

Possible ways to improve Olympiads in Informatics

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Why I'm here?

- On IOI schedule there is no [official] place for serious discussions about future of IOI
- IOI-level decisions are extremely important for regional and national OI
 - Let's include(exclude) language X!
(like Pascal at ACM...)
 - Let's switch from Windows to Linux!
(`cause Linux is cool!)
- I'm interested in computer competitions of different kind

What I am?

- Deputy teamleader at IOI since 1996
- Author of problems and head of jury of Latvian OI
- ★ • Teamleader or organiser of Baltic OI
- Jury member of other competitions



What I'm going to present?

- Some problems with IOI and some ideas about possibilities to improve IOI competition
- Introduce Latvian team competition in mathematics and computer science "Ugāle"


Format of OI

- Individual
- In-present
- 1-2 rounds, five hours each
- Tasks are (mainly) algorithmic-oriented
- Must be solved using fixed software
- Solutions are tested automatically
- Every contestant obtains task descriptions in English (this version is binding) and in his native tongue

Components of competition

- Task descriptions
 - input/output format description
 - time and memory limits
 - example(s)
- Grading system and interaction with them
 - solution submission
 - pre-testing (status “accepted”/“not accepted”)
 - tests and (final)testing

Task descriptions[★]

- Clear
 - give all necessary information to solve task
 - consistent (do not contain contradictory statements)
- Short
 - preferable - 1 page, no more than 2 pages
- Understandable (especially on IOI) 
 - language, cultural, social barriers
- Interesting
- Connected with technical things
 - grading system
 - test data

5. "KABELI"

Mēdienaš darīdas iekštas tīkl savienotas ar kabeļu pakārtību. Īā kī kabeļi ir vienādi pilkhi un laika gaitā tīkl gan pīnēlgū gan atēlgū gan no jauna pīnēlgū tad beigu beigs kabeļi var veidot vīai no pīstom mēdēllī. Pēc tāla vai garāla laika spīļa vairs nevīens nevar saprast kurš kabeļi us kuruai amsāt un gahēnās tīdos bēttos ir neastīlt stādējofurāšimū.

Ir dotas dīnas iekštas, katrai no kuruā ir N pīnēlgū gūtas, kas īrvīnotas vīrtīkīhī vīnā rīndā.

Pīnēlgū gūtas ir savienotas no augšas us lejup pīc kīrtas ar skaitļim no 1 līs N .

Vīenas iekštas katra pīnēlgū gūta ar kabeļu pakārtību ir savīnotā ar otras iekštas kīdu pīnēlgū gūtu (skatīstīnējumū). Šā pīnēlīstoms nekadīrot kura vīenas iekštas pīnēlgū gūta ir savīnotā ar kuru. Lai to nekadīrotū asīstoms Gūmā nohīal vīer kabeļu vīnā pīnēlī un pīnēlīstā pīc kīrtas vīer kabeļu krosēfānē pūntos (stīnējumā šīs pūnti apstīnēti ar burīnām alfabēttīkī sēcībā). Īā kī kabeļi ir vīnādi, tad Gūmā var pīnēlīstī tīkai, kuru dīnā vīalrs kabeļi pīc kīrtas, skatīstīs no augšas us lejū sājā vīer krosētojas. Pīnēlīstām, pūnti "d" krosētojas tīnēk us asturtās kabeļi. Par kīnā, nevīnā pūnti vīnākīnēgi nekrosētojas vīnādi par dīnām kabeļim.

Uzrakī tīst progāmmū, kas došīm kabeļu krosēfānē vīerīm nosakā, kuras pīnēlgū gūtas sātā stārpā ir savīnotas!

Ievēdēnā

Īakā failā `kaabw1.z.dat` pīnēlgū rīndā doti dīnā vīerā skaitļi N (pīnēlgū gūtu skait, $1 \leq N \leq 10000$) un K (krosēfānē vīerū skait, $0 \leq K \leq 100000$), kas atēlām ar tukšumamī bolū.

