Watch them fight!

Creativity Task Tournaments of the Swiss Olympiad in Informatics

IOI Conference
Kazan, Russia
August 14, 2016

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Creativity Task?

- task = multi-player game
- solution = program for one player (called bot)
- no perfect solution
- competitive grading
At the Swiss Olympiad

- one creative task per year
- 10 years = 10 tasks

paper: tasks and discussion
today: visualization of 5 tasks
online: http://creativity.soi.ch
Task: Cops & Robbers

- playground: undirected graph
- step: players move along an edge
- one robber: don’t get caught!
- many cops: catch robber asap!
Task: Cops & Robbers

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• background: boardgame „Scotland Yard“ from 1983
• active research area Meyniel‘s conjecture: \( \sqrt{n} \) cops are always enough
How do we use them?

• challenge task in the first round
• two months, solve at home
• motivation: open-ended puzzle

Round 1

Swiss Olympiad in Informatics
The SOI

The Swiss Olympiad in Informatics offers students a platform to prove their programming skills and to exchange knowledge. During the SOI year we select a team that represents Switzerland at the international olympiad. The SOI is organized by former participants in collaboration with the ETH Zurich.
## Overview

<table>
<thead>
<tr>
<th>Task</th>
<th>Subtask 1</th>
<th>Subtask 2</th>
<th>Subtask 3</th>
<th>Subtask 4</th>
<th>Subtask 5</th>
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<tbody>
<tr>
<td>cablecar (0/100)</td>
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<td>0/20</td>
<td>0/30</td>
<td>0/40</td>
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<td>0/30</td>
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<tr>
<td>waterslide (0/100)</td>
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Here you can see, which tasks you have already solved. Don’t let anything stop you from picking a task at the top and getting on it!
First Round SOI 2016

Matryoshka

Mouse Dimitri gave Mouse Stoff some packages containing different Matryoshka dolls as a present. Matryoshka dolls are wooden colourful pear-shaped Russian dolls that can be nested inside each other.

As Dimitri isn’t very tidy, dolls of different Matryoshka-sets are mixed together. That is why it is not necessarily the case that all dolls can be nested within each other. A doll can be put inside another if its height and its width are both strictly smaller.

Subtask 1: One Matryoshka-set (10 points)

Dimitri has put the Matryoshka dolls into 7 packages. Stoff opens the packages one by one and tries to nest all dolls that were in the same package into each other. Write a program that tells Stoff if all dolls within one package can be nested within each other.
Limits

- For the number of packages it holds that $T = 100$.
- For the number of dolls per package it holds that $N \leq 1000$.
- For the widths $W$ and heights $H$ it holds that $1 \leq W, H \leq 100000$.

Example

Input:

```
2
3
1 2 3
1 2 3
3
1 2 3
1 3 2
```

Output:

Case #1: YES
Case #2: NO

Comment:
The Matryoshka dolls in package 1 with sizes 1x1, 2x2 and 3x3 can be nested, so the answer is yes. The Matryoshka dolls in package 2 with sizes 1x1, 2x3 and 3x2 can only be nested partially, therefore the answer is no.
# First Round SOI 2016

## Ranking

<table>
<thead>
<tr>
<th>Rank</th>
<th>Username</th>
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<th>cablecar (100)</th>
<th>gotthard (100)</th>
<th>matryoshka (100)</th>
<th>waterslide (100)</th>
<th>salesman (100)</th>
<th>racing (100)</th>
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Racing

Each year, the grand cheese prix takes place in Kazan (Russia). This is one of the largest formula 1 races in the mouse world. Mouse Stofi will travel to the IOI in Kazan together with the Swiss delegation in order to participate in this prestigious race. Help him to win it.

The game

Each player handles one vehicle and the game takes place on a map consisting of squares. A game consists of several rounds. In each round, each player announces which square he would like to move to. After all players have announced their moves, they all move simultaneously. There is one constraint though: the velocity vector (the vector between the two preceding positions, or, in other words, the vector between the last and the next position) may only change by 1 in each direction. On the racing track, there are multiple different checkpoints, which must all be visited in an arbitrary order before the goal can be reached (the squares where the goal is located may, of course, be visited earlier, but the game does not complete in this case.) Multiple players can be on the same square at the same time.

Additionally, each player is given one cheese as well as one mouse trap. Players passing near cheese will be unable to
Task: Multisnake

- playground: grid with obstacles
- each player controls a snake
- grow and shrink over time
- die if obstacle is hit
Task: Multisnake

- many possible strategies:
  - attack or hide?
  - grow or shrink?
- best solution was minimax-like with complex scoring function
Task: Multisnake

• I/O format: just like IOI
How do we evaluate?

- compile and check submissions manually
- run many games in different settings
- select representative games for tournament
- points = basics + competitive performance
Turnier Bazaar
(Kreativitätsaufgabe)
SOI 2015 1C "Bazaar" Visualization

Navigation: Play | Stop | Prev | Next | Auction: 10 | Round: 0
Task: Bazaar

- $D$ diamonds are auctioned
- $N$ players can bid with $C$ coins
- highest bidder wins
- everyone pays
Task: Bazaar
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Swiss Olympiad in Informatics
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Swiss Olympiad in Informatics
<table>
<thead>
<tr>
<th>Rank</th>
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**SOI 2015 1C "Bazaar" Visualization**

**Navigation:**
- **Play**
- **500**
- **Prev**
- **Next**

**Auction:** 1

**Round:** 1
Task: Bazaar

- repeat this $A$ times so that the bots can learn each other's behavior and adapt
### Overall Ranking

<table>
<thead>
<tr>
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<th>Diam.</th>
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<tbody>
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### Active Auction

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### Active Round

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<td>+10</td>
</tr>
<tr>
<td>Joel Mathys</td>
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**SOI 2015 1C "Bazaar" Visualization**

Navigation: 

Auction: 8

Round: 1
A bit of statistics

• 10-year average: about 10 out of 50 participants submitted a reasonably sophisticated solution
• task complexity and participation heavily correlate
• winning solutions often 1000+ lines of code

Swiss Olympiad in Informatics
Task: Find the Anthill

- your program controls a single ant in the plane
- input: local 7x7 view around the ant
- output: N, E, S, W
- goal: find your own anthill asap
Task: Find the Anthill

• your program controls a single ant in the plane
• input: local 7x7 view around the ant
• output: N, E, S, W, or put a scent on the map
• goal: find your own anthill asap
Task: Find the Anthill

- there are $N$ ants in your population
- each ant runs a separate instance of your code
- coordination only through the scents you place
- many populations simultaneously

Swiss Olympiad in Informatics
How to select such tasks?

- interactivity
- hardness
- easy to learn
- novelty
- simple solutions exist
- big solution space
- can be played by hand
- visualizability

Swiss Olympiad in Informatics
Task: Racing

- drive a race car, visit all checkpoints, avoid walls
- simulated inertia: in each step you can change your velocity only by $+/- 1$ in each dimension
- Mario-Kart-style special gadgets
Task: Racing

- background: popular primary school pen-and-paper game in Switzerland
- popularized by Jürg Nievergelt
- featured by Martin Gardner in 1973
Task: Racing
Conclusion

• keep participants engaged for weeks
• direct competition between the contestants
• prepares for non-standard tasks with heuristics
• great way to visualize what our contestants do
Conclusion

It’s fun. Try it out!

Feel free to use our tasks and reach out to us.

http://creativity.soi.ch