How Ruby Works?

- Mayra Cabrera

“Ruby is magical”

- *Every rubyist programmer in the world*

```
> puts “Hello World”

=> “Hello World”



> 1 + 1

=> 2
```

“Ruby is not magical”

Let’s explore Ruby internals…

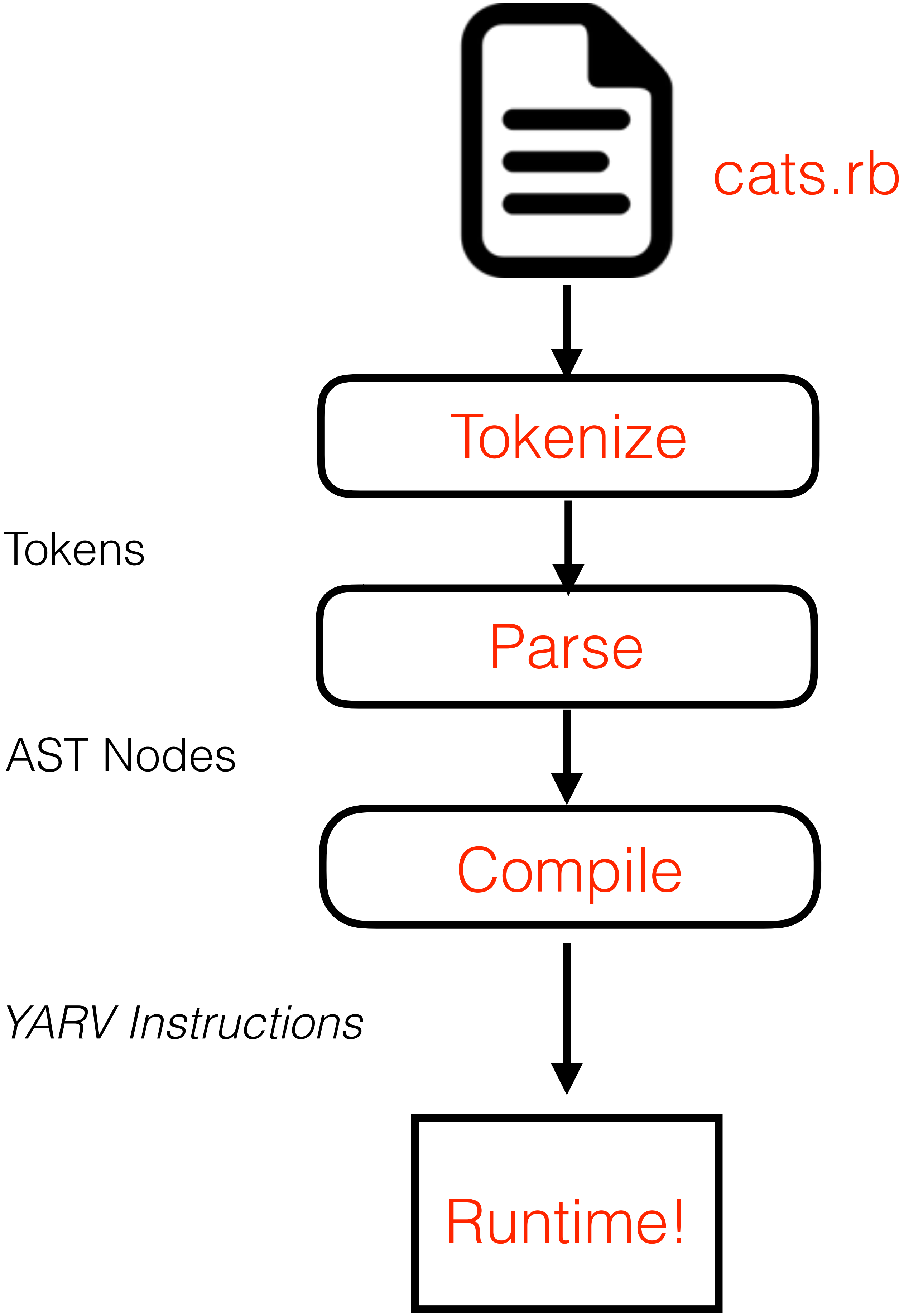
Stuff that we might know

- Ruby is written in C
- MRI (*Mat’z Ruby Interpreter*)

How many times do you think Ruby reads and transforms your code before running it?

🤔

3 times!



cats.rb

Tokenize

Tokens

Parse

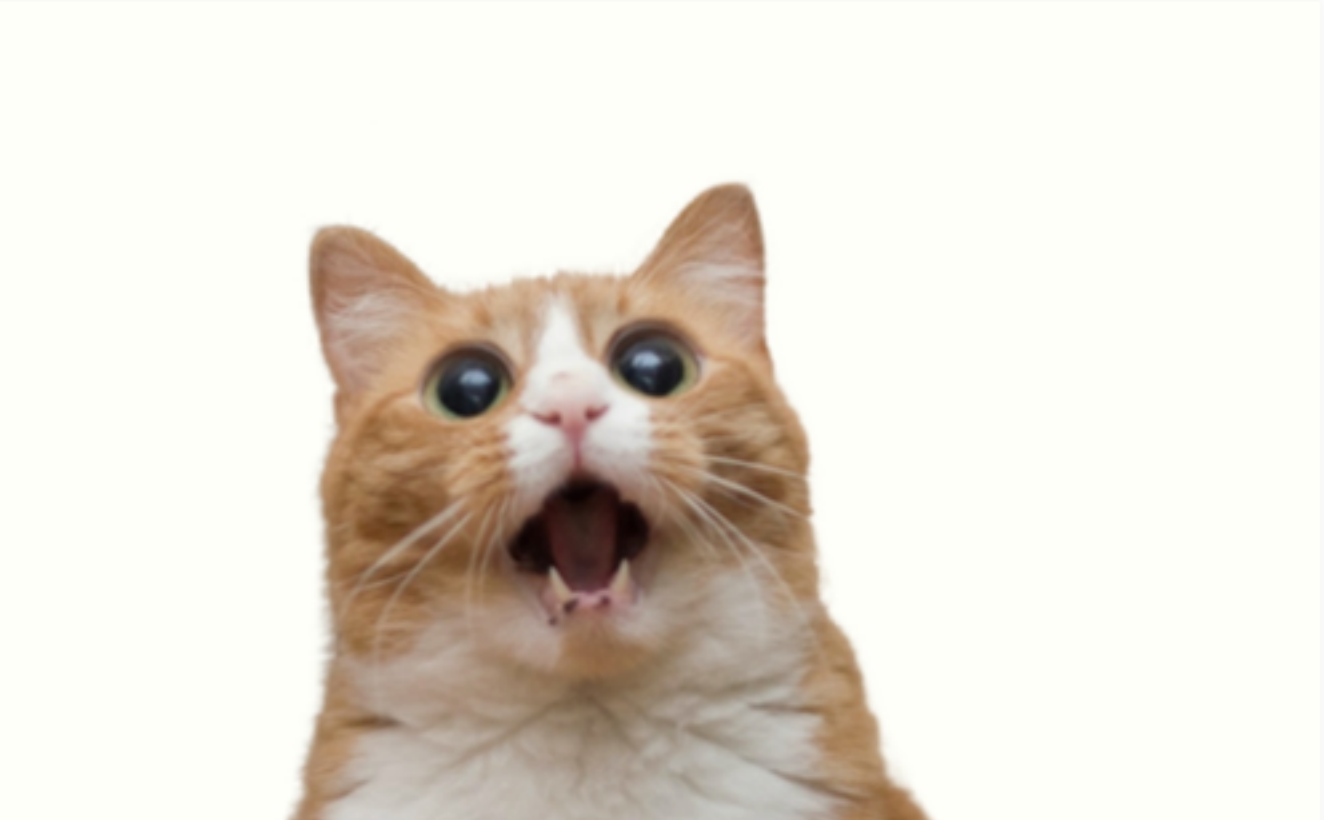
AST Nodes

Compile

YARV Instructions

Runtime!

