Next Ruby

Crafting a new ideal language with DSL and ruby-next

Ruby dev team goals

- Performance (JIT)
- Concurrency (Ractors)
- Typing (RBS)

Definitely YES

HR inbox

Are you ready to drop Ruby?

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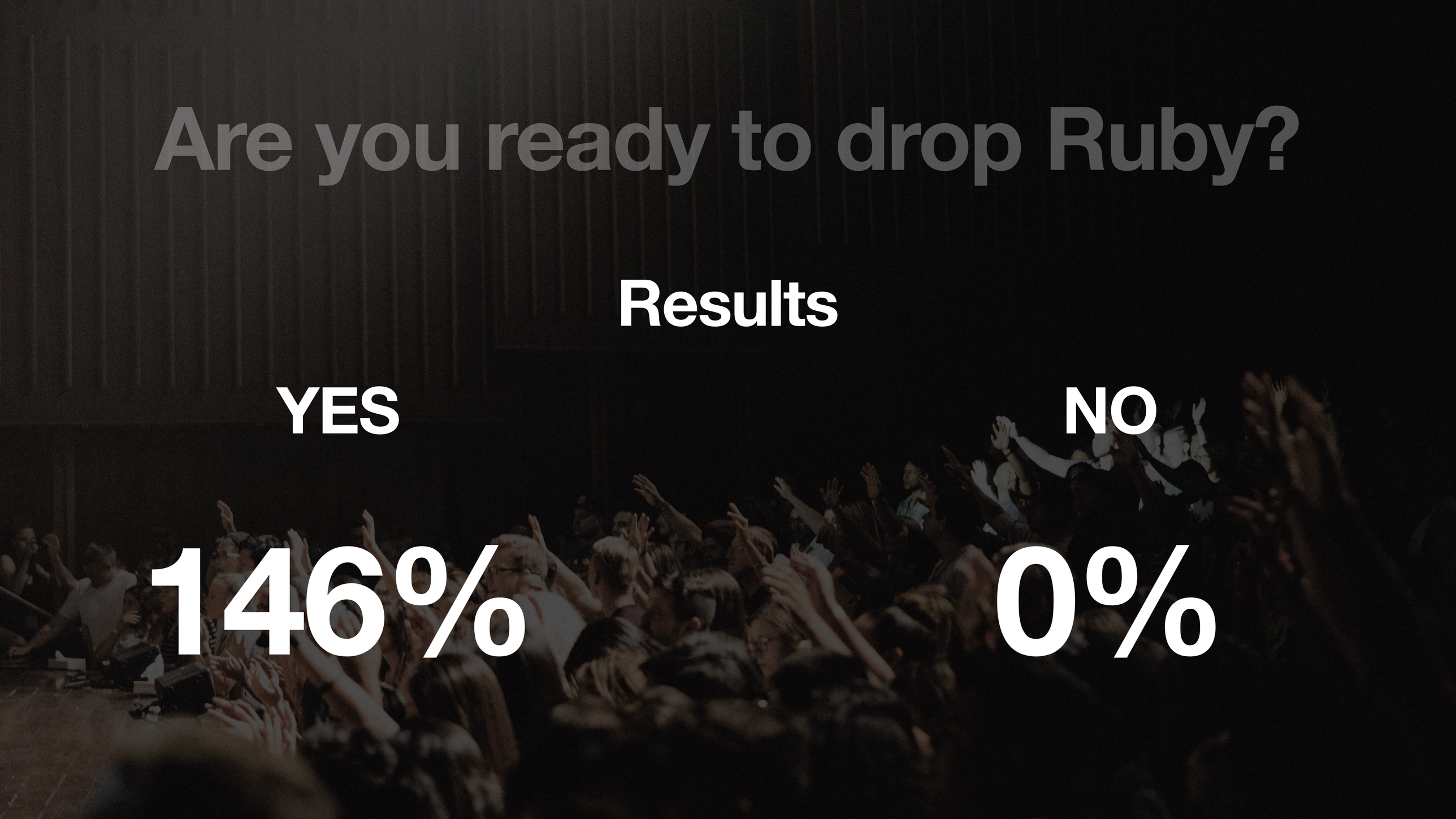


Wait a minute
Who are you?

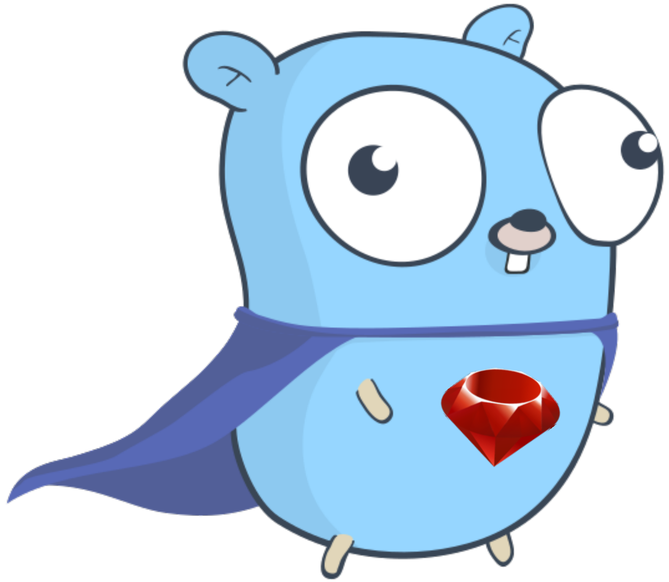
What's next?

How to move away from Ruby?

- **Complete rewrite**
- **Microservices**
- **Perfect solution, silver bullet...**

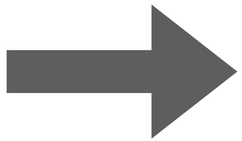
Let's write Go

Let's write Go in Ruby!



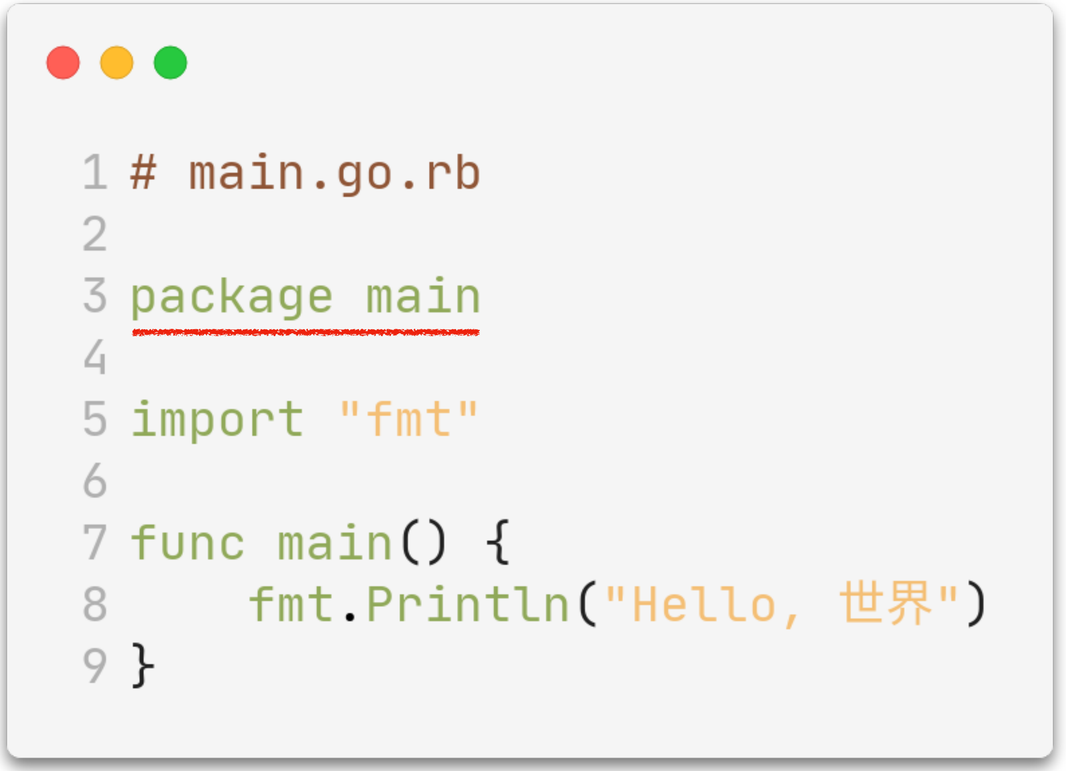
A Tour of Go: Hello World

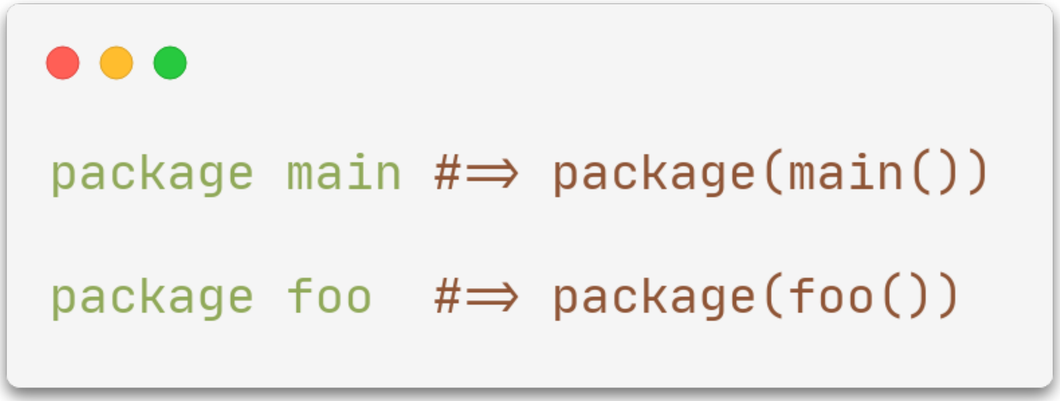
```go
// main.go

package main

import "fmt"

func main() {
    fmt.Println("Hello, 世界")
}
```



```ruby
# main.go.rb

package main

import "fmt"

func main() {
    fmt.Println("Hello, 世界")
}
```

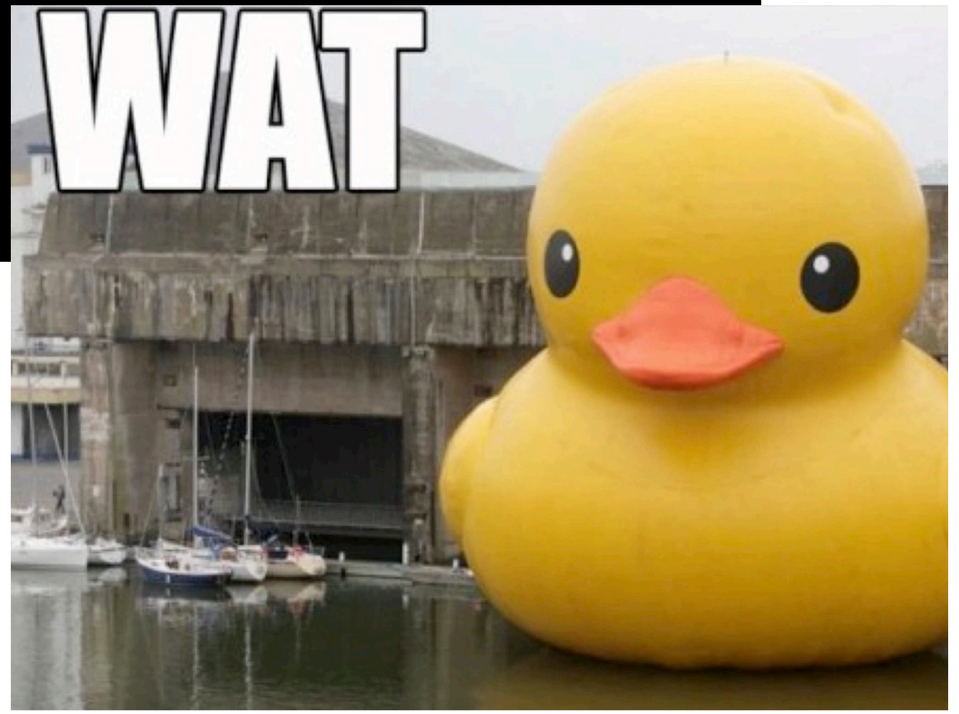
```
$ ruby main.go.rb
main.go.rb:1:in `<main>': undefined local variable or method
`main' for main:Object (NameError)
```


1 # main.go.rb
2
3 package main
4
5 import "fmt"
6
7 func main() {
8   fmt.Println("Hello, 世界")
9 }


package main #⟹ package(main())
package foo #⟹ package(foo())

```
package main #⟹ package(main())

package foo  #⟹ package(foo())
```

```
failbowl:~(master!?) $ irb
>> ruby has no bare words
NameError: undefined local variable or method `words' fo
r main:Object
        from (irb):1
>> def method_missing(*args); args.join(" "); end
=> nil
>> ruby has bare words
=> "ruby has bare words"
>> bare words can even have bangs!
=> "bare words can even have bangs!"
>>
```



```
package main #⟹ package(main())

package foo  #⟹ package(foo())
```

```
1 class << self
2   def method_missing(name, *args)
3     name
4   end
5 end
6
7 # package main #⟹ package(:main)
```

Go package

Functions, types, variables, and constants are visible to all source files within the same package

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Functions, types, variables, and constants are visible to all source files within the same package

Feels like a Ruby Module

```
package foo

# ⇒

module GoRuby
  module Foo
    # defined functions
  end
end
```

```ruby
class << self
  def package(pkg)
    mod_name = pkg.to_s.capitalize

    unless GoRuby.const_defined?(mod_name)
      GoRuby.module_eval("#{mod_name} = Module.new { extend self }")
    end

    @__go_package__ = GoRuby.const_get(mod_name)
  end
end
```

```
# main.go.rb

package main

import "fmt"

func main() {
    fmt.Println("Hello, 世界")
}
```


import "fmt"
⇒
def fmt
GoRuby::Fmt
end

```ruby
class << self
  def import(pkg)
    mod_name = pkg.camelize
    raise "unknown package #{pkg}" unless GoRuby.const_defined?(mod_name)

    define_method(pkg) { GoRuby.const_get(mod_name) }
  end
end
```

```
# main.go.rb

package main

import "fmt"

func main() {
    fmt.Println("Hello, 世界")
}
```

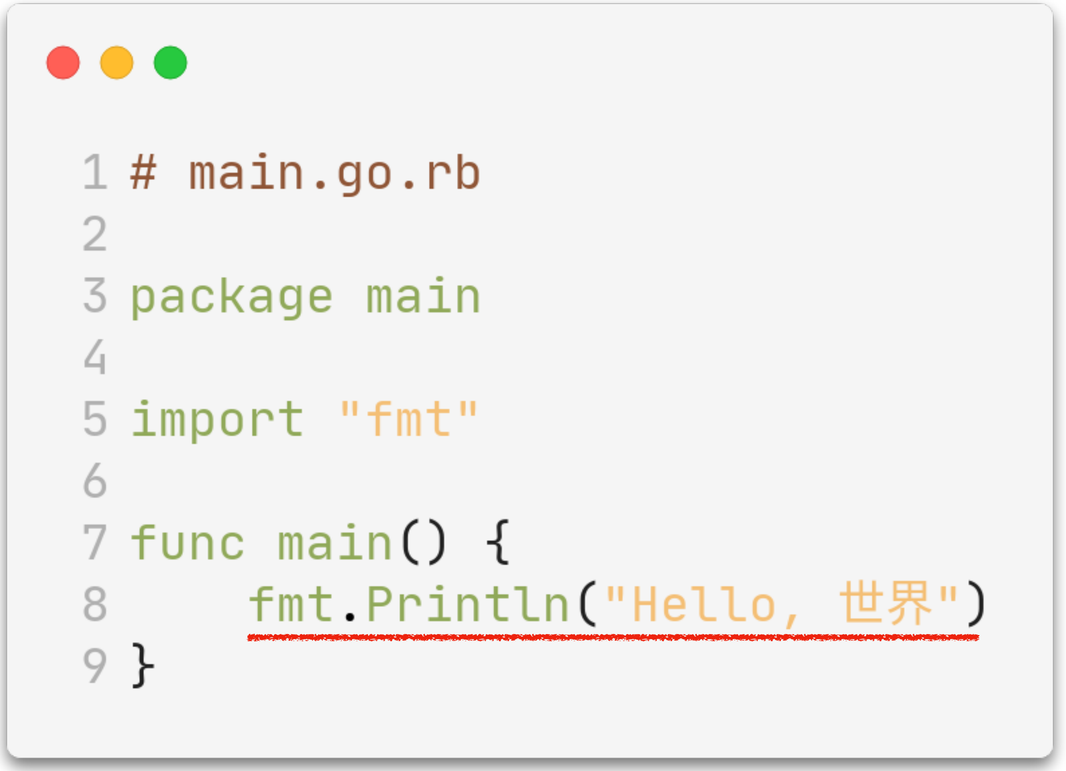
```
func main() {
  fmt.PrintLn("Hello, 世界")
}

# ⇒ ?

# 1 block goes to foo
func(main()) {
  fmt.PrintLn("Hello, 世界")
}

# 2 block goes to main
func(main() {
  fmt.PrintLn("Hello, 世界")
})
```

```ruby
class << self
  def method_missing(name, *args, &block)
    if block
      [name, block.to_proc]
    else
      name
    end
  end
end
```

