NWERC 2014
Presentation of solutions

The Jury

2014-11-30

NWERC 2014 Jury

- Per Austrin (KTH Royal Institute of Technology)
- Thomas Beuman (Leiden University)
- Jeroen Bransen (Utrecht University)
- Tommy Färnqvist (LiU)
- Jan Kuipers (AppTornado)
- Lukáš Poláček (KTH and Spotify)
- Alexander Rass (FAU)
- Fredrik Svensson (Autoliv Electronics)
- Tobias Werth (FAU)

J – Judging

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Statistics: 135 submissions, 92 accepted

E – Euclidean TSP

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Find minimum of the following function:

$$f(c) = \frac{n \cdot (\log_2 n)^{c\sqrt{2}}}{10^9 p} + (1 + \frac{1}{c}) \cdot \frac{s}{v}$$

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- Iterate this a few dozen times to narrow down the interval.

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Split list of n item prices into $d+1$ groups, minimize sum of rounded costs.

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Given a tree, assign a number (the frequency) to each edge, such that every node is adjacent to at most 2 different numbers (its NIC's frequencies), and as many numbers as possible are used.

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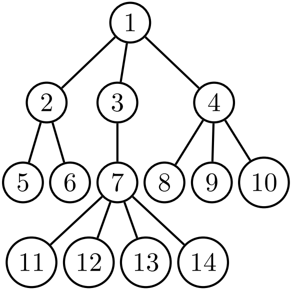
Solution

Greedy: start somewhere, assign a new number to an edge if possible, otherwise reuse one, and then recurse.

H – Hyacinth (sample 2)



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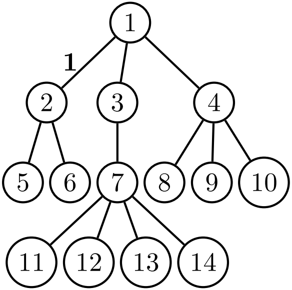

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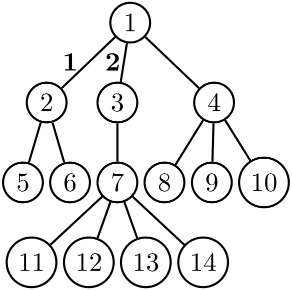

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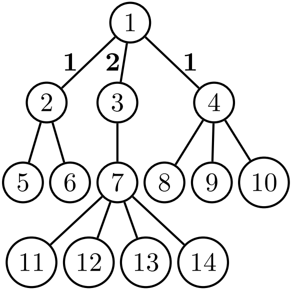

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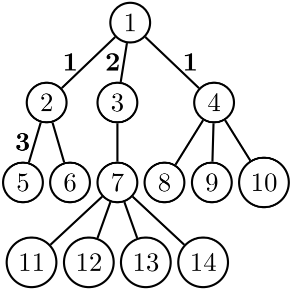

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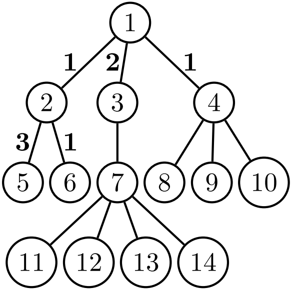

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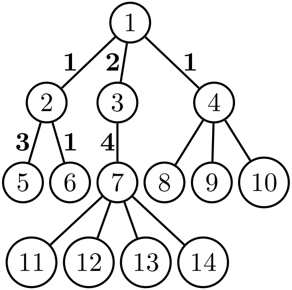

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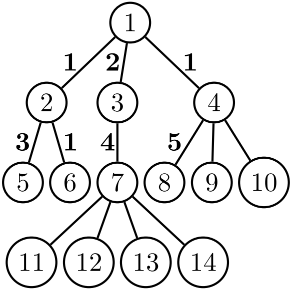

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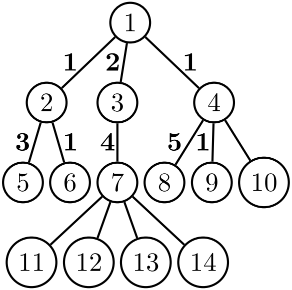

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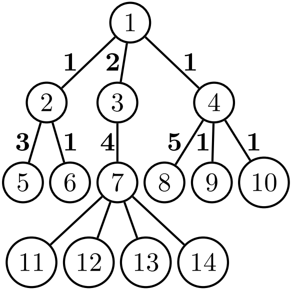

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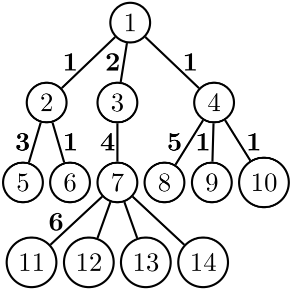

