Is integer` h_i `less than` y?"

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Statistics: 140 submissions, 7 accepted, 80 unknown

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[1] Or at least, *almost always* ;-)

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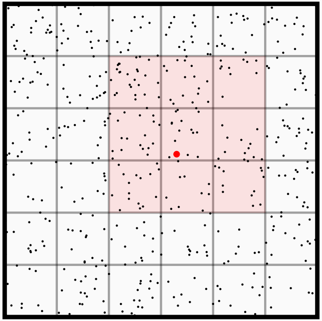

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Statistics: 63 submissions, 10 accepted, 35 unknown

A: Adjusted Average

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$P_u = \{a_i + a_j \mid i < j < u\}$	a_u	

$\uparrow$

u

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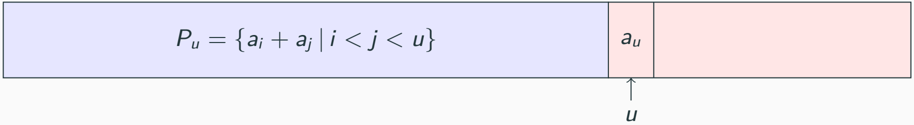

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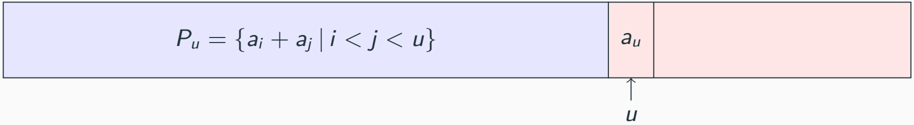

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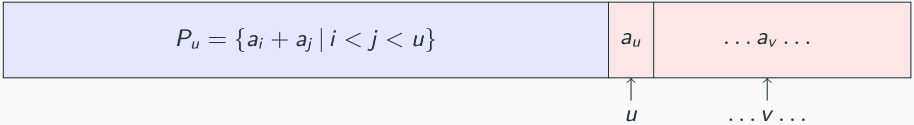

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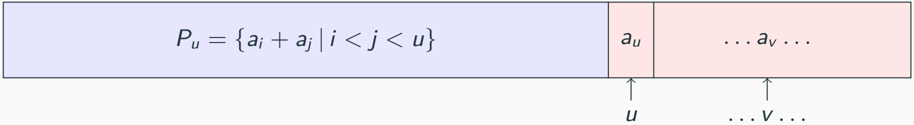

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Statistics: 25 submissions, 3 accepted, 13 unknown

G: Grinding Gravel

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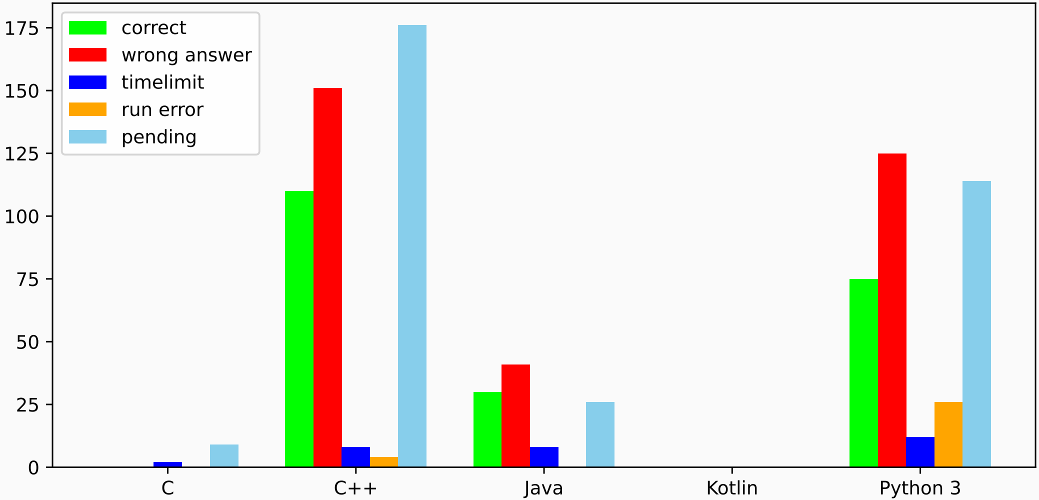
Statistics: 5 submissions, 1 accepted, 1 unknown

Language stats



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- 165 jury solutions (last year: 177)
- The minimum[2] number of lines the jury needed to solve all problems is

$$14 + 3 + 5 + 1 + 4 + 4 + 27 + 34 + 14 + 15 + 18 + 4 = 143$$

On average 11.9 lines per problem, up from 9.6 in BAPC 2021 or 6.6 in preliminaries 2022

[2] *After* codegolfing

Thanks to:

The proofreaders

Jaap Eldering
Kevin Verbeek
Mark van Helvoort
Nicky Gerritsen
Thomas Verwoerd

The jury

Boas Kluiving
Jorke de Vlas
Ludo Pulles
Maarten Sijm
Ragnar Groot Koerkamp
Reinier Schmiermann
Ruben Brokkelkamp
Wessel van Woerden

Want to join the jury? Submit to the Call for Problems of BAPC 2023 at:

`https://jury.bapc.eu/`