KTH Challenge 2013

April 21, 2013

Jury

- Lukáš Poláček (KTH, Spotify), head of jury
- Per Austrin (KTH)
- Oskar Werkelin Ahlin (Spotify)
- Ulf Lundström (KTH)
- Marc Vinyals (KTH)
- Erik Aas (KTH)
- Emma Enström (KTH)
- Andreas Lundblad (KTH)

B – Peragrams

- Only one letter can have odd number of occurrences in a palindrome.
- We need to remove $o - 1$ letters, where o is the number of letters with odd number of occurrences.
- Don't print -1!

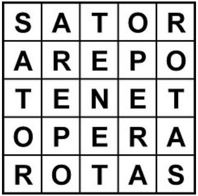


Photo by Ross Beresford

Problem author: Oskar Werkelin Ahlin

Statistics: 89 submissions, 51 correct, first at 0:04:10.

F – Bank Queue

- Create T time slots for T minutes.
- Put each person into their time slot.
- Process times slots from $T - 1$ to 0 and add all the people to the set of candidates.
- At each time slot pick the person with the most money which hasn't been picked yet.
- Need fast data structure to get $O(N \log N)$ time.

Problem author: Lukáš Poláček

Statistics: 93 submissions, 33 correct, first at 0:09:07.

A – Car Game

- Keep track of the first word for each possible licence plate (there are only 17 576 of them).
- For each word, list all license plates that fit.
  - Go through the word keeping a list of letters you have seen.
  - Use this to also keep a list of ordered pairs of letters.
  - Each such pair combined with a new letter gives a possible license plate.

Problem author: Ulf Lundström
Statistics: 135 submissions, 29 correct, first at 0:26:34.

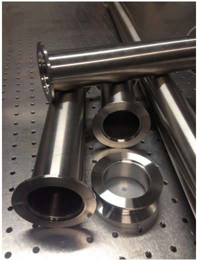
I – Flag Quiz

- Calculate $d(i, j)$, the distance between answer i and j.
- For each answer calculate the incongruousity – the maximum distance to other answers.
- Print all answers with the smallest maximum distance (incongruousity).

Problem authors: Ulf Lundström and Emma Enström

Statistics: 57 submissions, 23 correct, first at 1:10:43.

C – Vacuum Tubes



- Sort tubes: $l_1 \leq \cdots \leq l_L$.
- For each tube i, find an index p_i such that $l_i + l_{p_i} \leq L_1$ and p_i is as large as possible.
- Find similar index q_i for L_2.
- Try all $i, j \in \{1, \ldots, N\}$.
- Try pairing i with $p_i, p_i - 1, p_i - 2, p_i - 3$ and j with $q_i, q_i - 1, q_i - 2, q_i - 3$. Make sure we don't use a tube twice.
- Also possible in $O(N \log N)$.

Problem author: Ulf Lundström

Statistics: 47 submissions, 13 correct, first at 0:37:14.

D – Chicken Joggers

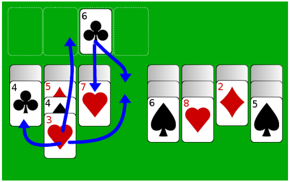
Photo by David Spencer

- Traverse the tree by depth-first-search, keep track of the distance from the root.
- If we can't visit any more intersections after visiting intersection u (leaf), we can decide if we need to put a lamp here.
- If u is not a leaf, we can decide whether we need a lamp by looking at already processed sons and edges going away from the root.

Problem author: Oskar Werkelin Ahlin

Statistics: 39 submissions, 7 correct, first at 0:44:26.

H – Free Cell

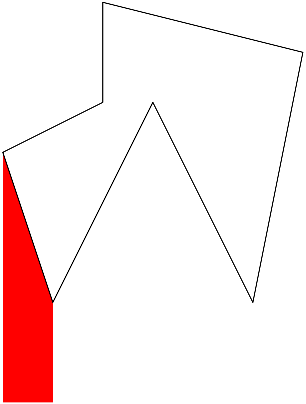


- We can move twice as many cards using $M + 1$ empty stacks than using only M.
- We can move $N + 1$ cards using 0 empty stacks and N free cells.
- Hence we can move at most $(N + 1) \cdot 2^M$ cards.
- Slower solutions also worked.

