

Adding
types to
Lua

typedlua

- [Github](#)
- Last activity - 2020
- Superset of Lua
- Supports Lua ≤ 5.3
- Features
 - type inference
 - generics
 - typing external modules
 - classes implementation
 - nominal x structural typing



Usage

typedlua works as compiler (`*.tl -> *.lua`)

```
echo "x: number = 3.14" > file.tl  
tlc file.tl  
lua file.lua
```

Basic example

```
local function greet(name: string?): string
    name = name or "Anon"
    return "Hello " .. name
end
print(greet("Alex"))
print(greet())
-- print(greet({})) - compilation error
```

Generated code

```
local function greet(name)
    name = name or "Anon"
    return "Hello " .. name
end
print(greet("Alex"))
print(greet())
```

Type inference

```
local function get_upload_server(  
    server: string | {"upload_server": string?}  
): (string, string) | (nil, string)  
    if type(server) == "string" then  
        return server, "specific"  
    else  
        local server = server.upload_server  
        if server then  
            return server, "default"  
        else  
            return nil, "no upload server set"  
        end  
    end  
end  
local server, mod_or_err = get_upload_server({})  
if not server then  
    print("Error: " .. mod_or_err)  
else  
    print("Using " .. mod_or_err .. " server " .. server)  
end
```

Modules

```
local mymath = {}  
local RADIANS_PER_DEGREE = 3.14 / 180.0  
function mymath.deg(r: number): number  
    return r / RADIANS_PER_DEGREE  
end  
function mymath.rad(d: number): number  
    return d * RADIANS_PER_DEGREE  
end  
mymath.pow = function (x: number, y: number): number  
    return x ^ y  
end  
return mymath
```

```
local mymath = require "mymath"  
print(mymath.deg(1))  
print(mymath.rad(1))  
-- print(mymath.pow(2, "foo")) compilation error
```

Typing external modules

```
draw: () -> ()
update: (number) -> ()
event: {"quit": () -> ()}
graphics: {
    "circle": (string, number, number, number) -> (),
    "setColor": (number, number, number, number?) -> (),
}
keyboard: {"isDown": (string) -> (boolean)}
typealias flags = {
    "fullscreen":boolean, "fullscreentype":string,
    "vsync":boolean, "msaa":number, "resizeable":boolean,
    "borderless":boolean, "centered":boolean,
    "display":number, "minwidth":number,
    "minheight":number, "highdpi":boolean,
    "refreshrate":number, "x":number, "y":number }

window : {
    "getMode": () -> (number, number, flags),
    "setTitle": (string) -> (),
}
```

Typing external modules

```
local love = require "love"

typealias Color = {"r":number, "g":number, "b":number}
typealias Circle = {"x":number, "y":number,
                    "radius":number, "color":Color}

love.window.setTitle("Gray Moon")
local width, height = love.window.getMode()
local gray:Color = { r = 128, g = 128, b = 128 }
local circle:Circle = { x = width / 2, y = height / 2,
                        radius = 10, color = gray, }

function love.update (dt:number)
    if love.keyboard.isDown("escape") then
        love.event.quit()
    end
end

function love.draw ()
    love.graphics.setColor(circle.color.r,
                           circle.color.g, circle.color.b)
    love.graphics.circle("fill", circle.x, circle.y,
                        circle.radius)
end
```


OOP

```
class Circle
  x: number
  y: number
  radius: number

  constructor new(x: number, y: number, radius: number)
    self.x = x
    self.y = y
    self.radius = radius
  end
  method move(x: number, y: number)
    self.x = self.x + x
    self.y = self.y + y
  end
end
```

```
require("circle")
local c1 = class(circle.Circle).new(10, 20, 5)
c1:move(50, 50)
```

OOP

```
class Color
  r: number
  g: number
  b: number

  ...
end

class ColoredCircle extends Circle
  color: Color

  constructor new(x: number, y: number, radius: number, color: Color)
    super.new(x, y, radius)
    self.color = color
  end
end
```

OOP

Interfaces

```
local love = require("love")
interface Drawable
    method draw: () => ()
end
class ColoredCircle extends Circle implements Drawable
    method draw()
        love.graphics.setColor(self.color.r, self.color.g, self.color.b)
        love.graphics.ciclr("fill", self.x, self.y, self.radius)
    end
end
```

Nominal vs. Structural

```
class Nominal1
  x: boolean
  constructor new(x: boolean) self.x = x end
end
class Nominal2
  x: boolean
  constructor new(x: boolean) self.x = x end
end
local function get_x_nominal(n: Nominal2): boolean
  return n.x
end
print(get_x_nominal(Nominal1.new(false))) -- not ok
```

