Using the cloud to grade student assignments

Vittorio Zaccaria

November 21, 2016

Outline

A few details on an ongoing experiment

Architecture

Summing up the experience so far

A possible proposal for PoliCloud

Outline

A few details on an ongoing experiment

Architecture

Summing up the experience so far

A possible proposal for PoliCloud

Polimi@home’s background:

- Informatica B (Introductory CS) for Mechanical, Energetic Engineers.
- More than two hundred students for each lab session (and counting).
- Fewer and fewer resources dedicated to lab each year (2 × Responsabili, 3 × Tutors).

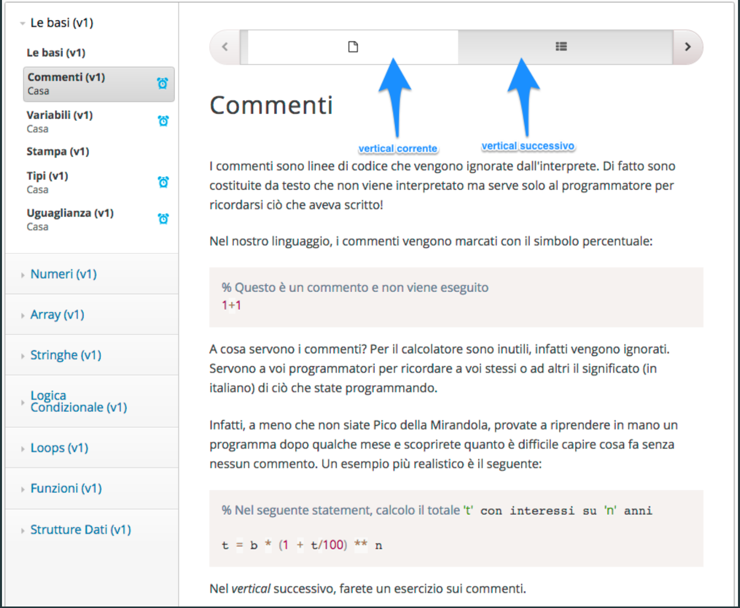
Polimi@home's idea

Provide an alternative practice environment where students can practice at home, in a self-paced manner.

Polimi@home - current features

- It is an EDX instance (Cypress), hosted at ASICT.
- Integrated with Shibbolet for conventional authentication.
- Simple authoring process for lectures (a `YAML` file and Markdown) converted into `XML` and imported. Easily collaborate with multiple teachers through a shared repository (Github).
- Remote execution of programming assignments (more on this later).

Demo



Commenti

I commenti sono linee di codice che vengono ignorate dall'interprete. Di fatto sono costituite da testo che non viene interpretato ma serve solo al programmatore per ricordarsi ciò che aveva scritto!

Nel nostro linguaggio, i commenti vengono marcati con il simbolo percentuale:

```
% Questo è un commento e non viene eseguito
1+1
```

A cosa servono i commenti? Per il calcolatore sono inutili, infatti vengono ignorati. Servono a voi programmatori per ricordare a voi stessi o ad altri il significato (in italiano) di ciò che state programmando.

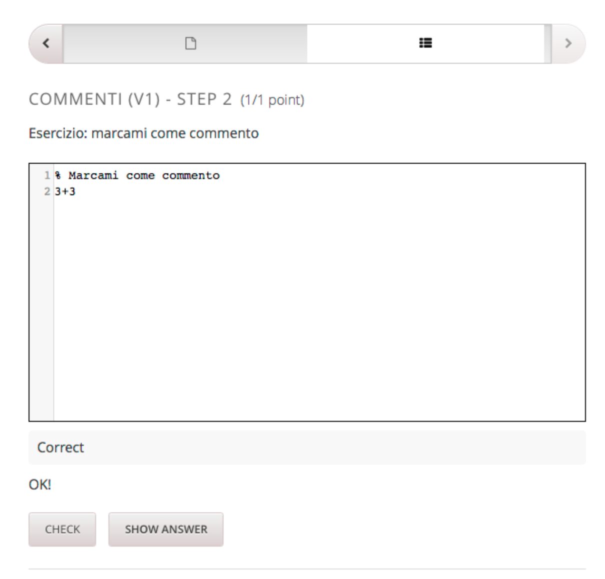
Infatti, a meno che non siate Pico della Mirandola, provate a riprendere in mano un programma dopo qualche mese e scoprirete quanto è difficile capire cosa fa senza nessun commento. Un esempio più realistico è il seguente:

```
% Nel seguente statement, calcolo il totale 't' con interessi su 'n' anni

t = b * (1 + t/100) ** n
```

Nel *vertical* successivo, farete un esercizio sui commenti.