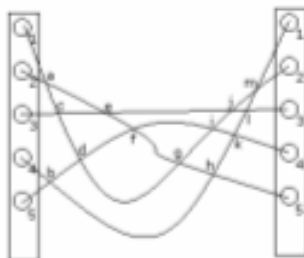
Katā no nīlōsājām K failā rīndām dot naturtīk skaiti n ($1 \leq n \leq N-1$), kas nozīda, ka sājā pūnti krosētojas n -tās un $n+1$ -ās kabeļi (skatīt no augšas). Ī-tās krosēpūnti ir aprakstī failā `it+1.gjā` rīndā.

Izēdēnā

Īakā failam `kaabw1.z.out` jāstatur tīkai N rīndas. Failā i -tājā rīndā jāīvīdā vīerā naturtīk skaiti - šīs otras iekštas pīnēlgū gūtas numurs, ar kuru ir savīnotā pīnēlī iekštas i -tās pīnēlgū gūta.

Pīemērs

Ievēdātā (kaabw1.z.dat)	Izēdātā (kaabw1.z.out)
5 13	2
1	5
4	3
2	1
3	4
1	
2	
3	
4	
2	
1	
3	
2	
1	



Figures, diagrams

Tale

Input format description

Output format description

Example(s)

Task descriptions

- **Quality** (not quality of underlying scientific problem!)
 - how much essential questions / mistakes / typos / suggestions to change anything

My aim at National and Baltics OI – **0 serious questions**

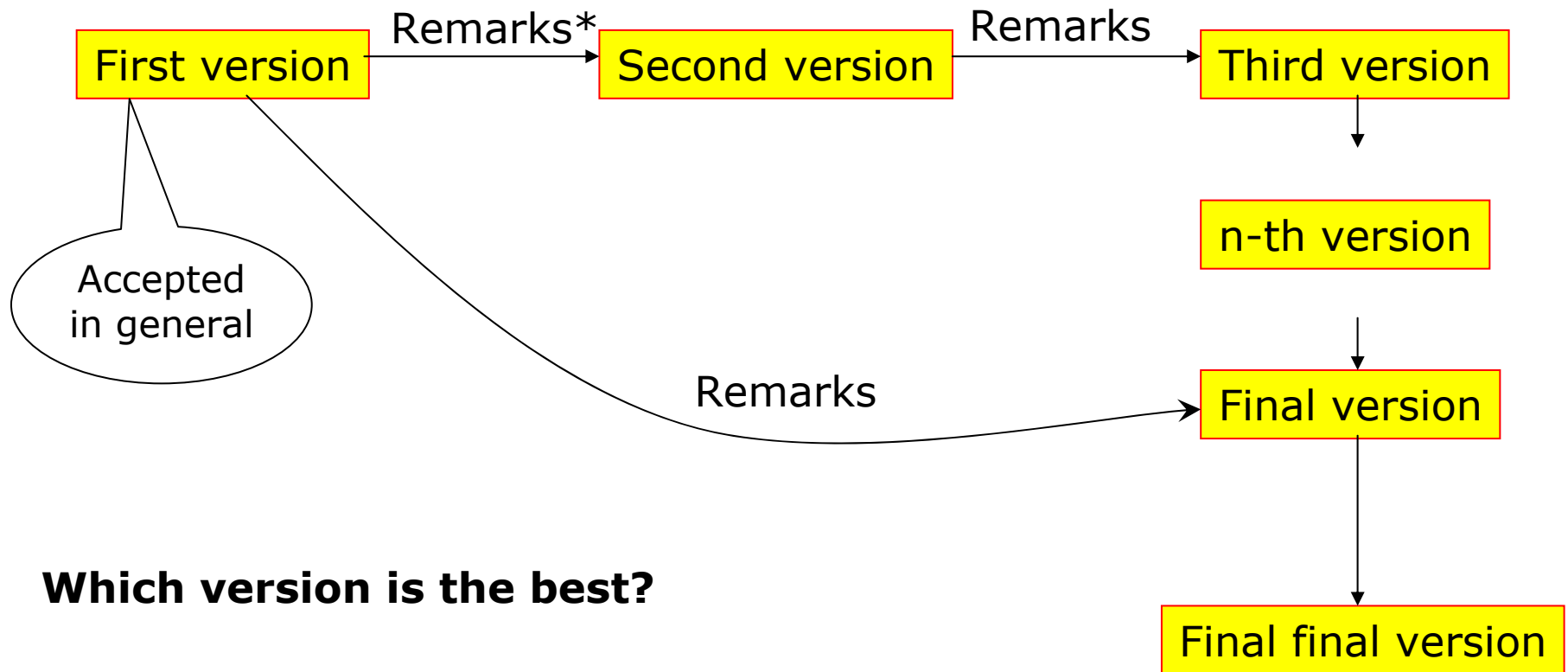
Lesson learned:

