LabLua
programming language research

Introduction to Lua

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http://www.dcc.ufrj.br/~fabiom/lua

Lua is…

- ...an scripting language:
  - Robust, fast, portable, extensible, small, and open
- Lua is similar to other scripting languages such as Perl, Pyton, Ruby, and JavaScript
- We can also use Lua as a data description language, such as XML and JSON
- Finally, Lua is an *extensible extension language*, focusing on multi-language development

Lua in Games

- “It is easy to see why Lua is rapidly becoming the de facto standard for game scripting” - Artificial Intelligence for Games, Morgan Kaufmann, 2006.

- “It’s quite possible that game developers will look back at the 2000s as the decade of Lua” - Game Programming Gems 5, Charles River Media, 2005.

- “A TREMENDOUS amount of this game is written in Lua. The engine, including the Lua interpreter, is really just a small part of the finished product.” - Bret Mogilefsky, programador-chefe do jogo Grim Fandango.

- Lua is used by games in all platforms and genres: mobile, consoles, PCs, FPS, strategy, casual, MMORPGs…

Lua in Games


COMPANY OF HEROES
GRIM FANDANGO
Tap Tap Revenge
BLITZKRIEG
MONOPOLY TYCOON
DRIVER
WORLD WARCRAFT
FARCRY
NATURAL SELECTION 2
ANGRY BIRDS
PLAY
NAPOLEON
SUPREME
FABLE II
BRUTAL LEGEND
SIMCITY
SONIC
THE INCREDIBLES
CRYSIS
EMPIRE
TOTAL WAR
MONKEY ISLAND
CIVILIZATION
plus+
CRACKDOWN
HEROES V
Bubble
Ball

But not just games…

- Scripting and template language for *Wikipedia*
- Interactive applications on the Brazilian Digital TV standard (Ginga)
- Embedded software: printers (Olivetti, Océ), routers (Cisco), telephones and smartphones (several, including Huawei), smart tvs (Samsung), Logitech keyboards, Lego Mindstorms...
- Security: scripting vulnerability scanners (nmap, Wireshark, Snort)
- A million lines of Lua code makes the bulk of Adobe Photoshop Lightroom, and several other applications have Lua as a scripting language: VLC, Tex, vim, lighttpd, Apache, nginx…

Why use Lua?

- Portability
- Simplicity
- Small size
- Embeddability
- Efficiency

Portability

- Lua runs in practically all known platforms
  - Not just “famous” ones such as Windows, Linux, *BSD, OS X, Android, iOS, Windows Mobile, …
  - … but lots of embedded platforms that do not have even operating systems and run Lua on the “bare metal”
  - If it has a C cross-compiler and about 64Kb of free RAM, it can run Lua
- Lua is written in a common subset of C and C++, and the core of the language has very few dependencies on libc

Simplicity and small size

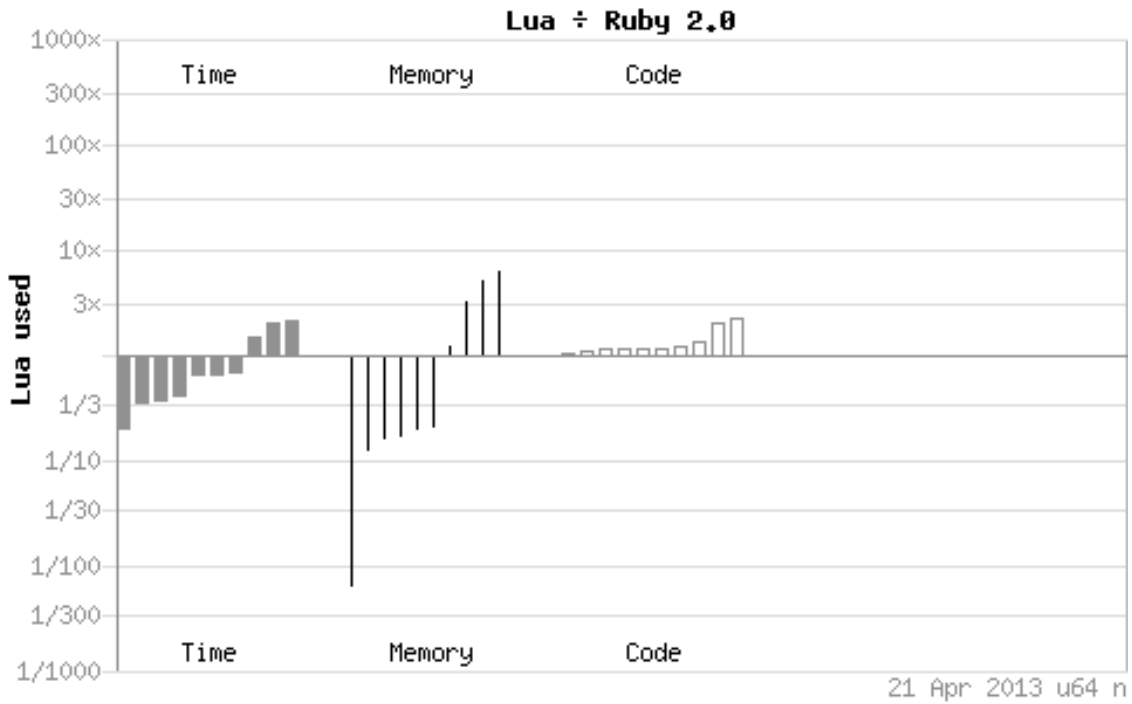
- Just a small set of powerful primitives
  - The reference manual, documenting the language, the C interface, and the standard library, has about 100 pages
  - Mechanisms instead of policies for higher-level features such as object orientation and concurrency
- Less than 200Kb of compiler code, of which less then 100Kb is the core, the rest is the optional standard library

