Language-side Foreign Function Interfaces with NativeBoost

IWST 2013

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Outline

Context

Language

Virtual Machine (VM)

Cairo

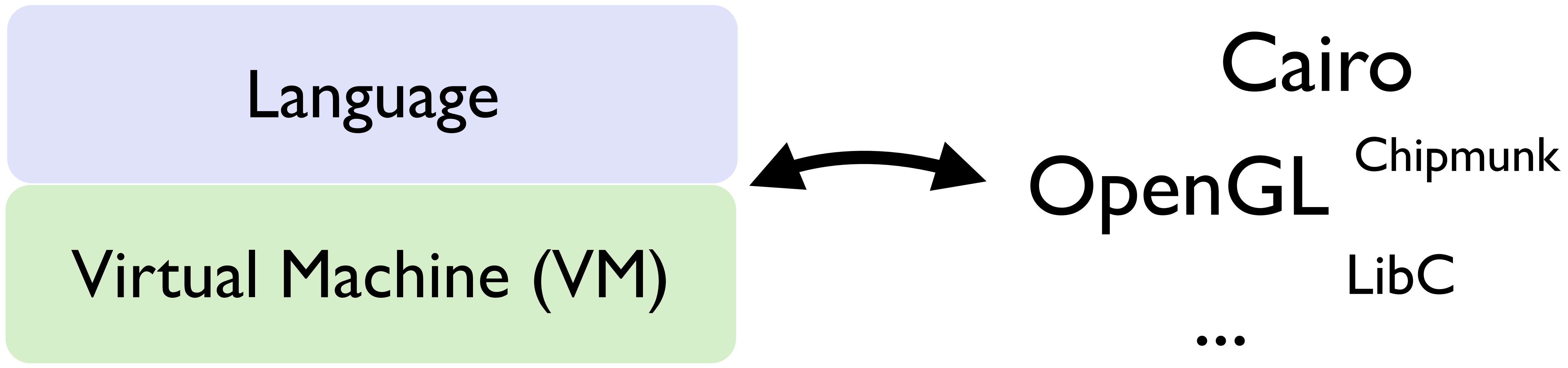
OpenGL

Chipmunk

LibC

...

Context



How to interact with external libraries?

Existing Solutions

- Language-side Library
- VM Extension
- VM Plugin
- Foreign Function Interface
    - VM-level
    - Language-level

Existing Solutions

- ✗ Language-side Library costly
- VM Extension
- VM Plugin
- Foreign Function Interface
  - VM-level
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Existing Solutions

- ✗ Language-side Library
- ✗ VM Extension
- ✗ VM Plugin
- Foreign Function Interface
  - VM-level
  - Language-level

costly

low-level

Existing Solutions

- ✗ Language-side Library — costly
- ✗ VM Extension — low-level
- ✗ VM Plugin
- ✓ Foreign Function Interface
  - ✗ VM-level — fast
  - ✓ Language-level — slow

NativeBoost

A *language-side*

and *fast*

FFI implementation

Language-side

- Extensible
- Easy to use
  - no VM code needed
  - no low-level code (C wrapper) needed

