Call-target-specific Method Arguments

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Overview

Introduction

- **Goal:** Make argument handling faster → make method calls faster
- **How to:** Prepare arguments at call site.
- **Running example:** Keyword arguments in JRuby → twice as fast

Overview

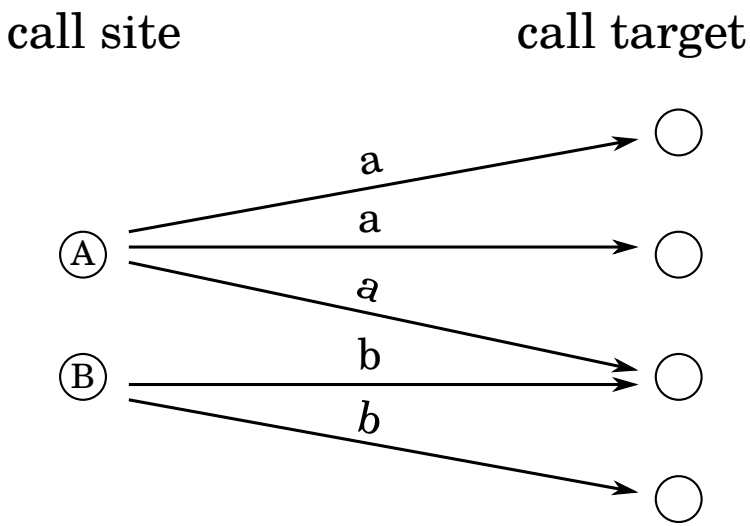
Argument Mismatch

Method Signature Parameters ≠ Call Arguments

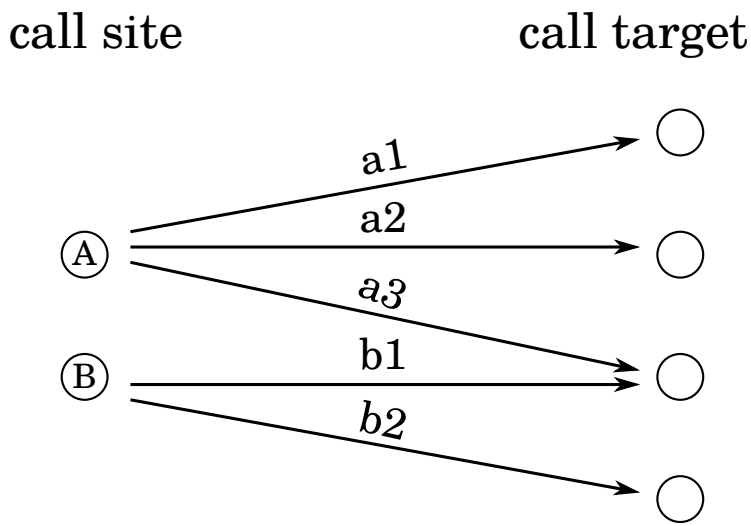
```
def method(a: 0, b: 0, c: 0)
  ...
end

method(a: 1, b: 2, c: 3)

method(b: 1, a: 2)
method(c: 4)
method()
```

When to Convert Arguments?

Convert after invoke:



Convert before invoke:



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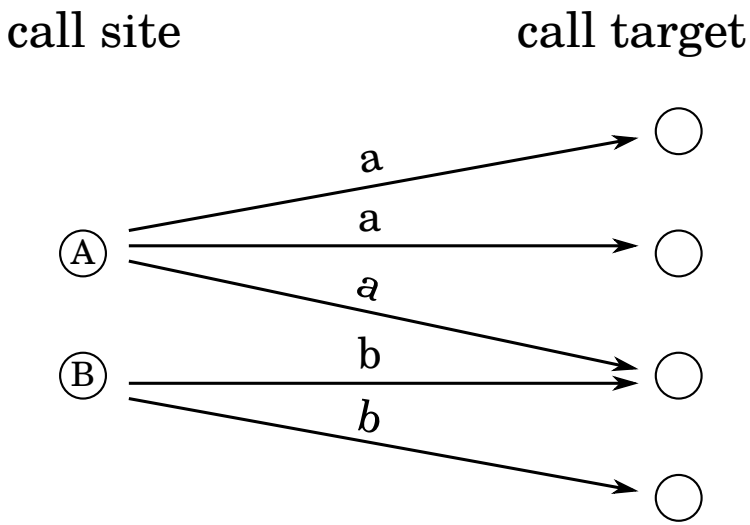
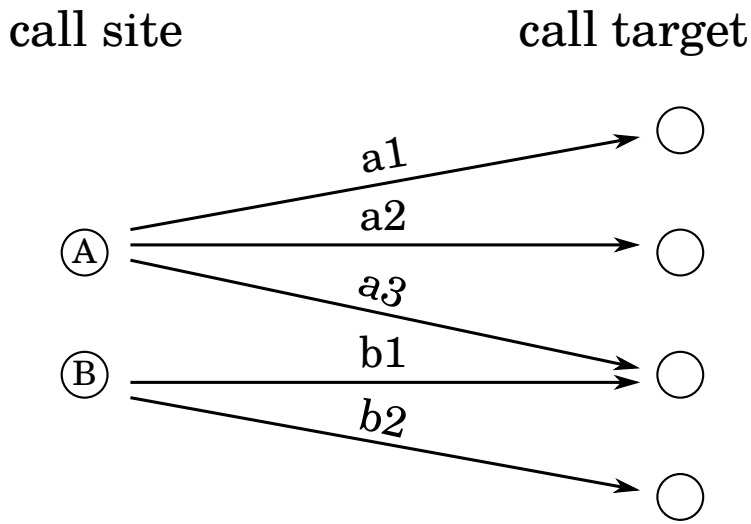


1. Convert args to generic repres.
2. Lookup receiver
3. Invoke target method
4. Convert args to specific repres.

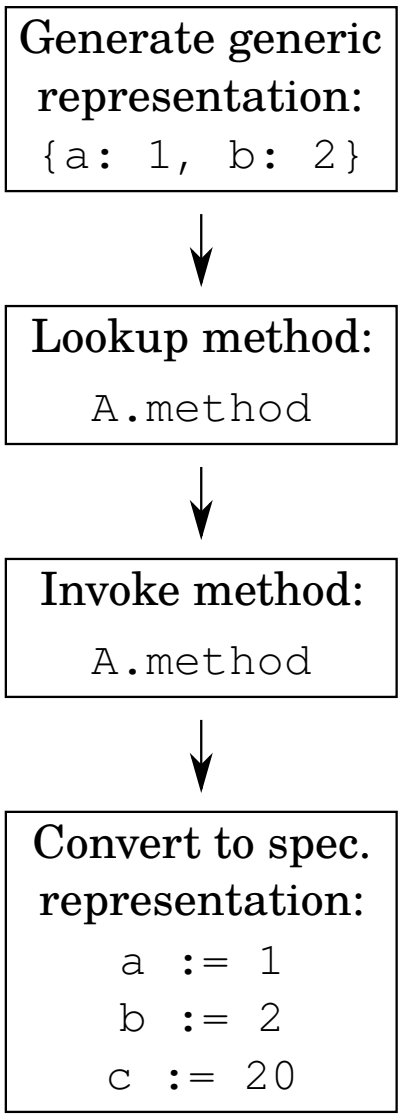
Convert before invoke:



1. Lookup receiver
2. Convert args to specific repres.
3. Invoke target method

Overview

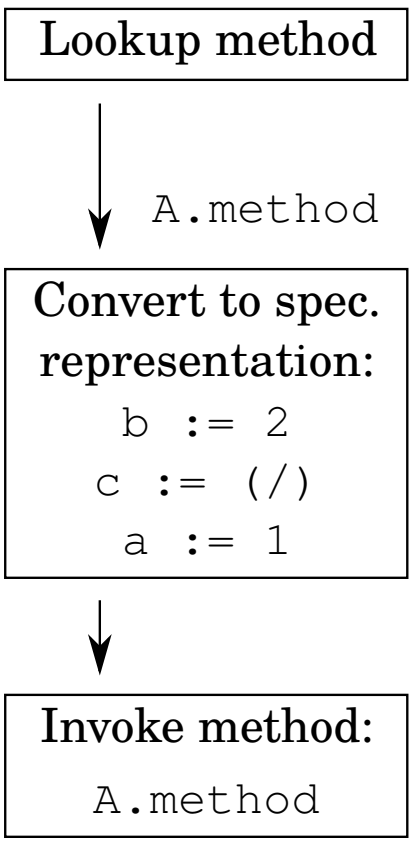
Convert After Invocation: Call-site-specific Arguments




```ruby
def A.method(b: 10, c: 20, a: 30)
  ...
end

obj.method(a: 1, b: 2)
```

Convert Before Invocation: Call-target-specific Arguments

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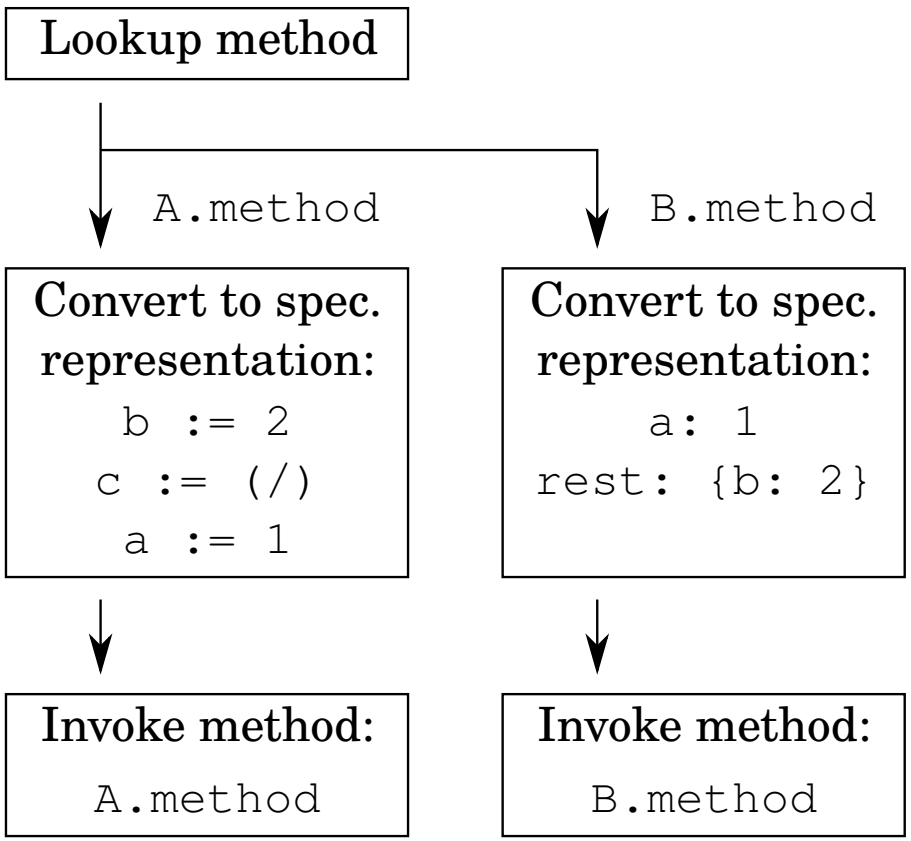
Convert Before Invocation: Call-target-specific Arguments

