An Overview of Lua

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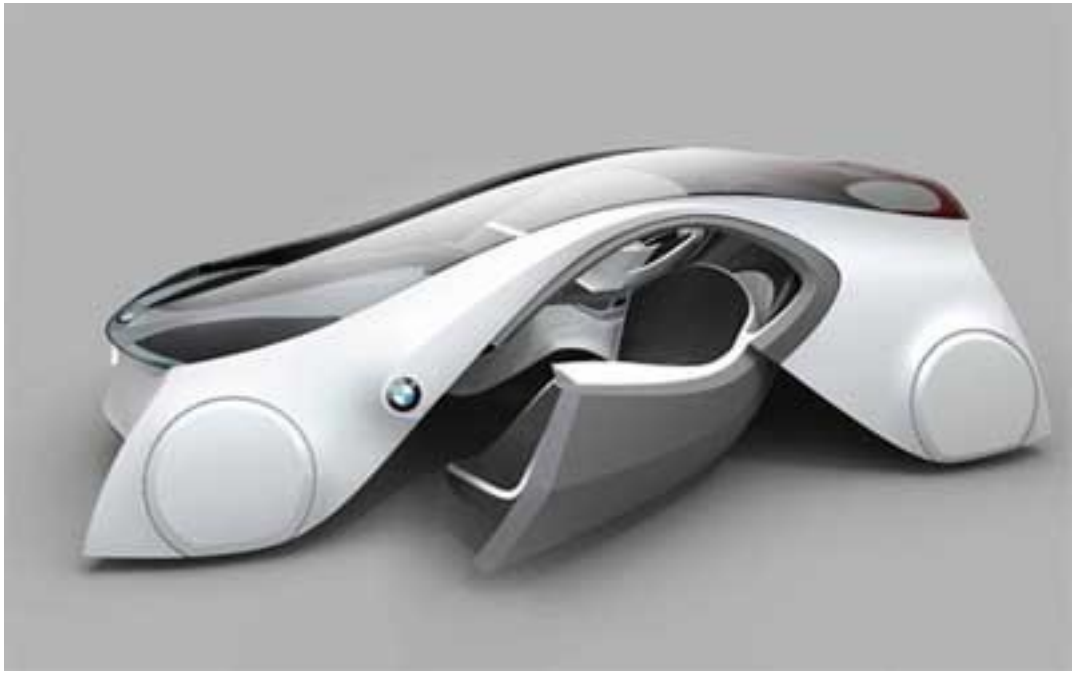
do Rio de Janeiro

http://perevodik.net/en/posts/39/

“If programming languages were cars”



“Haskell: How do I drive this thing? Despite being older than many languages on the list, Haskell is more modern in most ways.”

http://perevodik.net/en/posts/39/

“Lua: cute, efficient, and becoming very trendy.”

What is Lua?

- Yet another scripting language
  - a “dysfunctional language”?
- Not totally unlike Python, Ruby, Perl, etc.

Where is Lua?

- Scripting of applications
- Strong niche in games
- Strong niche in embedded devices

Scripting

Nmap, Snort, Wireshark, LuaTeX, Flame, VLC Media Player, Adobe Lightroom, ...

- Slashdot, Feb 1, 2012: "*Wikipedia Chooses Lua As Its New Template Language*"

- Wired, March 19, 2013: "*Meet Wikipedia, the Encyclopedia Anyone Can Code*"

