Mastering Functional Programming, Algorithms and Data Structures in OCaml, at Your Disposal

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Trends in Functional Programming in Education, January 2023

Part I

What This is About

The Courseware

- **Public** courseware based on the **open source** platform Learn-OCaml

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  - Monitored mode
  - Self-learning Mode

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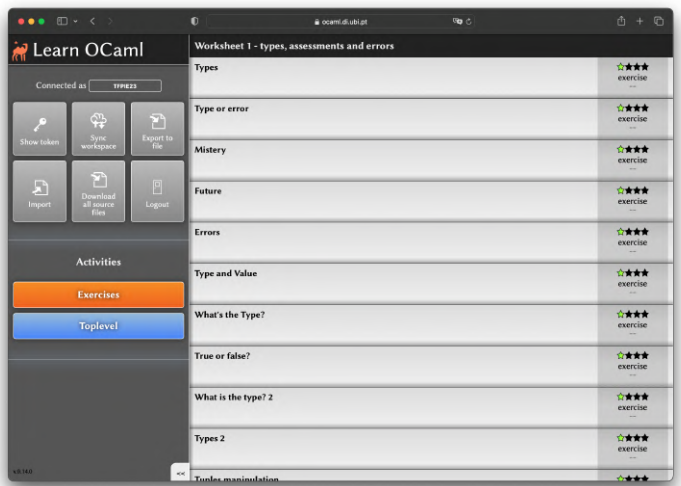

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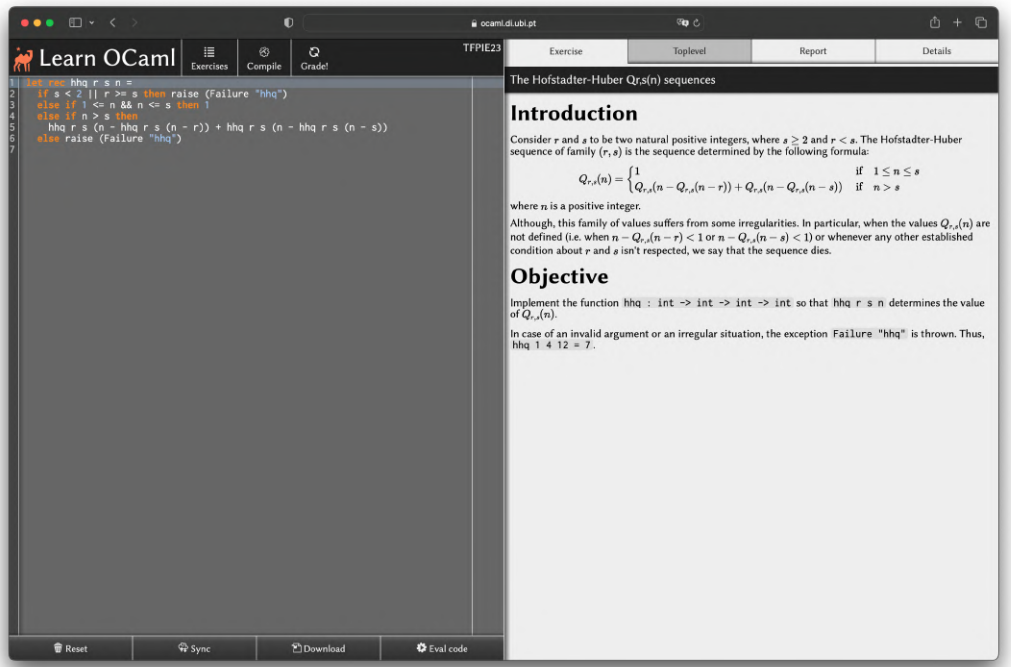

