Learn Lua in $\mathcal{X}$ minutes

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What is Lua

- Yet another dynamic language
  - not totally unlike Perl, Python, Tcl
- A scripting language
  - emphasis in inter-language communication
- Particular set of goals:
  - embedability
  - portability
  - simplicity
  - small size

Embedability

- Provided as a library
- Simple API
  - simple types
  - low-level operations
  - stack model
- Embedded in C/C++, Java, Fortran, C#, Perl, Ruby, Ada, etc.

Portability

- Runs on most machines we ever heard of
  - Unix, Windows, Windows CE, Symbian, embedded hardware, Palm, Sony PSP, etc.
- Written in ANSI C ∩ ANSI C++
  - avoids `#ifdefs`
  - avoids dark corners of the standard

Simplicity

- Just one data structure
  - tables
- Complete manual with 100 pages
- Mechanisms instead of policies

Small Size

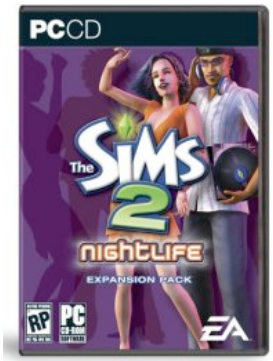
- Less than 200K
  - less than 20K lines of C code
- Core + libraries
  - clear interface
  - core has less than 100K
  - easy to remove libraries

Lua is also quite Efficient

- Several independent benchmarks show Lua as the most efficient in the realm of dynamically-typed interpreted languages
- Efficient in real code, too
- Smart implementation
  - register-based virtual machine
  - novel algorithm for tables
  - small and simple (!)

Uses of Lua

- Embedded systems
  - internet switches, robots, keyboards (Logitech G15), LCDs
- Scripting
  - Metaplace, nmap, Wireshark, Snort
- Programming
  - Adobe Photoshop Ligthroom
- Niche in games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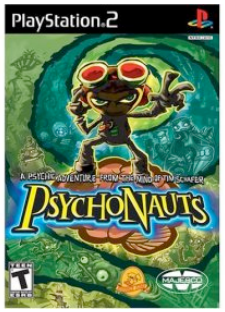
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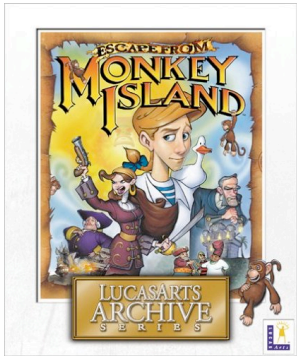
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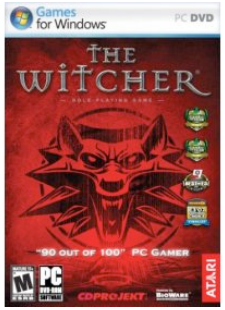
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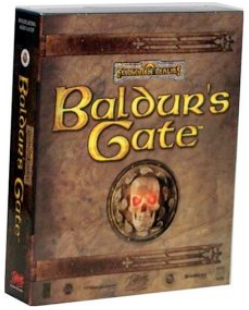
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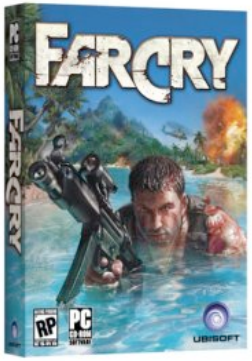
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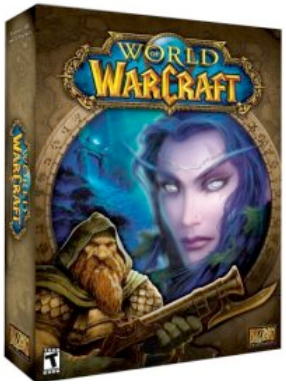
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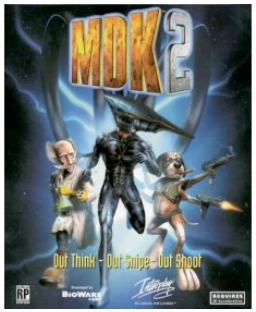
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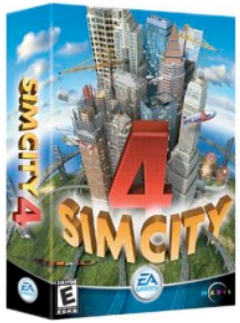
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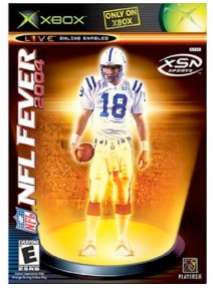
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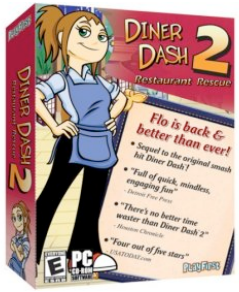
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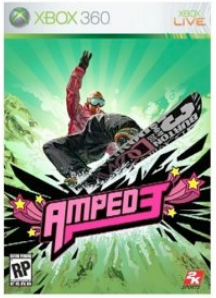
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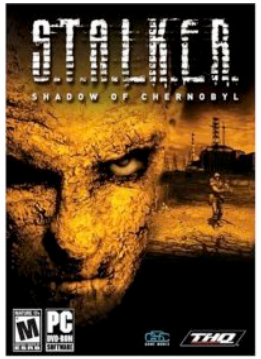
STALKER
SHADOW OF CHERNOBYL
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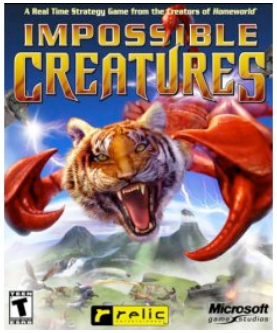