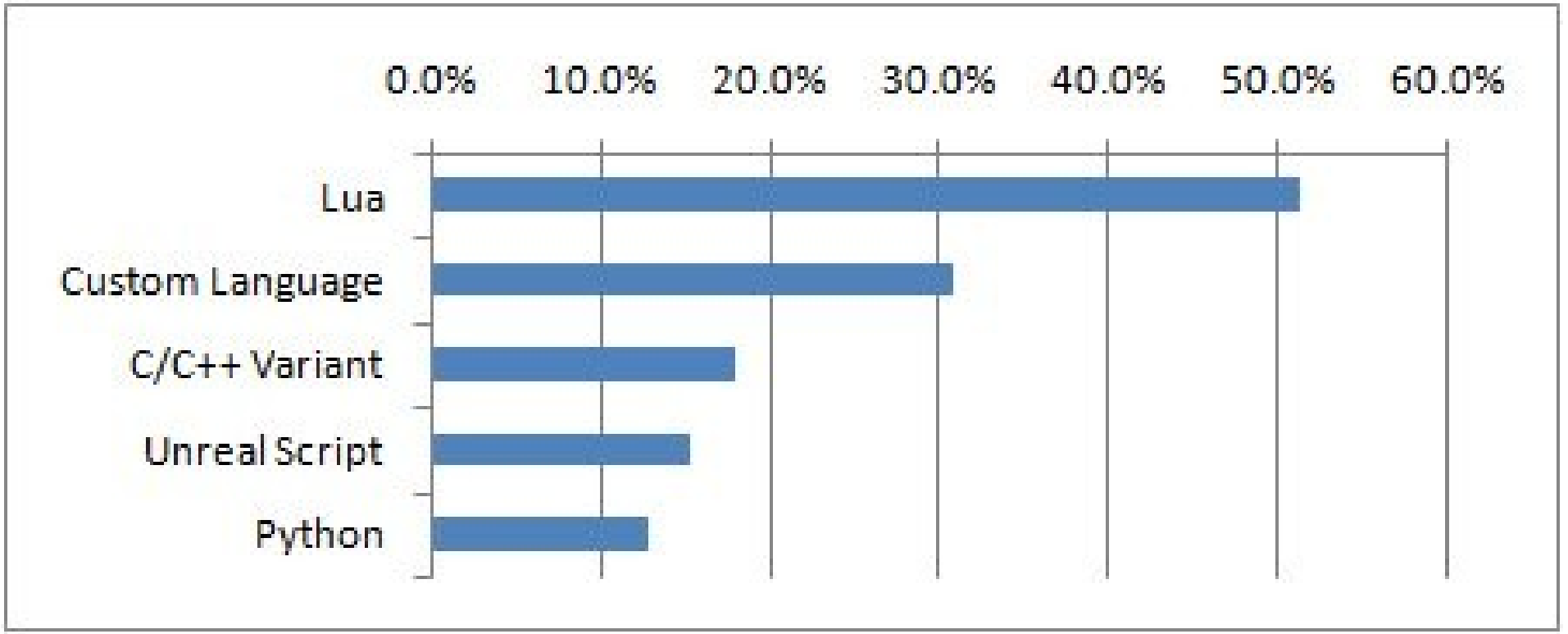
"*As of this weekend, anyone on Earth can use Lua [...] to build material on Wikipedia and its many sister sites, such as Wikiquote and Wiktionary.*"

Wikipedia: Example

```
{{chess diagram-fen
|fen=r3r1k1/1bqn1p1p/ppnpp1p1/6P1/P2NPP2/2N4R/
1PP2QBP/5R1K
}}
```

Lua in Games

- The Engine Survey (Mark DeLoura, 03/02/09,Gamasutra)
- What script languages are most people using?

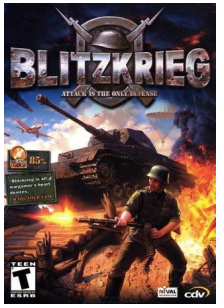



Games for Windows
COMPANY of HEROES
relic
THQ


Games for Windows
UNIVERSE AT WAR
SEGA


Games for Windows
DUNGEONS
kalypso


Tap Tap
Revenge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ATTACK IS THE ONLY DEFENSE
TEEN
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MONOPOLY
TYCOON
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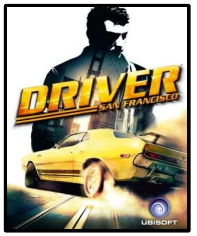
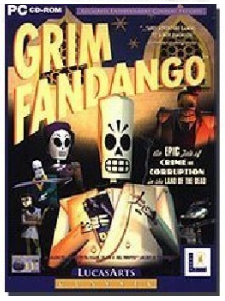