Problem author: Andreas Lundblad
Statistics: 18 submissions, ?? correct, first at 1:42:57.

Forest (1/2)

Trapezoid method:



Forest (1/2)

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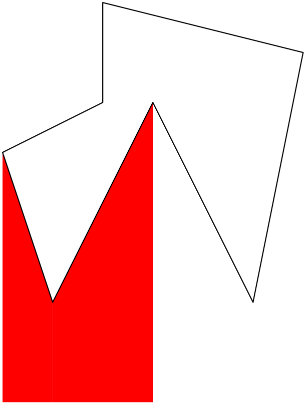

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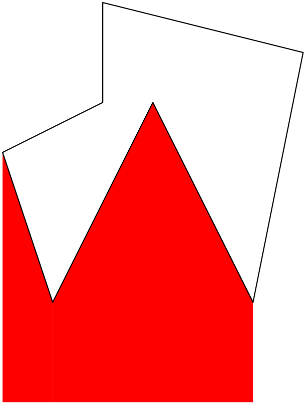

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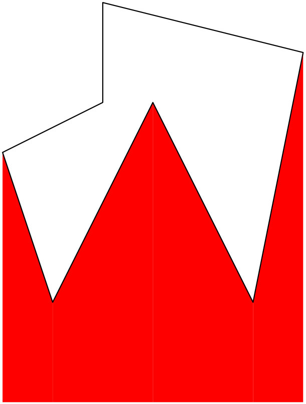

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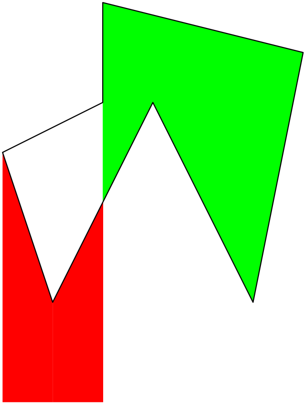

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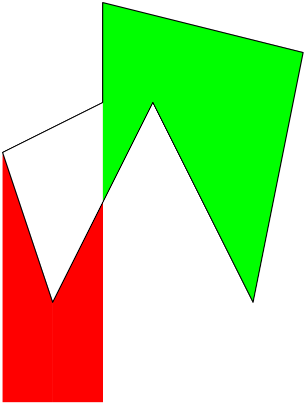

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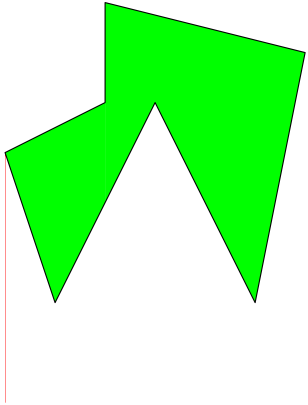

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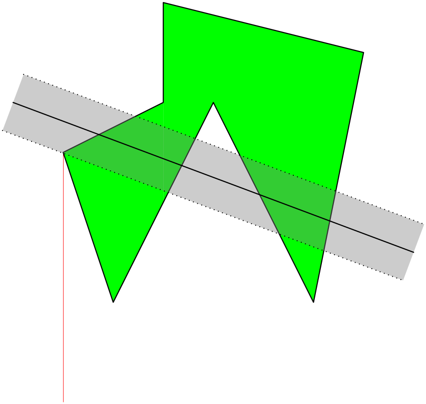

Forest (1/2)

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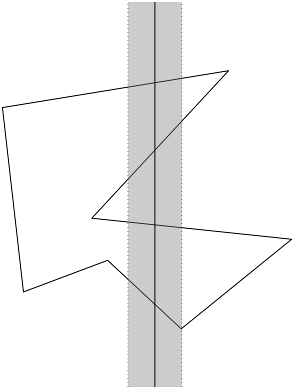

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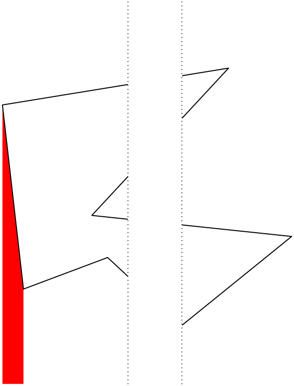

