

# Languages Implementation with Parrot

## A study case: Lua on Parrot

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# Languages in Parrot

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- today, more than 50
  - see `languages/LANGUAGES_STATUS.pod`
- PIR generators (`antlr`, `yapp`, `yacc`, ...)
  - `jako`, `basic`, `PJS`
- PIR generators written with PIR
  - `TCL`, `Python`, `Ruby`, `Perl`, `PHP`, `Lua`
- Bytecode Translators
  - `dotnet`, `WMLScript`
- Obfuscated
  - `bf`, `befunge`, `ook`

# Parrot Compiler Toolkit

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- Patrick R. Michaud
  - See his presentation at YAPC::NA2007
- Parser Grammar Engine
- Tree Grammar Engine
- Parrot Abstract Syntax Tree
  - *Node*, *Op*, *Val*, *Var*, *Stmts*, *Block*
- Parrot Opcode Syntax Tree
  - *Node*, *Ops*, *Op*, *Label*, *Sub*
- HLLCompiler

# Why choose Lua

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- Prove the design goal :  
« supports all dynamic languages »
- Lua has advanced features
- Lua is small & simple
- A good way to learn Lua

# Lua

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- Academic origin (1993, Brazil)
- Open Source
  - but Closed Development
- Often embedded into applications
- Widely used in Game industry
- [www.lua.org](http://www.lua.org)

# Lua features

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- function as first class
- exception (as library)
- closure
- coroutine (as library)
- iterator
- regex (with its own dialect)
- some OO mechanisms
- tail call

# Lua is small

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- 8 types
  - nil, boolean, number, string, function, userdata, thread, table
- 21 keywords
  - No builtin function,
  - only standard libraries
- Grammar EBNF
  - 1 page
- Reference Manual
  - < 100 pages

# Lua On Parrot

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- Native PMC
- Tests
- Compiler based on Parse::Yapp
- Lua Standard Libraries
- Interpreter based on PGE/TGE



# Lua PMC

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- Native implementation of all Lua types
  - As a shared library or a DLL
- Preprocessed C dialect
  - VTABLE methods
  - Non-VTABLE methods
  - Specifics methods

- Allows in PIR :

```
.HLL 'Lua', 'lua_group'
```

```
.local pmc MyStr
```

```
new MyStr, 'LuaString'
```

```
set MyStr, 'Some text'
```

# Lua PMC

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```
pmclass LuaNumber extends LuaAny does float
    dynpmc group lua_group hll Lua maps Float {

    void init() {
        PMC_num_val(SELF) = 0.0;
    }

    STRING* name() {
        return const_string(INTERP, "number");
    }

    void increment() {
        PMC_num_val(SELF) ++;
    }
}
```

# Lua PMC

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```
    INTVAL cmp(PMC* value) {
MMD_LuaNumber: {
    FLOATVAL diff;
    diff = PMC_num_val(SELF) - PMC_num_val(value);
    return diff > 0 ? 1 : diff < 0 ? -1 : 0;
}
MMD_DEFAULT: {
    real_exception(INTERP, NULL, ILL_INHERIT,
        "attempt to compare number with %s",
        string_to_cstring(INTERP, VTABLE_name(INTERP, value)));
    return 0;
}
}
```

# Lua Tests

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- as part of smoke test
  - make languages-smoke
  - <http://smoke.parrotcode.org/smoke/>
- a framework from Perl
  - use Test::More;
  - pir\_output\_is, pir\_output\_like, ...
  - language\_output\_is, language\_output\_like
- Test Driven Development
- today, Lua has more than 970 tests

# Lua Tests

---

```
# file: examples.t
...
language_output_is('lua', <<'CODE', <<'OUT', 'factorial');
function factorial (n)
    if n == 0 then
        return 1
    else
        return n * factorial(n-1)
    end
end

print(factorial(7))
CODE
5040
OUT
```

# luac.pl with Parse::Yapp

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- PGE was not available at this time
- Yapp is a good tool
- Split complexity
  - What PIR needed by Lua
  - How generate it

# Lua Standard Libraries

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- 9 libraries written in PIR:
  - basic (24/25), coroutine (6/6), package (3/4), string (13/14), table (8/8), math (28/28), IO (17/18), OS (11/11), debug (7/14)
- More complex functions are :
  - Eval,
  - Exception,
  - Regex (extends PGE)
- A huge work