DRIVER
SAN FRANCISCO
UBISOFT


RōBLOX


Games for Windows
PC DVD
The Lord of the Rings
Online
Shadows of Angmar
PC


REQUIEM
MEMENTO MORI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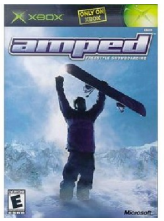
GRIM FANDANGO
LUCASARTS


XBOX
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Microsoft


XBOX 360
THE INCREDIBLE HULK
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PlayStation.2
DESTROY ALL HUMANS!
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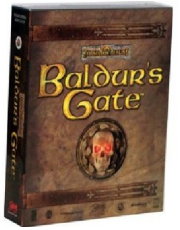
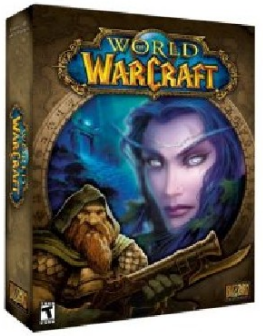
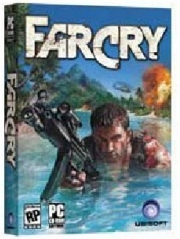
THQ


Baldur's Gate


RAIL SIMULATOR
EA


WORLD of WARCRAFT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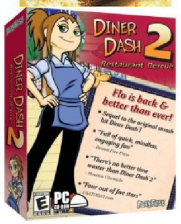
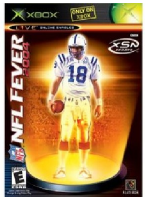

PlayStation.2
DINER DASH 2
Restaurant Rescue
Flo is back & better than ever!
E
PC


Blossom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NFL FEVER
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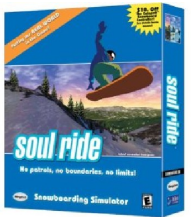
soul ride
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NATURAL SELECTION 2


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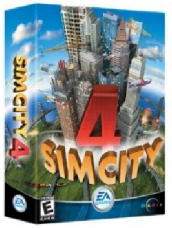
There


BRÜTAL LEGEND
EA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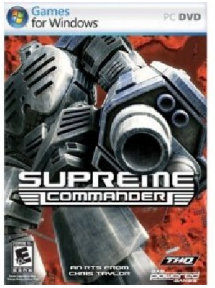
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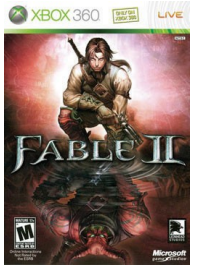
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XBOX 360
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SONIC
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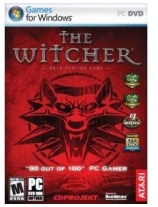
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PC DVD
DAWN of WAR
DARK CRUSADE
THQ

PC DVD
YOU ARE EMPTY
16+

Bubble
Ball

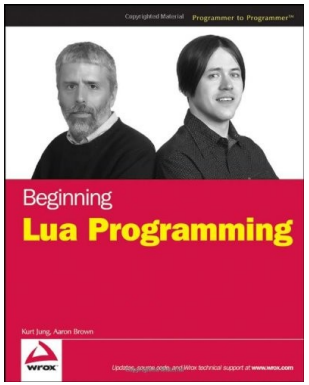
Embedded Systems

Samsung (TVs), Cisco (routers), Logitech (keyboards), Olivetti (printers), Océ (printers), Ginga (Brazilian TV middleware), Verison (set-top boxes), Texas Instruments (calculators Nspire), Huawei (cell phones), Sierra Wireless (M2M devices), …

Scripting the Internet of Things

November 2011: Sierra Wireless, IBM, Eurotech, and the Eclipse Foundation establish an M2M Industry Working Group to ease the development, testing, and deployment of machine-to-machine solutions.