Embeddability

- The Lua interpreter is a library for C programs
- The API for communication with C is simple and well-defined
- C programs have bi-directional communication, with Lua values going from the application to Lua and back with ease, and no marshalling
- Programs in other languages can easily consume the API, as long as the language can interface with C code: C++, Java, FORTRAN, C#, Pascal, Perl, Python...
    - Yes, even other scripting languages; a large application that embeds Lua for scripting is a version control system written in Python

Efficiency

- Independent benchmarks show Lua as the fastest language in the class of interpreted scripting languages



- An alternative implementation, LuaJIT, provides performance similar to *compiled* languages such as Java

How Lua started

- Lua was born in 1993 inside PUC-Rio, at the Tecgraf, PUC-Rio's Computer Graphics Laboratory
- Tecgraf needed an structured language that non-programmers could use for data description tasks
- The language needed to be portable, as Tecgraf had heterogeneous hardware, and needed to interface easily with C, as the applications were written in C
- Not many options at the time that fulfilled all prerequisites, so they decided to create their own language

Lua 1

- Lua 1.0 was implemented as a library, in less then 6000 lines of C

- “The simplest thing that could possibly work”: compiler used lex and yacc, simple stack based virtual machine, linked lists for associative arrays

- Some of the syntax still lives in the current version:

```
function track(t)
  if type(t.x) ~= "number" then
    print("invalid 'x' value")
  end
  if type(t.y) ~= "number" then
    print("invalid 'y' value")
  end
end
t1 = @track{ x = 10.3, y = 25.9, title = "depth" }
```

- Lua 1.1 just added a reference manual, and a cleaned-up C API

Lua 2

- From Lua 2.1 (February 1995) to Lua 2.5 (November 1996)
- Object oriented programming via delegation
- Pattern matching in the standard library
- Hooks for writing debuggers
- First users outside Tecgraf, with papers in *Software: Practice and Experience* and *Dr. Dobb's Journal*
- LucasArts begins using Lua in games

Lua 3

- From Lua 3.0 (September 1997) to Lua 3.2 (September de 1999)
- Anonymous functions and a restricted form of *closures* give better support for functional programming, which would mature in Lua 5
- Major refactoring in the source code
- The next version brings big changes to the C API, so some applications from this time still embed this version of Lua

Lua 4

- A single version, Lua 4.0, released on November 2000
- C API completely redone, using the stack model that we will see in this course
- An application can now have several independent instances of the Lua interpreter
- The standard library has been rewritten to use just the public C API, reinforcing the separation between the core and the standard libraries

Lua 5

- From Lua 5.0 (April 2003) to Lua 5.2, the current version, released December 2011
- Maturity of the language, and the release of the “Programming in Lua” book
- Several big changes: metatables, true lexical scope for anynonymous functions, the module system, coroutines, lexical environments…
- Changes in the implementation: more efficient register-based virtual machine, replacing the stack-based one, an incremental garbage collector for shorter pauses
- The implementation now has around 20.000 lines of code, 3x Lua 1.0

Lua today

- Current license is the MIT license, free for both non-commercial and commercial use
- Open language, but closed development: new releases are still the responsibility of the three original authors
- Big community participation in the lua-l mailing list and the lua-users wiki
- A package manager, LuaRocks, and alternative Lua implementations: LuaJIT, JVM, .NET, JavaScript...
- Several frameworks for developing mobile games: Corona, Gideros, Codea, MOAI...