Fast

Transparent

generation of Assembly code from the language-side

NativeBoost Example

```
char* getenv(const char*)
```

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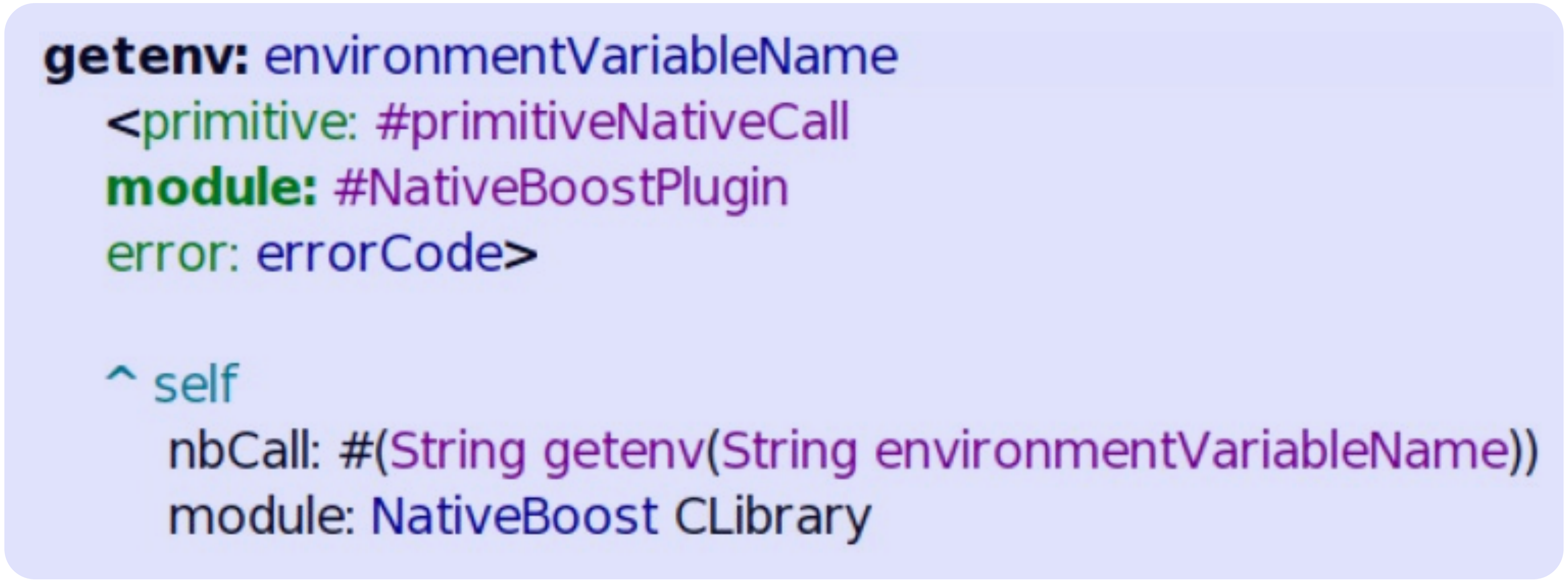