Books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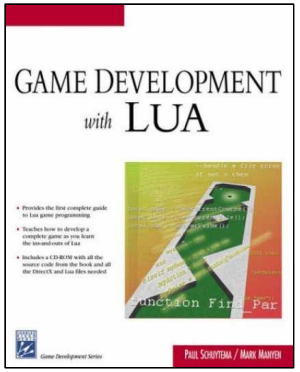
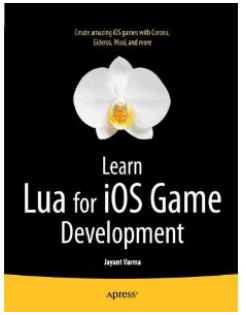

GAME DEVELOPMENT
with LUA
PAUL SCHUYTEMA / MARK MANYEN


スクリプト言語による
効率的ゲーム開発
C/C++へのLua組込み実践
GAME DEVELOPER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Learn by doing: less theory, more results
Corona SDK Mobile Game Development
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Beginner's Guide
Michelle M. Fernandez


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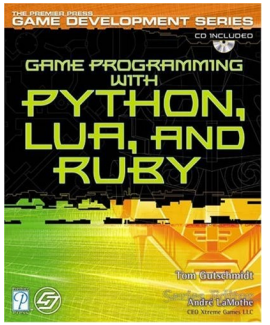
PROGRAMMING LUA
IN MINECRAFT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Lua
The Programming Language


はじめての
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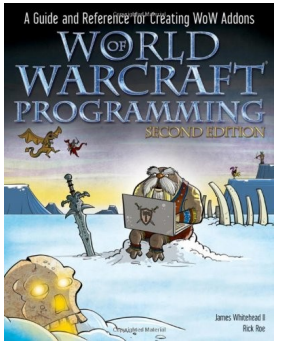
[ルア]
プログラミング
清水 美樹


D-BOOKER
LE GUIDE DE LUA
ET SES APPLICATIONS
Lua


A Guide and Reference for Creating WoW Addons
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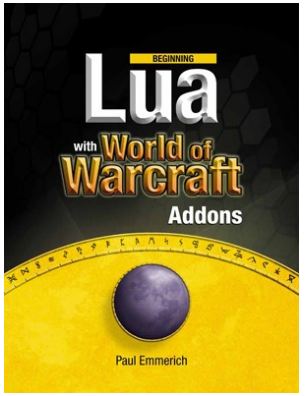
SECOND EDITION
James Whitehead II
Rick Roe


Basic
ROBLOX
Lua
Programming
By: Brandon LaRouche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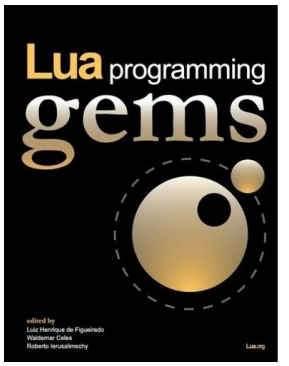
Lua
with World of Warcraft
Addons
Paul Emmerich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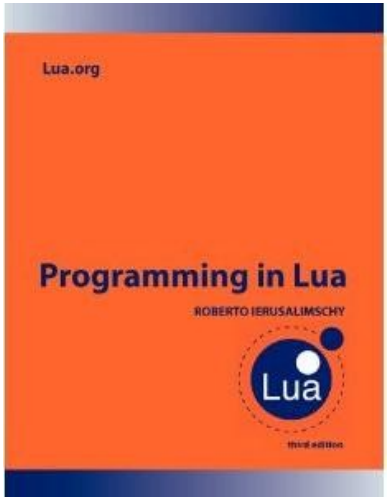
Lua.org
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Lua


