

oii-web: an interactive online programming contest training system

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10th IOI Conference - Kazan, Russia August - 14th, 2016



Outline of this talk

In this talk we present oii-web, an open source social programming training system, designed to help students to train for *programming contests*.



Italian Olympiads in Informatics (OII)

Italy participated in IOI since 2000, and since 2001 organized its own national olympiads, divided in three phases:

- ▶ First selection (Schools, November): 20k students solve on paper a test that involves math, logic, and programming skills
- ▶ Second selection (Regions, April): 1.3k students has to solve three programming tasks. No time or memory limits.
- ▶ Third selection (National final, September): 100 students has to solve three programming tasks, under both time and memory limits; the top students are awarded 5 gold, 10 silver, and 20 bronze medals.

Later, all the gold and silver medals winners, together with few young bronze winners form the IOI-candidates group. They are repeatedly trained and selected until the team to represent Italy at IOI is chosen.



A contest management system

A contest management system should provide the following functionalities:

- ▶ allow users to submit their code
- ▶ run user codes in a sandbox
- ▶ provide users some or full feedback
- ▶ provide a contest dashboard
- ▶ provide a ranking



Contest management systems

There are several contest management systems:

- ▶ IOI: open source Contest Management System (CMS)
- ▶ ICPC: proprietary Kattis and open source PC
- ▶ open source Open Judge System
- ▶ open source DOMjudge



Differences between a CMS and a training system (TS)

Common core: running codes written by the users.

Contest Management System:

- ▶ focused on a single event, running for (usually) few hours
- ▶ provide few (usually mandatory) problems
- ▶ social activities between users: forbidden!!
- ▶ limited space for statistics

Training System:

- ▶ is an always running system
- ▶ provide many problems (how to navigate amongst them?)
- ▶ social activities between users: highly recommended!!
- ▶ large space for statistics



Training systems

There are several training systems, the (probably) most famous are:

- ▶ UVa Online Judge
- ▶ Sphere Online Judge
- ▶ Codeforces

but none of them is open source!



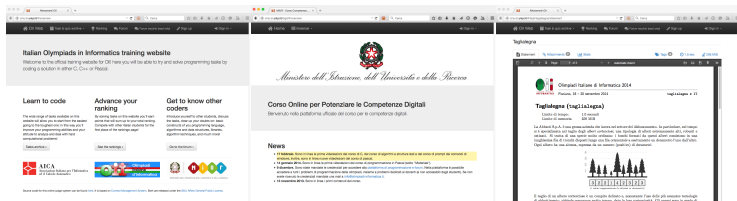
We developed an online open source social programming training system, `oii-web`, that:

- ▶ is built upon CMS (IOI)
- ▶ is integrated with the open source forum platform *discourse*
- ▶ provides (for the moment) basic statistics about the problems available for all the users
- ▶ is freely available via github or as a *dockerized* app for docker



We used oii-web for three distinct systems...

- ▶ **OII-training**: to be used by students interested in OII. Still in beta, it provides 240 problems spanning several techniques to the approximately 500 registered users.
- ▶ **DIGIT**: is the platform dedicated to teachers: we realized this platform in a project sponsored by the MIUR, where the aim was to build a self-paced on-line course of computer programming, focused on the Olympiads in Informatics.
- ▶ **IOI-candidates** is private, dedicated to italian IOI candidates.



Future Current work

- ▶ a static analysis stage where solution strategies (algorithm, data structure and their mutual feasibility) rather than syntactic/semantics errors, are considered,
- ▶ an interactive communication between system and student, to help
 - ▶ developing one's capability to select solution strategies, by giving feedback on the actual choice, and
 - ▶ planning a path of growth of one's skills, by suggestions about next suitable problems to undertake.
- ▶ an easier way to manage the system, and
- ▶ support for different languages for tasks statements and interface, allowing international usage of the platform



Challenges in *suggesting the next suitable problem*

- ▶ Rating the problems with difficulty levels is not enough: how do you rate a problem that requires a basic application of a difficult technique (e.g., max flow algorithm)?
- ▶ Attaching labels to problems (and students) must be done carefully: a student proficient in *dynamic programming* technique and *graph algorithms* might likely still not be ready to face a problem that requires *dynamic programming on graphs*.