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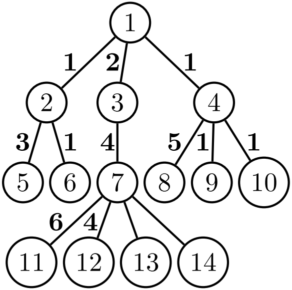

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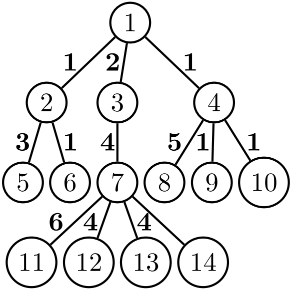

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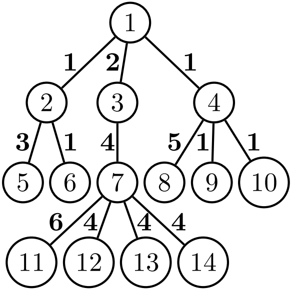

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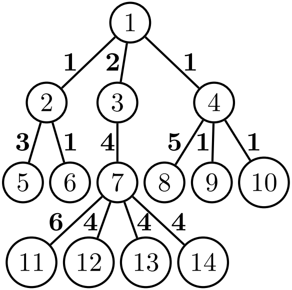

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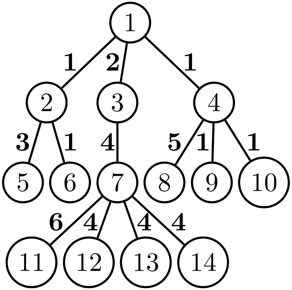

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- The interesting starting positions are the $\leq n$ slots where there are knapsacks.

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- Time from others grow arithmetically

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How long does it take to pick up all *n* knapsacks at the luggage carousel?

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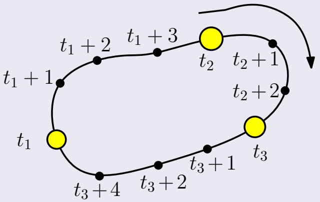

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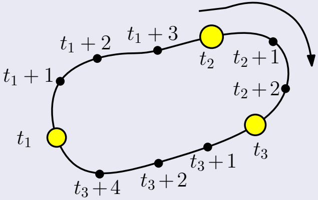

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Given a weighted graph, determine whether there exists a cycle with length L that visits every vertex once.

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Statistics: 79 submissions, 7 accepted

G – Gathering

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- But might be more than distance d away from some point...

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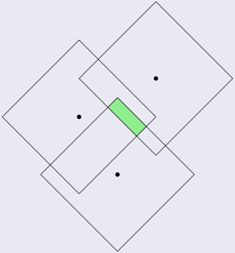
Solution

Feasible region is intersection of diamonds, forms a "skewed diamond"



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  1. Is a corner of the feasible region, or
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- Given a candidate value for x^*, we get a range of allowed y values $y_{lo} ... y_{hi}$. Best choice is median y (if in range) or y_{lo} or y_{hi}.
- (Similarly for best x value given candindate value of y^*)

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Solution

- Key observation: there is an optimal point which either:
    1. Is a corner of the feasible region, or
    2. Shares x-value with an input point, or
    3. Shares y-value with an input point.
- Given a candidate value for x^*, we get a range of allowed y values $y_{lo} \ldots y_{hi}$. Best choice is median y (if in range) or y_{lo} or y_{hi}.
- (Similarly for best x value given candindate value of y^*)

Statistics: 20 submissions, ? accepted

B – Biking Duck

Problem

Find shortest path, possibly via some of the given bike stations or the (infinitely many possible) stations the boundary.

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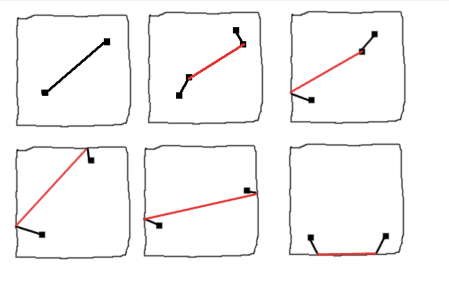
Solution

Possible solutions use 0 or 2 stations:



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Solution

- Loop over station 1 and 2 (existing, or NSEW boundary).

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Solution

- Loop over station 1 and 2 (existing, or NSEW boundary).
- Calculate distance.

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- To determine correct location on the boundary use ternary search, since distance as function of position is a convex function.

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- Doing it with math becomes a terrible mess.

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Statistics: 7 submissions, ? accepted

A – Around the Track

Problem

Find shortest tour around a track defined by two polygons.