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    <primitive: #primitiveNativeCall
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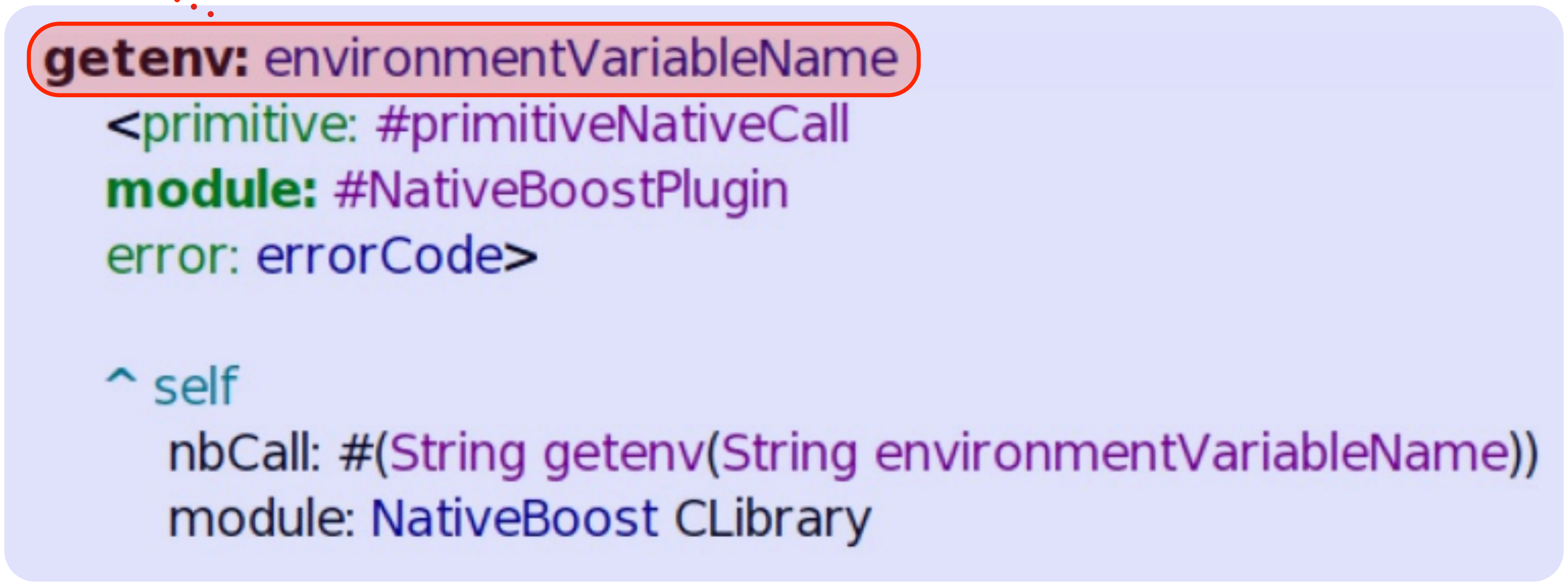
```

NativeBoost Example

Regular Smalltalk method
with one argument



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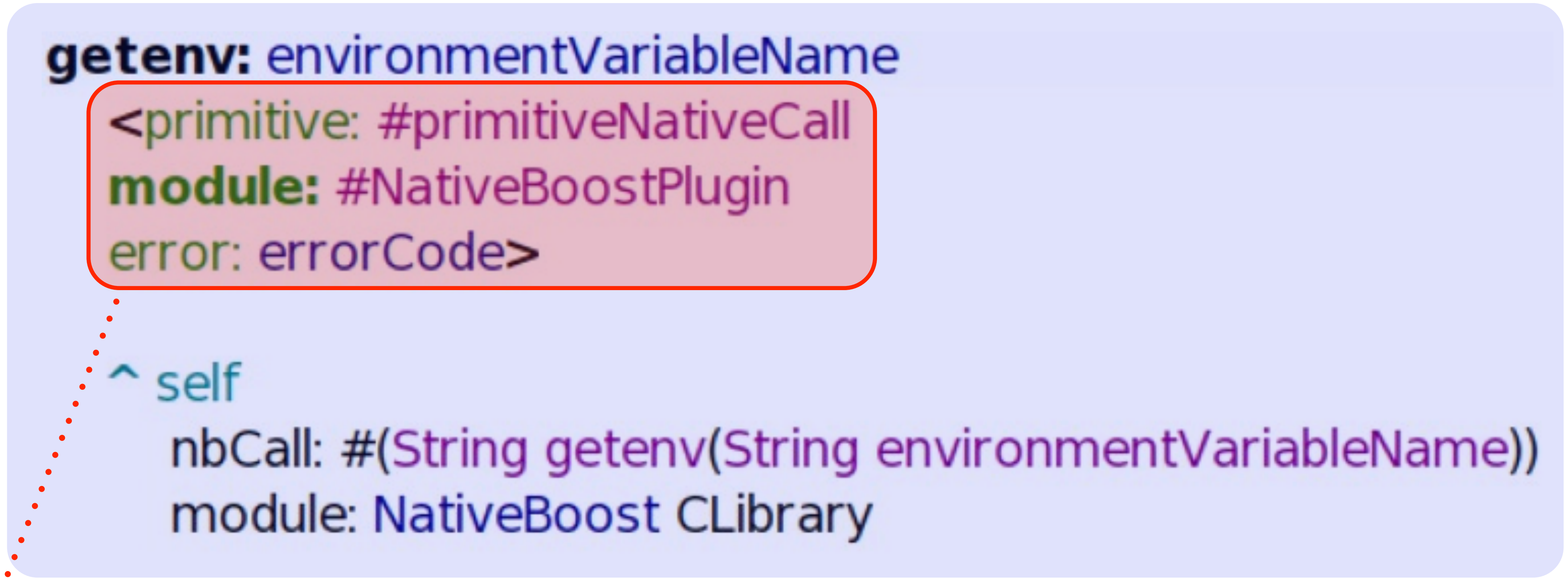