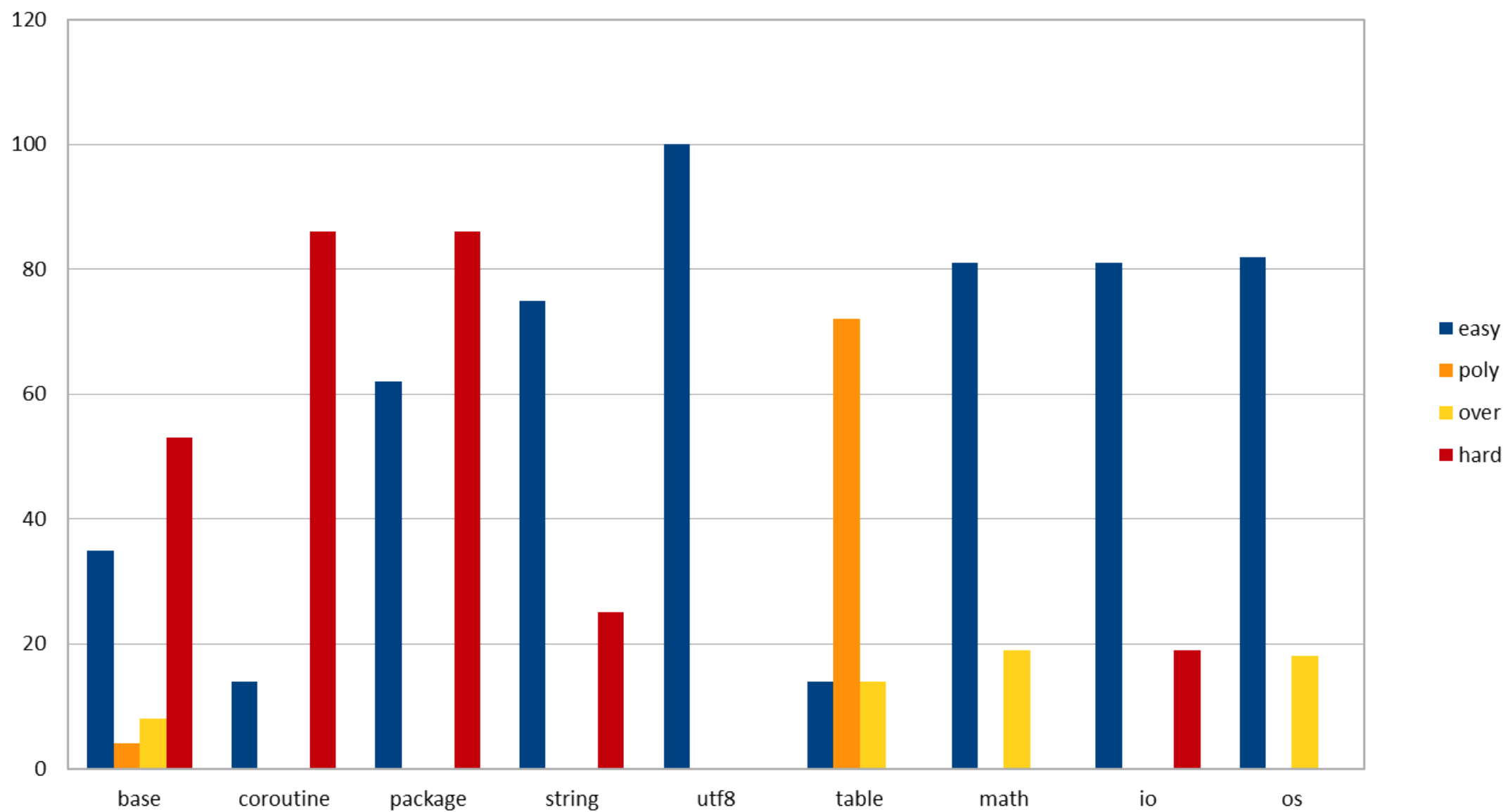
```
typedef Structural1 = {"x": boolean}
typedef Structural2 = {"x": boolean}
local function get_x_structural(s: Structural2): boolean
  return s.x
end
print(get_x_structural({ x = true })) -- ok
```

Generics

```
class Stack<T>
  contents: {T}
  constructor new() self.contents = {} end
  method push(x: T)
    self.contents[#self.contents + 1] = x
  end
  method pop(): T?
    local top = self.contents[#self.contents]
    self.contents[#self.contents] = nil
    return top
  end
end
local stack = Stack.new<string>()
stack.push("Good evening")
print(stack.pop())
```

Problems

- Lua is dynamic language and relies on it in runtime
- Some libraries hard or impossible type checked (ex. `coroutines`)
- Requires compilation



Problems

```
local is_even: (number) -> (boolean)
local is_odd: (number) -> (boolean)
function is_even (n: integer):boolean
  if (n == 0) then
    return true
  else
    return is_odd(n - 1)
  end
end
function is_odd (n: integer):boolean
  if (n == 0) then
    return false
  else
    return is_even(n - 1)
  end
end
print(is_even(8))
print(is_odd(8))
```


Alternatives

Teal

- superset of Lua too
- supports Lua ≥ 5.4
- active (last changes in `master` - 16/11/2024)
- better docs (than typedlua)
- adds more types of types

Teal

```
-- an enum: a set of accepted strings
local enum State
    "open"
    "closed"
end
-- a record: a table with a known set of fields
local record Point
    x: number
    y: number
end
-- an interface: an abstract record type
local interface Character
    sprite: Image
    position: Point
    kind: string
end
-- records can implement interfaces,
-- using a type-identifying `where` clause
local record Spaceship
    is Character
    where self.kind == "spaceship"

    weapon: Weapons
end
```

Teal

```
-- a record can also declare an array interface,  
-- making it double as a record and an array  
local record TreeNode<T>  
  is {TreeNode<T>}  
  
  item: T  
end  
local root: TreeNode<number> = {  
  item = 1,  
  {item = 2},  
  {item = 3, {item = 4}}  
}  
print(root[2][1].item)  
  
local record File  
  is userdata  
  
  status: function(): State  
  close: function(File): boolean, string  
end
```

Luau

- created and backed by Roblox Inc.
- superset of Lua 5.1 but not compatible with latest Lua
- adds other features as sandboxing and performance
- optional typing

```
type Point = {x: number, y: number}
```

```
local p: Point = {x = 1, y = 2}
```

```
print(p.x, p.y)
```