KTH Challenge 2012

March 3, 2012

Jury

- Lukáš Poláček (head of jury)
- Ulf Lundström
- Mikael Goldmann
- Emma Enström
- Gunnar Kreitz

D – Toilet Seat

Photo by Henry Stern

- Simulate
  the 3 different strategies.
- First
  position is special, be careful.
- For the first 2 strategies, write a
  function that takes 'U' or 'D' as a parameter. No need to have the same code twice.

Statistics: 96 submissions, 55 correct, first at 00:08:04.

B – Birds on Wire

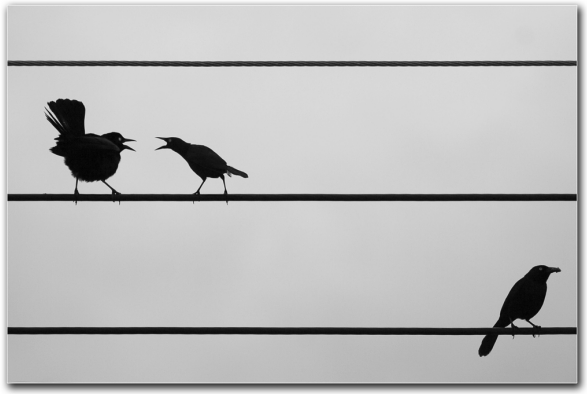


Photo by Tarik Browne

- Add imaginary birds at distances $-d + 6$ and $\ell + d - 6$. Now we don't need to handle start and end as a special case.
- Sort all positions of birds. For every 2 neighboring birds, calculate how many can possibly fit between them.

Statistics: 150 submissions, 47 correct, first at 00:11:46.

C – Lifting Walls

- For each crane, calculate which walls can be lifted by this crane.
- Try all possible combinations of up to 4 cranes and see if they can lift all walls.

Photo by Richard Štefanec

Statistics: 114 submissions, 28 correct, first at 00:39:38.

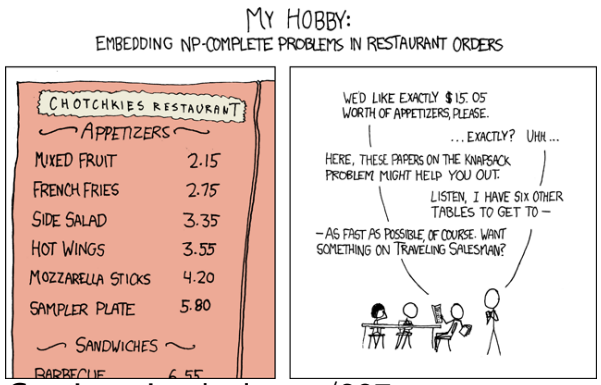
E – Pub-lic Good

- Start a search in some unvisited node v. Divide nodes into groups by the distance from v and mark them as visited.
- Nodes of odd distance get pubs, nodes of even distance get houses.
- If there is an isolated node, there is no solution.
- The graph can be disconnected.

Photo by National Library of Australia

Statistics: 33 submissions, 14 correct, first at 01:07:09.

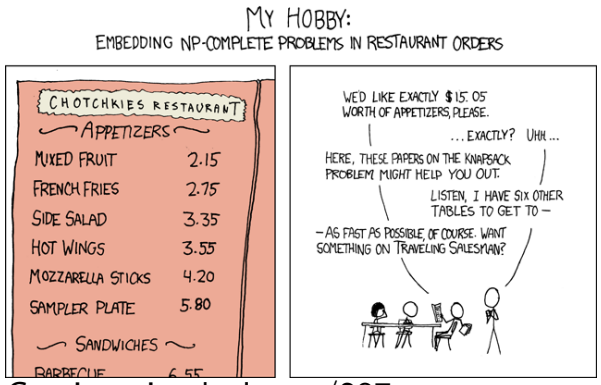
G – Restaurant Orders (1/2)



Comic strip xkcd.com/287.