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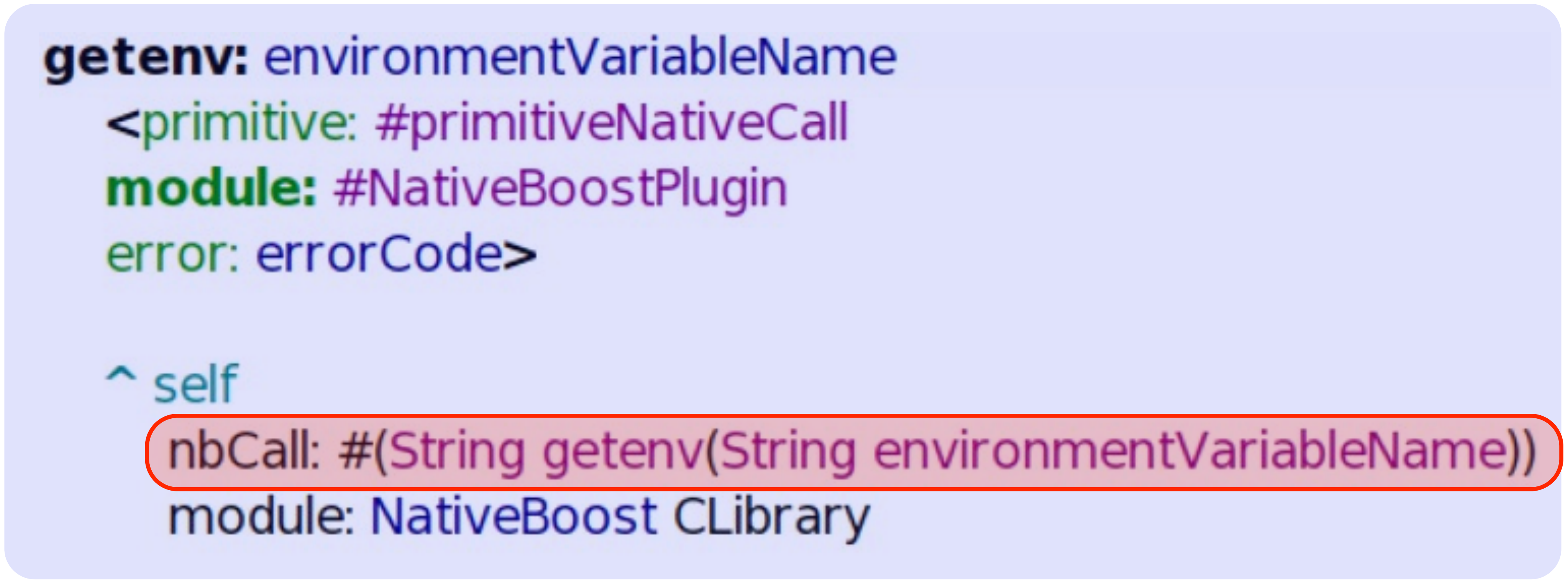
A pragma indicating that #primitiveNativeCall of #NativeBoost plugin should be executed when this method is executed

NativeBoost Example



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NativeBoost Example