Impossible to do by author of description alone – several independent people must carefully read description (better – try to solve task).

Is it possible to achieve this on international level?

YES (I saw it on CEOI'97)!

“Improvement” of task descriptions on IOI



Which version is the best?

In practice decisions
“leave as is” took place (IOI’97, BOI’99)

Task: MOU

Mountain

Official English Version



Nowy Sącz, POLAND 2005
The 17-th International
Olympiad in Informatics

Day 1. Source file `mou.*`

Saturday, 20-08-2005

Available memory: 256 MB. Maximum running time: 3 s.

The Mountain Amusement Park has opened a brand-new simulated roller coaster. The simulated track consists of n rails attached end-to-end with the beginning of the first rail fixed at elevation 0. Byteman, the operator, can reconfigure the track at will by adjusting the elevation change over a number of consecutive rails. The elevation change over other rails is not affected. Each time rails are adjusted, the following track is raised or lowered as necessary to connect the track while maintaining the start at elevation 0. The figure on the next page illustrates two example track reconfigurations.

Each ride is initiated by launching the car with sufficient energy to reach height h . That is, the car will continue to travel as long as the elevation of the track does not exceed h , and as long as the end of the track is not reached.

Given the record for all the day's rides and track configuration changes, compute for each ride the number of rails traversed by the car before it stops.

Internally, the simulator represents the track as a sequence of n elevation changes, one for each rail. The i -th number d_i represents the elevation change (in centimetres) over the i -th rail. Suppose that after traversing $i - 1$ rails the car has reached an elevation of h centimetres. After traversing i rails the car will have reached an elevation of $h + d_i$ centimetres.

Initially the rails are horizontal; that is, $d_i = 0$ for all i . Rides and reconfigurations are interleaved throughout the day. Each reconfiguration is specified by three numbers: a , b and D . The segment to be adjusted consists of rails a through b (inclusive). The elevation change over each rail in the segment is set to D . That is, $d_i = D$ for all $a \leq i \leq b$.

Each ride is specified by one number h — the maximum height that the car can reach.

Input

The first line of input contains one positive integer n — the number of rails, $1 \leq n \leq 1\,000\,000\,000$. The following lines contain reconfigurations interleaved with rides, followed by an end marker. Each line contains one of:

- Reconfiguration — a single letter 'I', and integers a, b and D , all separated by single spaces ($1 \leq a \leq b \leq n, -1\,000\,000\,000 \leq D \leq 1\,000\,000\,000$).
- Ride — a single letter 'Q', and an integer h ($0 \leq h \leq 1\,000\,000\,000$) separated by a single space;

All minor improvements can be predicted in advance (if it can be found by GA member in an hour, it can be by ISC member in the similar period).

Obviously, this will simplify and make faster translation process.

How about more than one (English) official version (like in IMO)?
I know, I know that they work one week in advance...

What is main problem – no overall need, personalities (nobody willing to do this), problems with English version, other one?