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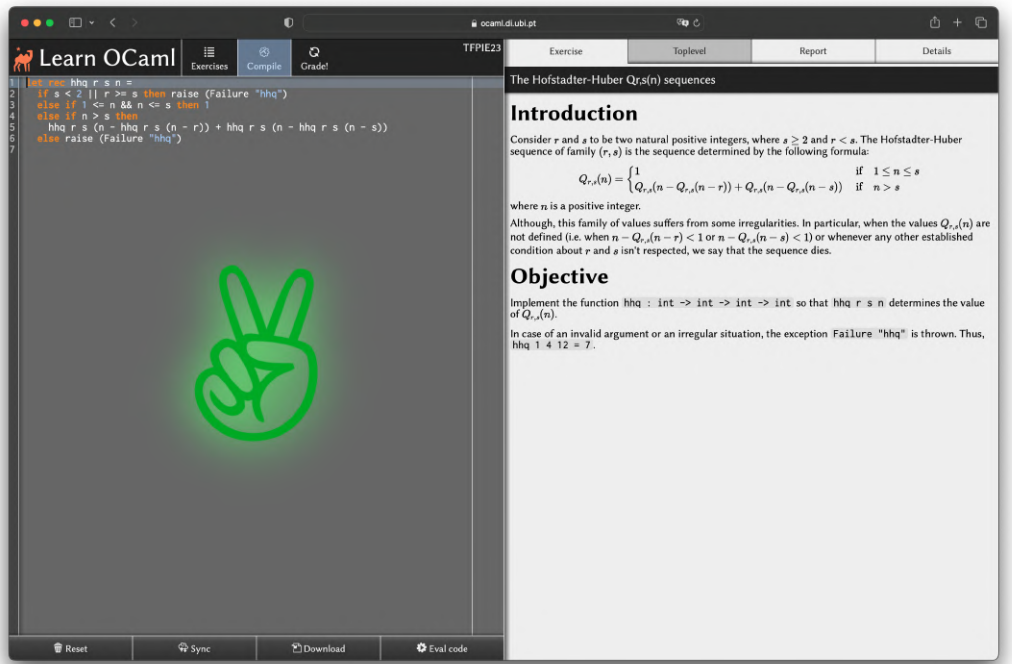

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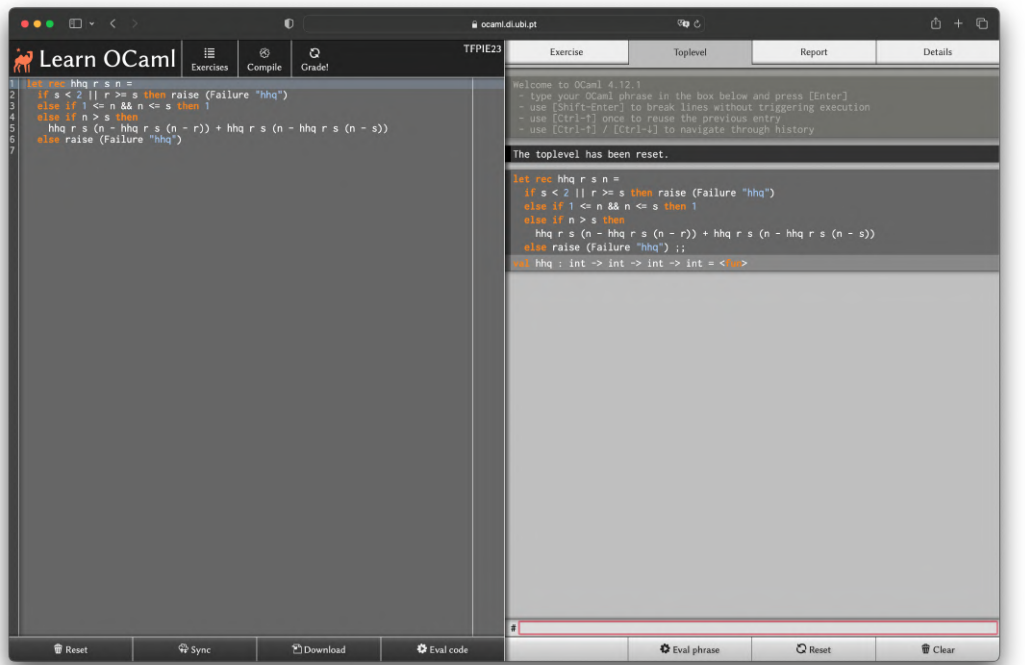