A Real Time Strategy Game from the Creators of Homeworld
IMPOSSIBLE CREATURES
relic
Microsoft

How Is Lua

- Conventional syntax

```
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
```

Tables

- Associative arrays
  - any value as key
- Variables store references to tables, not tables
- Only data-structuring mechanism
  - easily implements arrays, records, sets, etc.

Table Constructors

- Syntax to create tables

```
{}
{x = 5, y = 10}
{“Sun”, “Mon”, “Tue”}
{10, 20, 30, n = 3}
{["+"] = "add", ["-"] = "sub"}

{{x=10.5, y=13.4},
 {x=12.4, y=13.4},
  ... }
```

Data Structures

- Tables implement most data structures in a simple and efficient way
- records: syntactical sugar `t.x` for `t["x"]`:

```
t = {}
t.x = 10
t.y = 20
print(t.x, t.y)
print(t["x"], t["y"])
```

Data Structures (2)

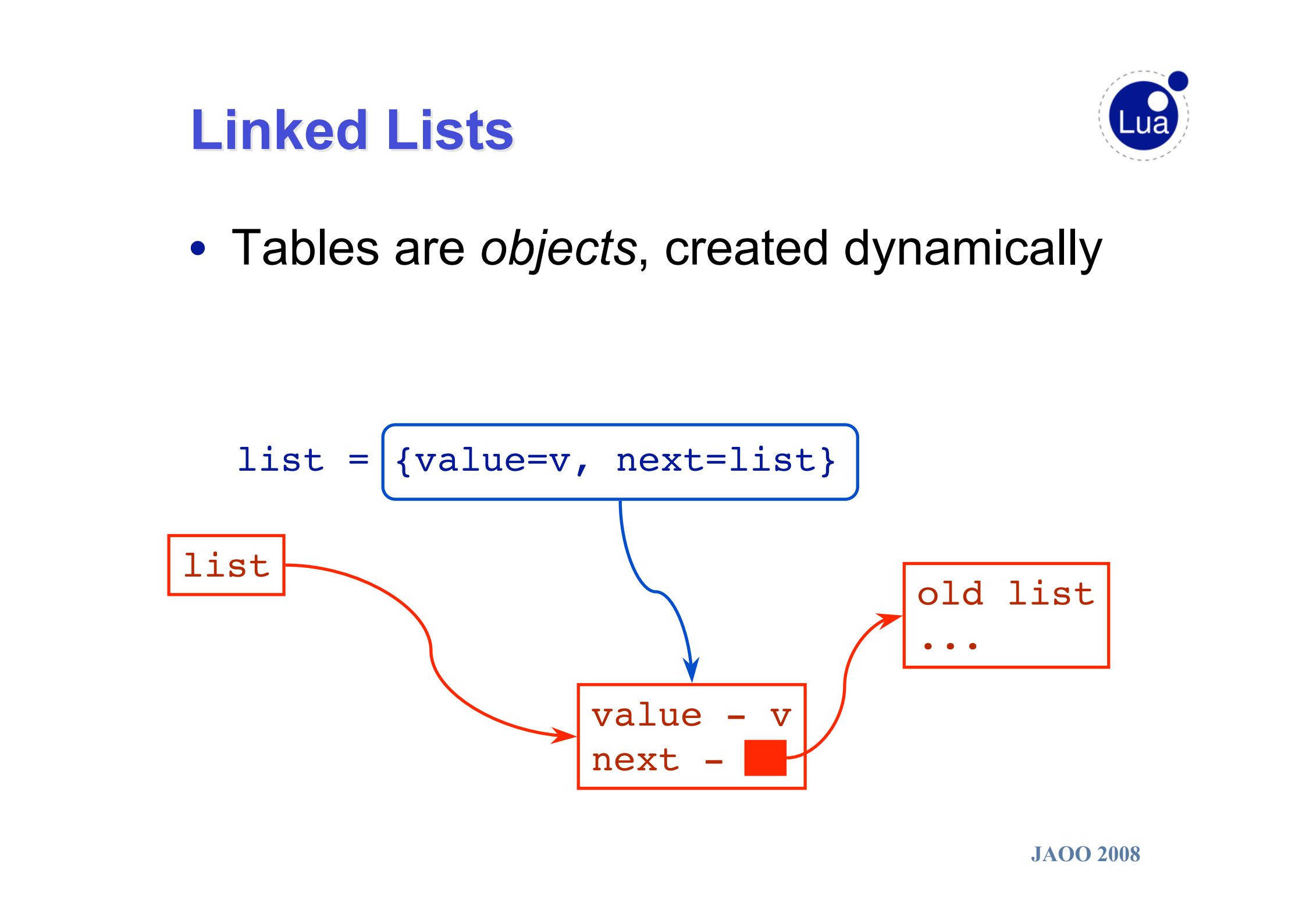
- Arrays: integers as indices

```
a = {}
for i=1,n do a[i] = 0 end
a[1000000000] = 1
```

- Sets: elements as indices

```
t = {}
t[x] = true      -- t = t ∪ {x}
if t[x] then     -- x ∈ t?
  ...
```

Linked Lists



- Tables are *objects*, created dynamically

Data Description


```
book{
  author = "F. P. Brooks",
  title = "The Mythical Man-Month",
  year = 1975
}

book{
  author = "Brian Kernighan & Rob Pike",
  title = "The Practice of Programming",
  year = 1999
}

...
```

Functions

- First-class Values

```
function inc (x)