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Problem

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Solution

- Without the outer boundary: convex hull

A – Around the Track

Problem

Find shortest tour around a track defined by two polygons.

Solution

- Without the outer boundary: convex hull
- A somewhat unusual convex hull algorithm.
  1. Find a point where we make a right-turn, shortcut if possible
  2. Repeat until done

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Can also use Dijkstra, need to be careful to make a full lap around the inner polygon.

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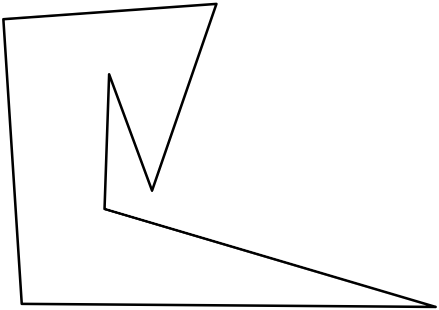

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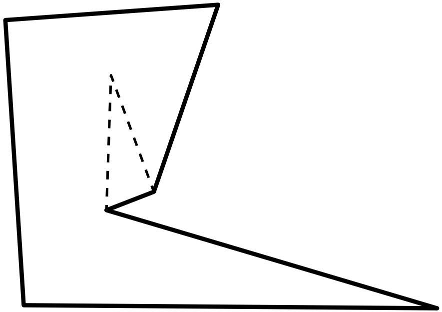

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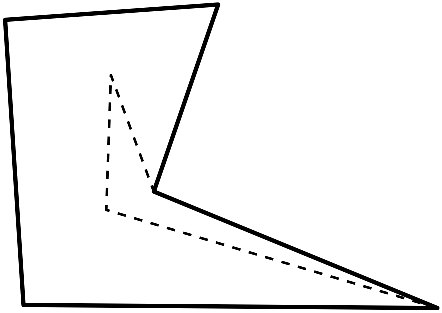

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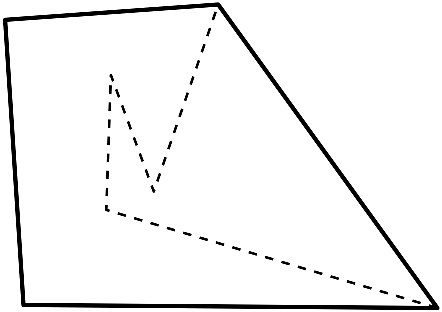

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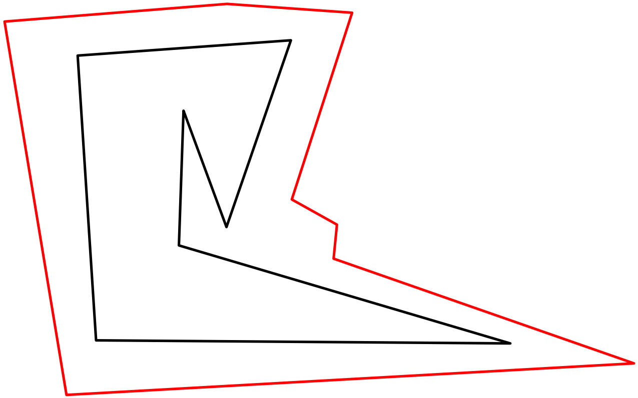

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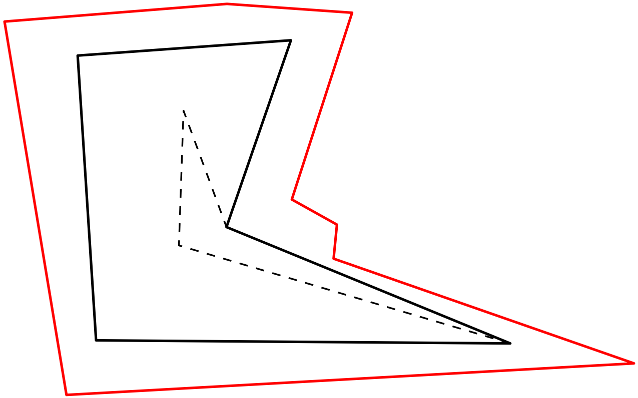

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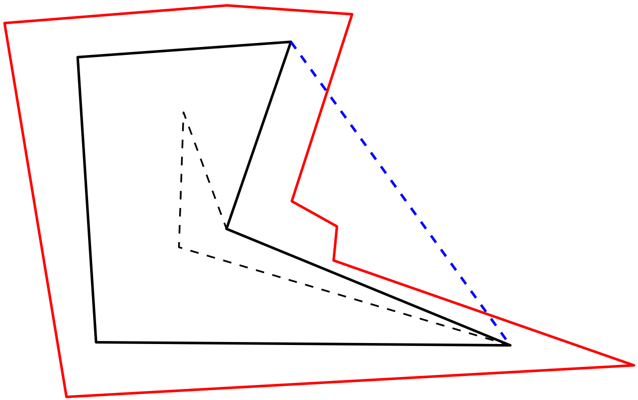