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mit Lua
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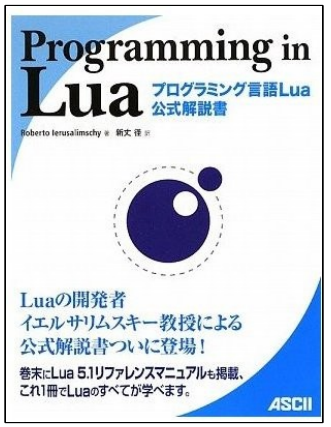
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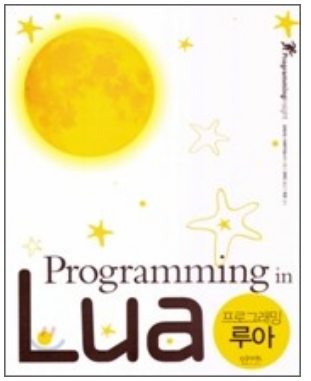
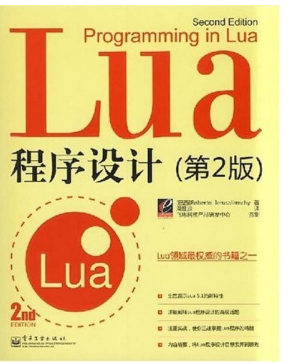
プログラミング言語Lua
公式解説書
Roberto Ierusalimschy
Luaの開発者
イエルサリムスキー教授による
公式解説書ついに登場！
巻末にLua 5.1リファレンスマニュアルも掲載、
これ1冊でLuaのすべてが学べます。
ASCII


Programming in
Lua
프로그래밍
루아


Second Edition
Programming in Lua
Lua
程序设计（第2版）
Lua
2nd

Why Lua?

- Embedability
- Portability
- Small size
- Simplicity

Embedability

- Emphasis on *scripting*
  - to be used together with a *system language*
  - *tight integration between languages*
  - by-directional communication
- Not only an implementation issue
  - big impact on language design
- Embedded in C/C++, Java, Fortran, C#, Perl, Ruby, Python, etc.

Scripting in Grim Fandango

“[The engine] doesn't know anything about adventure games, or talking, or puzzles, or anything else that makes Grim Fandango the game it is. It just knows how to render a set from data that it's loaded and draw characters in that set. […]
The real heroes in the development of Grim Fandango were the scripters. They wrote everything from how to respond to the controls to dialogs to camera scripts to door scripts to the in-game menus and options screens. […]
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

Portability

- Written in ANSI C ∩ ANSI C++
  - avoids `#ifdef's`
  - avoids dark corners of the C standard
- Runs on most platforms we ever heard of
  - iOS, Android, PS3, PSP, Nintendo DS, IBM z/OS, Arduino boards, embedded hardware, etc.
- Runs on bare metal
  - eLua

Small size

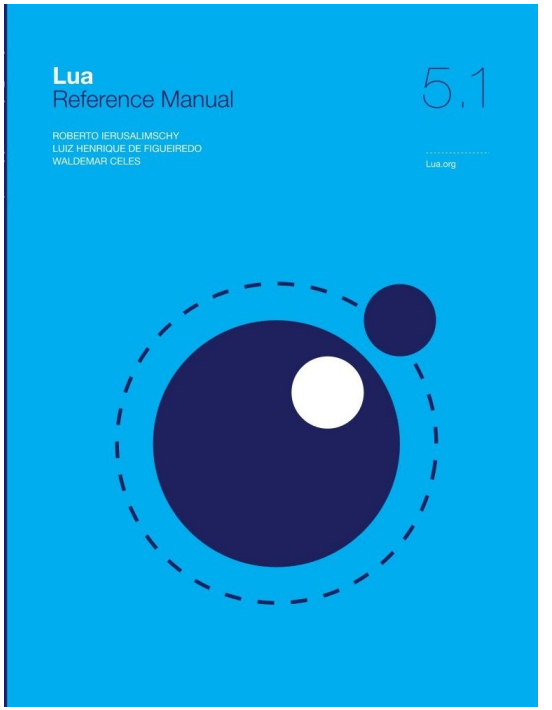
- Less than 20,000 lines of C code
- ELF binary: less than 200 KB
  - complete package
- Important for portability
  - allows Lua to run in small machines

Simplicity

Reference manual with 100 pages (proxy for complexity)

documents language, libraries, and C API

(spine)



How is Lua?