One method_missing to rule them all

```
func main() {
  fmt.PrintLn("Hello, 世界")
}

# ⇒

module GoRuby
  module Main
    def main
      fmt.PrintLn("Hello, 世界")
    end
  end
end
```

```ruby
class << self
  def func(attrs)
    current_package = @__go_package__
    name, block = attrs

    if current_package.respond_to?(name)
      raise "#{name} already defined for package #{current_package}"
    end

    current_package.module_eval { define_method(name, block) }
  end
end
```



```
# main.go.rb

package main

import "fmt"

func main() {
    fmt.Println("Hello, 世界")
}
```

```ruby
module GoRuby
  module Fmt
    class << self
      def Println(*attrs)
        str = "#{attrs.join(' ')}\n"
        $stdout << str
        [str.bytesize, nil]
      end
    end
  end
end
```

```ruby
# main.go.rb

package main

import "fmt"

func main() {
    fmt.Println("Hello, 世界")
}
```

Go, Ruby, Go!

```
$ ruby -r'./lib/go_ruby.rb' main.go.rb
```

```
# main.go.rb

package main

import "fmt"

func main() {
    fmt.Println("Hello, 世界")
}
```


1 at_exit do
2   GoRuby::Main.main
3 end

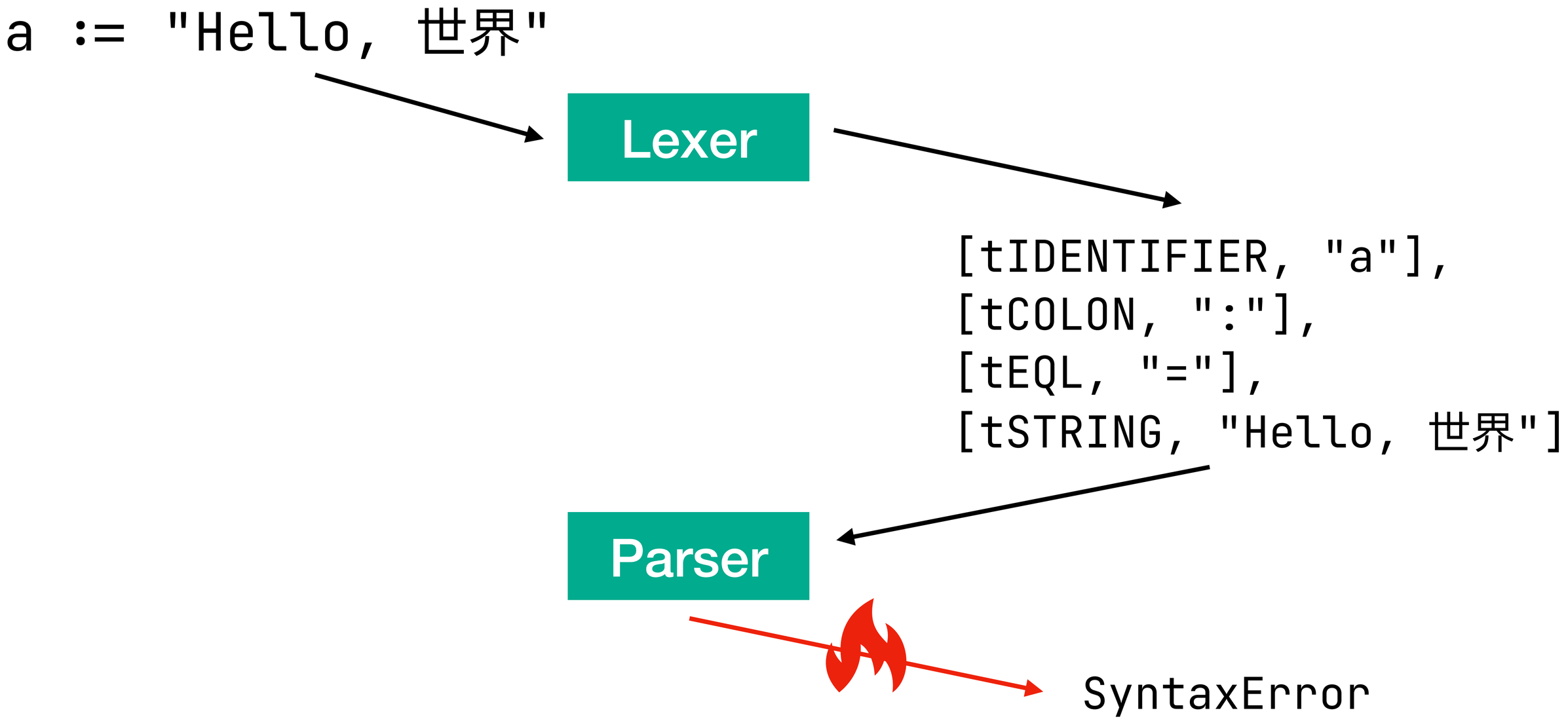
Go, Ruby, Go!

```
$ ruby -r'./lib/go_ruby.rb' main.go.rb
Hello, 世界
```


YOU'RE
WINNER !
WIN
WIN
risovach.ru

```ruby
# main.go.rb

package main

import "fmt"

func main() {
  str := "Hello, 世界"
  fmt.Println(str)
}
```

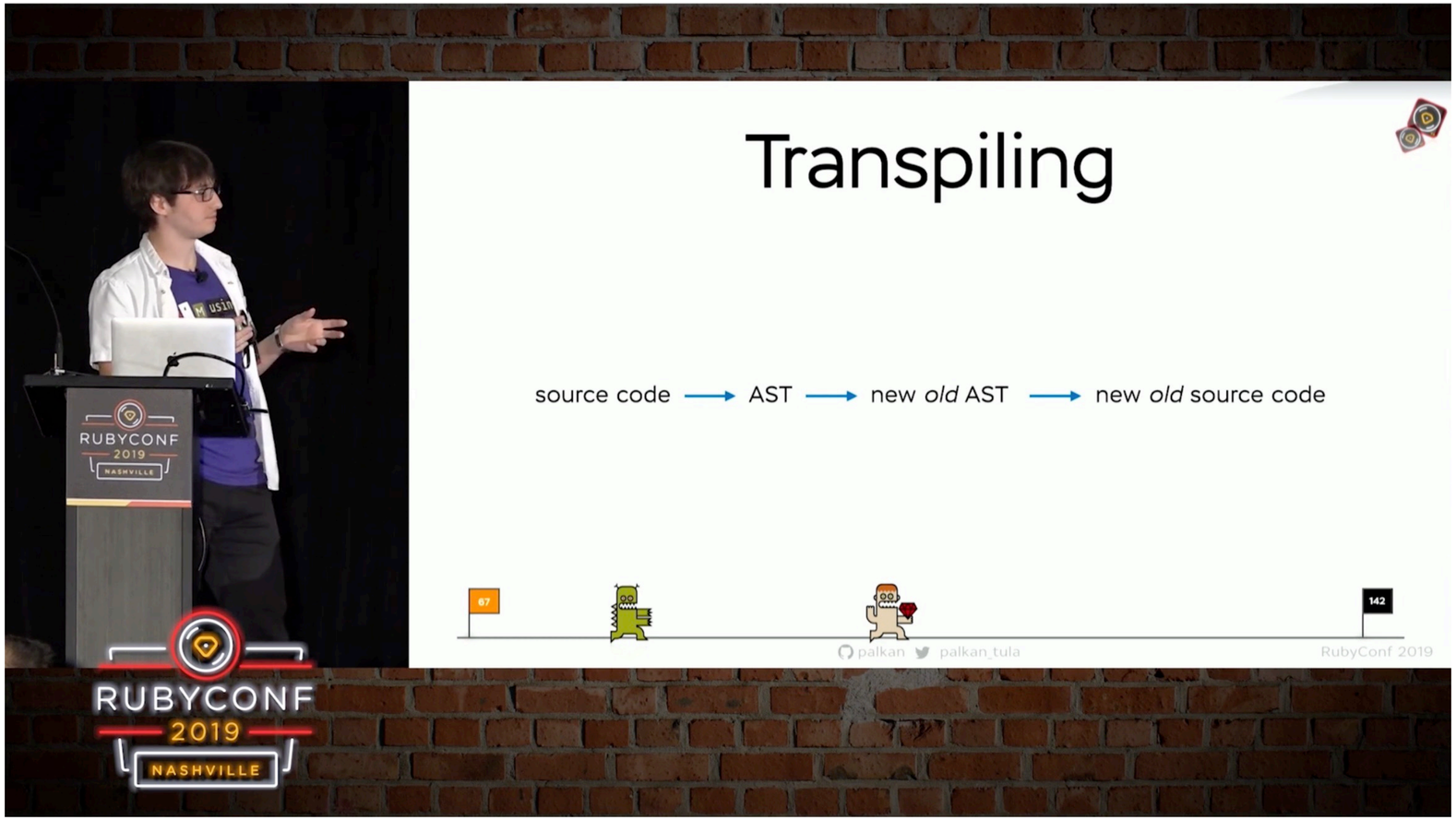
```
$ ruby -e "a := 1"

  -e:1: syntax error, unexpected '=', expecting literal content or
terminator or tSTRING_DBEG or tSTRING_DVAR
  a := 1
```

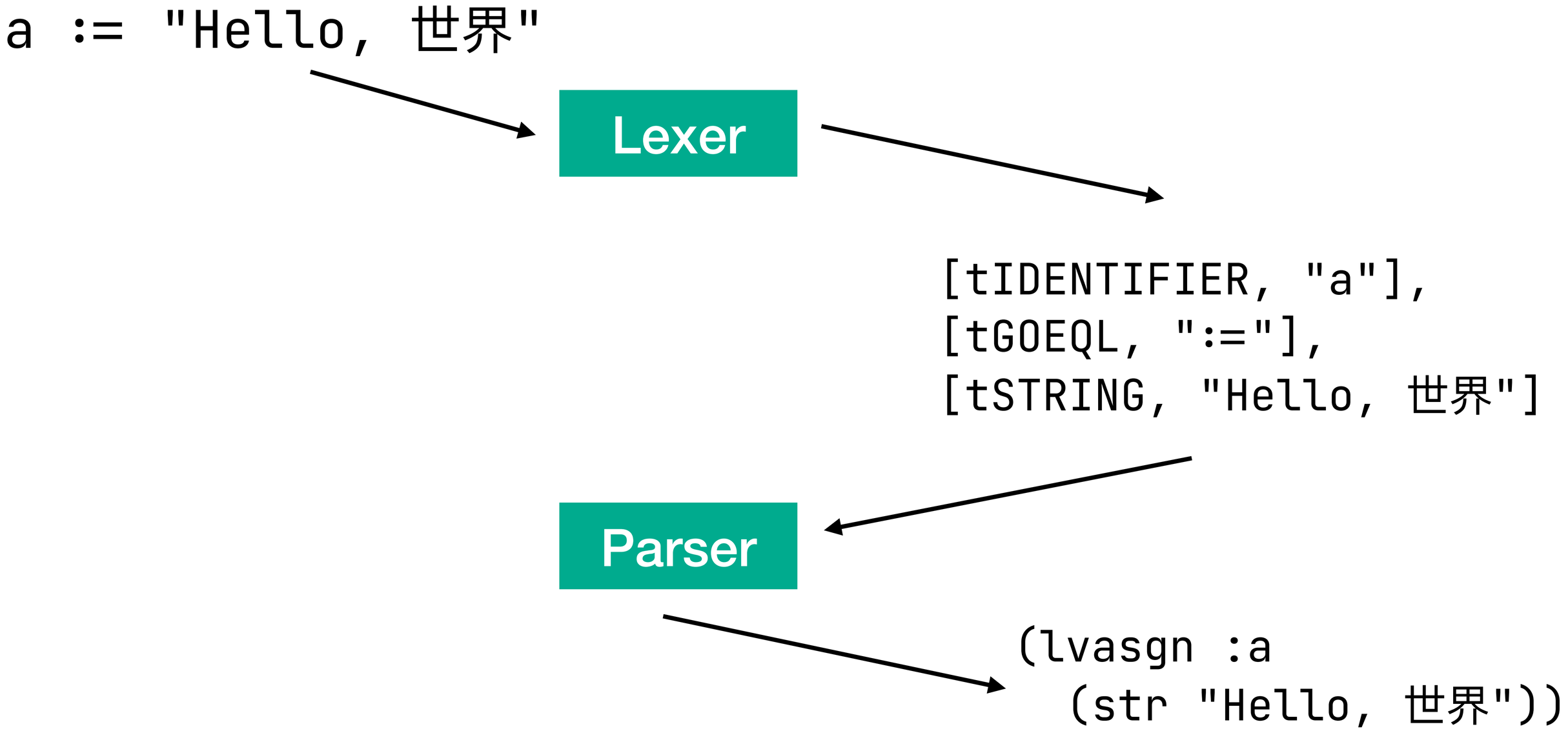

a := "Hello, 世界"
Lexer
[tIDENTIFIER, "a"],
[tCOLON, ":"],
[tEQL, "="],
[tSTRING, "Hello, 世界"]
Parser
SyntaxError

How to fix this?