Tokenize



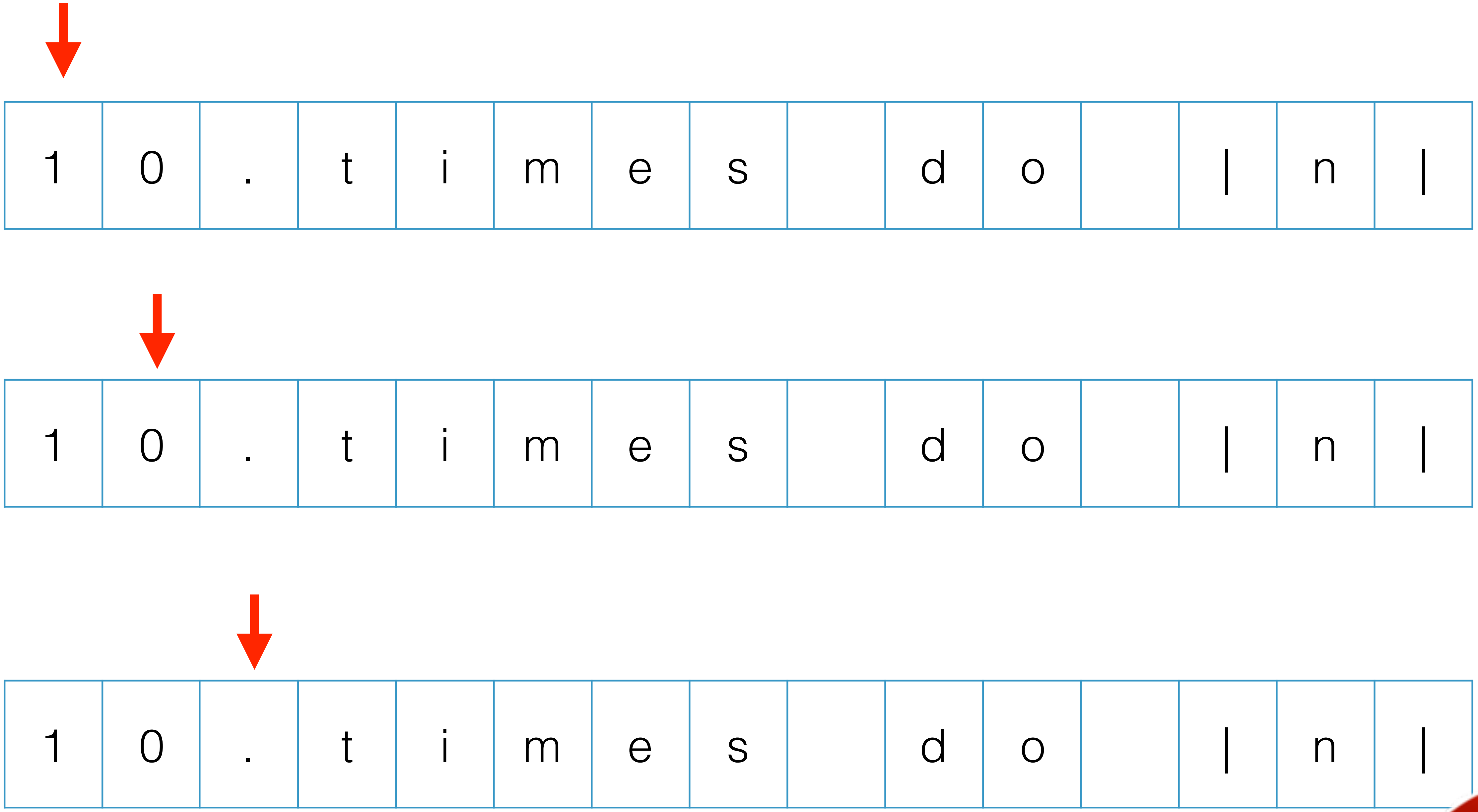
Tokenize

counter.rb

```
10.times do |n|
  puts n
end
```

```
> ruby counter.rb
1
2
3
...
10
```

