The state of OCaml, 2013

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Outline

1. OCaml development news
2. OCaml community news
3. Work in progress
Recent releases

**Major release 4.00.0:** (June 2012)
- Generalized Algebraic Data Types
- Exposing rich typed ASTs and compiler internals (for IDEs and more)
- ... and much more.

**Minor release 4.00.1:** (Oct 2012)
- 23 bugs fixed

**Release 4.01.0:** (Sept 2013)
What’s new in OCaml 4.01.0

Type checking and inference:
- More clever typing of ambiguous record labels and datatype constructors.

Usability:
- A lot of new warnings.
- `-short-path` option to choose shorter, more readable names when printing inferred types.
- Suggested corrections for misspelt identifiers.
- Richer, more efficient API to record and display stack backtraces.
Ambiguous record labels

type t = { a: int }
type u = { a: int; b: int }

What is the type of fun x -> x.a ?

Last definition hides previous definitions: (OCaml ≤ 4.00)
label a is always associated with type u, never with t.

fun x -> x.a : u -> int
{ a = 1 } : x

Problem: programmers must make label names unique.

Polymorphic records: (using objects)

fun x -> x#a : < a:α, ... > -> α

Problem: high run-time cost of field accesses; no pattern-matching.
The new disambiguation strategy

\[
\text{type } t = \{ \ a: \text{int} \ \} \\
\text{type } u = \{ \ a: \text{int}; \ b: \text{int} \ \}
\]

- Use “last definition” approach if it type-checks.
- Otherwise, consider other definitions of the label of interest (based on type constraints and context). If one causes the term to type-check, choose it.

Also applies to constructors of sum types.

<table>
<thead>
<tr>
<th>In 4.01</th>
<th>Before</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{fun } x \rightarrow x.a</td>
<td>u \rightarrow \text{int}</td>
</tr>
<tr>
<td>\text{fun } (x: t) \rightarrow x.a</td>
<td>t \rightarrow \text{int}</td>
</tr>
<tr>
<td>{a = 1; b = 2}</td>
<td>u</td>
</tr>
<tr>
<td>{a = 1}</td>
<td>t</td>
</tr>
</tbody>
</table>
Development process

More external contributions, more careful PR triaging
   → 135 minor bugs fixed
   → 25 feature wishes granted.

Much improved & automated testing:
   ● Continuous integration for the core system (esp. all Windows ports)
   ● OCamlot testing of OPAM packages (under Linux & BSD)
This release brought to you by...

**Damien Doligez**,  
release manager and general wizard.

The core Caml development team: **Alain Frisch, Jacques Garrigue, Benedikt Meurer, Fabrice Le Fessant, Gabriel Scherer, Hongbo Zhang, Jonathan Protzenko, Wojciech Meyer, Xavier Clerc, Xavier Leroy.**

With much appreciated contributions from: Anil Madhavapeddy, Benjamin Monate, Benoît Vaugon, Chet Murthy, Christoph Bauer, Christophe Papazian, Christophe Troestler, Dan Bensen, Daniel Bünzli, David Allsopp, François Berenger, Gabriel Kerneis, Gerd Stolpmann, Grégoire Henry, Jacques-Henri Jourdan, Jeffrey Scofield, Jérémy Dimino, Jérôme Vouillon, John Carr, Khoo Yit Phang, Leo P. White, Markus Mottl, Maxence Guesdon, Michel Mauny, Pierre Chambart, Pierre Weis, Tiphaine Turpin, Valentin Gatien-Baron, William Smith, ygrek.
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The OPAM package manager

OPAM is taking off: from alpha one year ago to 512 packages today.

A great help for:
- beginners (one-stop shopping installation & upgrade)
- power users, library developers (e.g. support for multiple versions)
- the upcoming OCaml Platform
- ... not to forget the core OCaml dev team (testing, and more).

Many thanks to OCamlPro, esp. Thomas Gazagnaire.
Dissemination

Not one but two new very good books in English:

- *Real-World OCaml*, Jason Hickey, Anil Madhavapeddy, and Yaron Minsky, O’Reilly.
- *OCaml from the very beginning*, John Whittington, Coherent Press.

New resources for beginners (OCamlPro):

- tryocaml.ocamlpro.com (the toplevel in your browser)
- OCaml-Top (at last a decent GUI for the toplevel)

The ocaml.org infrastructure (OCamlLabs):

- the new OCaml Web site
- consolidation of mailing lists, forge, etc.
Some new projects (not exhaustive)

Recently released:

- Merlin (Emacs and Vim-based IDE)
- SPOC (GPGPU programming)
- OCaml-Java (OCaml on the JVM)
- UCore (Unicode support library)
- Wodi (the GODI distribution for Windows)

Plus much activity on older projects (too many to list).
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Reorganizing the core OCaml distribution

OPAM and the upcoming OCaml Platform make it possible to split off certain parts of the core OCaml distribution as separate projects, e.g.
- the LablTK GUI library (done)
- Camlp4 (soon)
- OCamlbuild; the Num, Str, Graphics libraries (under discussion).

Expected benefits:
- Decoupling the development & release cycles of these projects.
- Attracting more contributors.
- Lightening up the burden on the core OCaml developers.

Vision: in the future, very few users should download and install the core OCaml distro themselves; instead, it will come as a component of the OCaml Platform.
Extension points and \texttt{-ppx} preprocessing

\texttt{-pp camlp4:}

![Diagram showing the process of parsing and type-checking](image)

\texttt{-ppx myprepro:}

The Camlp4 way: a special parser; each preprocessor extends the syntax.

The \texttt{-ppx} way: parsetree-to-parsetree rewriting; use the standard parser from \texttt{ocamlc/ocamlopt}, which supports “extension points” (a.k.a. attributes, annotations).
The Camlp4 way: a special parser; each preprocessor extends the syntax.

The -ppx way: parsetree-to-parsetree rewriting; use the standard parser from ocamlc/ocamlopt, which supports “extension points” (a.k.a. attributes, annotations).
Extension points and \texttt{-ppx} preprocessing

Extension points = free-form annotations that are attached to the parsetree, ignored by the compiler, exploited by preprocessors.

Example: generating functions from type definitions. The Camlp4 way:

\begin{verbatim}
    type t = {
        x : int with default(42);
        y : int with default(3), sexp_drop_if(y_test);
    } with sexp
\end{verbatim}

With extension points:

\begin{verbatim}
    type t = {
        x : int [@default 42];
        y : int [@default 3] [@sexp_drop_if y_test];
    } [@@sexp]
\end{verbatim}

Status: first proposal in SVN trunk; ongoing discussions on syntax & contents of extension points.
A code generator for the ARM 64-bits platform
(a.k.a. AArch64)

The first new target architecture since x86-64, ten years ago.
Improving performance

Several ongoing experiments:

- **Middle-end**: inlining (P. Chambard), unboxing (A. Frisch)
- **Back-end**: CSE, aggressive constant propagation (X. Leroy)
- **Run-time system**: more lightweight write barriers, page table, major heap allocation, ...
- **Profiling tools**: better `perf` support (OCamlPro), memory usage profiling (OCamlPro, M. Shinwell).

A prerequisite: building a benchmark suite, ideally as part of Platform packages.
In closing. . .

A lively language; a very lively community.

Two milestones reached this year (OPAM, *Real World OCaml*).

Next milestone: the OCaml Platform. Support it!

Thanks for all the contributions. Keep them flowing!