- Ask the Core team to add `:=`
- Fork Ruby
- Juggle AST like it's 1999

Coming up next, ruby-next



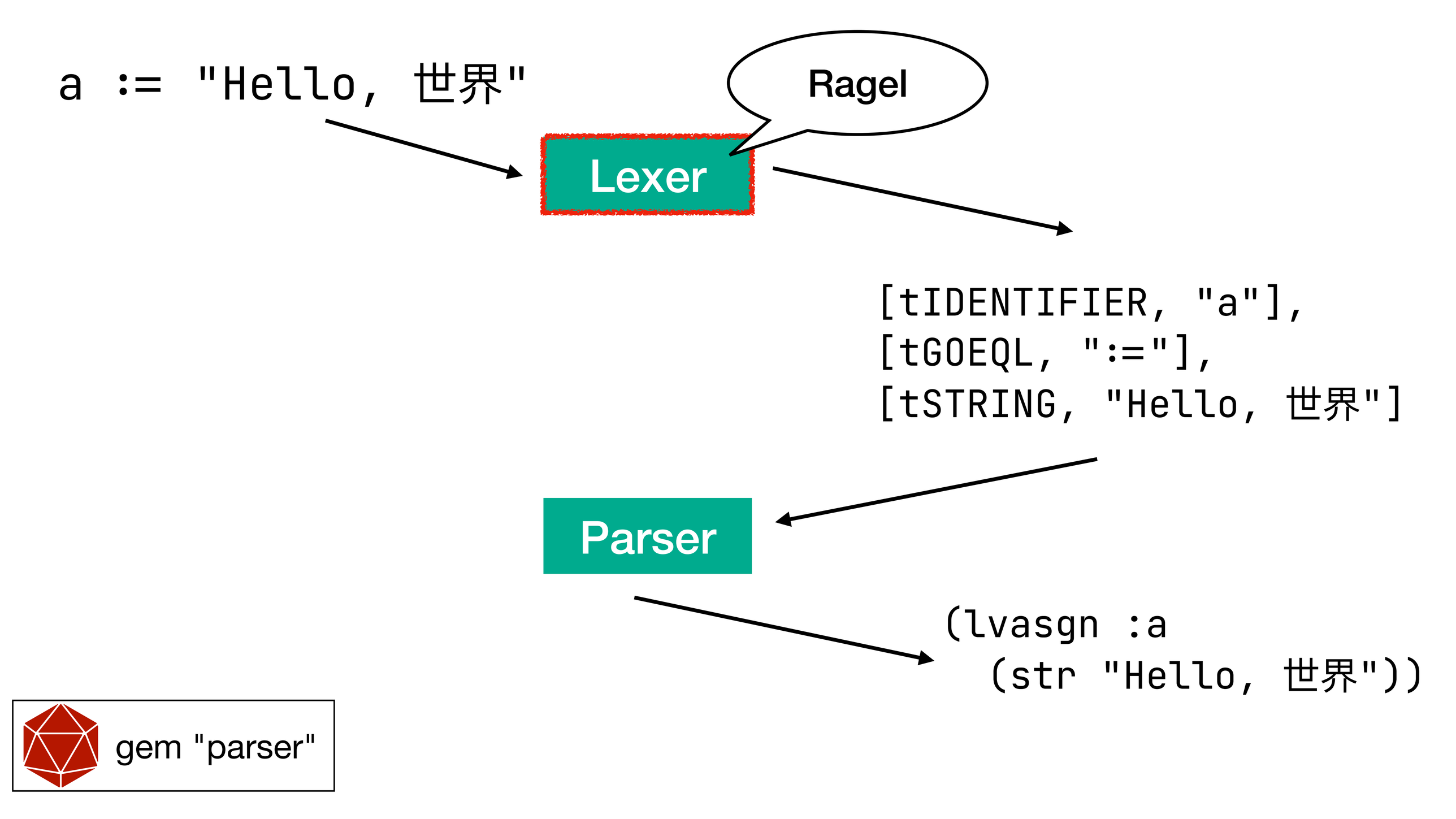

a := "Hello, 世界"
Lexer
[tIDENTIFIER, "a"],
[tGOEQL, ":="],
[tSTRING, "Hello, 世界"]
Parser
(lvasgn :a
(str "Hello, 世界"))

```
a := "Hello, 世界"
```


```
[tIDENTIFIER, "a"],
[tGOEQL, ":="],
[tSTRING, "Hello, 世界"]
```


```
(lvasgn :a
  (str "Hello, 世界"))
```

gem "parser"


a := "Hello, 世界"
Ragel
Lexer
[tIDENTIFIER, "a"],
[tGOEQL, ":="],
[tSTRING, "Hello, 世界"]
Parser
(lvasgn :a
(str "Hello, 世界"))
gem "parser"


Serious Shchi

Ragel State Machine Compiler

- Finite-state machine compiler and a parser generator.
- Works with a lot of languages (C, C++, Java, Go, Ruby, etc.)


$ wc -l lib/parser/lexer.rl
2556 lib/parser/lexer.rl
$ ragel -F1 -R lib/parser/lexer.rl -o lib/parser/lexer.rb
$ wc -l lib/parser/lexer.rb
23779 lib/parser/lexer.rb

```
  attr_reader   :source_buffer

  attr_accessor :diagnostics
  attr_accessor :static_env
  attr_accessor :force_utf32

  attr_accessor :cond, :cmdarg, :in_kwarg, :context, :command_start

  attr_accessor :tokens, :comments

  attr_reader :paren_nest, :cmdarg_stack, :cond_stack, :lambda_stack

  def initialize(version)
    @version    = version
    @static_env = nil
    @context    = nil

    @tokens     = nil
    @comments   = nil

    reset
  end

  def reset(reset_state=true)
    # Ragel state:
    if reset_state
      # Unit tests set state prior to resetting lexer.
      @cs     = self.class.lex_en_line_begin

      @cond   = StackState.new('cond')
      @cmdarg = StackState.new('cmdarg')
      @cond_stack   = []
      @cmdarg_stack = []
    end

    @force_utf32   = false # Set to true by some tests

    @source_pts    = nil # @source as a codepoint array

    @p             = 0   # stream position (saved manually in #advance)
    @ts            = nil # token start
    @te            = nil # token end
    @act           = 0   # next action

    @stack         = []  # state stack
    @top           = 0   # state stack top pointer

    # Lexer state:
    @token_queue   = []
    @literal_stack = []

    @eq_begin_s    = nil # location of last encountered =begin
    @sharp_s       = nil # location of last encountered #

    @newline_s     = nil # location of last encountered newline

    @num_base      = nil # last numeric base
    @num_digits_s  = nil # starting position of numeric digits
    @num_suffix_s  = nil # starting position of numeric suffix
    @num_xfrm      = nil # numeric suffix-induced transformation

    @escape_s      = nil # starting position of current sequence
    @escape        = nil # last escaped sequence, as string

    @herebody_s    = nil # starting position of current heredoc line

    # Ruby 1.9 ->() lambdas emit a distinct token if do/{ is
    # encountered after a matching closing parenthesis.
    @paren_nest    = 0
    @lambda_stack  = []

    # After encountering the closing line of <<~SQUIGGLY_HEREDOC,
    # we store the indentation level and give it out to the parser
    # on request. It is not possible to infer indentation level just
    # from the AST because escape sequences such as `\ ` or `\t` are
    # expanded inside the lexer, but count as non-whitespace for
    # indentation purposes.
    @dedent_level  = nil

    # If the lexer is in `command state' (aka expr_value)
    # at the entry to #advance, it will transition to expr_cmdarg
    # instead of expr_arg at certain points.
    @command_start = true

    # True at the end of "def foo a:"
    @in_kwarg      = false

    # State before =begin / =end block comment
    @cs_before_block_comment = self.class.lex_en_line_begin
  end
```

```ruby
  attr_reader   :source_buffer

  attr_accessor :diagnostics
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  attr_accessor :tokens, :comments

  attr_reader :paren_nest, :cmdarg_stack, :cond_stack, :lambda_stack

  def initialize(version)
    @version    = version
    @static_env = nil
    @context    = nil

    @tokens     = nil
    @comments   = nil

    reset
  end

  def reset(reset_state=true)
    # Ragel state:
    if reset_state
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      @cond   = StackState.new('cond')
      @cmdarg = StackState.new('cmdarg')
      @cond_stack   = []
      @cmdarg_stack = []
    end

    @force_utf32   = false # Set to true by some tests

    @source_pts    = nil # @source as a codepoint array

    @p             = 0   # stream position (saved manually in #advance)
    @ts            = nil # token start
    @te            = nil # token end
    @act           = 0   # next action

    @stack         = []  # state stack
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    @token_queue   = []
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    # instead of expr_arg at certain points.
    @command_start = true

    # True at the end of "def foo a:"
    @in_kwarg      = false

    # State before =begin / =end block comment
    @cs_before_block_comment = self.class.lex_en_line_begin
  end
```

```ruby
  def eof_codepoint?(point)
    [0x04, 0x1a, 0x00].include? point
  end

  def version?(*versions)
    versions.include?(@version)
  end

  def stack_pop
    @top -= 1
    @stack[@top]
  end

  def encode_escape(ord)
    ord.chr.force_encoding(@source_buffer.source.encoding)
  end

  def tok(s = @ts, e = @te)
    @source_buffer.slice(s...e)
  end

  def range(s = @ts, e = @te)
    Parser::Source::Range.new(@source_buffer, s, e)
  end

  def emit(type, value = tok, s = @ts, e = @te)
    token = [ type, [ value, range(s, e) ] ]

    @token_queue.push(token)

    @tokens.push(token) if @tokens

    token
  end

  def emit_table(table, s = @ts, e = @te)
    value = tok(s, e)

    emit(table[value], value, s, e)
  end

  def emit_do(do_block=false)
    if @cond.active?
      emit(:kDO_COND, 'do'.freeze)
    elsif @cmdarg.active? || do_block
      emit(:kDO_BLOCK, 'do'.freeze)
    else
      emit(:kDO, 'do'.freeze)
    end
  end

  def arg_or_cmdarg(cmd_state)
    if cmd_state
      self.class.lex_en_expr_cmdarg
    else
      self.class.lex_en_expr_arg
    end
  end

  def emit_comment(s = @ts, e = @te)
    if @comments
      @comments.push(Parser::Source::Comment.new(range(s, e)))
    end

    if @tokens
      @tokens.push([ :tCOMMENT, [ tok(s, e), range(s, e) ] ])
    end

    nil
  end

  def diagnostic(type, reason, arguments=nil, location=range, highlights=[])
    @diagnostics.process(
        Parser::Diagnostic.new(type, reason, arguments, location,
highlights))
  end

  #
  # === LITERAL STACK ===
  #

  def push_literal(*args)
    new_literal = Literal.new(self, *args)
    @literal_stack.push(new_literal)
    next_state_for_literal(new_literal)
  end

  def next_state_for_literal(literal)
    if literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited_words
      else
        self.class.lex_en_plain_backslash_delimited_words
      end
    elsif literal.words? && !literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_words
      else
        self.class.lex_en_plain_words
      end
    elsif !literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited
      else
        self.class.lex_en_plain_backslash_delimited
      end
    else
      if literal.interpolate?
        self.class.lex_en_interp_string
      else
        self.class.lex_en_plain_string
      end
    end
  end

  def literal
    @literal_stack.last
  end

  def pop_literal
    old_literal = @literal_stack.pop

    @dedent_level = old_literal.dedent_level

    if old_literal.type == :tREGEXP_BEG
      # Fetch modifiers.
      self.class.lex_en_regexp_modifiers
    else
      self.class.lex_en_expr_end
    end
```

```
  attr_reader   :source_buffer

  attr_accessor :diagnostics
  attr_accessor :static_env
  attr_accessor :force_utf32

  attr_accessor :cond, :cmdarg, :in_kwarg, :context, :command_start

  attr_accessor :tokens, :comments

  attr_reader :paren_nest, :cmdarg_stack, :cond_stack, :lambda_stack

  def initialize(version)
    @version    = version
    @static_env = nil
    @context    = nil

    @tokens     = nil
    @comments   = nil

    reset
  end

  def reset(reset_state=true)
    # Ragel state:
    if reset_state
      # Unit tests set state prior to resetting lexer.
      @cs     = self.class.lex_en_line_begin

      @cond   = StackState.new('cond')
      @cmdarg = StackState.new('cmdarg')
      @cond_stack   = []
      @cmdarg_stack = []
    end

    @force_utf32   = false # Set to true by some tests

    @source_pts    = nil # @source as a codepoint array

    @p             = 0   # stream position (saved manually in #advance)
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    @stack         = []  # state stack
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    @token_queue   = []
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    @escape_s      = nil # starting position of current sequence
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    # Ruby 1.9 ->() lambdas emit a distinct token if do/{ is
    # encountered after a matching closing parenthesis.
    @paren_nest    = 0
    @lambda_stack  = []

    # After encountering the closing line of <<~SQUIGGLY_HEREDOC,
    # we store the indentation level and give it out to the parser
    # on request. It is not possible to infer indentation level just
    # from the AST because escape sequences such as `\ ` or `\t` are
    # expanded inside the lexer, but count as non-whitespace for
    # indentation purposes.
    @dedent_level  = nil

    # If the lexer is in `command state' (aka expr_value)
    # at the entry to #advance, it will transition to expr_cmdarg
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    @command_start = true

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    # State before =begin / =end block comment
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    ord.chr.force_encoding(@source_buffer.source.encoding)
  end

  def tok(s = @ts, e = @te)
    @source_buffer.slice(s...e)
  end

  def range(s = @ts, e = @te)
    Parser::Source::Range.new(@source_buffer, s, e)
  end

  def emit(type, value = tok, s = @ts, e = @te)
    token = [ type, [ value, range(s, e) ] ]

    @token_queue.push(token)

    @tokens.push(token) if @tokens

    token
  end

  def emit_table(table, s = @ts, e = @te)
    value = tok(s, e)

    emit(table[value], value, s, e)
  end

  def emit_do(do_block=false)
    if @cond.active?
      emit(:kDO_COND, 'do'.freeze)
    elsif @cmdarg.active? || do_block
      emit(:kDO_BLOCK, 'do'.freeze)
    else
      emit(:kDO, 'do'.freeze)
    end
  end

  def arg_or_cmdarg(cmd_state)
    if cmd_state
      self.class.lex_en_expr_cmdarg
    else
      self.class.lex_en_expr_arg
    end
  end

  def emit_comment(s = @ts, e = @te)
    if @comments
      @comments.push(Parser::Source::Comment.new(range(s, e)))
    end

    if @tokens
      @tokens.push([ :tCOMMENT, [ tok(s, e), range(s, e) ] ])
    end

    nil
  end

  def diagnostic(type, reason, arguments=nil, location=range, highlights=[])
    @diagnostics.process(
        Parser::Diagnostic.new(type, reason, arguments, location,
highlights))
  end

  #
  # === LITERAL STACK ===
  #

  def push_literal(*args)
    new_literal = Literal.new(self, *args)
    @literal_stack.push(new_literal)
    next_state_for_literal(new_literal)
  end

  def next_state_for_literal(literal)
    if literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited_words
      else
        self.class.lex_en_plain_backslash_delimited_words
      end
    elsif literal.words? && !literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_words
      else
        self.class.lex_en_plain_words
      end
    elsif !literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited
      else
        self.class.lex_en_plain_backslash_delimited
      end
    else
      if literal.interpolate?
        self.class.lex_en_interp_string
      else
        self.class.lex_en_plain_string
      end
    end
  end

  def literal
    @literal_stack.last
  end

  def pop_literal
    old_literal = @literal_stack.pop

    @dedent_level = old_literal.dedent_level

    if old_literal.type == :tREGEXP_BEG
      # Fetch modifiers.
      self.class.lex_en_regexp_modifiers
    else
      self.class.lex_en_expr_end
    end
  end
```

```
# Mapping of strings to parser tokens.

PUNCTUATION = {
  '='   => :tEQL,      '&'   => :tAMPER2,  '|'   => :tPIPE,
  '!'   => :tBANG,     '^'   => :tCARET,   '+'   => :tPLUS,
  '-'   => :tMINUS,    '*'   => :tSTAR2,   '/'   => :tDIVIDE,
  '%'   => :tPERCENT,  '~'   => :tTILDE,   ','   => :tCOMMA,
  ';'   => :tSEMI,     '.'   => :tDOT,     '..'  => :tDOT2,
  '...' => :tDOT3,     '['   => :tLBRACK2, ']'   => :tRBRACK,
  '('   => :tLPAREN2, ')'   => :tRPAREN,  '?'   => :tEH,
  ':'   => :tCOLON,    '&&'  => :tANDOP,   '||'  => :tOROP,
  '-@'  => :tUMINUS,   '+@'  => :tUPLUS,   '~@'  => :tTILDE,
  '**'  => :tPOW,      '->'  => :tLAMBDA,  '=~'  => :tMATCH,
  '!~'  => :tNMATCH,   '=='  => :tEQ,      '!='  => :tNEQ,
  '>'   => :tGT,       '>>'  => :tRSHFT,   '>='  => :tGEQ,
  '<'   => :tLT,       '<<'  => :tLSHFT,   '<='  => :tLEQ,
  '=>'  => :tASSOC,    '::'  => :tCOLON2,  '===' => :tEQQ,
  '<=>' => :tCMP,      '[]'  => :tAREF,    '[]=' => :tASET,
  '{'   => :tLCURLY,   '}'   => :tRCURLY,  '`'   => :tBACK_REF2,
  '!@'  => :tBANG,     '&.'  => :tANDDOT,
}

PUNCTUATION_BEGIN = {
  '&'   => :tAMPER,    '*'   => :tSTAR,    '**'  => :tDSTAR,
  '+'   => :tUPLUS,    '-'   => :tUMINUS,  '::'  => :tCOLON3,
  '('   => :tLPAREN,   '{'   => :tLBRACE,  '['   => :tLBRACK,
}

KEYWORDS = {
  'if'     => :kIF_MOD,      'unless'   => :kUNLESS_MOD,
  'while'  => :kWHILE_MOD,   'until'    => :kUNTIL_MOD,
  'rescue' => :kRESCUE_MOD,  'defined?' => :kDEFINED,
  'BEGIN'  => :klBEGIN,      'END'      => :klEND,
}

KEYWORDS_BEGIN = {
  'if'     => :kIF,          'unless'   => :kUNLESS,
  'while'  => :kWHILE,       'until'    => :kUNTIL,
  'rescue' => :kRESCUE,      'defined?' => :kDEFINED,
  'BEGIN'  => :klBEGIN,      'END'      => :klEND,
}

%w(class module def undef begin end then elsif else ensure case when
   for break next redo retry in do return yield super self nil true
   false and or not alias __FILE__ __LINE__ __ENCODING__).each do
|keyword|
  KEYWORDS_BEGIN[keyword] = KEYWORDS[keyword] = :"k#{keyword.upcase}"
end
```

```
  attr_reader   :source_buffer

  attr_accessor :diagnostics
  attr_accessor :static_env
  attr_accessor :force_utf32

  attr_accessor :cond, :cmdarg, :in_kwarg, :context, :command_start

  attr_accessor :tokens, :comments

  attr_reader :paren_nest, :cmdarg_stack, :cond_stack, :lambda_stack

  def initialize(version)
    @version    = version
    @static_env = nil
    @context    = nil

    @tokens     = nil
    @comments   = nil

    reset
  end

  def reset(reset_state=true)
    # Ragel state:
    if reset_state
      # Unit tests set state prior to resetting lexer.
      @cs     = self.class.lex_en_line_begin

      @cond   = StackState.new('cond')
      @cmdarg = StackState.new('cmdarg')
      @cond_stack   = []
      @cmdarg_stack = []
    end

    @force_utf32   = false # Set to true by some tests

    @source_pts    = nil # @source as a codepoint array

    @p             = 0   # stream position (saved manually in #advance)
    @ts            = nil # token start
    @te            = nil # token end
    @act           = 0   # next action

    @stack         = []  # state stack
    @top           = 0   # state stack top pointer

    # Lexer state:
    @token_queue   = []
    @literal_stack = []

    @eq_begin_s    = nil # location of last encountered =begin
    @sharp_s       = nil # location of last encountered #

    @newline_s     = nil # location of last encountered newline

    @num_base      = nil # last numeric base
    @num_digits_s  = nil # starting position of numeric digits
    @num_suffix_s  = nil # starting position of numeric suffix
    @num_xfrm      = nil # numeric suffix-induced transformation

    @escape_s      = nil # starting position of current sequence
    @escape        = nil # last escaped sequence, as string

    @herebody_s    = nil # starting position of current heredoc line

    # Ruby 1.9 ->() lambdas emit a distinct token if do/{ is
    # encountered after a matching closing parenthesis.
    @paren_nest    = 0
    @lambda_stack  = []

    # After encountering the closing line of <<~SQUIGGLY_HEREDOC,
    # we store the indentation level and give it out to the parser
    # on request. It is not possible to infer indentation level just
    # from the AST because escape sequences such as `\ ` or `\t` are
    # expanded inside the lexer, but count as non-whitespace for
    # indentation purposes.
    @dedent_level  = nil

    # If the lexer is in `command state' (aka expr_value)
    # at the entry to #advance, it will transition to expr_cmdarg
    # instead of expr_arg at certain points.
    @command_start = true

    # True at the end of "def foo a:"
    @in_kwarg      = false

    # State before =begin / =end block comment
    @cs_before_block_comment = self.class.lex_en_line_begin
  end
```

```
  def eof_codepoint?(point)
    [0x04, 0x1a, 0x00].include? point
  end

  def version?(*versions)
    versions.include?(@version)
  end

  def stack_pop
    @top -= 1
    @stack[@top]
  end

  def encode_escape(ord)
    ord.chr.force_encoding(@source_buffer.source.encoding)
  end

  def tok(s = @ts, e = @te)
    @source_buffer.slice(s...e)
  end

  def range(s = @ts, e = @te)
    Parser::Source::Range.new(@source_buffer, s, e)
  end

  def emit(type, value = tok, s = @ts, e = @te)
    token = [ type, [ value, range(s, e) ] ]

    @token_queue.push(token)

    @tokens.push(token) if @tokens

    token
  end

  def emit_table(table, s = @ts, e = @te)
    value = tok(s, e)

    emit(table[value], value, s, e)
  end

  def emit_do(do_block=false)
    if @cond.active?
      emit(:kDO_COND, 'do'.freeze)
    elsif @cmdarg.active? || do_block
      emit(:kDO_BLOCK, 'do'.freeze)
    else
      emit(:kDO, 'do'.freeze)
    end
  end

  def arg_or_cmdarg(cmd_state)
    if cmd_state
      self.class.lex_en_expr_cmdarg
    else
      self.class.lex_en_expr_arg
    end
  end

  def emit_comment(s = @ts, e = @te)
    if @comments
      @comments.push(Parser::Source::Comment.new(range(s, e)))
    end

    if @tokens
      @tokens.push([ :tCOMMENT, [ tok(s, e), range(s, e) ] ])
    end

    nil
  end

  def diagnostic(type, reason, arguments=nil, location=range, highlights=[])
    @diagnostics.process(
        Parser::Diagnostic.new(type, reason, arguments, location,
highlights))
  end

  #
  # === LITERAL STACK ===
  #

  def push_literal(*args)
    new_literal = Literal.new(self, *args)
    @literal_stack.push(new_literal)
    next_state_for_literal(new_literal)
  end

  def next_state_for_literal(literal)
    if literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited_words
      else
        self.class.lex_en_plain_backslash_delimited_words
      end
    elsif literal.words? && !literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_words
      else
        self.class.lex_en_plain_words
      end
    elsif !literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited
      else
        self.class.lex_en_plain_backslash_delimited
      end
    else
      if literal.interpolate?
        self.class.lex_en_interp_string
      else
        self.class.lex_en_plain_string
      end
    end
  end

  def literal
    @literal_stack.last
  end

  def pop_literal
    old_literal = @literal_stack.pop

    @dedent_level = old_literal.dedent_level

    if old_literal.type == :tREGEXP_BEG
      # Fetch modifiers.
      self.class.lex_en_regexp_modifiers
    else
      self.class.lex_en_expr_end
    end
```

```
# Mapping of strings to parser tokens.

PUNCTUATION = {
  '='   => :tEQL,      '&'   => :tAMPER2,  '|'   => :tPIPE,
  '!'   => :tBANG,     '^'   => :tCARET,   '+'   => :tPLUS,
  '-'   => :tMINUS,    '*'   => :tSTAR2,   '/'   => :tDIVIDE,
  '%'   => :tPERCENT,  '~'   => :tTILDE,   ','   => :tCOMMA,
  ';'   => :tSEMI,     '.'   => :tDOT,     '..'  => :tDOT2,
  '...' => :tDOT3,     '['   => :tLBRACK2, ']'   => :tRBRACK,
  '('   => :tLPAREN2, ')'   => :tRPAREN,  '?'   => :tEH,
  ':'   => :tCOLON,    '&&'  => :tANDOP,   '||'  => :tOROP,
  '-@'  => :tUMINUS,   '+@'  => :tUPLUS,   '~@'  => :tTILDE,
  '**'  => :tPOW,      '->'  => :tLAMBDA,  '=~'  => :tMATCH,
  '!~'  => :tNMATCH,   '=='  => :tEQ,      '!='  => :tNEQ,
  '>'   => :tGT,       '>>'  => :tRSHFT,   '>='  => :tGEQ,
  '<'   => :tLT,       '<<'  => :tLSHFT,   '<='  => :tLEQ,
  '=>'  => :tASSOC,    '::'  => :tCOLON2,  '===' => :tEQQ,
  '<=>' => :tCMP,      '[]'  => :tAREF,    '[]=' => :tASET,
  '{'   => :tLCURLY,   '}'   => :tRCURLY,  '`'   => :tBACK_REF2,
  '!@'  => :tBANG,     '&.'  => :tANDDOT,
}

PUNCTUATION_BEGIN = {
  '&'   => :tAMPER,    '*'   => :tSTAR,    '**'  => :tDSTAR,
  '+'   => :tUPLUS,    '-'   => :tUMINUS,  '::'  => :tCOLON3,
  '('   => :tLPAREN,   '{'   => :tLBRACE,  '['   => :tLBRACK,
}

KEYWORDS = {
  'if'      => :kIF_MOD,      'unless'   => :kUNLESS_MOD,
  'while'   => :kWHILE_MOD,   'until'    => :kUNTIL_MOD,
  'rescue'  => :kRESCUE_MOD,  'defined?' => :kDEFINED,
  'BEGIN'   => :klBEGIN,      'END'      => :klEND,
}

KEYWORDS_BEGIN = {
  'if'      => :kIF,          'unless'   => :kUNLESS,
  'while'   => :kWHILE,       'until'    => :kUNTIL,
  'rescue'  => :kRESCUE,      'defined?' => :kDEFINED,
  'BEGIN'   => :klBEGIN,      'END'      => :klEND,
}

%w(class module def undef begin end then elsif else ensure case when
   for break next redo retry in do return yield super self nil true
   false and or not alias __FILE__ __LINE__ __ENCODING__).each do
|keyword|
  KEYWORDS_BEGIN[keyword] = KEYWORDS[keyword] = :"k#{keyword.upcase}"
end
```

