

Introduction

This text uses OCaml to teach programming fundamentals.

Once installed, one can use OCaml in the terminal by typing OCaml and writing your expression after the `#`. An expression should be ended with `;;`. If you use OCaml while in a directory containing a `*.ml` file, you can use the functions contained in this file with the syntax: `#use "filename.ml";;`.

The simplest way to leave OCaml is to use `exit 0;;`. One can interrupt a running program by pressing Ctrl-C.

1 Concepts

An OCaml program is an *expression* (or a collection of expressions) with a *type*. This expression can be evaluated to give a *value*. Operators can be applied to sub-expressions to yield larger expressions. Some operators only apply to certain types.

The type **int** is the integers. Your machine will have a so called `min_int` and `max_int`, which are the smallest and largest integer that is available, respectively. Adding to `max_int` will wrap back around to `min_int` as `min_int = max_int + 1`. A similar situation occurs when subtracting from `min_int`. Thus, the integers from `min_int`, ..., -1, 0, 1, ..., `max_int` are *all* of the objects with type **int**. It is worth being careful when working close to the edges of this range to prevent unexpected results.

The type **bool** is the Boolean values `true` and `false`. It is useful to have a separate type for Booleans rather than using, say, 0 and 1 as this would introduce potential situations where a non 0 or 1 value is unintentionally returned. This acts to prevent unnecessary errors. This is possible as OCaml has a strict type system.

The type **char** is single characters, for example `'a'`, `'!'` and `'E'`.

Mathematical operators only act between expressions of type **int**. These are `+` `-` `*` `/` `mod`. The result of such an expression will also have type **int** (remember this when using division operations).

Comparison operators compare expressions of the same type. This means that Booleans and characters can also be compared. These are `=` `<` `<=` `>` `>=` `<>` (where `<>` is the operator for "not equal to" in OCaml). The result of such an expression will have type **bool**.

Boolean operators `&&` and `||` are "and" and "or" respectively and compare expressions of type **bool**.

Operators of higher precedence are evaluated first. For example, `*` has precedence over `+` and `"and"` has precedence over `"or"`. Otherwise, operators are evaluated from left to right.

If *statements* have the following syntax: `if expression1 then expression2 else expression3` where *expression1* has type **bool**, and *expression2* and *expression3* have the same type.

2 Names and Functions

One can assign a value to a name using the syntax: `let name = expression`. This can be extended to compound expressions using the syntax: `let name1 = expression1 in let name1 = expression2 in` For example:

```
# let x = 200 in x * x * x;;  
# let a = 500 in (let b = a * a in a + b);;
```

. The rightmost expression will be fully evaluated first, even if brackets aren't explicitly written.

A *function* takes some input, called an *argument*, and evaluates to some value. These are created using the syntax: `let name argument1 argument2 ... = expression`. This function has type $\alpha \rightarrow \beta$, $\alpha \rightarrow \beta \rightarrow \gamma$ etc. for some types α , β , γ , where the rightmost type corresponds to the type of the value of the function and the other types correspond to those of the arguments respectively. For example:

```
# let cube x = x * x * x
val cube : int -> int = <fun>
```

where the second line shows the output by the OCaml interpreter, making the type of the function explicit.

In OCaml, whitespace (notably indentation) is used purely to aid readability.