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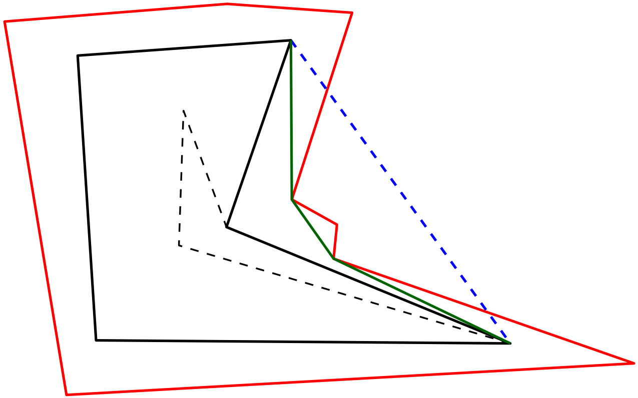

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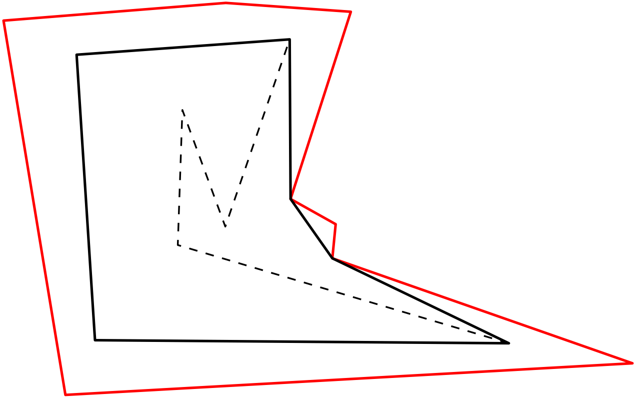

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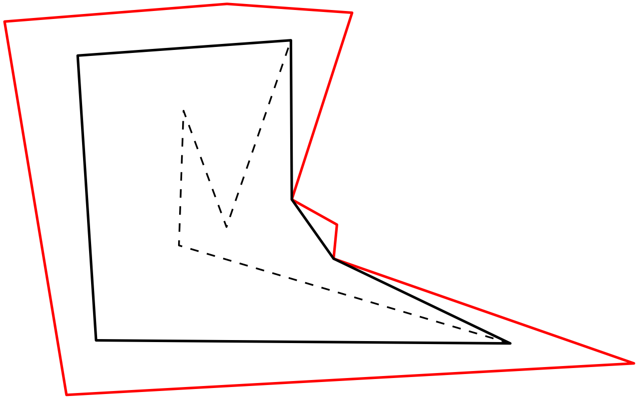
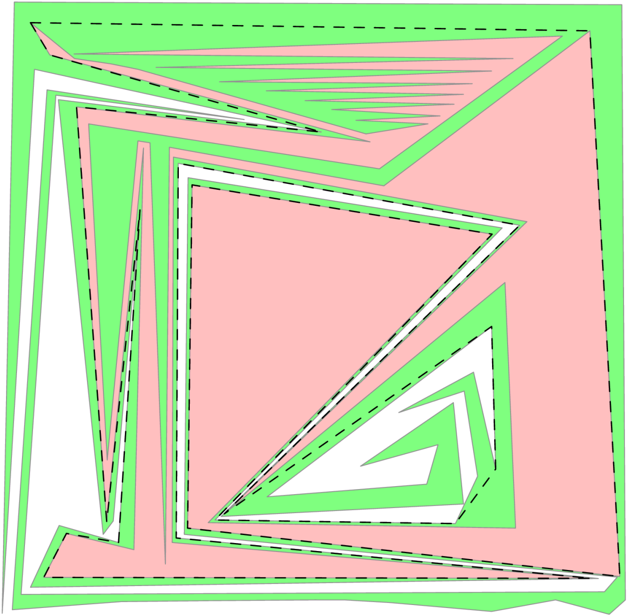


Statistics: 12 submissions, ? accepted



Random numbers produced by the jury

1087 number of posts made in the jury's forum.

671 commits made to the problem set repository.

380 number of lines of code used in total by the shortest judge solutions to solve the entire problem set.

16.7 average number of jury solutions per problem (including incorrect ones)

1 number of beers Jan lost to Per over bets on the problems

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- **1** number of beers Per lost to Jan over bets on the contest results