Tokenize

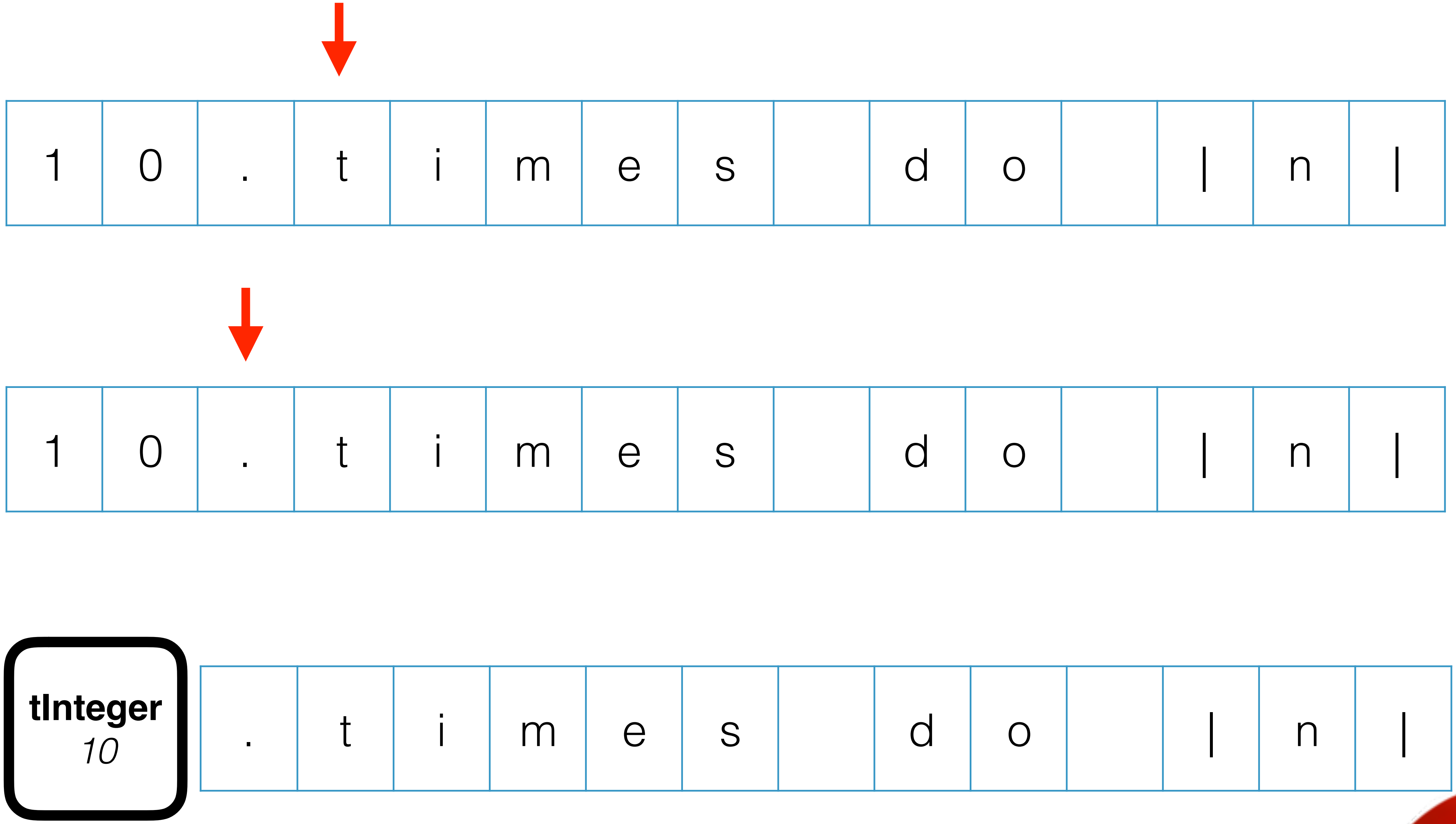


1	0	.	t	i	m	e	s		d	o		|	n	|

1	0	.	t	i	m	e	s		d	o		|	n	|

1	0	.	t	i	m	e	s		d	o		|	n	|

Tokenize

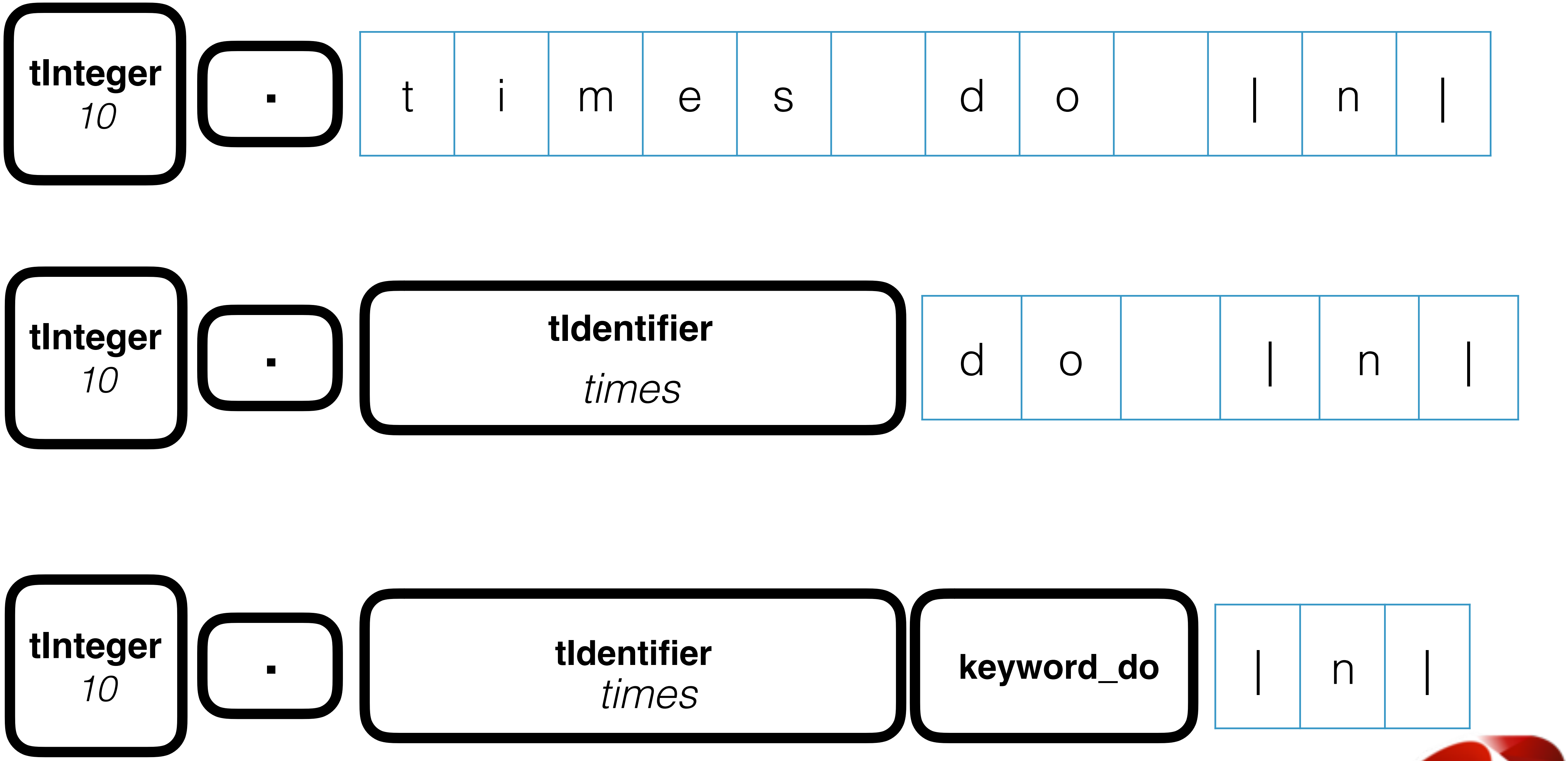


1	0	.	t	i	m	e	s		d	o		|	n	|

1	0	.	t	i	m	e	s		d	o		|	n	|

tInteger *10*	.	t	i	m	e	s		d	o		|	n	|

Tokenize

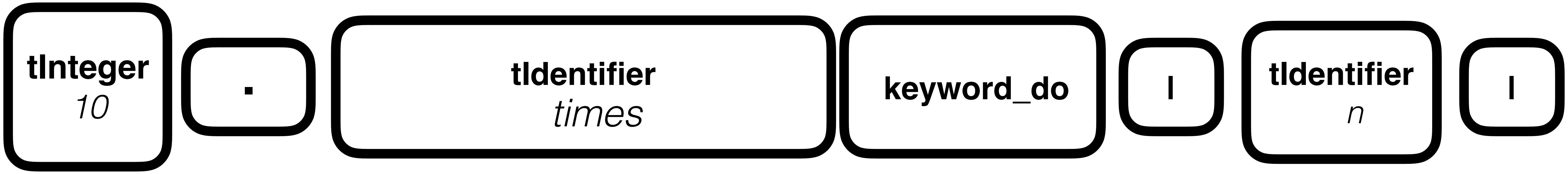


tInteger *10* | . | t | i | m | e | s | | d | o | | \| | n | \|

tInteger *10* | . | **tIdentifier** *times* | d | o | | \| | n | \|

tInteger *10* | . | **tIdentifier** *times* | **keyword_do** | \| | n | \|

Tokenize



tInteger
10

.