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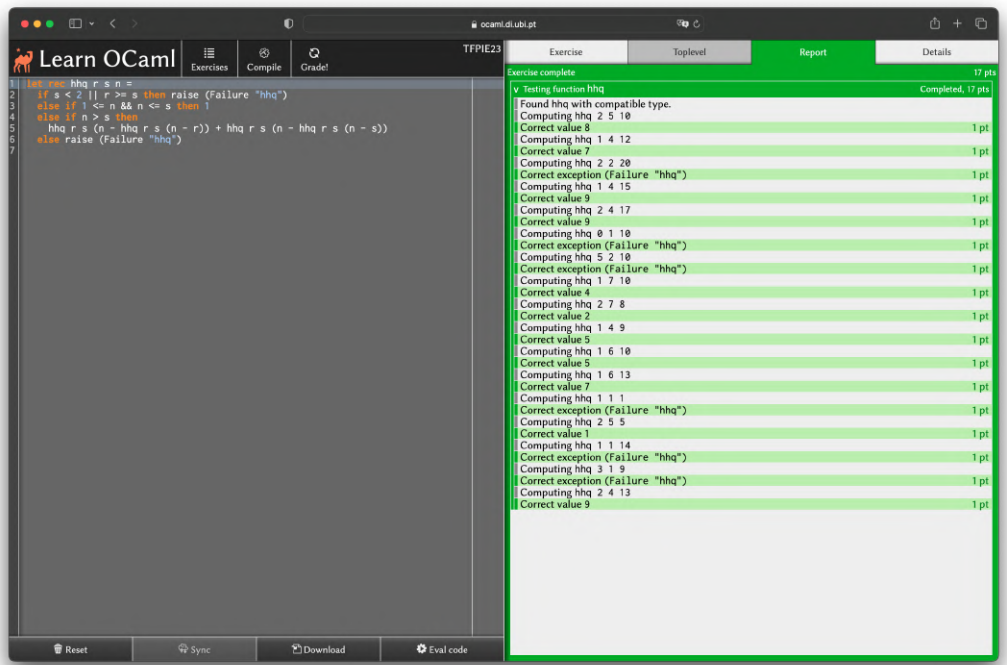

Part II

The Necessity

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- OCAML is a mature, principled, evolving and modern programming language
- There are good books about programming in OCaml, but...
- Scarcity of pedagogical materials in algorithms and data structures in OCaml (even worse in Portuguese)
- We have been teaching OCaml programming for years and the community outside our university is regularly interacting with us

Part III

The Opportunity

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- Large classes, heterogeneous levels and modest size teaching teams: challenging **logistics**

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- Large classes, heterogeneous levels and modest size teaching teams: challenging **logistics**
- A sad reality, the pandemic

Part IV

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- Mechanisms for fine-tuning the progress of each student's learning process

Part V

The Function

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Theoretical Exposition Support

The platform includes lecture notes that consist of the Portuguese translation of the excellent book of Sylvain Conchon
and Jean-Christophe Filliâtre. (english translation is ongoing)

The Function

Practical Component Support

As of today, the practical lessons covers half of the book (enough for a one semester course), the full coverage is on going

The assignment of exercises to each student works as follows:

- first-year students: 3 basic level exercises, 2 intermediate level exercises;
- second-year students: 1 or 2 basic level exercises, 2 or 3 intermediate level exercises, 1 experienced level exercise;
- third-year students: 2 or 3 intermediate level exercises, 2 or 3 experienced level exercises.

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Support and control of student progress

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https://join.slack.com/t/azizos/shared_invite/zt-1mrkozpqf-EYEsVBEUocfVreUqCHBM9Q

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Helps the teacher to follow the student's progress