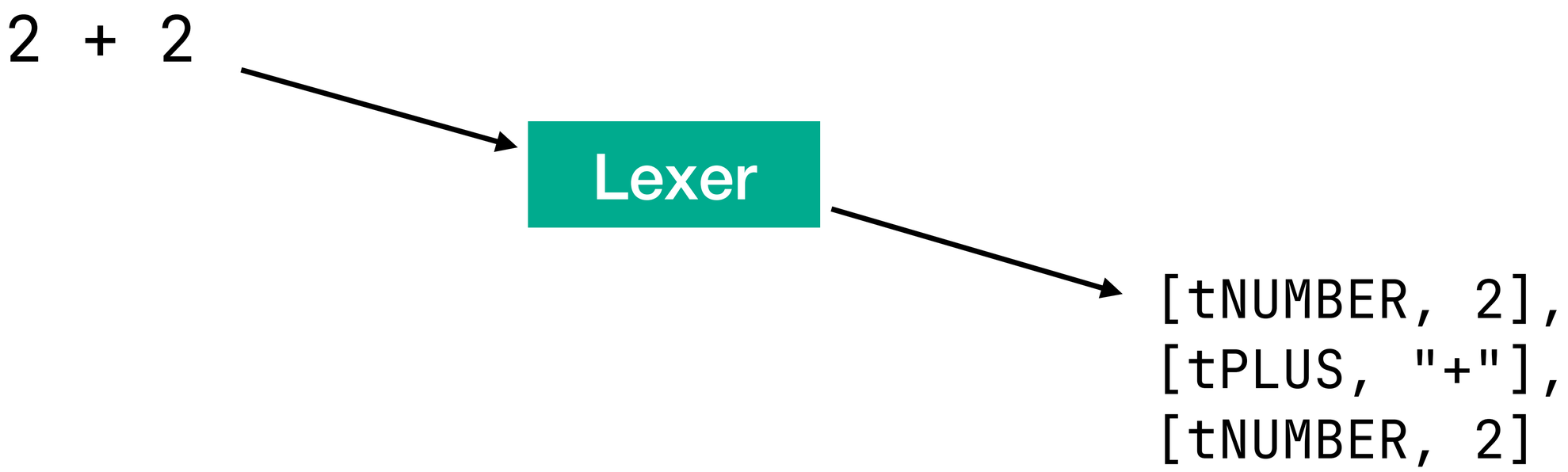
```
# === CHARACTER CLASSES ===
#
# Pay close attention to the differences between c_any and any.
# c_any does not include EOF and so will cause incorrect behavior
# for machine subtraction (any-except rules) and default transitions
# for scanners.

action do_nl {
  # Record position of a newline for precise location reporting on tNL
  # tokens.
  #
  # This action is embedded directly into c_nl, as it is idempotent and
  # there are no cases when we need to skip it.
  @newline_s = p
}

c_nl       = '\n' $ do_nl;
c_space    = [ \t\r\f\v];
c_space_nl = c_space | c_nl;

c_eof      = 0x04 | 0x1a | 0 | zlen; # ^D, ^Z, \0, EOF
c_eol      = c_nl | c_eof;
c_any      = any - c_eof;

c_nl_zlen  = c_nl | zlen;
c_line     = any - c_nl_zlen;

c_unicode  = c_any - 0x00..0x7f;
c_upper    = [A-Z];
c_lower    = [a-z_]  | c_unicode;
c_alpha    = c_lower | c_upper;
c_alnum    = c_alpha | [0-9];

action do_eof {
  # Sit at EOF indefinitely. #advance would return $eof each time.
  # This allows to feed the lexer more data if needed; this is only used
  # in tests.
  #
  # Note that this action is not embedded into e_eof like e_heredoc_nl and
e_bs
  # below. This is due to the fact that scanner state at EOF is observed
  # by tests, and encapsulating it in a rule would break the
introspection.
  fhold; fbreak;
}

#
# === TOKEN DEFINITIONS ===
#

# All operators are punctuation. There is more to punctuation
# than just operators. Operators can be overridden by user;
# punctuation can not.

# A list of operators which are valid in the function name context, but
# have different semantics in others.
operator_fname      = '[]' | '[]=' | '`'  | '+@' | '-@' | '~@' | '!@' ;

# A list of operators which can occur within an assignment shortcut (+ →
+=).
operator_arithmetic = '&'  | '|'  | '&&' | '||' | '^'  | '+'  | '-'  |
                      '*'  | '/'  | '%'  | '**' | '~'  | '<<' | '>>' | '&.' ;

# A list of all user-definable operators not covered by groups above.
operator_rest       = '=~' | '!~' | '=='  | '===' | '!'  | '<=>' |
                      '<'  | '<=' | '>'  | '>=' | '<=>' | '=>' ;

# Note that `{` and `}` need to be referred to as e_lbrace and e_rbrace,
# as they are ambiguous with interpolation `#{}` and should be counted.
# These braces are not present in punctuation lists.

# A list of punctuation which has different meaning when used at the
# beginning of expression.
punctuation_begin   = '-'  | '+'  | '::' | '(' | '[' |
                      '*'  | '**' | '&' ;

# A list of all punctuation except punctuation_begin.
punctuation_end     = ','  | '='  | '->' | '(' | '[' | ']' |
                      '::' | '?'  | ':'  | '.' | '..' | '...' ;

# A list of keywords which have different meaning at the beginning of
expression.
keyword_modifier    = 'if'     | 'unless' | 'while'  | 'until' | 'rescue'
;

# A list of keywords which accept an argument-like expression, i.e. have
the
# same post-processing as method calls or commands. Example: `yield 1`,
# `yield(1)`, `yield(1)*2`, are interpreted as if `yield` was a function.
keyword_with_arg    = 'yield'  | 'super'  | 'not'    | 'defined?' ;

# A list of keywords which accept a literal function name as an argument.
keyword_with_fname  = 'def'    | 'undef'  | 'alias' ;

# A list of keywords which accept an expression after them.
keyword_with_value  = 'else'   | 'case'   | 'ensure' | 'module' | 'elsif'
| 'then'   |
                      'for'    | 'in'     | 'do'     | 'when'   | 'begin'
| 'class' |
                      'and'    | 'or'     ;

# A list of keywords which accept a value, and treat the keywords from
# `keyword_modifier` list as modifiers.
keyword_with_mid    = 'rescue' | 'return' | 'break'  | 'next'   ;

# A list of keywords which do not accept an expression after them.
keyword_with_end    = 'end'    | 'self'   | 'true'   | 'false'  | 'retry'
  |
                      'redo'   | 'nil'    | 'BEGIN'  | 'END'    |
'__FILE__' |
                      '__LINE__' | '__ENCODING__';

# All keywords.
keyword             = keyword_with_value | keyword_with_mid |
                      keyword_with_end   | keyword_with_arg |
                      keyword_with_fname | keyword_modifier ;

constant       = c_upper c_alnum*;
bareword       = c_alpha c_alnum*;

call_or_var    = c_lower c_alnum*;
class_var      = '@@' bareword;
instance_var   = '@' bareword;
global_var     = '$'
    ( bareword | digit+
    | [ `~=*$?!@/\\;,.:<>"] #`
    | '-' c_alnum
    )
;

# Ruby accepts (and fails on) variables with leading digit
# in literal context, but not in unquoted symbol body.
class_var_v    = '@@' c_alnum+;
instance_var_v = '@' c_alnum+;

label          = bareword [?!]? ':';
```

```
  attr_reader   :source_buffer

  attr_accessor :diagnostics
  attr_accessor :static_env
  attr_accessor :force_utf32

  attr_accessor :cond, :cmdarg, :in_kwarg, :context, :command_start

  attr_accessor :tokens, :comments

  attr_reader :paren_nest, :cmdarg_stack, :cond_stack, :lambda_stack

  def initialize(version)
    @version    = version
    @static_env = nil
    @context    = nil

    @tokens     = nil
    @comments   = nil

    reset
  end

  def reset(reset_state=true)
    # Ragel state:
    if reset_state
      # Unit tests set state prior to resetting lexer.
      @cs       = self.class.lex_en_line_begin

      @cond   = StackState.new('cond')
      @cmdarg = StackState.new('cmdarg')
      @cond_stack   = []
      @cmdarg_stack = []
    end

    @force_utf32    = false # Set to true by some tests

    @source_pts     = nil # @source as a codepoint array

    @p              = 0   # stream position (saved manually in #advance)
    @ts             = nil # token start
    @te             = nil # token end
    @act            = 0   # next action

    @stack          = []  # state stack
    @top            = 0   # state stack top pointer

    # Lexer state:
    @token_queue    = []
    @literal_stack  = []

    @eq_begin_s     = nil # location of last encountered =begin
    @sharp_s        = nil # location of last encountered #

    @newline_s      = nil # location of last encountered newline

    @num_base       = nil # last numeric base
    @num_digits_s   = nil # starting position of numeric digits
    @num_suffix_s   = nil # starting position of numeric suffix
    @num_xfrm       = nil # numeric suffix-induced transformation

    @escape_s       = nil # starting position of current sequence
    @escape         = nil # last escaped sequence, as string

    @herebody_s     = nil # starting position of current heredoc line

    # Ruby 1.9 ->() lambdas emit a distinct token if do/{ is
    # encountered after a matching closing parenthesis.
    @paren_nest     = 0
    @lambda_stack   = []

    # After encountering the closing line of <<~SQUIGGLY_HEREDOC,
    # we store the indentation level and give it out to the parser
    # on request. It is not possible to infer indentation level just
    # from the AST because escape sequences such as `\ ` or `\t` are
    # expanded inside the lexer, but count as non-whitespace for
    # indentation purposes.
    @dedent_level   = nil

    # If the lexer is in `command state' (aka expr_value)
    # at the entry to #advance, it will transition to expr_cmdarg
    # instead of expr_arg at certain points.
    @command_start = true

    # True at the end of "def foo a:"
    @in_kwarg       = false

    # State before =begin / =end block comment
    @cs_before_block_comment = self.class.lex_en_line_begin
  end
```

```
  def eof_codepoint?(point)
    [0x04, 0x1a, 0x00].include? point
  end

  def version?(*versions)
    versions.include?(@version)
  end

  def stack_pop
    @top -= 1
    @stack[@top]
  end

  def encode_escape(ord)
    ord.chr.force_encoding(@source_buffer.source.encoding)
  end

  def tok(s = @ts, e = @te)
    @source_buffer.slice(s...e)
  end

  def range(s = @ts, e = @te)
    Parser::Source::Range.new(@source_buffer, s, e)
  end

  def emit(type, value = tok, s = @ts, e = @te)
    token = [ type, [ value, range(s, e) ] ]

    @token_queue.push(token)

    @tokens.push(token) if @tokens

    token
  end

  def emit_table(table, s = @ts, e = @te)
    value = tok(s, e)

    emit(table[value], value, s, e)
  end

  def emit_do(do_block=false)
    if @cond.active?
      emit(:kDO_COND, 'do'.freeze)
    elsif @cmdarg.active? || do_block
      emit(:kDO_BLOCK, 'do'.freeze)
    else
      emit(:kDO, 'do'.freeze)
    end
  end

  def arg_or_cmdarg(cmd_state)
    if cmd_state
      self.class.lex_en_expr_cmdarg
    else
      self.class.lex_en_expr_arg
    end
  end

  def emit_comment(s = @ts, e = @te)
    if @comments
      @comments.push(Parser::Source::Comment.new(range(s, e)))
    end

    if @tokens
      @tokens.push([ :tCOMMENT, [ tok(s, e), range(s, e) ] ])
    end

    nil
  end

  def diagnostic(type, reason, arguments=nil, location=range, highlights=[])
    @diagnostics.process(
        Parser::Diagnostic.new(type, reason, arguments, location,
highlights))
  end

  #
  # === LITERAL STACK ===
  #

  def push_literal(*args)
    new_literal = Literal.new(self, *args)
    @literal_stack.push(new_literal)
    next_state_for_literal(new_literal)
  end

  def next_state_for_literal(literal)
    if literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited_words
      else
        self.class.lex_en_plain_backslash_delimited_words
      end
    elsif literal.words? && !literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_words
      else
        self.class.lex_en_plain_words
      end
    elsif !literal.words? && literal.backslash_delimited?
      if literal.interpolate?
        self.class.lex_en_interp_backslash_delimited
      else
        self.class.lex_en_plain_backslash_delimited
      end
    else
      if literal.interpolate?
        self.class.lex_en_interp_string
      else
        self.class.lex_en_plain_string
      end
    end
  end

  def literal
    @literal_stack.last
  end

  def pop_literal
    old_literal = @literal_stack.pop

    @dedent_level = old_literal.dedent_level

    if old_literal.type == :tREGEXP_BEG
      # Fetch modifiers.
      self.class.lex_en_regexp_modifiers
    else
      self.class.lex_en_expr_end
    end
  end
```

```
# Mapping of strings to parser tokens.

PUNCTUATION = {
  '='   => :tEQL,     '&'   => :tAMPER2,  '|'   => :tPIPE,
  '!'   => :tBANG,    '^'   => :tCARET,   '+'   => :tPLUS,
  '-'   => :tMINUS,   '*'   => :tSTAR2,   '/'   => :tDIVIDE,
  '%'   => :tPERCENT, '~'   => :tTILDE,   ','   => :tCOMMA,
  ';'   => :tSEMI,    '.'   => :tDOT,     '..'  => :tDOT2,
  '...' => :tDOT3,    '['   => :tLBRACK2, ']'   => :tRBRACK,
  '('   => :tLPAREN2, ')'   => :tRPAREN,  '?'   => :tEH,
  ':'   => :tCOLON,   '&&'  => :tANDOP,   '||'  => :tOROP,
  '-@'  => :tUMINUS,  '+@'  => :tUPLUS,   '~@'  => :tTILDE,
  '**'  => :tPOW,     '->'  => :tLAMBDA,  '=~'  => :tMATCH,
  '!~'  => :tNMATCH,  '=='  => :tEQ,      '!='  => :tNEQ,
  '>'   => :tGT,      '>>'  => :tRSHFT,   '>='  => :tGEQ,
  '<'   => :tLT,      '<<'  => :tLSHFT,   '<='  => :tLEQ,
  '=>'  => :tASSOC,   '::'  => :tCOLON2,  '===' => :tEQQ,
  '<=>' => :tCMP,     '[]'  => :tAREF,    '[]=' => :tASET,
  '{'   => :tLCURLY,  '}'   => :tRCURLY,  '`'   => :tBACK_REF2,
  '!@'  => :tBANG,    '&.'  => :tANDDOT,
}

PUNCTUATION_BEGIN = {
  '&'   => :tAMPER,   '*'   => :tSTAR,    '**'  => :tDSTAR,
  '+'   => :tUPLUS,   '-'   => :tUMINUS,  '::'  => :tCOLON3,
  '('   => :tLPAREN,  '{'   => :tLBRACE,  '['   => :tLBRACK,
}

KEYWORDS = {
  'if'      => :kIF_MOD,      'unless'   => :kUNLESS_MOD,
  'while'   => :kWHILE_MOD,   'until'    => :kUNTIL_MOD,
  'rescue'  => :kRESCUE_MOD,  'defined?' => :kDEFINED,
  'BEGIN'   => :klBEGIN,      'END'      => :klEND,
}

KEYWORDS_BEGIN = {
  'if'      => :kIF,          'unless'   => :kUNLESS,
  'while'   => :kWHILE,       'until'    => :kUNTIL,
  'rescue'  => :kRESCUE,      'defined?' => :kDEFINED,
  'BEGIN'   => :klBEGIN,      'END'      => :klEND,
}

%w(class module def undef begin end then elsif else ensure case when
   for break next redo retry in do return yield super self nil true
   false and or not alias __FILE__ __LINE__ __ENCODING__).each do
|keyword|
  KEYWORDS_BEGIN[keyword] = KEYWORDS[keyword] = :"k#{keyword.upcase}"
end
```

```
# === CHARACTER CLASSES ===
#
# Pay close attention to the differences between c_any and any.
# c_any does not include EOF and so will cause incorrect behavior
# for machine subtraction (any-except rules) and default transitions
# for scanners.

action do_nl {
  # Record position of a newline for precise location reporting on tNL
  # tokens.
  #
  # This action is embedded directly into c_nl, as it is idempotent and
  # there are no cases when we need to skip it.
  @newline_s = p
}

c_nl      = '\n' $ do_nl;
c_space   = [ \t\r\f\v];
c_space_nl = c_space | c_nl;

c_eof     = 0x04 | 0x1a | 0 | zlen; # ^D, ^Z, \0, EOF
c_eol     = c_nl | c_eof;
c_any     = any - c_eof;

c_nl_zlen  = c_nl | zlen;
c_line     = any - c_nl_zlen;

c_unicode  = c_any - 0x00..0x7f;
c_upper    = [A-Z];
c_lower    = [a-z_]  | c_unicode;
c_alpha    = c_lower | c_upper;
c_alnum    = c_alpha | [0-9];

action do_eof {
  # Sit at EOF indefinitely. #advance would return $eof each time.
  # This allows to feed the lexer more data if needed; this is only used
  # in tests.
  #
  # Note that this action is not embedded into e_eof like e_heredoc_nl and
e_bs
  # below. This is due to the fact that scanner state at EOF is observed
  # by tests, and encapsulating it in a rule would break the
introspection.
  fhold; fbreak;
}

#
# === TOKEN DEFINITIONS ===
#

# All operators are punctuation. There is more to punctuation
# than just operators. Operators can be overridden by user;
# punctuation can not.

# A list of operators which are valid in the function name context, but
# have different semantics in others.
operator_fname      = '[]' | '[]=' | '`'  | '-@' | '+@' | '~@'  | '!@' ;

# A list of operators which can occur within an assignment shortcut (+ →
+=).
operator_arithmetic = '&'  | '|'  | '&&' | '||' | '^'  | '+'   | '-'  |
                      '*'  | '/'  | '%'  | '**' | '<<' | '>>'  | '&.' ;

# A list of all user-definable operators not covered by groups above.
operator_rest       = '=~' | '!~' | '~'  | '!'  | '<=>' |
                      '<'  | '<=' | '>'  | '>=' | '===' | '=>' ;

# Note that `{` and `}` need to be referred to as e_lbrace and e_rbrace,
# as they are ambiguous with interpolation `#{}` and should be counted.
# These braces are not present in punctuation lists.

# A list of punctuation which has different meaning when used at the
# beginning of expression.
punctuation_begin   = '-'  | '+'  | '::' | '('  | '[' |
                      '*'  | '**' | '&' ;

# A list of all punctuation except punctuation_begin.
punctuation_end     = ','  | '='  | '->' | '{'  | ']' | '}' |
                      '::' | '?'  | ':'  | '.'  | '..' | '...' ;

# A list of keywords which have different meaning at the beginning of
expression.
keyword_modifier    = 'if'     | 'unless' | 'while'  | 'until' | 'rescue'
;

# A list of keywords which accept an argument-like expression, i.e. have
the
# same post-processing as method calls or commands. Example: `yield 1`,
# `yield(1)`, `yield[1]`, are interpreted as if `yield` was a function.
keyword_with_arg    = 'yield'  | 'super'  | 'not'    | 'defined?' ;

# A list of keywords which accept a literal function name as an argument.
keyword_with_fname  = 'def'    | 'undef'  | 'alias' ;

# A list of keywords which accept an expression after them.
keyword_with_value  = 'else'   | 'case'   | 'ensure' | 'module' | 'elsif'
| 'then'   |
                      'for'    | 'in'     | 'do'     | 'when'   | 'begin'
| 'class' |
                      'and'    | 'or'     ;

# A list of keywords which accept a value, and treat the keywords from
# `keyword_modifier` list as modifiers.
keyword_with_mid    = 'rescue' | 'return' | 'break'  | 'next'   ;

# A list of keywords which do not accept an expression after them.
keyword_with_end    = 'end'    | 'self'   | 'true'   | 'false'  | 'retry'
  |
                      'redo'   | 'nil'    | 'BEGIN'  | 'END'    |
'__FILE__' |
                      '__LINE__' | '__ENCODING__';

# All keywords.
keyword             = keyword_with_value | keyword_with_mid |
                      keyword_with_end   | keyword_with_arg |
                      keyword_with_fname | keyword_modifier ;


constant        = c_upper c_alnum*;
bareword        = c_alpha c_alnum*;

call_or_var     = c_lower c_alnum*;
class_var       = '@@' bareword;
instance_var    = '@' bareword;
global_var      = '$'
    ( bareword | digit+
    | [~*$?!@/\\;,.=:<>"] #
    | '-' c_alnum
    )
;

# Ruby accepts (and fails on) variables with leading digit
# in literal context, but not in unquoted symbol body.
class_var_v     = '@@' c_alnum+;
instance_var_v  = '@' c_alnum+;

label           = bareword [?!]? ':';
```