tIdentifier
times

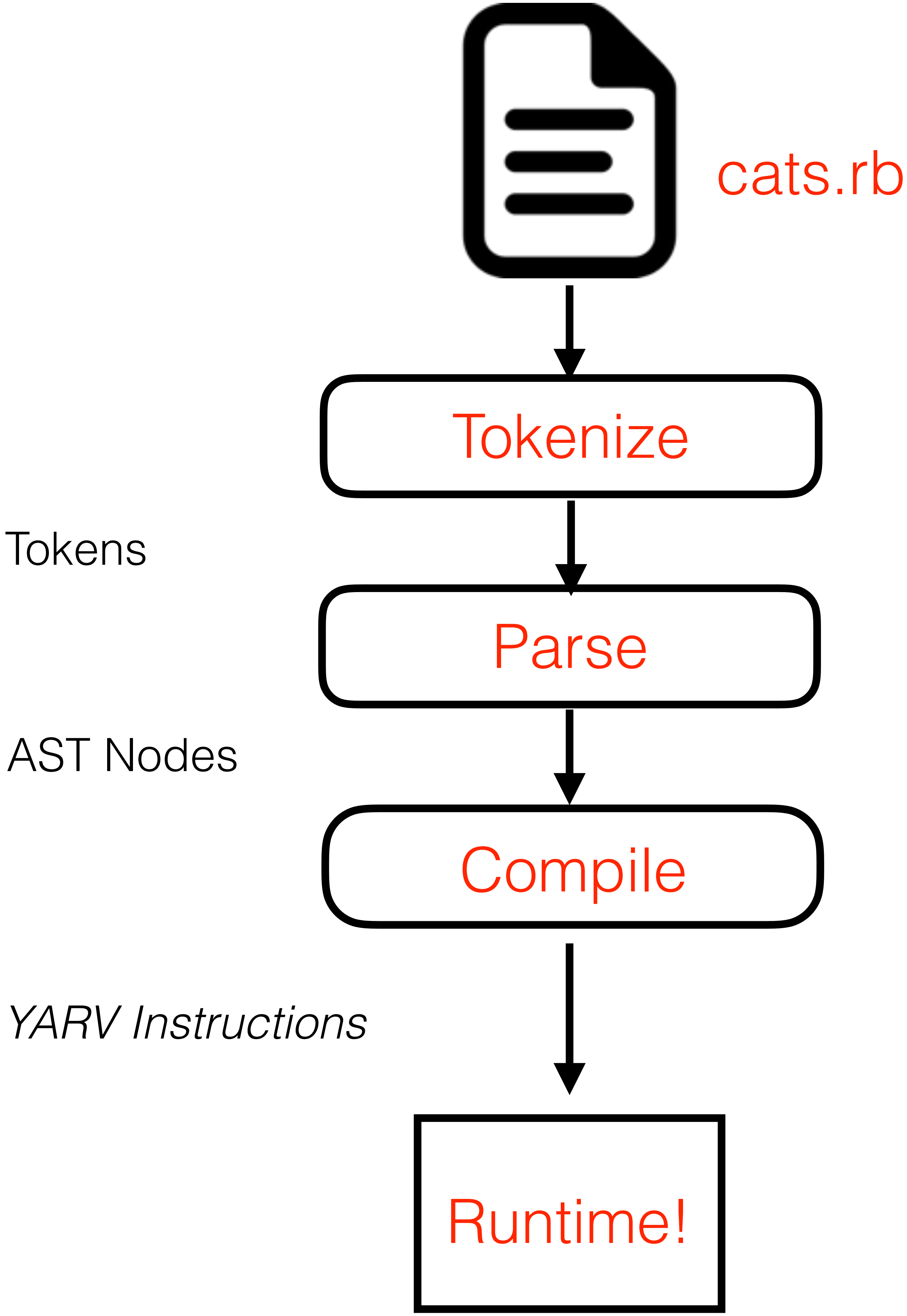
keyword_do

|

tIdentifier
n

|

What’s next?



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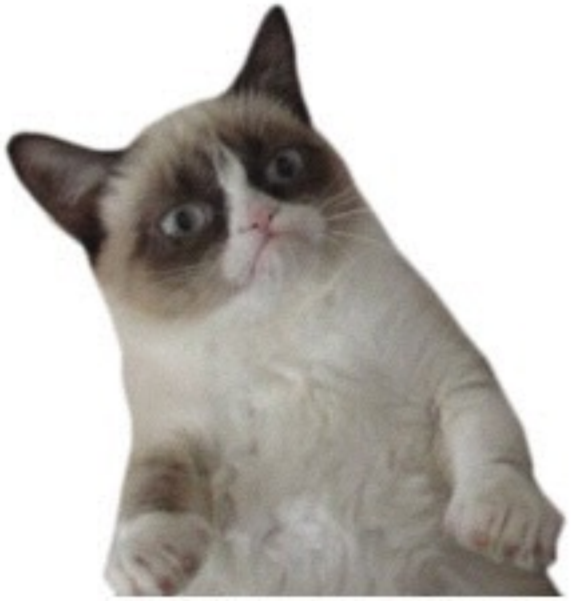
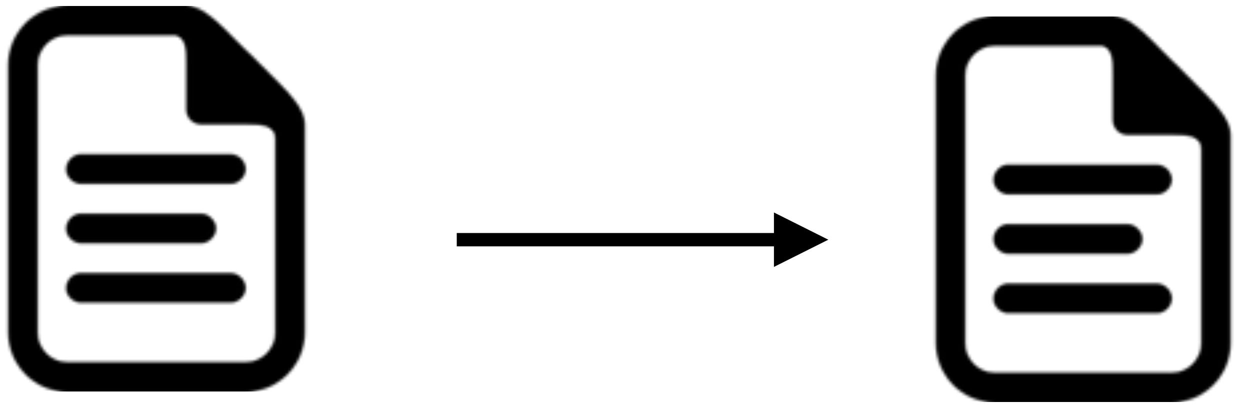
Parsing