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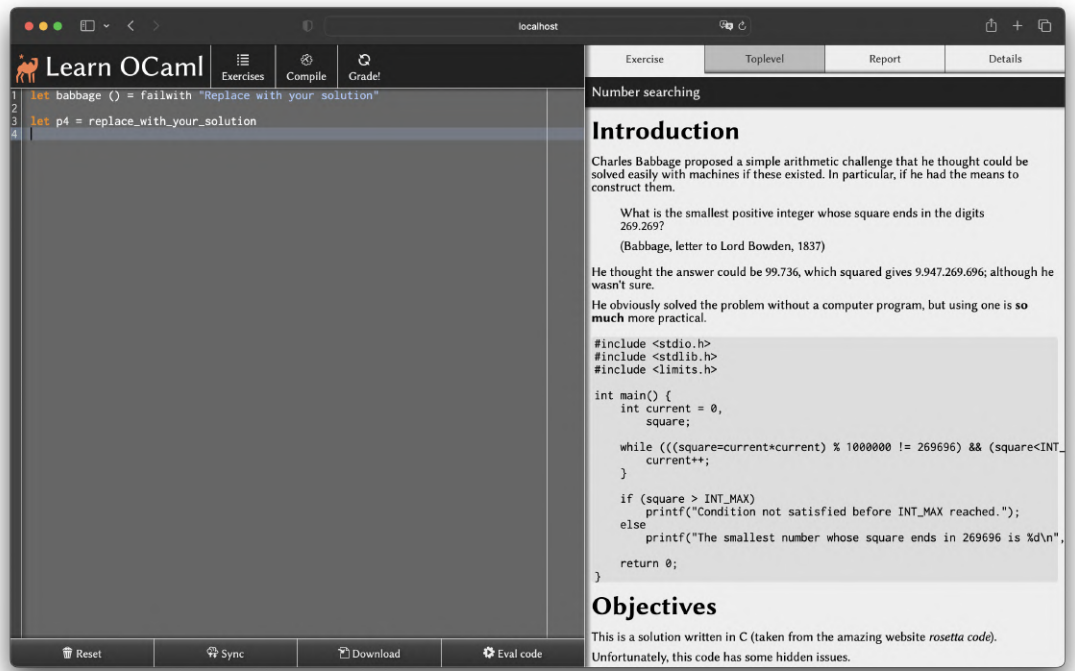
- Tracking of which exercises students have completed
- Assigning, if needed, additional exercises
- The feedback on the student's performance is detailed

Demo


localhost
Learn OCaml
Exercises
Compile
Grade!
let babbage () = failwith "Replace with your solution"
let p4 = replace_with_your_solution
Reset
Sync
Download
Eval code
Exercise
Toplevel
Report
Details
Number searching
Introduction
Charles Babbage proposed a simple arithmetic challenge that he thought could be solved easily with machines if these existed. In particular, if he had the means to construct them.
What is the smallest positive integer whose square ends in the digits 269.269?
(Babbage, letter to Lord Bowden, 1837)
He thought the answer could be 99.736, which squared gives 9.947.269.696; although he wasn't sure.
He obviously solved the problem without a computer program, but using one is so much more practical.
#include <stdio.h>
#include <stdlib.h>
#include <limits.h>
int main() {
int current = 0,
square;
while (((square=current*current) % 1000000 != 269696) && (square<INT_
current++;
}
if (square > INT_MAX)
printf("Condition not satisfied before INT_MAX reached.");
else
printf("The smallest number whose square ends in 269696 is %d\n",
return 0;
}
Objectives
This is a solution written in C (taken from the amazing website rosetta code).
Unfortunately, this code has some hidden issues.

Part VI

TODAY

Today

Current perspectives:

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- Platform stability and scalability: the computation is on the client side

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- Fine-tuned mechanism of graders

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Current perspectives:

- Platform stability and scalability: the computation is on the client side
- Fine-tuned mechanism of graders
- The English version is still evolving

Part VII

Tomorrow

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The next steps for the current teaching team are:

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- Videos

Tomorrow

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- Videos
- Improved control center

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The next steps for the current teaching team are:

- Videos
- Improved control center
- More contents
- And...

Tomorrow

More research

Tomorrow

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- Automatic program transformation

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- Mechanisms that allow the student to specify pre-/post-annotations and invariant and graders to verify/test them

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- Algorithmic complexity checking
- Extend platforms like Learn-OCaml to the teaching of other areas of computer science (see OFlat, OCaml workshop 2022, for a formal language course)

Thank You!

Questions?

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