2 + 2
Lexer
[tNUMBER, 2],
[tPLUS, "+"],
[tNUMBER, 2]

```ruby
class Lexer
  def initialize
    @data = nil # array of input symbols
    @ts = nil # token start index
    @te = nil # token end index
    @eof = nil # EOF index
    @tokens = [] # resulting array of tokens
  end
end
```

```
class Lexer
  %%{ #%
    machine ultimate_math_machine;

    access @;
    variable eof @eof;

    number   = [0-9]+;
    operator = "+" | "-" | "/" | "*";
    paren    = "(" | ")";

    main := |*
      number           => { puts "number [#{@ts},#{@te}]" };
      operator | paren => { puts "operator [#{@ts},#{@te}]" };
      space;
    *|;
  }%% #%
end
```

```
class Lexer
  def run(input)
    @data = input.unpack("c*")
    @eof = input.length

    %% write data; #%# Ragel static data init
    %% write init; #%# State machine init
    %% write exec; #%# State machine execution
  end
end
```

```ruby
class Lexer
  def run(input)
    @data = input.unpack("c*")
    @eof = input.length

    %% write data; #%# Ragel static data init
    %% write init; #%# State machine init
    %% write exec; #%# State machine execution
  end
end
```

```
$ ragel -R lexer.rl -o lexer.rb

$ ruby -r './lexer.rb' -e 'Lexer.new.run("40 + 2")'
number [0,2]
operator [3,4]
number [5,6]
```

```
class Lexer
  def current_token
    @data[@ts...@te].pack("c*")
  end

  def emit(type, tok = current_token)
    @tokens.push([type, tok])
  end
end
```

```ruby
class Lexer
  def current_token
    @data[@ts...@te].pack("c*")
  end

  def emit(type, tok = current_token)
    @tokens.push([type, tok])
  end
end
```