Parsing

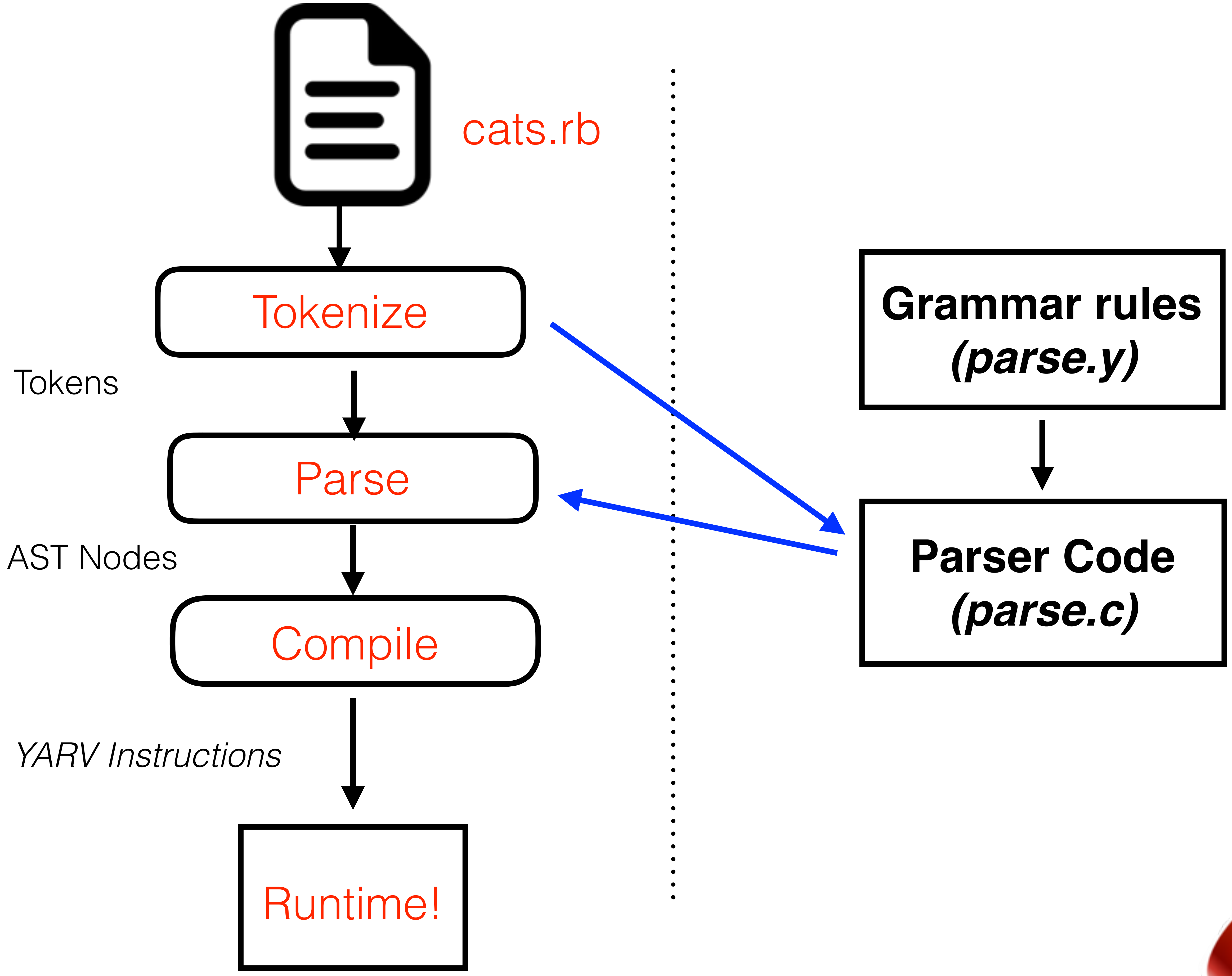
Ruby uses a parser to process tokens, but the parser itself is generated with a **parser generator**



parse.y

parse.c

Grammatical rules



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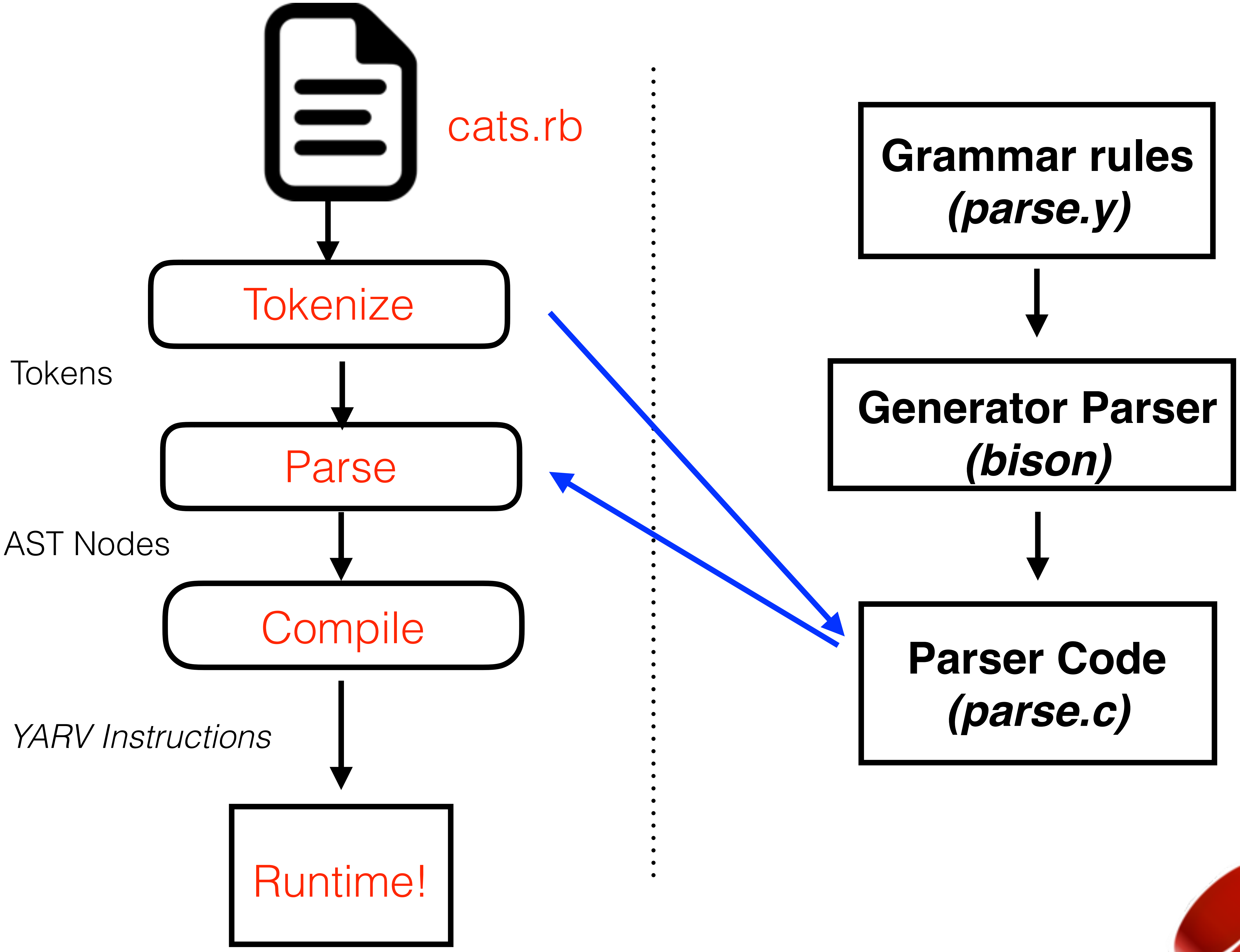
Grammar rules
(parse.y)

Parser Code
(parse.c)