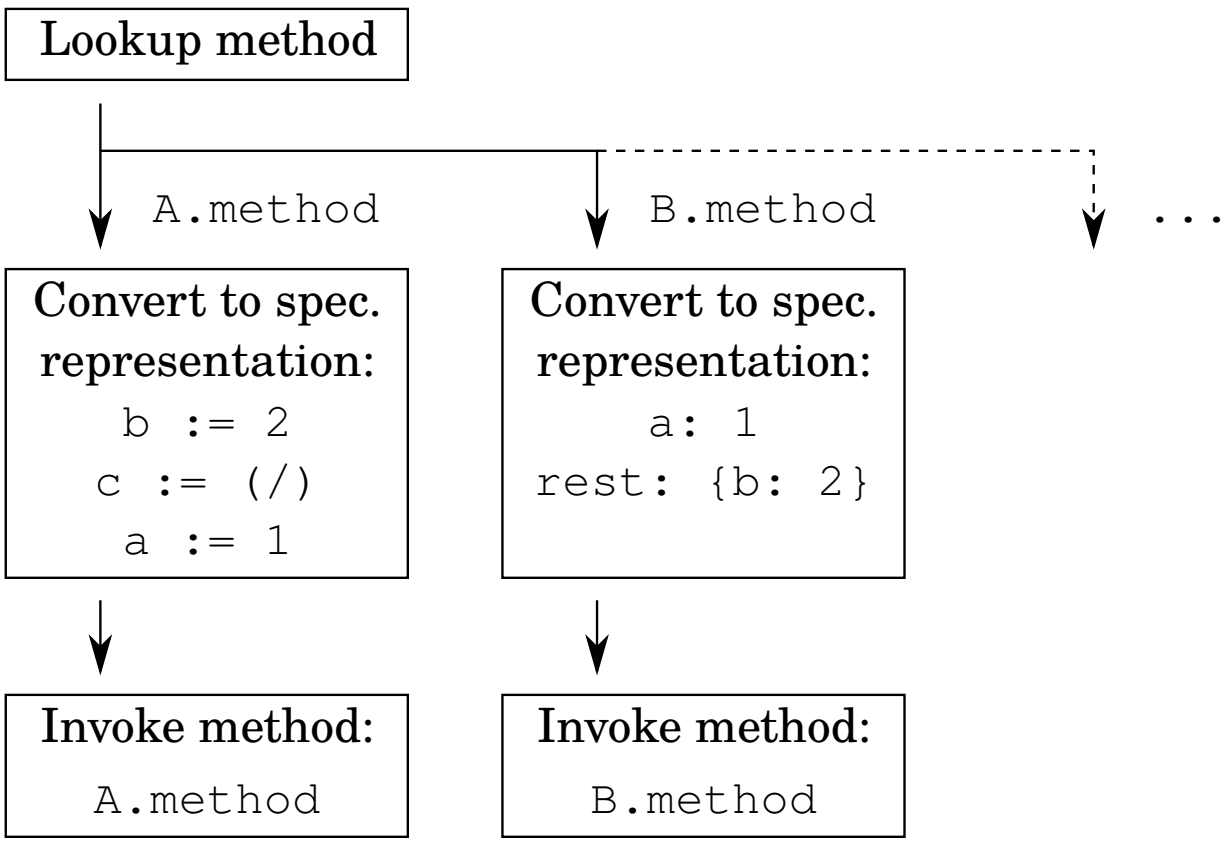



```
def A.method(b: 10,
    c: 20, a: 30)
  ...
end

def B.method(a:, **
   rest)
  ...
end

obj.method(a: 1, b:
    2)
```

Convert Before Invocation: Call-target-specific Arguments



Call-target-specific Method Arguments

- Code/AST for generating arguments representation depends on call target.
- We cache one AST subtree generating the arguments array per PIC entry.
- Call-target-specific argument handling is part of the PIC.