  return x+1
end
```

sugar

```
inc = function (x)
        return x+1
      end
```

- Multiple returns

```
function f()
  return 1, 2
end
```

```
a, b = f()
print(f())
{f()}
```

Functions

- Lexical Scoping

```
function newcounter (x)
  return funcion ()
           x = x + 1
           return x
         end
end

c1 = newcounter(10)
c2 = newcounter(20)
print(c1()) --> 11
print(c2()) --> 21
print(c1()) --> 12
```

Modules

- Tables populated with functions

```
require “math”
print(math.sqrt(10))
print(type(math))         --> table
print(type(math.sqrt))    --> function
```

Modules as Tables

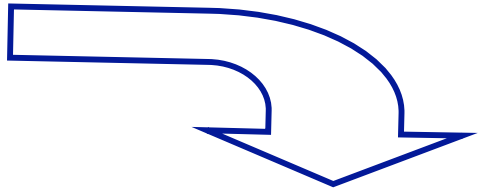
- Several facilities come for free
  - submodules
  - local names

```
local m = require “math”
print(m.sqrt(20))
local f = m.sqrt
print(f(10))
```

Objects

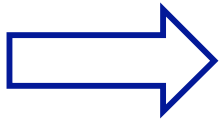
- First-class functions + tables ≈ objects
- Syntactical sugar for methods
  - handles *self*

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



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

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



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

Objects: Example


```
point = {x = 10, y = 0}
function point:move (dx, dy)
  self.x = self.x + dx
  self.y = self.y + dy
end

point:move(5, 5)
print(point.x, point.y)

point.move(point, 4, 2)
print(point.x, point.y)
```