Competition starts... First hour - question time...

Officially – “YES”, “NO”, “NO COMMENT”

On IOI'2003 there were more possible answers (even in free form?)

Suggestion:

Expand list of possible answers.

Candidates:

- Error in translation
- Already stated in description
- ...

Task solution process

- creating of program
 - ✓ effort graded by giving points
- creating of own test data
 - ✓ effort (till now) NOT graded on OI

Suggestion:

Grade also test data.

How to do:

- Allow to prepare whole test set and grade it's quality (what is it?)
- Submit one/several tricky tests
- Make white box testing of best submissions
(according to results of jury testing)

If we look more carefully:

- Allow to prepare whole test set and grade it's quality (what is it?)

Is it OK if ALL participants will construct only test data not trying to write proper (efficient enough) program?

How to grade quality of test **set**? The same question about jury test set. Points must not be granted simply "for test case" (we can get a bunch of simple test cases).

- Submit one/several tricky tests

What if jury solution fails on one (or some) of these tests?

- Make white box testing of best (according to results of jury testing) submissions

What if program code is prepared in such a way to make reading by human nearly impossible?

However:

If contestant's solution passes lot of tricky tests made by different authors it's good with higher probability than solution which passes only one (jury) test set.

Some *rules* to grade quality of test set can be established:

- Perfect solution must be given 100 points;
- Partially correct solution must not be given 100 points;
- Partially correct solution must be given non-zero amount of points
(this is very slippery point, because "one wrong symbol" program will get 0 on nearly all test sets and this is not fault of the test set);
- Non-efficient (slow) solution must not be given 100 points;
- Non-efficient, but correct solution must be given some non-zero amount of points (this rule corresponds with IOI 50% rule);
- Wrong program must not be given significant amount of points
(where is a line between wrong and partially correct programs?)

"Testing tournament"

		Tests submitted			
		Jury	Contestant A	Contestant B	Contestant C
Program submitted by:	Jury	Passed all tests (100)	Passed all tests (100)	Tests not submitted (0)	Passed partially (95)
	Contestant A	Passed all tests (100)	Passed all tests (100)	Tests not submitted (0)	Passed all tests (100)
	Contestant B	Passed all tests (100)	Passed all tests (100)	Tests not submitted (0)	Passed partially (80)
	Contestant C	Passed partially (90)	Passed partially (55)	Tests not submitted (0)	Passed partially (85)

May be also 100 - this will influence final score (but not place)

$295/300 = 98.3$

100

$280/300 = 93.3$

How about equivalent test cases from different sources?

Suggestion: provide more help in testing process

- Include more (also bigger?) tests in pretesting (to avoid boundary problems and found out “one wrong symbol” programs) or
- Allow **one** test run on whole test set – this will allow further debugging knowing results of full testing (in existing IOI format it’s impossible to return to program improvement after final testing)

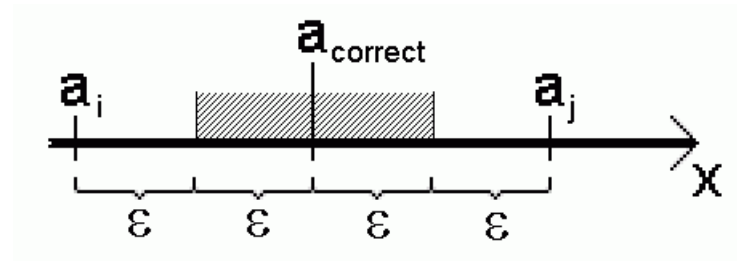
Problem – what if mistake in test set is discovered **after** competition round?

(Extremally dangerous: correct program is reported to be incorrect and vice versa)

How to bring real(non-integer) numbers back to IOI

- Works for problems where output is real number

Reformulate problem by giving possible choices (say 100) and asking for index of closest answer:



- Simple “overhead” code in program.
- No special checker necessary.
- May check also precision of solution by changing set of answers.