Parsing

Yacc: *Yet Another Compiler Compiler*

Ruby uses a newer version of Yacc called Bison



cats.rb

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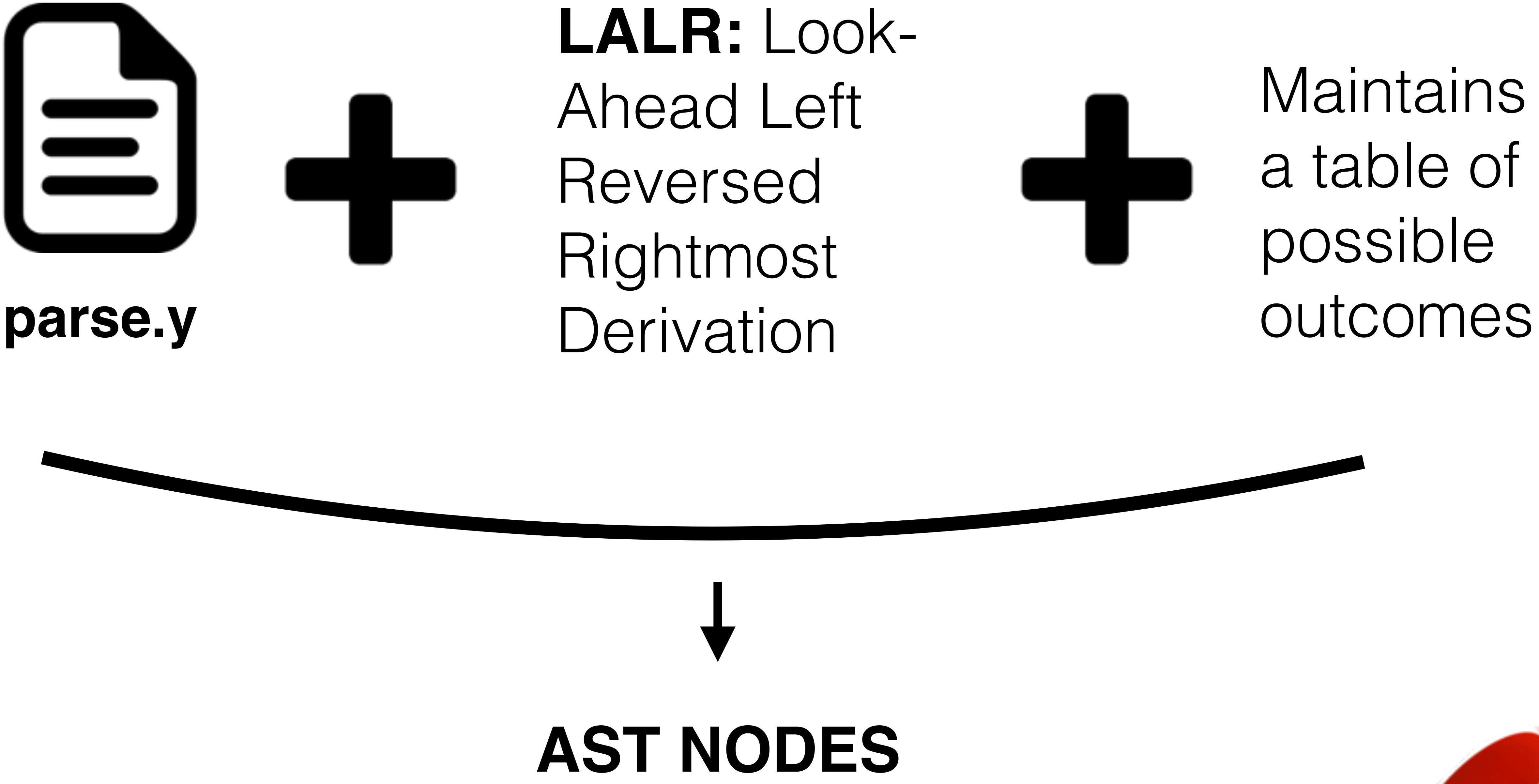
Runtime!

Grammar rules
(parse.y)

Generator Parser
(bison)

Parser Code
(parse.c)

Parsing



parse.y

+

LALR: Look-Ahead Left Reversed Rightmost Derivation

+

Maintains a table of possible outcomes

↓

AST NODES

Parsing

counter.rb

```
10.times do |n|
  puts n
end
```

Grammar rules

program: top_compstmt
top_compstmt: top_stmts opt_terms
top_stmts: ... l top_stmt l ...
top_stmt: stmt l ...
stmt: ... l expr
expr: ... l arg
arg: ... l primary
primary: ... l method_call brace_block l ...

Parsing

counter.rb

```ruby
10.times do |n|
  puts n
end
```

Grammar rules

```
program: top_compstmt
top_compstmt: top_stmts opt_terms
top_stmts: ... | top_stmt | ...
top_stmt: stmt | ...
stmt: ... | expr
expr: ... | arg
arg: ... | primary
primary: ... | method_call brace_block | ...
```

Parsing

counter.rb

```
10.times
```

Grammar rules

method_call: ... | primary_value '.' operation2 | ...

Table

primary_value	10
.	.
operation2	times

Parsing

counter.rb

```
do |n|
  puts n
end
```

Grammar rules

```
brace_block: ... l keyword_do opt_block_param
compstmt keyword_end l ...
```