Delegation

- When table *a* delegates from table *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

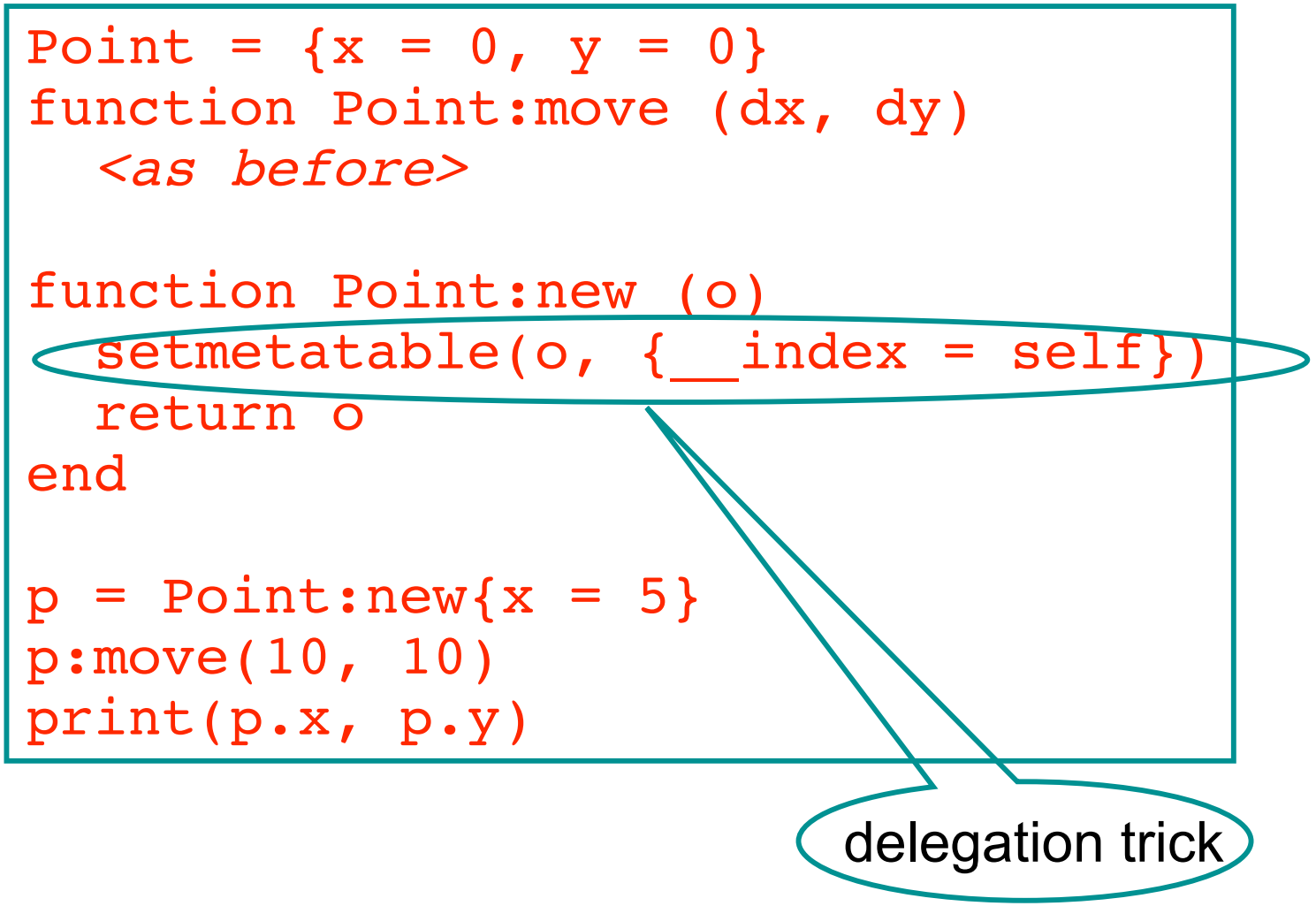
Delegation in Lua: example


```
Point = {x = 0, y = 0}
function Point:move (dx, dy)
  <as before>

function Point:new (o)
  setmetatable(o, {__index = self})
  return o
end

p = Point:new{x = 5}
p:move(10, 10)
print(p.x, p.y)
```