# Lua Standard Libraries

---

```
=item C<string.len (s)>
```

Receives a string and returns its length.

```
=cut
```

```
.sub 'len' :anon
  .param pmc s :optional
  .param pmc extra :slurpy
  .local pmc res
  $S1 = lua_checkstring(1, s)
  $I0 = length $S1
  new res, 'LuaNumber'
  set res, $I0
  .return (res)
.end
```



# Lua on Parrot

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- PGE
  - Lua grammar + optable : src/lua51.pg
- TGE
  - PAST-pm : src/PASTGrammar.tg
  - POST : src/POSTGrammar.tg
- HLLCompiler
  - Lua::Compiler + Utils : src/lua51.pir
- Standalone interpreter
  - Entry point : lua.pir
  - A single PBC : lua.pbc
- PIR generation & execution

# Lua on Parrot

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- A lexicography test : test\_lex.pir
- luap.pir -target=PARSE|PAST|POST|PIR

```
.sub 'main' :main
    .param pmc args
    load_bytecode 'languages/lua/lua.pbc'
    $P0 = compreg 'Lua'
    $S0 = "Compiler Lua 5.1 on Parrot"
    $P0.commandline_banner($S0)
    $P0.command_line(args)
.end
```

# Lua – Parse

```
"parse" => PMC 'Lua::Grammar' => "print \"Hello world!\"\\r\\n" @ 0 {
  <block> => PMC 'Lua::Grammar' => "print \"Hello world!\"\\r\\n" @ 0 {
    <statement> => ResizablePMCArray (size:1) [
      PMC 'Lua::Grammar' => "print \"Hello world!\"\\r\\n" @ 0 {
        <expression_stat> => PMC 'Lua::Grammar' => "print \"Hello world!\"\\r\\n" @ 0 {
          <primary_expression> => PMC 'Lua::Grammar' => "print \"Hello world!\"\\r\\n" @ 0 {
            <prefix_expression> => PMC 'Lua::Grammar' => "print " @ 0 {
              <Name> => PMC 'Lua::Grammar' => "print" @ 0
            }
          <slice_expression> => ResizablePMCArray (size:1) [
            PMC 'Lua::Grammar' => "\"Hello world!\"\\r\\n" @ 6 {
              <function_args> => PMC 'Lua::Grammar' => "\"Hello world!\"\\r\\n" @ 6 {
                <string> => PMC 'Lua::Grammar' => "\"Hello world!\"" @ 6 {
                  <quoted_literal> => PMC 'Lua::Grammar' => "Hello world!" @ 7
                }
              }
            }
          ]
        }
      }
    ]
  }
}
```

# Lua – PAST

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```
"past" => PMC 'PAST::Block' {
  [0] => PMC 'PAST::Var' {
    <name> => "vararg"
    <scope> => "parameter"
    <isslurpy> => 1
  }
  [1] => PMC 'PAST::Stmts' {
    [0] => PMC 'PAST::Op' {
      <pasttype> => "call"
      [0] => PMC 'PAST::Var' {
        <name> => "print"
        <scope> => "package"
      }
      [1] => PMC 'PAST::Val' {
        <vtype> => "LuaString"
        <name> => "Hello world!"
      }
    }
  }
}
```

# Lua - PIR

---

```
.HLL "Lua", "lua_group"

.sub "&start" :anon :main
...
.end

.sub "&main_10" :outer("&start") :anon :lex
.param pmc vararg :slurpy
.const .LuaString k_print = "print"
.local pmc subr
subr = interpinfo .INTERPINFO_CURRENT_SUB
$P11 = subr.getfenv()
set $P12, $P11[k_print]
new $P13, "LuaString"
set $P13, "Hello world!"
$P12($P13)
.end
```

# Status of Lua on Parrot

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- Garbage Collection problems
  - performance
- Parrot IO & OS subsystems are incomplete
- Next step : shift to PCT
  
- See `languages/lua/doc/status.pod`

# Feedback to Parrot

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- Lua on Parrot is successful
- Tool effectiveness
  - Only 4 kLoC
- Learning curve challenge

# Back to Perl6 / Parrot

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- Conditions of success
  - Language Perl6 : **OK**
  - Parrot Core VM : **OK**
  - Parrot Compiler Toolkit : **OK**
  - Wrapper Toolkit
    - NCI is better than Perl XS
    - The state of the art : Python pyrex & ctype
  - Distributed Computing
    - ~ Java RMI