Validation of the system

- ▶ We performed our study by means of a survey technique, with a questionnaire as a tool (15 questions).
- ▶ We focused on the users of the **OII-training** platform: 171 answered our questionnaire.
- ▶ In the following, with *active* user we denote a user that submitted at least one solution of a problem, and with *problem solved* we denote the number of submission that completely solved a problem.

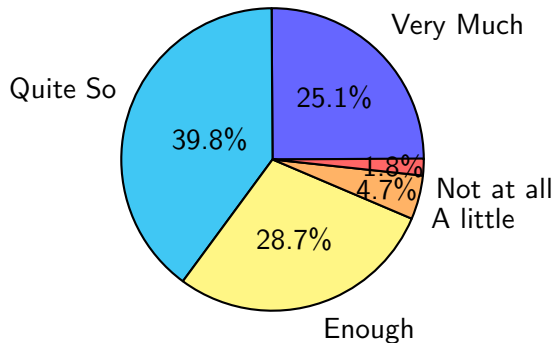


Some statistics about the **OII-training** platform

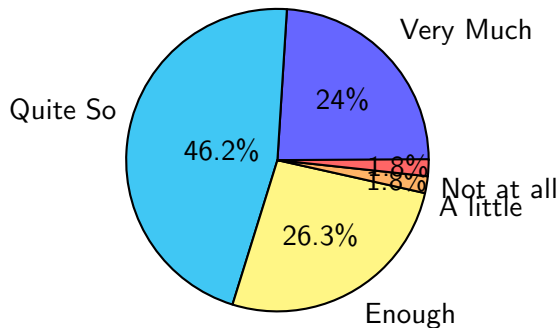
Number of registered users	1413
Number of active users Jan. 2015 - May 2016	812
Number of active users Jan. 2016 - May 2016	399
Problems in the system	253
Problems solved by users Jan. 2015 - May 2016	9754
Problems solved by users Jan. 2016 - May 2016	6192
Avg. # of probl. solved per user Jan. 2015 - May 2016	≈ 12
Avg. # of probl. solved per user Jan. 2016 - May 2016	$\approx 15,5$



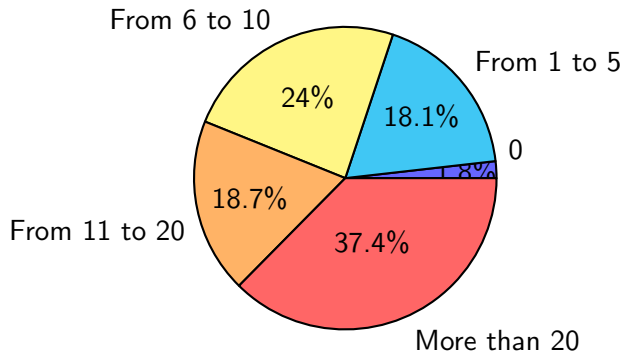
Q1. Did you find the system useful to fulfill your learning goals?



Q2. Is the system simple to use?



Q3. How many problems did you tackle in the system?



Conclusions

In this talk we briefly presented oii-web and discussed the challenges in the realization of a social programming training system.

- ▶ oii-web is freely available via github or as a docker application.
- ▶ We are extending its functionalities:
 - ▶ *suggesting the next suitable problem*
 - ▶ a web based IDE, to allow users to use it without an installed compiler;
 - ▶ (backend) a web based *task packaging tool*, that supports the creation of a task and facilitates the tuning of its limits.



Live platform

You can try oii-web by visiting <http://cms.di.unipi.it/>.

IOI2007 and IOI2009 problems an English statement.