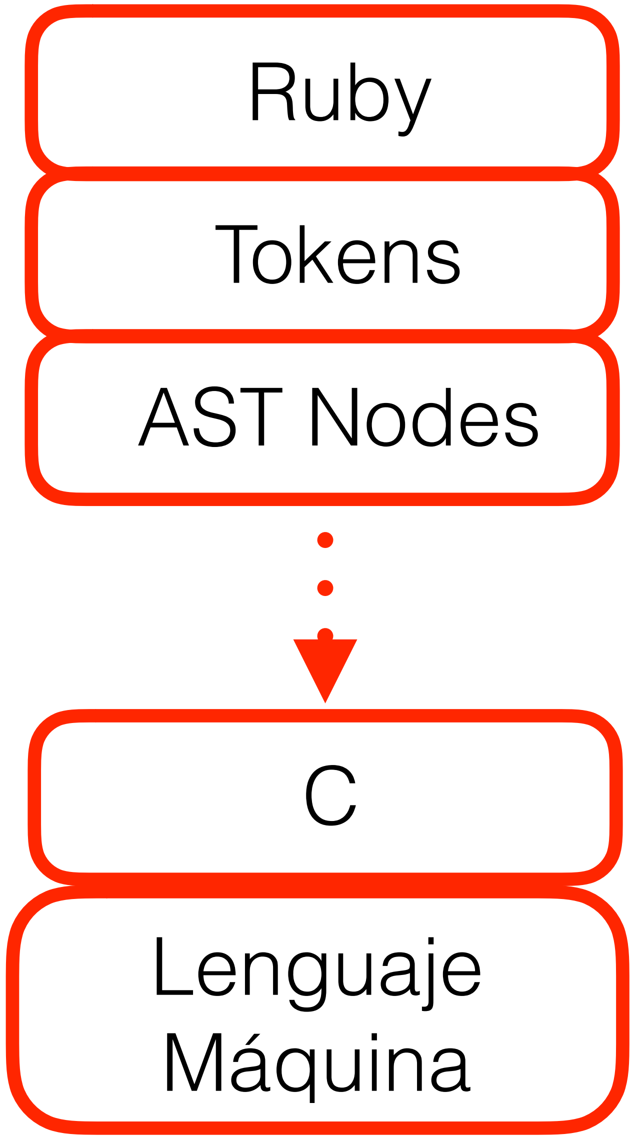
Table

keyword_do	do
opt_block_param	|n|
compstmt	puts n
keyword_end	end

Compilation

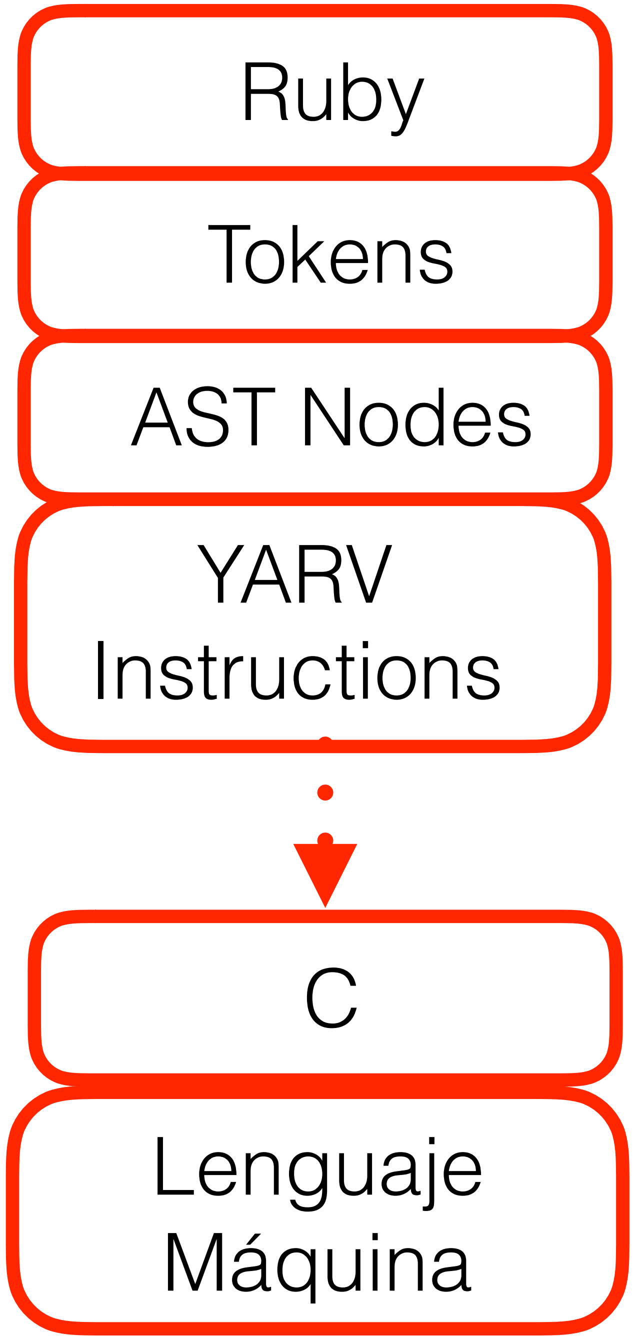
the final step…

Compilation



No Compiler for Ruby 1.8

Compilation



Ruby

Tokens

AST Nodes

YARV Instructions

C

Lenguaje Máquina

Ruby 1.9 introduce a Compiler: YARV (Yet Another Ruby Virtual Machine)

O

YARV: Stack Oriented Virtual Machine

```
puts 2 + 2
```

Taken from Ruby Under a Microscope

Compilation

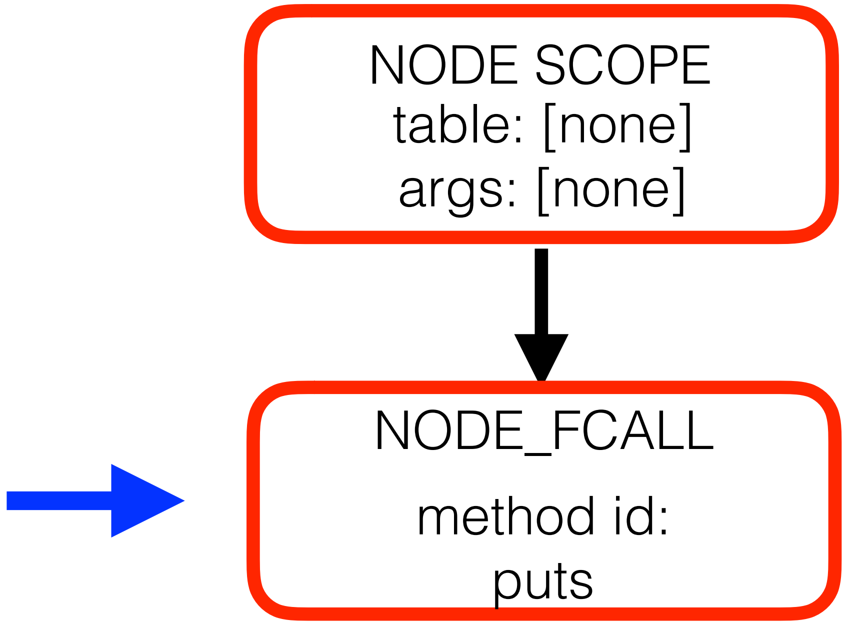
puts 2 + 2

NODE SCOPE
table: [none]
args: [none]

YARV Instructions

Compilation

puts 2 + 2



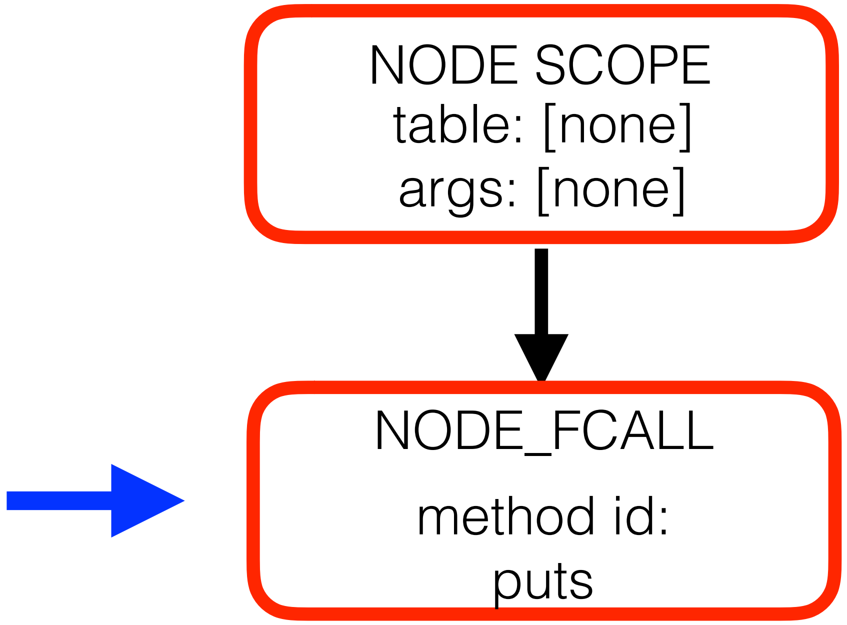
YARV Instructions

```
putself
putsobject 2
putsobject 2
send  <callinfo!mid:+, argc:1, ...
```

Taken from Ruby Under a Microscope

Compilation

puts 2 + 2



NODE SCOPE
table: [none]
args: [none]