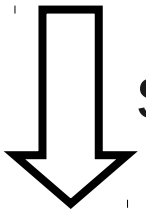
- Conventional syntax
  - somewhat verbose (end-user programming)

```
function fact (n)
  if n == 0 then
    return 1
  else
    return n * fact(n - 1)
  end
end
```

```
function fact (n)
  local f = 1
  for i=2,n do
    f = f * i
  end
  return f
end
```

BTW...

```
function fact (n)
  local f = 1
  for i=2,n do f = f * i; end
  return f
end
```



syntactic sugar

```
fact = function (n)
         local f = 1
         for i=2,n do f = f * i; end
         return f
       end
```

How is Lua?

- semantically somewhat similar to Scheme
- similar to JavaScript, too
  - Lua predates JS by two years
- functions are first-class values with static scoping
- proper tail recursive
- co-routines
  - equivalent to one-shot continuations (`call/1cc`)

Tables

- associative arrays
  - any value to any value
- only data-structure mechanism in Lua
- tables implement most data structures in a simple and efficient way
- records: syntactical sugar `t.x` for `t["x"]`
- arrays: integers as indices
- sets: elements as indices

Modules

- Tables populated with functions

```
local math = require "math"
print(math.sqrt(10))
```

- Several facilities come for free
  - submodules
  - local names

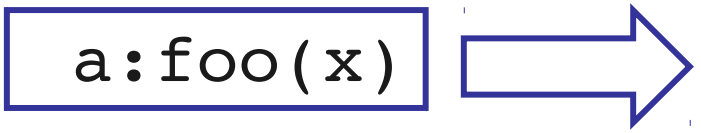
Objects

- first-class functions + tables ≈ objects
- + syntactical sugar for methods (to handle self) + delegation

Objects

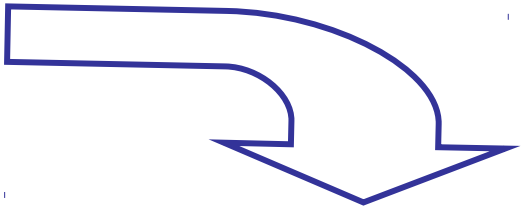
- first-class functions + tables ≈ objects
- syntactical sugar for methods
  - handles self

```
a:foo(x)
```



```
a.foo(a,x)
```

```
function a:foo (x)
  ...
end
```