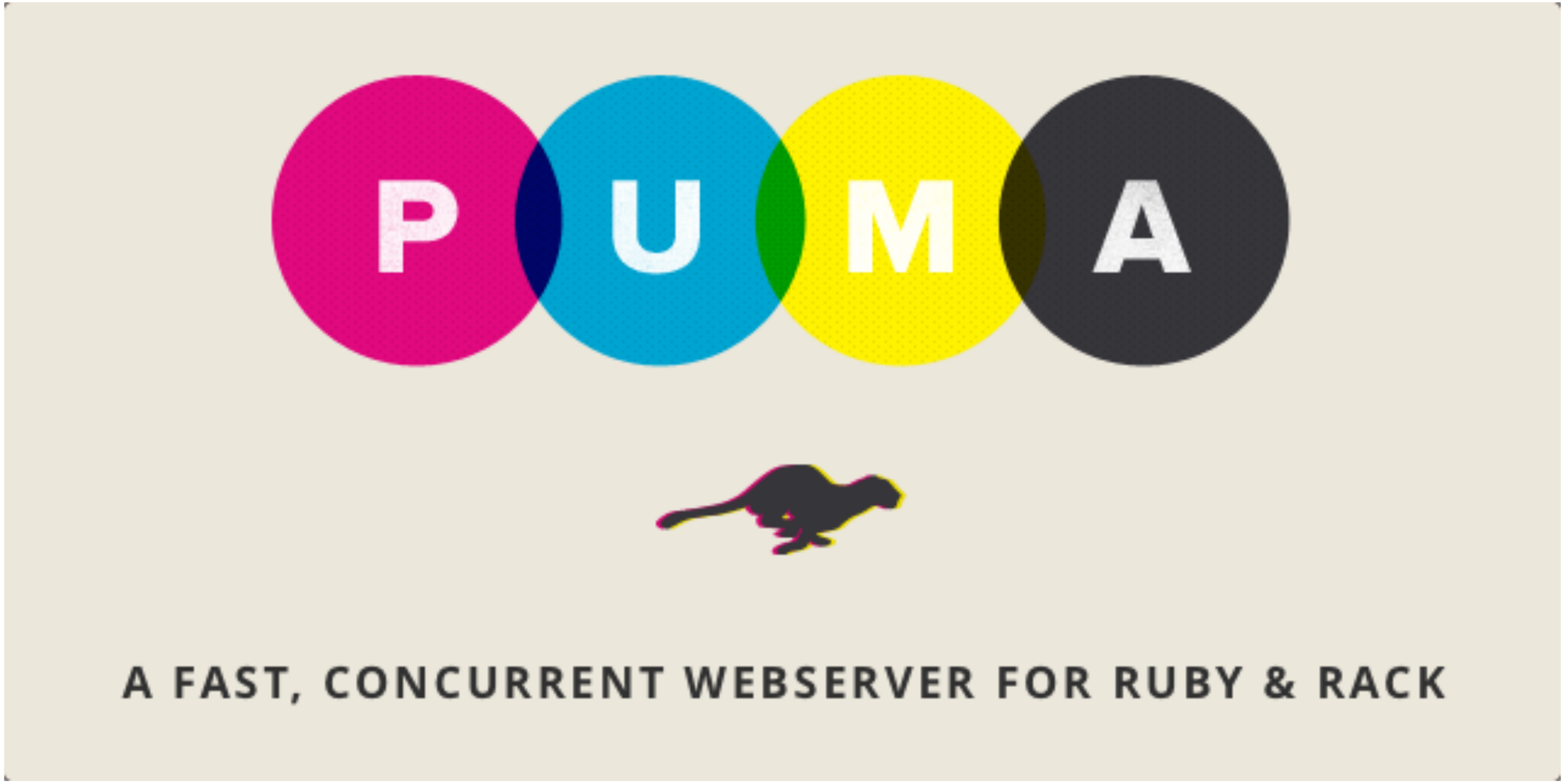
```ruby
class Lexer
  PUNCTUATION = {
    '+' ⇒ :tPLUS,   '-' ⇒ :tMINUS,
    '*' ⇒ :tSTAR,   '/' ⇒ :tDIVIDE,
    '(' ⇒ :tLPAREN, ')' ⇒ :tRPAREN
  }

  def emit_table(table)
    token = current_token
    emit(table[token], token)
  end
end
```

```
1 class Lexer
2   %%{ #%
3     main := |*
4       number             ⇒ { emit(:tNUMBER) };
5       operator | paren ⇒ { emit_table(PUNCTUATION) };
6       space;
7     *|;
8   }%% #%
9 end
```

```
class Lexer
  %%{ #%
    main := |*
      number            ⇒ { emit(:tNUMBER) };
      operator | paren ⇒ { emit_table(PUNCTUATION) };
      space;
    *|;
  }%% #%
end
```

```
class Lexer
  def run(input)
    @data = input.unpack("c*")
    @eof = input.length

    %% write data; #%
    %% write init; #%
    %% write exec; #%

    @tokens
  end
end
```

```
$ ragel -R lexer.rl -o lexer.rb

$ ruby -r './lexer.rb' -e 'p Lexer.new.run("2 + (8 * 5)")'
[[:tNUMBER, "2"], [:tPLUS, "+"], [:tLPAREN, "("], [:tNUMBER, "8"],
[:tSTAR, "*"], [:tNUMBER, "5"], [:tRPAREN, ")"]]
```


PUMA
A FAST, CONCURRENT WEBSERVER FOR RUBY & RACK


$ wc -l lib/parser/lexer.rl
2556 lib/parser/lexer.rl
$ ragel -F1 -R lib/parser/lexer.rl -o lib/parser/lexer.rb
$ wc -l lib/parser/lexer.rb
23779 lib/parser/lexer.rb

```
443   PUNCTUATION = {
444     '='   => :tEQL,      '&'   => :tAMPER2,  '|'   => :tPIPE,
445     '!'   => :tBANG,     '^'   => :tCARET,   '+'   => :tPLUS,
446     '-'   => :tMINUS,    '*'   => :tSTAR2,   '/'   => :tDIVIDE,
447     '%'   => :tPERCENT,  '~'   => :tTILDE,   ','   => :tCOMMA,
448     ';'   => :tSEMI,     '.'   => :tDOT,     '..'  => :tDOT2,
449     '...' => :tDOT3,     '['   => :tLBRACK2, ']'   => :tRBRACK,
450     '('   => :tLPAREN2,  ')'   => :tRPAREN,  '?'   => :tEH,
451     ':'   => :tCOLON,    '&&'  => :tANDOP,   '||'  => :tOROP,
452     '-@'  => :tUMINUS,   '+@'  => :tUPLUS,   '~@'  => :tTILDE,
453     '**'  => :tPOW,      '->'  => :tLAMBDA,  '=~'  => :tMATCH,
454     '!~'  => :tNMATCH,   '=='  => :tEQ,      '!='  => :tNEQ,
455     '>'   => :tGT,       '>>'  => :tRSHFT,   '>='  => :tGEQ,
456     '<'   => :tLT,       '<<'  => :tLSHFT,   '<='  => :tLEQ,
457     '=>'  => :tASSOC,    '::'  => :tCOLON2,  '===' => :tEQQ,
458     '<=>' => :tCMP,      '[]'  => :tAREF,    '[]=' => :tASET,
459     '{'   => :tLCURLY,   '}'   => :tRCURLY,  '`'   => :tBACK_REF2,
460     '!@'  => :tBANG,     '&.'  => :tANDDOT,  '.:'  => :tMETHREF,
461     ':='  => :tGOEQL
462   }
```

```
569 # A list of all punctuation except punctuation_begin.
570 punctuation_end     = ','   | '='   | ':='   | '→' | '('   | '['   |
571                       ']'   | '::'  | '?'    | ':'  | '.'   | '..'  | '...' ;
```

```
1399 # expr_fname := |*
1400 # ...
1401         '::'
1402             => { fhold; fhold; fgoto expr_end; };
1403
1404         ':='
1405             => { fhold; fhold; fgoto expr_end; };
1406
1407         ':'
1408             => { fhold; fgoto expr_beg; };
```

```ruby
# test/ruby-next/test_lexer.rb

  def test_go_eql
    setup_lexer "next"

    assert_scanned('foo := 42',
      :tIDENTIFIER, 'foo', [0, 3],
      :tGOEQL,       ':=',  [4, 6],
      :tINTEGER,      42, [7, 9])
  end
```

```
$ bundle exec rake test
Run options: --seed 35817

# Running:

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Finished in 7.056126s, 152.0664 runs/s, 48174.1681 assertions/s.

1073 runs, 339923 assertions, 0 failures, 0 errors, 0 skips
3 additional tests on 221724 nodes ran successfully
```
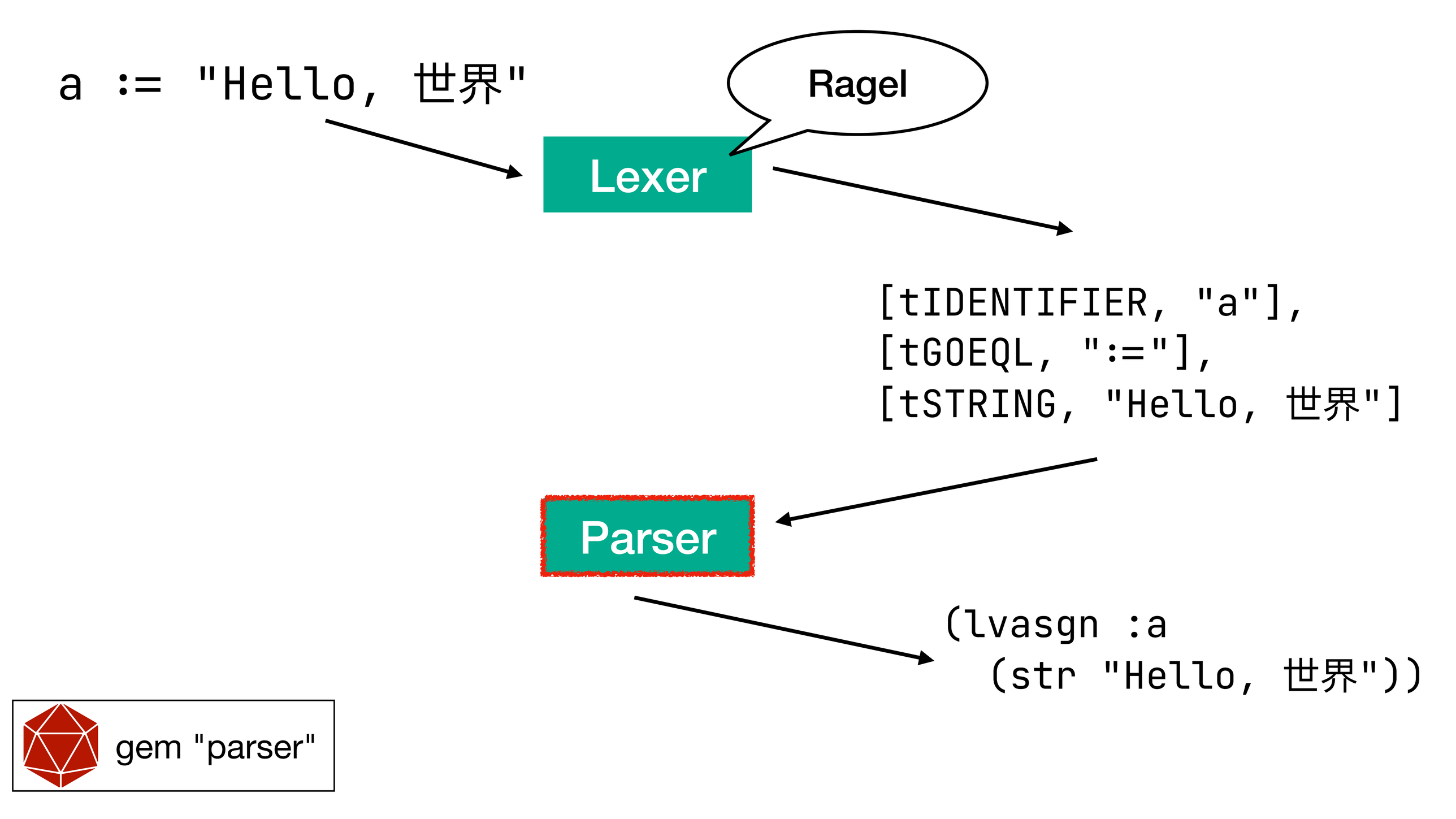
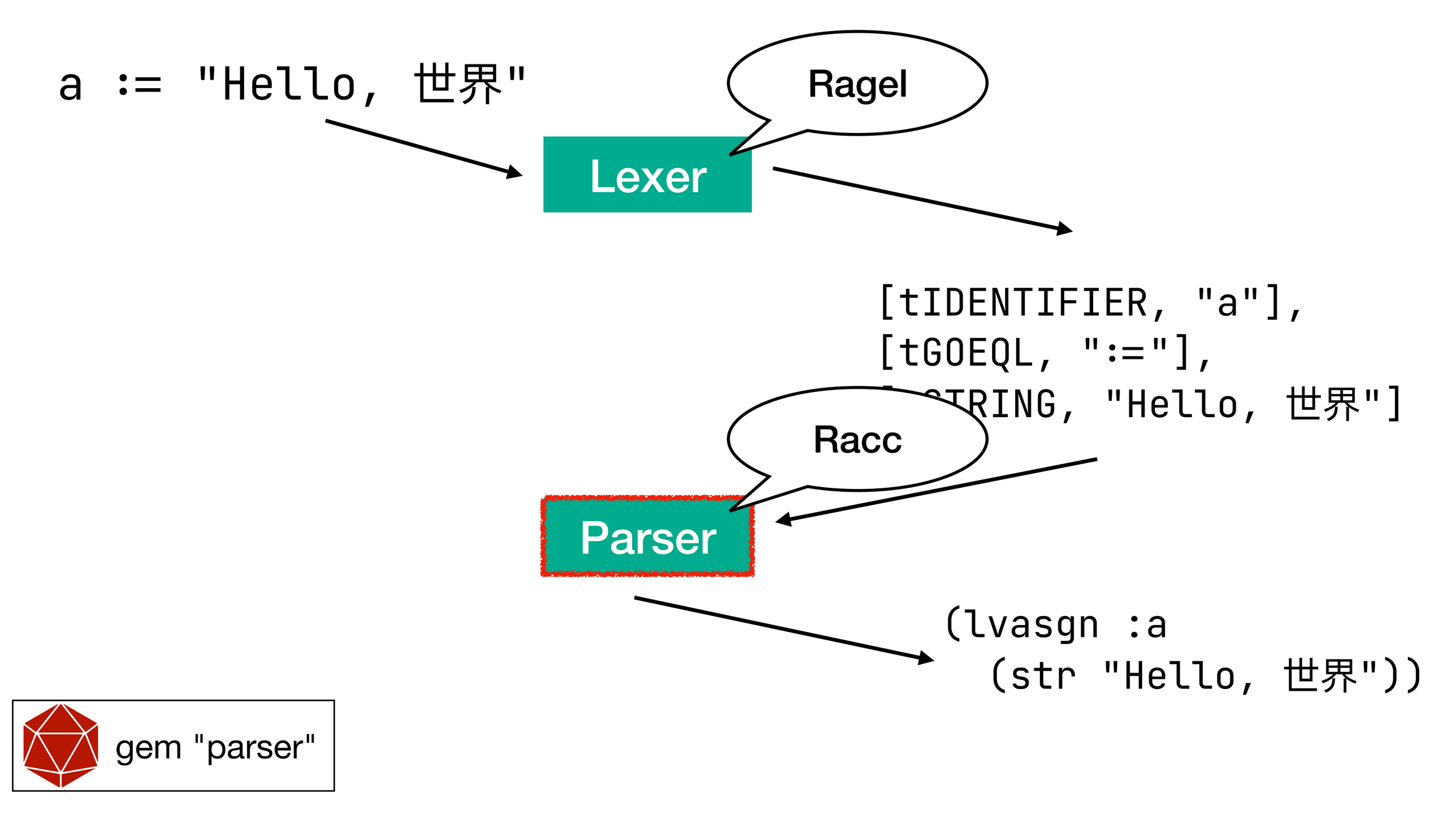
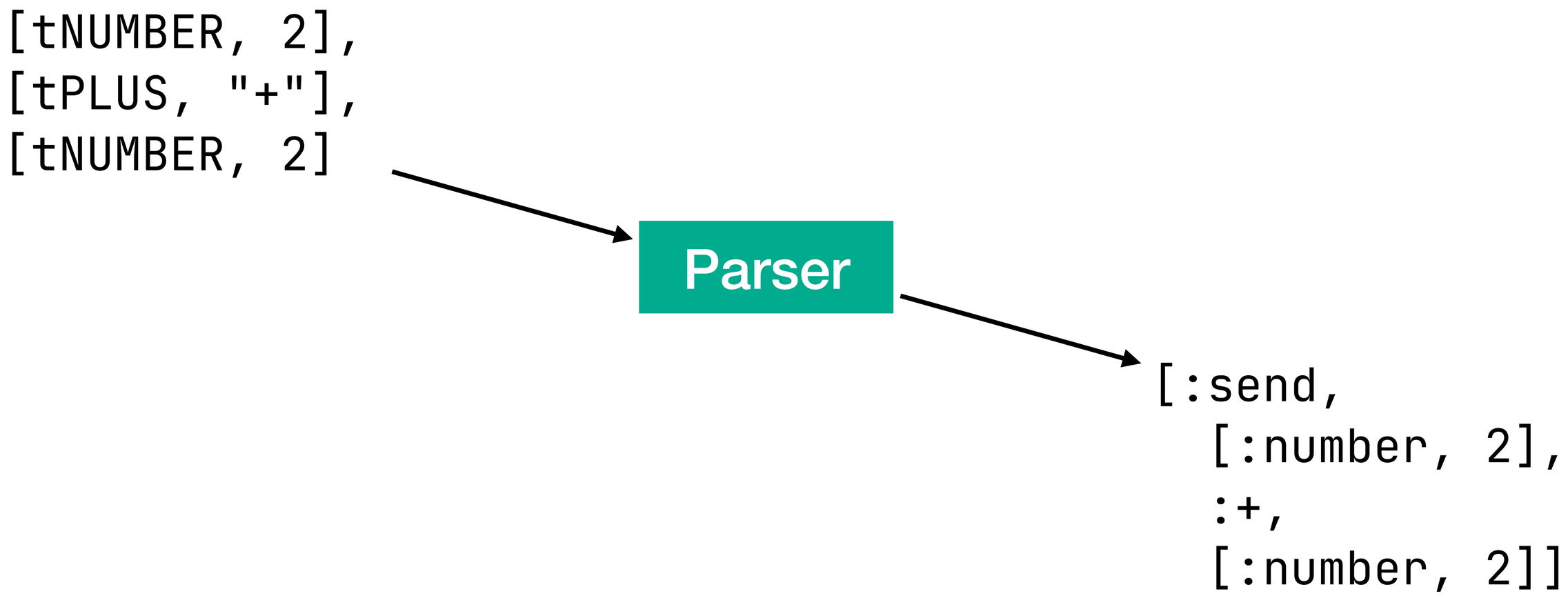