Overview

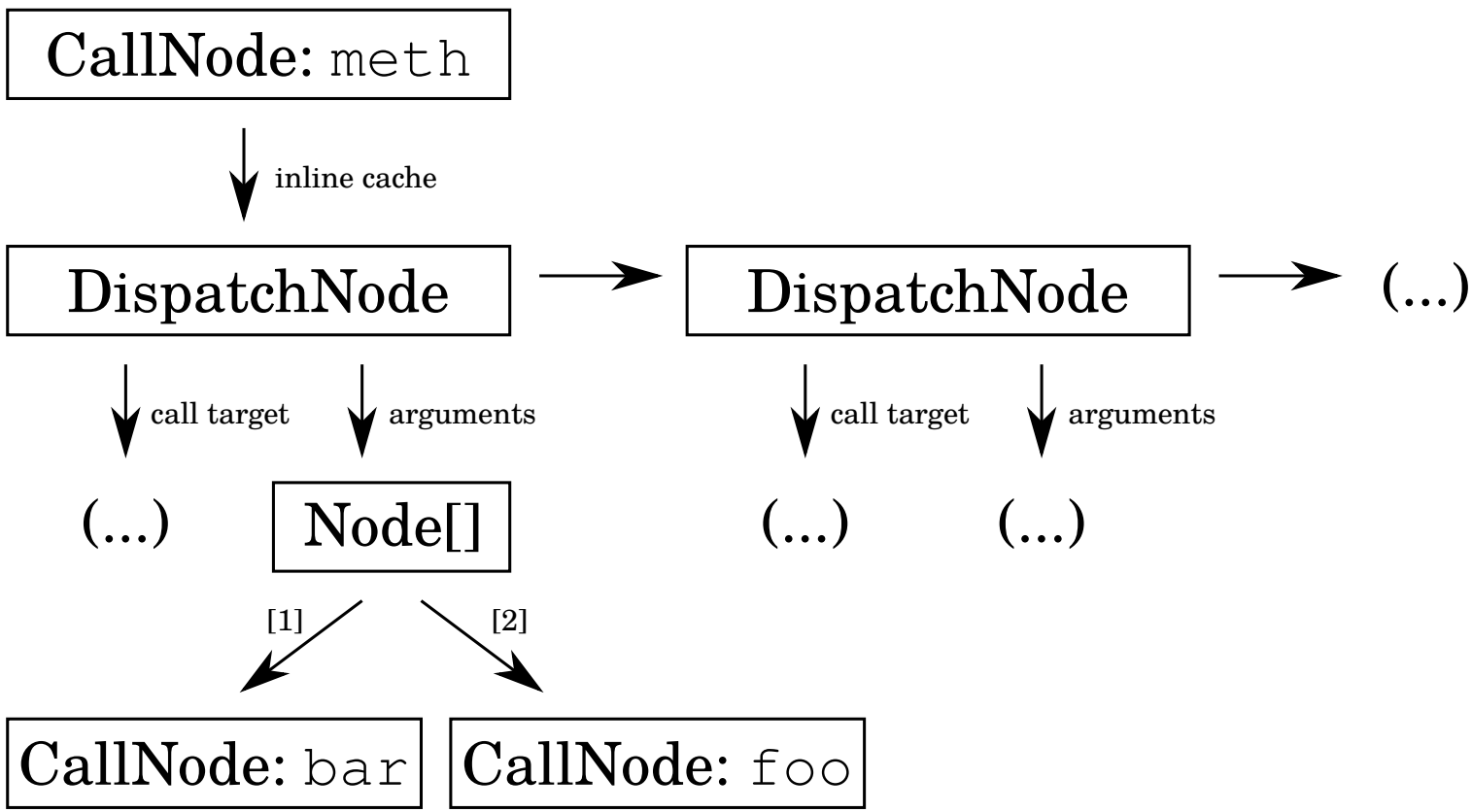
PIC Argument Cache

- Truffle: AST Interpreter Framework.
- PIC is implemented as linked list of AST nodes.
- We cache one AST subtree generating the array of arguments per PIC entry. No bytecode manipulations neccessary.

Execution Order of Argument Nodes

```
def meth(a: 0, b: 0)
  ...
end
```

```
meth(b: foo(), a: bar())
```