Demo



COMMENTI (V1) - STEP 2 (1/1 point)

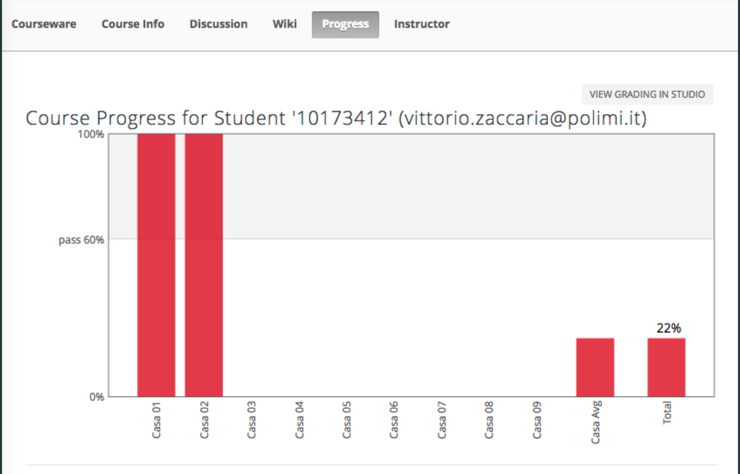
Esercizio: marcami come commento

```
% Marcami come commento
3+3
```

Correct

OK!

Demo



Course Progress for Student '10173412' (vittorio.zaccaria@polimi.it)

Polimi@home - future

- Serve complete course studies (1000s of students).
- Provide intelligent feedback (sort of advanced linting).
- Base the evaluation of students partly on their measured performance.
- Making it easier to employ a flipped classroom model into a face-to-face class.
- Real-time feedback on teaching (future).

Outline

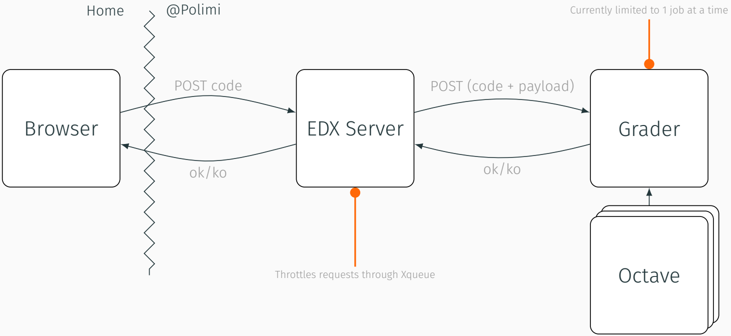
A few details on an ongoing experiment

Architecture

Summing up the experience so far

A possible proposal for PoliCloud

Remote execution



Example request

```
let xqueue_body = {
        student_info: '782$81AB'
        student_response: 'a = 0; a = a + 1',
        grader_payload: gp
};
```

Payload contains assertions to be evaluated at the end of the execution

```
let gp = {
        lang: 'octave',
        context: '',
        validation: 'assert(a==1)'
};
```

Security concerns

- Containerized process (Docker).
- Each assignment is run into its own (file system) sandbox.
- A timeout is used to kill long running processes.

A primer on Docker

- Lightweight runtime and packaging tool.
- Similar to a basic virtual machine (isolation), but with much less overhead.
- Guarantees that deployed apps run in identical environments.
- Provides versioned images.

Outline

A few details on an ongoing experiment

Architecture

Summing up the experience so far

A possible proposal for PoliCloud

Positive points

- 267 students enrolled so far, service never broke once since beginning of October.
- Good responsiveness even if everything (EDX + Docker) is based on a virtual machine.
- Service offered at no cost

Current shortcomings

- Only maintainable by ASICT staff. No streamlined way to setup experimental services for students[1].
- Long iteration times for deploying updates to the micro-service — forget about updating EDX.
- Can't have feedback. Ports are completely isolated by policy (performance logs cannot be even transmitted over UDP).
- Summing up: less than perfect agility, limited insight and limited feedback.

[1] More than a year passed since first meetings with METID/ASICT and first deploy.

Outline

A few details on an ongoing experiment

Architecture

Summing up the experience so far

A possible proposal for PoliCloud

How would I use PoliCloud

- I’d move both EDX and grading services into a virtual machine for which I have complete control OR
- I’d move at least the micro-service on PoliCloud premises.
- This would provide a faster way to:
    - gather insight into students’ performance and the system’s performance.
    - solve possible problems in (almost) realtime.
    - experiment with different models (e.g., feedback on assignment).