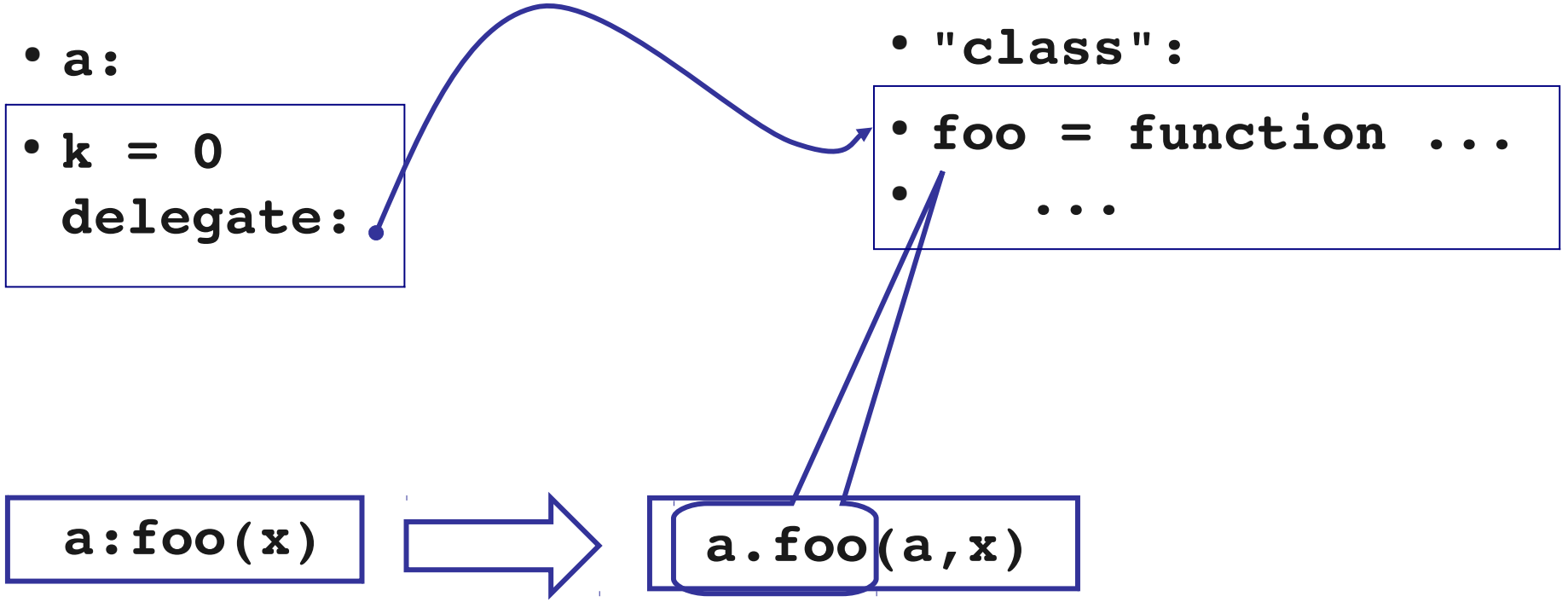


```
a.foo = function (self,x)
  ...
end
```

Delegation

- field-access delegation (instead of method-call delegation)
- when a delegates to b, any field absent in a is got from b
  - `a[k]` becomes `(a[k] or b[k])`
- allows prototype-based and class-based objects
- allows single inheritance

Delegation at work



Coroutines

- old and well-established concept, but with several variations
- variations not equivalent
  - several languages implement restricted forms of coroutines that are not equivalent to one-shot continuations

Coroutines in Lua

```
c = coroutine.create(function ()
      print(1)
      coroutine.yield()
      print(2)
    end)

coroutine.resume(c)  --> 1
coroutine.resume(c)  --> 2
```

Coroutines in Lua

- first-class values
  - in particular, we may invoke a coroutine from any point in a program
- *stackful*
  - a coroutine can transfer control from inside any number of function calls
- asymmetrical
  - different commands to resume and to yield

Coroutines in Lua

- simple and efficient implementation
  - the easy part of multithreading
- first class + stackful = complete coroutines
  - equivalent to one-shot continuations
  - we can implement call/1cc
- coroutines present one-shot continuations in a format that is more familiar to most programmers

Asymmetric coroutines

- asymmetric and symmetric coroutines are equivalent
- not when there are different kinds of contexts
  - integration with C
- how to do a **`transfer`** with C activation records in the stack?
- **`resume`** fits naturally in the C API

Coroutines x continuations

- most uses of continuations can be coded with coroutines
  - “who has the main loop” problem
    - producer-consumer
    - extending x embedding
  - iterators x generators
    - the same-fringe problem
  - collaborative multithreading

So, What About Lua?

- Emphasis on scripting
- Small and simple
- Leading scripting language in games
- Very popular in embedded devices
- Several other big applications
- Virtually unknown in some circles
  - both games and embedding have some cultural barriers
  - not a “Web language”?

Escape from Monkey Island (2000)