a := "Hello, 世界"
Ragel
Lexer
[tIDENTIFIER, "a"],
[tGOEQL, ":="],
[tSTRING, "Hello, 世界"]
Parser
(lvasgn :a
(str "Hello, 世界"))
gem "parser"


I VOTED
Maricopa County Recorder & Elections Department

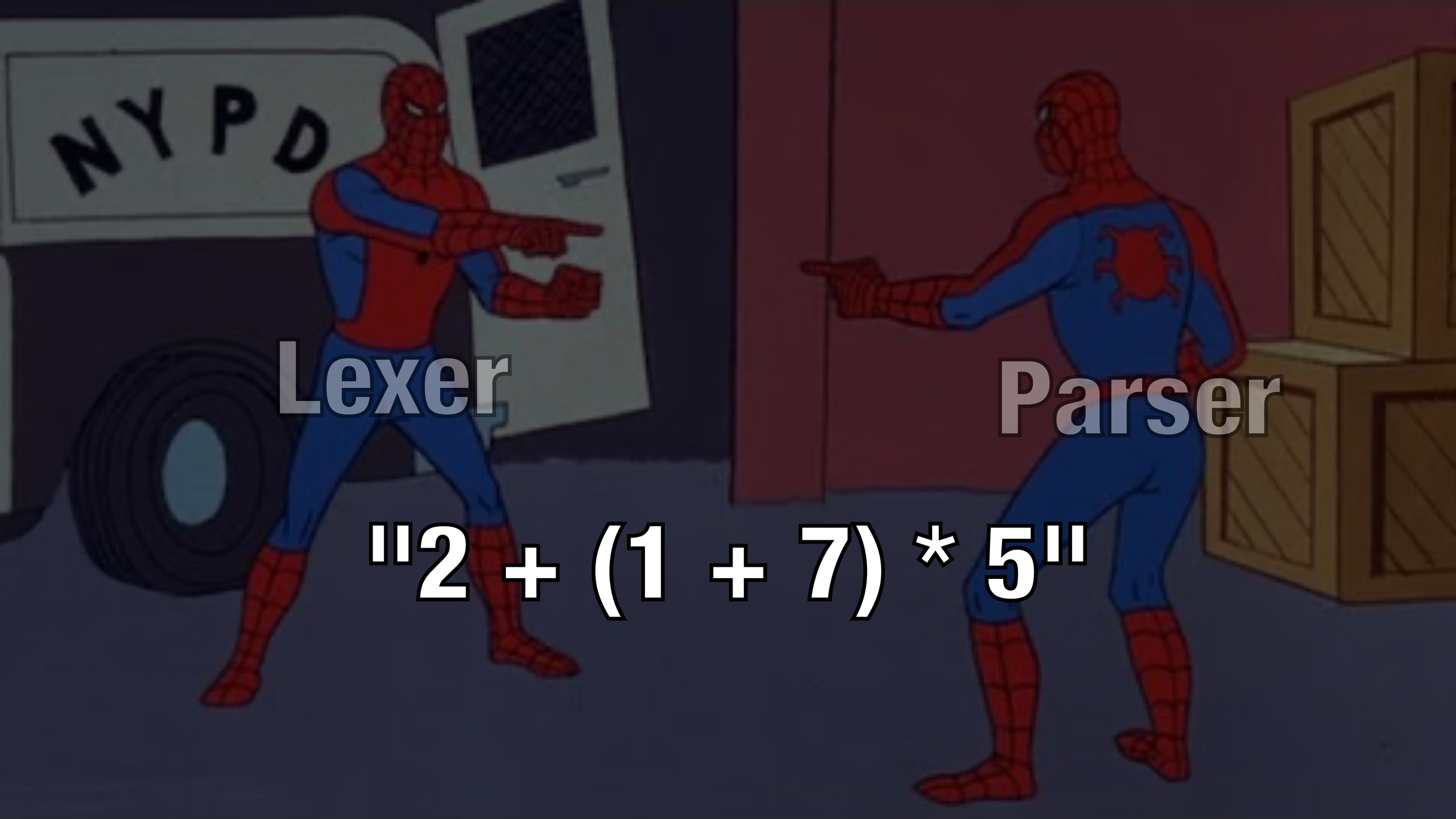

a := "Hello, 世界"
Ragel
Lexer
[tIDENTIFIER, "a"],
[tGOEQL, ":="],
Racc
Parser
(lvasgn :a
(str "Hello, 世界"))
gem "parser"

~~Rake~~ ~~Rack~~ Racc

- Yacc/Bison like parser generator
- Grammar file should contain:
  - parser class with defined #next_token
  - rules block


[tNUMBER, 2],
[tPLUS, "+"],
[tNUMBER, 2]
Parser
[:send,
[:number, 2],
:+,
[:number, 2]]


NYPD
Lexer
Parser


NYPD
Lexer
Parser
"2 + (1 + 7) * 5"

```
class MathParser
  token tNUMBER tPLUS   tMINUS  tSTAR
        tDIVIDE tLPAREN tRPAREN

  prechigh
    left tSTAR tDIVIDE
    left tPLUS tMINUS
  preclow
end
```

```
class MathParser
  # ...
  rule
    exp: operation
       | paren
       | number

    number: tNUMBER { result = [:number, val[0]] }

    paren: tLPAREN exp tRPAREN { result = val[1] }

    operation: exp tPLUS exp   { result = [:send, val[0], val[1], val[2]] }
             | exp tMINUS exp  { result = [:send, val[0], val[1], val[2]] }
             | exp tSTAR exp   { result = [:send, val[0], val[1], val[2]] }
             | exp tDIVIDE exp { result = [:send, val[0], val[1], val[2]] }
end
```

```ruby
# class MathParser ... end

---- header
require_relative "./lexer.rb"

---- inner

def parse(arg)
  @tokens = Lexer.new.run(arg)
  do_parse
end

def next_token
  @tokens.shift
end
```

```
$ racc parser.y -o parser.rb

$ ruby -r './parser.rb' -e 'pp MathParser.new.parse("5 * (4 + 3) + 2");'
[:send,
  [:send,
    [:number, "5"],
    "*",
    [:send,
      [:number, "4"],
      "+",
      [:number, "3"]]],
  "+",
  [:number, "2"]]
```