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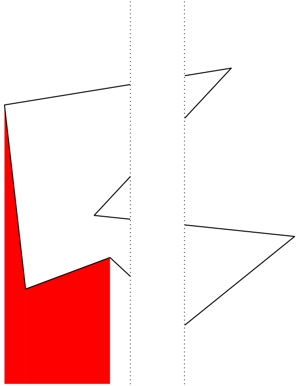

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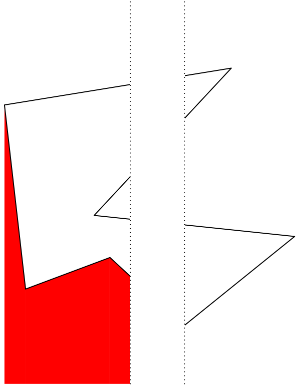

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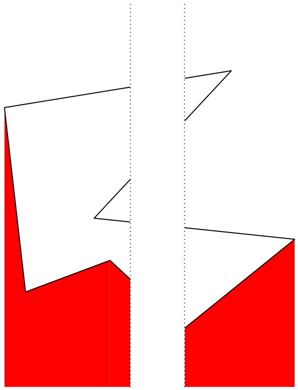

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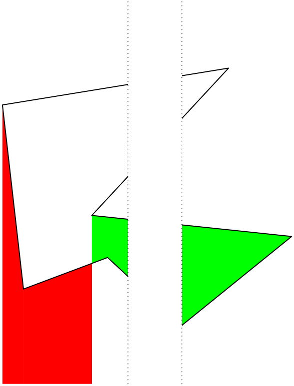

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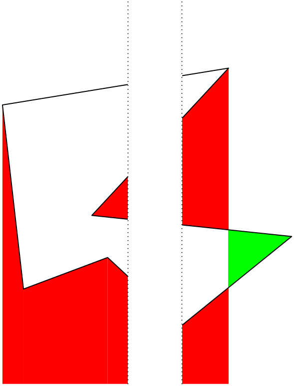
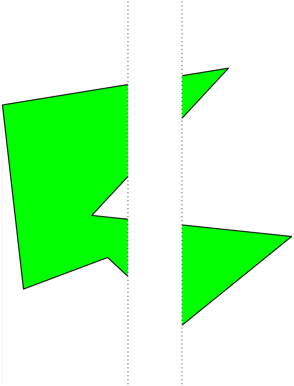


Forest (1/2)

Trapezoid method:



Forest (2/2)

- Rotation is easy using complex numbers.

Problem author: Lukáš Poláček
Statistics: 5 submissions, ?? correct, first at ??.

E – Hogwarts (1/2)

Photo by erinjudge

- Use
  black color for an existing edge,
  white color for missing edge.
- It's possible to rotate colors on a cycle u, v, w or a path of length 3 u, v, w, x.
- Process edges in lexicographic order $(0,1), \ldots, (0, N-1), (1,2), \ldots, (N-2, N-1)$:
  - Try to fix color of (i, j) by rotating a cycle i, j, k, such that $i < j < k$.
  - Otherwise try a path i, j, k, l, such that $i < k < l$.
  - We never change an edge that was already processed.

E – Hogwarts (2/2)

- In the end we might not be able to fix the last node – repeat the same process backwards.
- If this didn't succeed, randomly change labels from i to $(i + c) \bmod N$ and try again.
- This works for big graphs, for small graphs use brute force.

Problem author: Erik Aas

Statistics: 17 submissions, ?? correct, first at ??.

This was fun! When is the next contest?

- We train every two weeks at KTH, check www.csc.kth.se/contest.
- Next training on Wednesday at 17:15 in Orange.
- Nordic Championships in October, North-western Europe qualifier in November.
- Plenty of other online competitions every week.
- Subscribe to our calendar and RSS feed.

Boot camp June 7 – June 9

- 3 days
  on Möja in the archipelago.
- Lectures,
  trainings and fun activities.
- By invitation only.
- Also camp for Swedish IOI
  team and Linköping University.

Photo by The U.S. Army

Guide To Programming Contests

- `http://contest-wiki.csc.kth.se/`
- Written by Lukáš.
- Chapters "How to get better?" and "Team strategy" almost complete. More to come.
- The first training program for programming contests.
- Well received in the contest community.