Delegation in Lua: example



Active Delegation

- When *a* delegates from a function *b*, any field absent in *a* is got from calling *b*
  - `a[k]` becomes `a[k] or b(a,k)`
- Allows all kinds of inheritance
- Also implements proxies and similar structures

Coroutines

- Lua implements asymmetric, first-class, “stackfull” coroutines
- (We can implement `call/cc` on top of them)
- We can implement cooperative (non-preemptive) multithreading on top of them

Reflexive Facilities

- Introspection
  - function `type`
  - table traversal

```
function clone (t)
  local new = {}
  for k,v in pairs(t) do
    new[k] = v
  end
  return new
end
```

- Access to global table

```
for n in pairs(_G) do
  print(n)
end
```

Reflexive Facilities (2)

- Dynamic calls

```
t[1] = a; t[2] = b;
f(unpack(t))
```

- Debug interface
  - execution stack
  - local variables
  - current line

Lua-C API

- Reentrant library
- Impedance mismatch:
  - dynamic x static typing
  - automatic x manual memory management
- Uses a stack for inter-language communication

Lua-C API (2)

- Load Lua code
  - in files, strings, etc.
- Call Lua functions
- Manipulate Lua data
- Register of C functions to be called by Lua code

Basic Lua Interpreter


```
#include <lua.h>
#include <lauxlib.h>
#include <lualib.h>

int main (int argc, char **argv) {
  lua_State *L = luaL_newstate();
  luaL_openlibs(L);
  luaL_loadfile(L, argv[1]);
  lua_call(L, 0, 0);
  lua_close(L);
  return 0;
}
```

Communication Lua - C

- All data exchange through a stack of Lua values

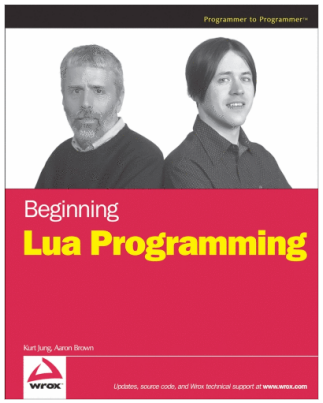
```
/* calling f("hello", 4.5) */
lua_getglobal(L, "f");
lua_pushstring(L, "hello");
lua_pushnumber(L, 4.5);
lua_call(L, 2, 1);
if (lua_isnumber(L, -1))
  printf("%f\n", lua_getnumber(L, -1));
```

C Functions

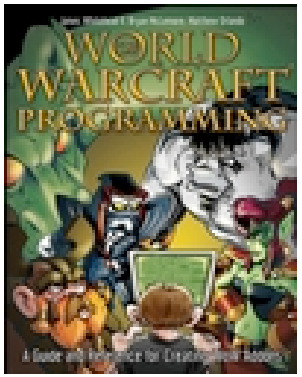

```
static int l_sqrt (lua_State *L) {
  double n = luaL_checknumber(L, 1);
  lua_pushnumber(L, sqrt(n));
  return 1;  /* number of results */
}
```

```
lua_pushcfunction(L, l_sqrt);
lua_setglobal(L, "sqrt");
```

Books



Beginning Lua Programming
Wrox, 2007



World of Warcraft Programming
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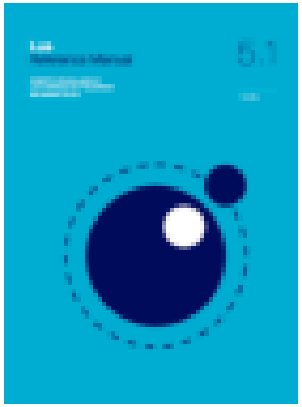

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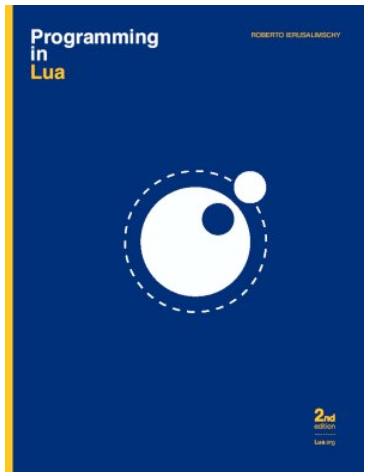

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PHEI, 2008

프로그래밍 루아
Insight, 2007

To Know More...

www.lua.org