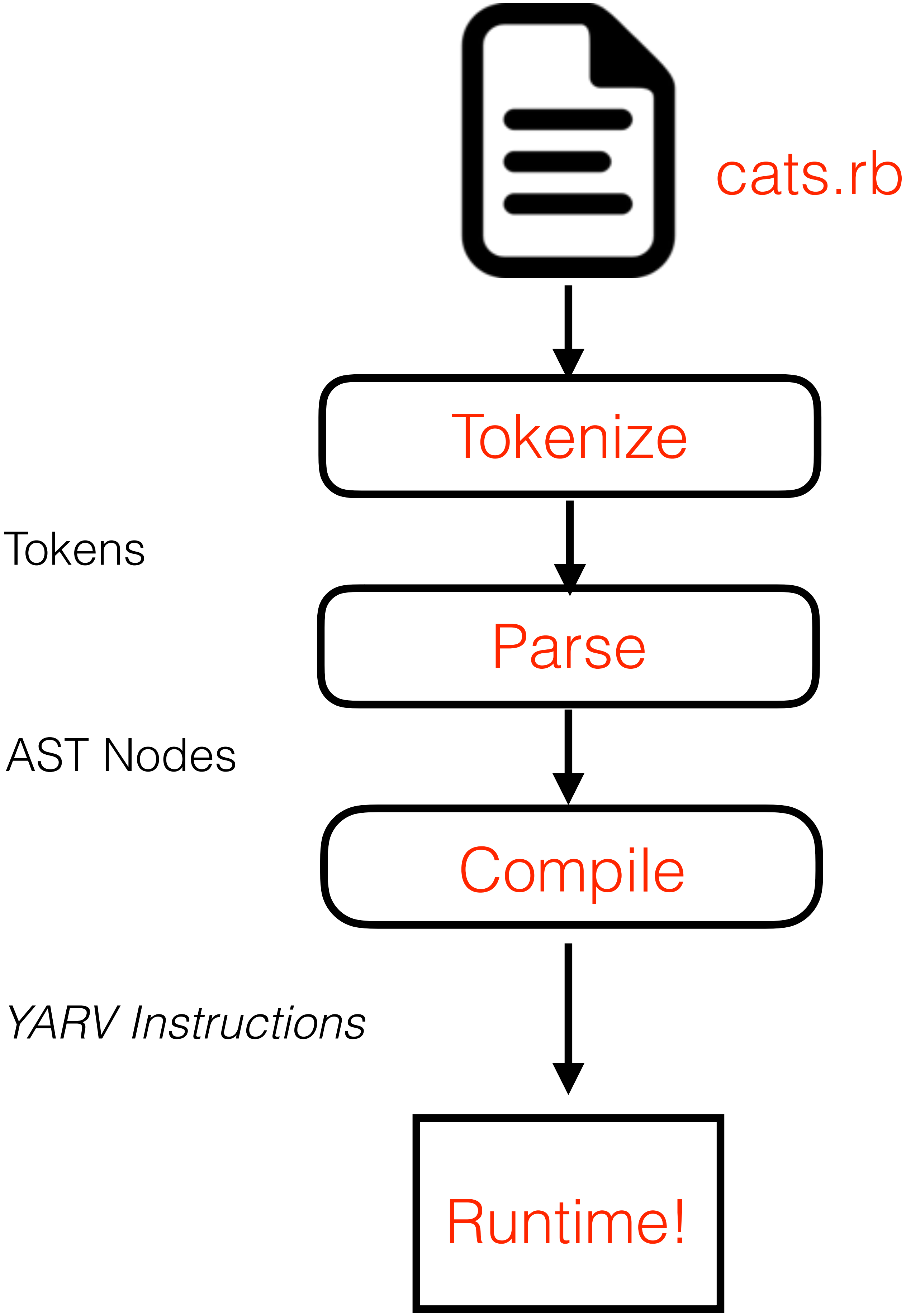
NODE_FCALL
method id:
puts

YARV Instructions

```
putself
putsobject 4

send <callinfo!mid:puts, argc:1, ...
```

Taken from Ruby Under a Microscope



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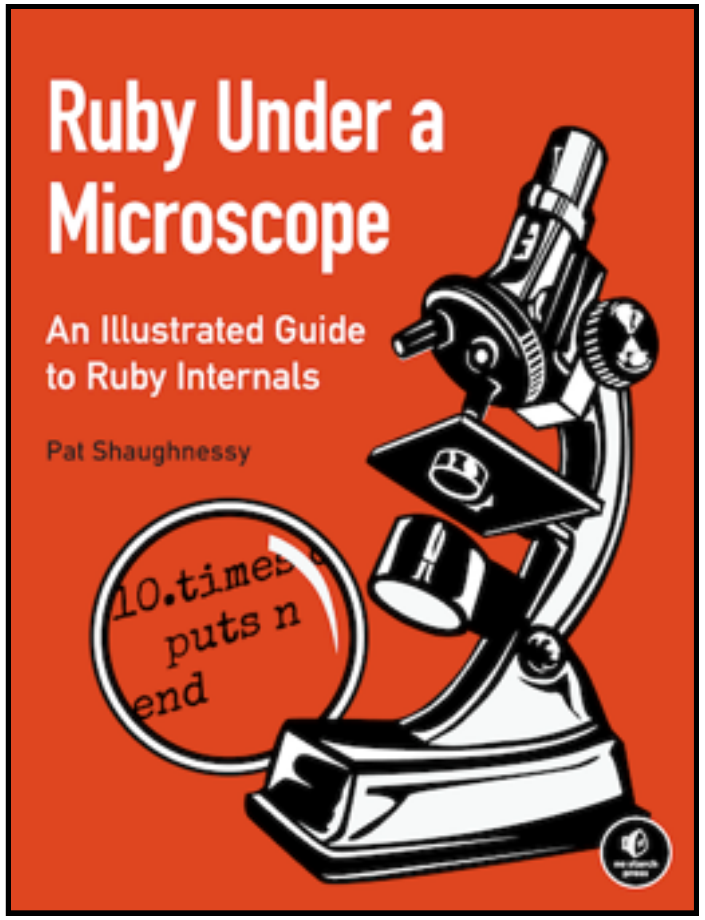
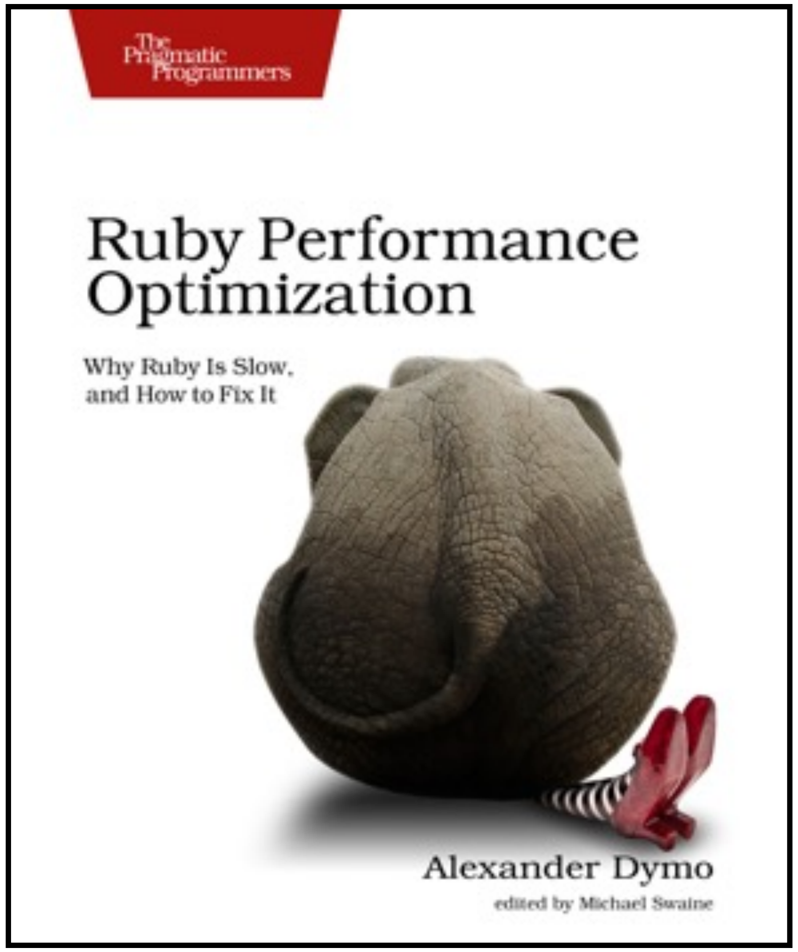
¿Preguntas?

Referencias




The Pragmatic Programmers
Ruby Performance Optimization
Why Ruby Is Slow, and How to Fix It
Alexander Dymo
edited by Michael Swaine

https://github.com/mayra-cabrera/ruby_meetup_11dic

Gracias!

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