- As the comics suggests, this is a variant of the knapsack problem.
- Dynamic programming.
  We have array $p[0..n][0..30000]$.
- $p[i]$ considers only the first i items.
- $p[i][cost]$ is either
  - "Ambiguous" if there are at least 2 orders of price *cost*
  - "Impossible" if there is no order of price *cost*
  - $(a_1, \ldots, a_k)$ if $a_1, \ldots, a_k$ is the only order of price *cost*

G – Restaurant Orders (2/2)



Comic strip xkcd.com/287.

Implementation details:

- Only need to have one-dimensional array $p[0..30000]$ and do the changes in place.
- Only store the last item of the order. To restore the order, jump back in the array.

Statistics: 43 submissions, 13 correct, first at 01:12:26.

H – Three digits

- We can write $n!$ as $2^k 5^\ell m$, where m is not divisible by 2 or 5.
- The result is $(2^{k-\ell} m) \bmod 1000$.
- "Factorize" every number between 1 and n and calculate k, ℓ and m mod 1000.

Photo by Sjoerd van Oosten

Statistics: 108 submissions, 7 correct, first at 01:41:30.

A – Spam

- Suppose there is an optimal subsequence of length $\ell \geq 2k$.
- Either left or right half have at least as good success rate.
- We only need to consider subsequences of length at most $2k - 1$.

Photo by AJ Cann

Statistics: 43 submissions, ?? correct, first at 02:43:18.

F – Xor Maximization (1/2)

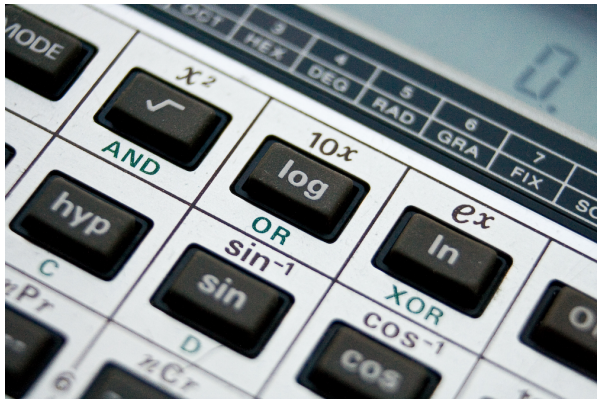


Photo by Mark Ramsay

- View this as a system of linear equations mod 2.
- Matrix A with columns being the numbers in the input in binary.
- Multiplying by a 0/1 vector x selects a subset of numbers and calculates their xor-sum.
- Want to find the biggest vector b such that $Ax = b$.

F – Xor Maximization (2/2)

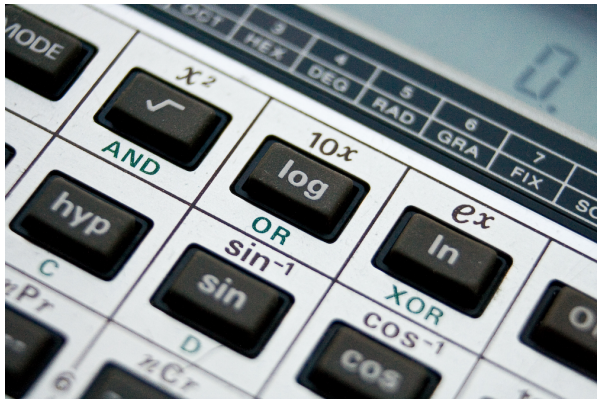


Photo by Mark Ramsay

- We can have $b_1 = 1$ (most significant bit) only if there is a one in the first row.
- If the i-th row of A is a linear combination of the first $i - 1$ rows of A, the value of b_i is determined by $b_1, \ldots, b_{i-1}$.
- Otherwise we can set it to 1.
- Gaussian elimination mod 2 is fast, because the matrix has small height.

Statistics: 11 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.
- Google Code Jam and TopCoder Open start in May. Both have usually around 10000 participants.
- Nordic Championships in October, North-western Europe qualifier in November.
- Plenty of other online competitions every week.
- More info on our webpage. Subscribe to our calendar and RSS feed.

Bootcamp in September

- 3 days outside of Stockholm.
- Lectures,
  trainings and fun activities.
- By invitation only.
- Come to our trainings,
  compete in online competitions
  and you might get invited.
- Also camp for highschoolers
  going to IOI.

Photo by The U.S. Army