Word of the Day : August 26, 2021

parser

noun | pars·er

```
764 #...
765       arg: lhs tEQL arg_rhs
766               {
767                 result = @builder.assign(val[0], val[1], val[2])
768               }
769             #...
```

```
764 #...
765       arg: lhs tEQL arg_rhs
766               {
767                 result = @builder.assign(val[0], val[1], val[2])
768               }
769             #...
```

```
697 # lib/parser/builders/default.rb
698
699 def assign(lhs, eql_t, rhs)
700   (lhs << rhs).updated(nil, nil,
701     :location ⇒ lhs.loc.
702       with_operator(loc(eql_t)).
703       with_expression(join_exprs(lhs, rhs)))
704 end
```

```
class Parser::RubyNext

token kCLASS kMODULE kDEF kUNDEF kBEGIN kRESCUE kENSURE kEND kIF kUNLESS
      kTHEN kELSIF kELSE kCASE kWHEN kWHILE kUNTIL kFOR kBREAK kNEXT
      kREDO kRETRY kIN kDO kDO_COND kDO_BLOCK kDO_LAMBDA kRETURN kYIELD kSUPER
      kSELF kNIL kTRUE kFALSE kAND kOR kNOT kIF_MOD kUNLESS_MOD kWHILE_MOD
      kUNTIL_MOD kRESCUE_MOD kALIAS kDEFINED klBEGIN klEND k__LINE__
      k__FILE__ k__ENCODING__ tIDENTIFIER tFID tGVAR tIVAR tCONSTANT
      tLABEL tCVAR tNTH_REF tBACK_REF tSTRING_CONTENT tINTEGER tFLOAT
      tUPLUS tUMINUS tUNARY_NUM tPOW tCMP tEQ tEQQ tNEQ
      tGEQ tLEQ tANDOP tOROP tMATCH tNMATCH tDOT tDOT2 tDOT3 tAREF
      tASET tLSHFT tRSHFT tCOLON2 tCOLON3 tOP_ASGN tASSOC tLPAREN
      tLPAREN2 tRPAREN tLPAREN_ARG tLBRACK tLBRACK2 tRBRACK tLBRACE
      tLBRACE_ARG tSTAR tSTAR2 tAMPER tAMPER2 tTILDE tPERCENT tDIVIDE
      tDSTAR tPLUS tMINUS tLT tGT tPIPE tBANG tCARET tLCURLY tRCURLY
      tBACK_REF2 tSYMBEG tSTRING_BEG tXSTRING_BEG tREGEXP_BEG tREGEXP_OPT
      tWORDS_BEG tQWORDS_BEG tSYMBOLS_BEG tQSYMBOLS_BEG tSTRING_DBEG
      tSTRING_DVAR tSTRING_END tSTRING_DEND tSTRING tSYMBOL
      tNL tEH tCOLON tCOMMA tSPACE tSEMI tLAMBDA tLAMBEG tCHARACTER
      tRATIONAL tIMAGINARY tLABEL_END tANDDOT tMETHREF tBDOT2 tBDOT3
      tGOEQL
```

```
223     command_asgn: lhs tEQL command_rhs
224                     {
225                       result = @builder.assign(val[0], val[1], val[2])
226                     }
227                 | lhs tGOEQL command_rhs
228                     {
229                       result = @builder.assign(val[0], val[1], val[2])
230                     }
231
```

```
765       arg: lhs tEQL arg_rhs
766               {
767                 result = @builder.assign(val[0], val[1], val[2])
768               }
769           | lhs tGOEQL arg_rhs
770               {
771                 result = @builder.assign(val[0], val[1], val[2])
772               }
773           # ...
```

```ruby
# test/ruby-next/test_parser.rb

  def test_go_eql
    assert_parses(
      s(:lvasgn, :foo, s(:int, 42)),
      %q{foo := 42},
      %q{    ^^ operator
        |~~~~~~~~~ expression},
      SINCE_NEXT)
  end
```

```
$ bundle exec rake test
Run options: --seed 35817

# Running:

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.....................................................................................................................

Finished in 7.056126s, 152.0664 runs/s, 48174.1681 assertions/s.

1073 runs, 339923 assertions, 0 failures, 0 errors, 0 skips
3 additional tests on 221724 nodes ran successfully
```
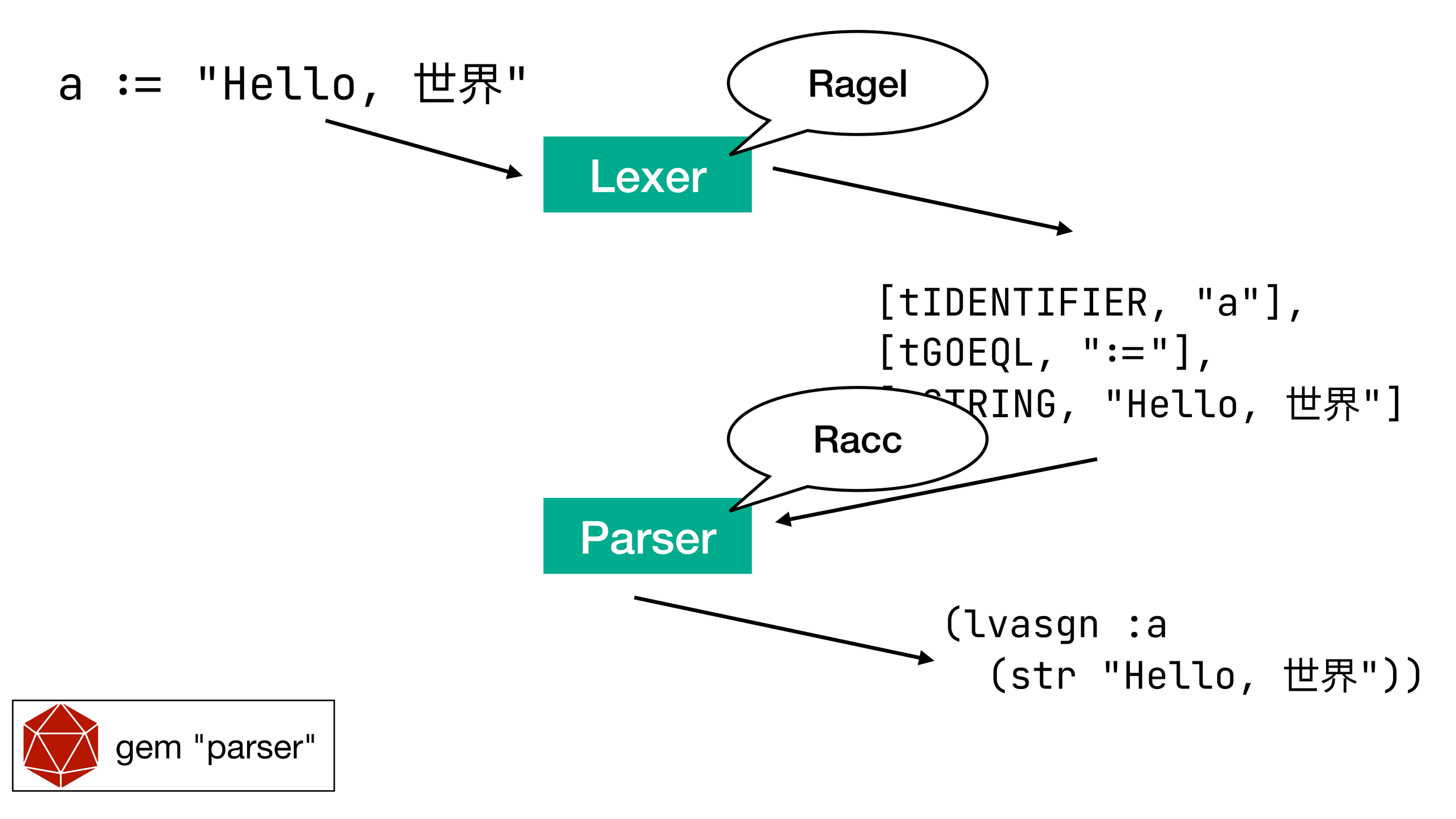
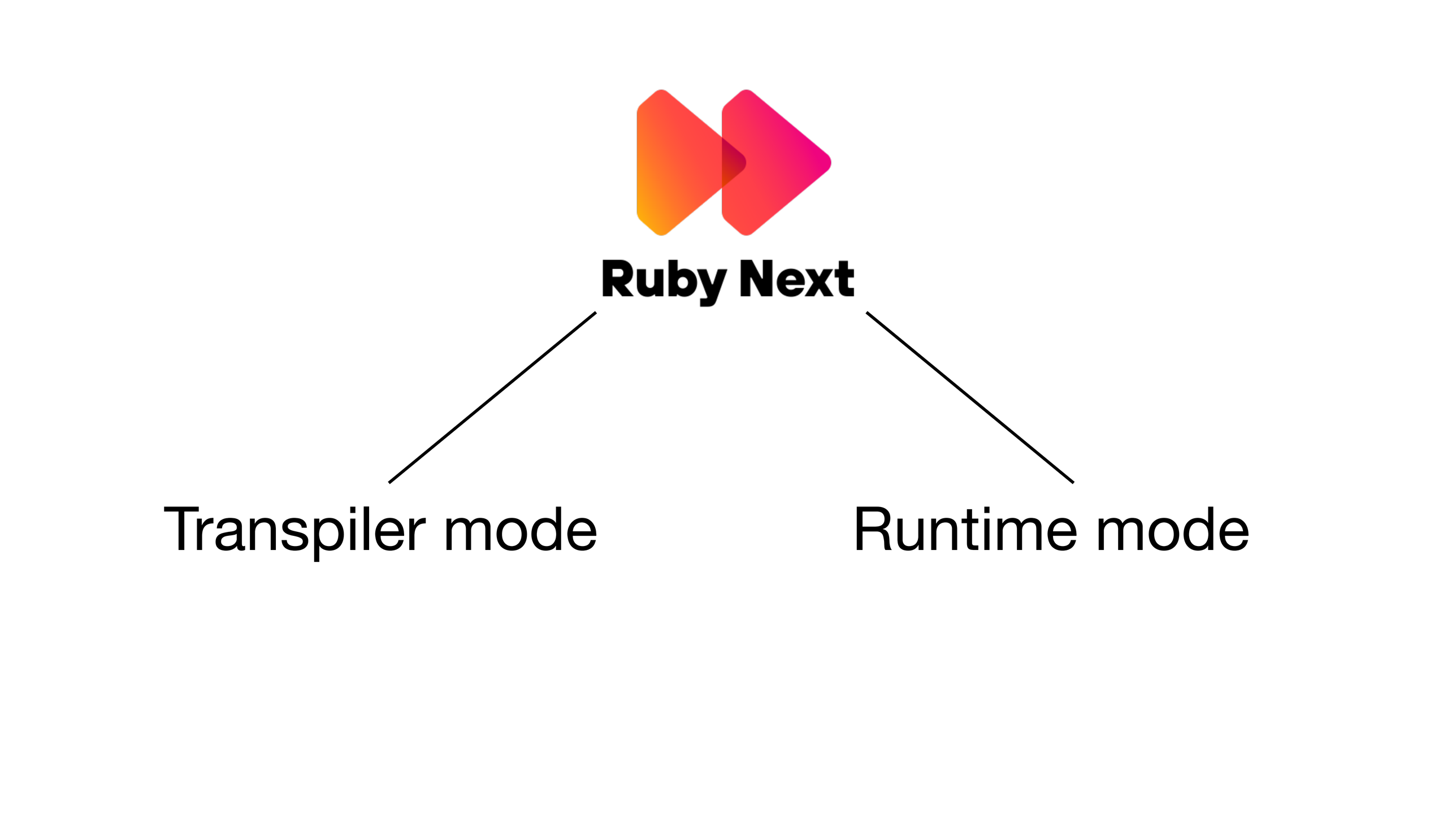
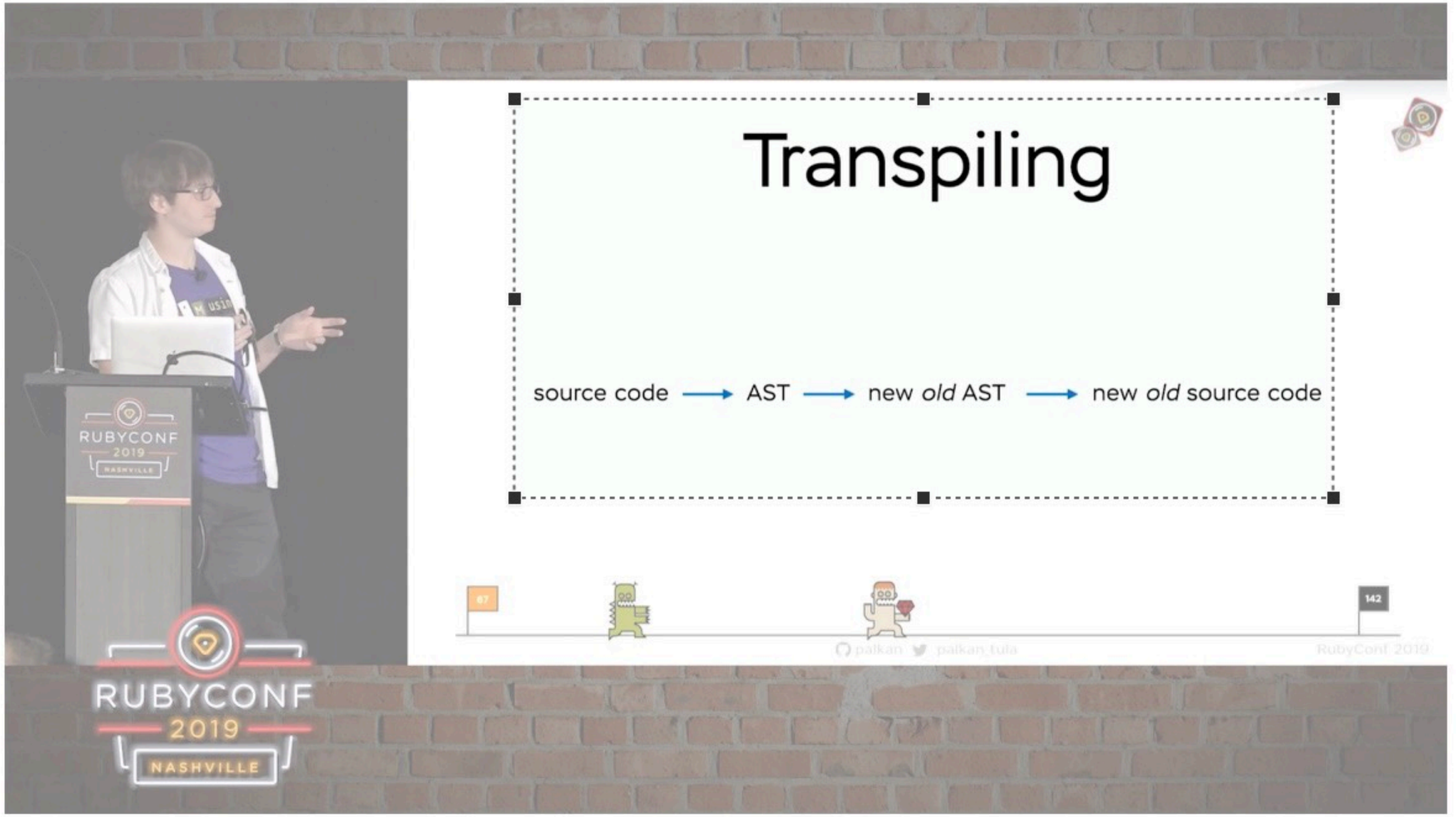


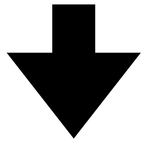
Vin again


a := "Hello, 世界"
Ragel
Lexer
[tIDENTIFIER, "a"],
[tGOEQL, ":="],
Racc
Parser
(lvasgn :a
(str "Hello, 世界"))
gem "parser"


Ruby Next
Transpiler mode
Runtime mode

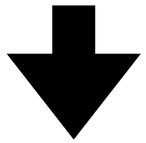

RUBYCONF
2019
NASHVILLE
Transpiling
source code → AST → new *old* AST → new *old* source code
67
142
palkan
palkan_tula
RubyConf 2019
RUBYCONF
2019
NASHVILLE
Done

```
a := "Hello, 世界"
```



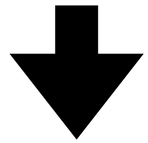
```
(lvasgn :a
  (str "Hello, 世界"))
```

```
a := "Hello, 世界"
```



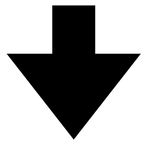
```
(lvasgn :a
  (str "Hello, 世界"))
```

```
a = "Hello, 世界"
```



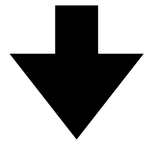
```
(lvasgn :a
  (str "Hello, 世界"))
```

```
a := "Hello, 世界"
  ^^ tGOEQL ":="
```



```
(lvasgn :a
  (str "Hello, 世界"))
```

```
a = "Hello, 世界"
  ^ tEQL "="
```



```
(lvasgn :a
  (str "Hello, 世界"))
```

```ruby
# frozen_string_literal: true

module RubyNext
  module Language
    module Rewriters
      class GoAssign < Base
        NAME = "go-assign"
        SYNTAX_PROBE = "foo := 42"
        MIN_SUPPORTED_VERSION = Gem::Version.new(RubyNext::NEXT_VERSION)

        def on_lvasgn(node)
          return if node.loc.operator == "="

          context.track! self

          replace(node.loc.operator, "=")
        end
      end
    end
  end
end
```


$ ruby -r './lib/go_ruby.rb' ./main.go.rb
Hello, 世界


If you give a man a fish...

skryukov / ruby-go Private

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skryukov Initial commit 15823f2 now 1 commit

README.md Initial commit now

README.md

ruby-go

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Stupidest thing I've never done

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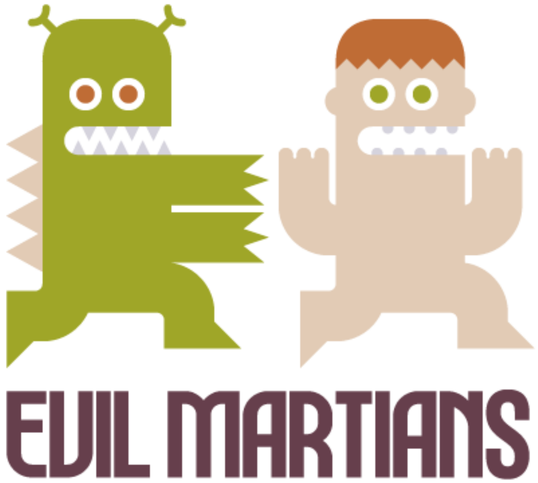
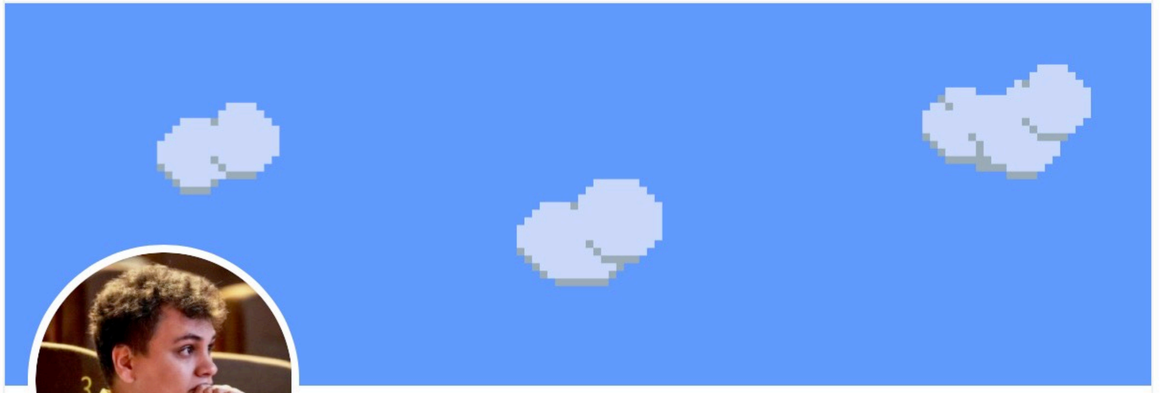


https://evl.ms/obey

Svyatoslav Kryukov
1 Tweet



Edit profile

Svyatoslav Kryukov
@kryukov_s

Backend at @evilmartians

Moscow, Russia github.com/skryukov Joined April 2017

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Svyatoslav Kryukov @kryukov_s · Mar 4

Verifying myself: I am skryukov on Keybase.io.
wZNHF5ZAQR1j50rXxU0w9h-xexpLw7D2V7ue / keybase.io/skryukov/sigs/...


Questions?