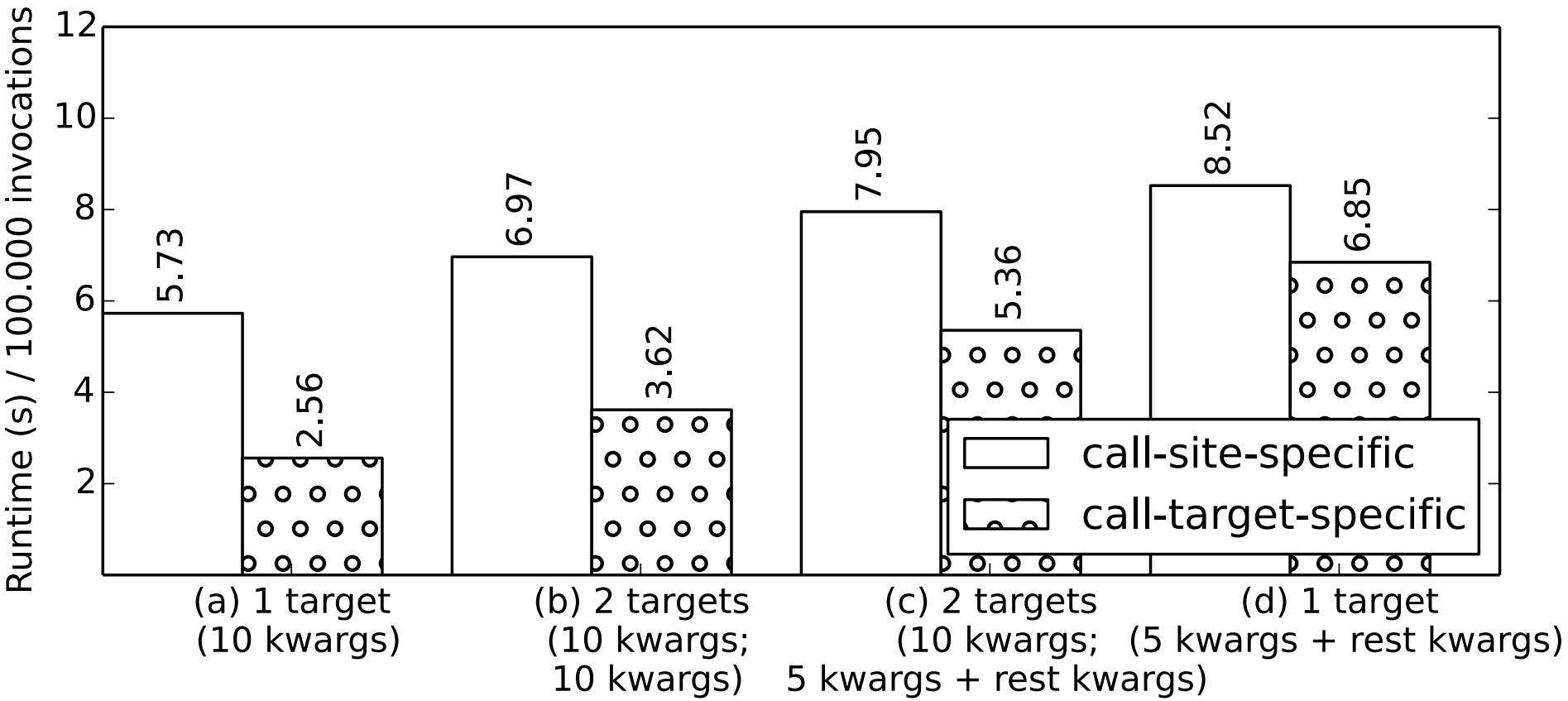


Megamorphic Call Sites

- Call site switches to *megamorphic* once the PIC treshold is reached.
- Megamorphic call sites use call-site-specific method argument (old behavior).
- Call target is able to detect whether call is *optimized* (call-target-specific args) or *unoptimized* (call-site-specific args).

Overview

Micro-Benchmarks



Summary

- Call-site-specific method arguments: an **optimization for method argument handling** in dynamically-typed languages.
- Call sites can have multiple polymorphic call targets.
- **Prepare arguments** for call target at call site.
- Only efficient if **call target analysis is cached** at the call site (as part of the PIC).

Overview

MagLev

- MagLev: a Ruby implementation in Smalltalk (GemStone/S).
- Compiled to byte code for a Smalltalk virtual machine
- Generates a number of wrapper (*bridge*) methods for different method arguments.

```ruby
def method(a, b = 1, *args)
...
end

def method#1(a)
# call method(a, 1)
end

def method#3(a, b, c, d, e)
# call method(a, b, [c, d, e])
end
```