Not suitable for all problems with real output!

When all is graded...

... medal distribution show with histograms, emotions and loud discussions.

Suggestion:

Establish **exact** formula for medal distribution:

- All contestants must be ranked according their scores
- Splitting line between gold and silver medalists must be drawn at the first place after number of registered participants divided by 12 and rounded down to closest integer where there is difference of points
- Splitting line between silver and bronze medalists must be drawn at the first place after number of registered participants divided by 4 and rounded down to closest integer where there is difference of points
- Splitting line between bronze medalists and non-medalists must be drawn at the first place after number of registered participants divided by 2 and rounded down to closest integer where there is difference of points.

Team competition in mathematics and computer science “Ugāle”

- Teams of three high school students
- One computer (software NOT fixed!)
- Separate room (at least on finals)
- 5,5 hours
- 10 problems (at finals)
- answer is exact and short in form (number, string, filled table, program source code etc.)
- 64 teams at U’2006 semifinals, 12 teams at finals

Most challenging part (for me as problem set creator) – to create (or find)

- original problems
- problems solvable mathematically or by computer
- problems of appropriate level (problem not solved by at least one team is “wasted” – was not suitable for this competition)

5.* “BURKĀNS”

Ir vārds, kurā ir n burtu un visi burti ir dažādi. Šis vārds tiek uzrakstīts kādā rūtiņu lapas rindā, rakstot katru burtu pēc kārtas savā rūtiņā, nevienu neizlaižot. Nākošajā lapas rindā tiek rakstīts šis pats vārds tādā pat veidā, tikai, salīdzinot ar iepriekšējo rindu, sākot vienu rūtiņu pa kreisi. Tā šis vārds tiek rakstīts tikmēr, kamēr tas ierakstīts $n+1$ rindā. Zīmējumā parādīts piemērs, ja $n=7$.

							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S
							B	U	R	K	Ā	N	S

Noteikt, cik dažādos veidos iespējams izlasīt lapā ierakstīto vārdu, ja vārdu drīkst sākt lasīt no jebkuras rindas pirmās rūtiņas un visu laiku jāpārvietojas uz blakus rūtiņu pa labi vai uz leju, pie kam vārda lasīšanas virzienu drīkst mainīt ne vairāk kā divas reizes. Viens no iespējamajiem vārda izlasīšanas veidiem parādīts zīmējumā ar tumšākām rūtiņām (virziens mainīts vienreiz).

Cik dažādos variantos var izlasīt vārdu, ja a) $n=7$, b) $n=36$, c) $n=711$, d) $n=1492$?

In how much ways you can read word with n letters, starting from the first letter in a row, always going to the right or down and changing direction no more than twice. Example for $n=7$ is given.

n	<i>Number of ways</i>
7	160
36	23244
711	179710944
1492	1660640020

"Function of functions" (finals of U'2005)

Function $f(x)$ is defined for all integers from 1 to 2000000000 and function values are positive integers. Function values are known for one hundred argument values:

x	f(x)
1	2
2	1
3	2
5	2
7	2
9	3
10	5
11	3

.....

1999999961	54054053
1999999967	285714281
1999999969	181818179
1999999975	399999995
1999999981	285714283
1999999997	37735849
1999999999	64516129

.....

Your task is to write **as short as** possible program in one of the programming languages Pascal, C or C++, which implements this function for all x values given in table above.

“Smart program” (U’98)

Write a program in Pascal, BASIC or C/C++ which

- outputs on the screen just 1998 only once
- if exactly one symbol is replaced so, that program still compiles, it still outputs just 1998 only once.

Grading was done by experts – two IOI’97 silver medalists

Warning: Do not try such tasks on your own without experts!

● lamppost #2

Task:

Calculate distance (in ropes) between centers of lampposts without destruction of school building.

Only given tool – short (approx. 1.5m) rope.

Ugāle secondary school building

● lamppost #1