```
char* getenv(const char*)
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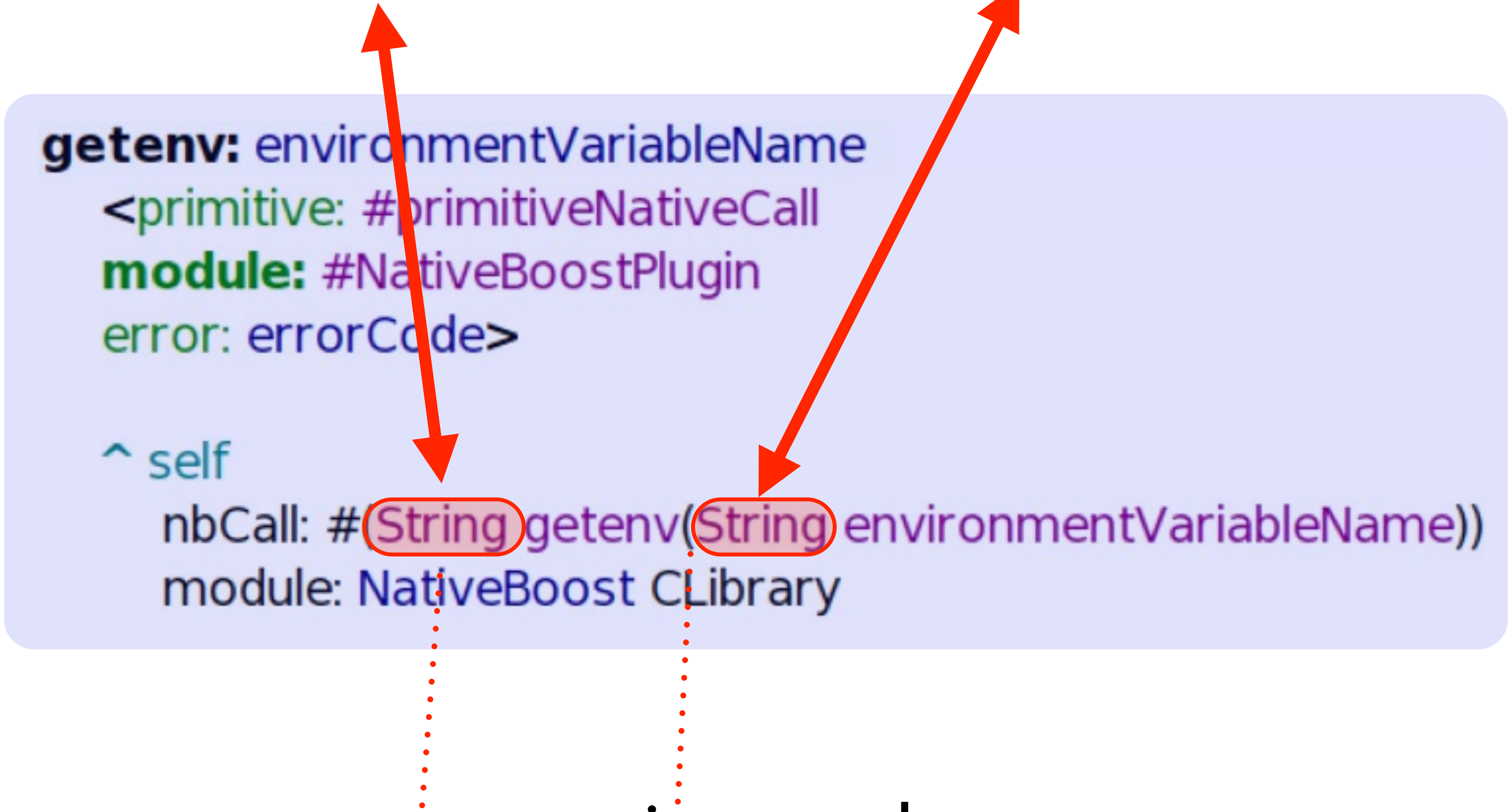

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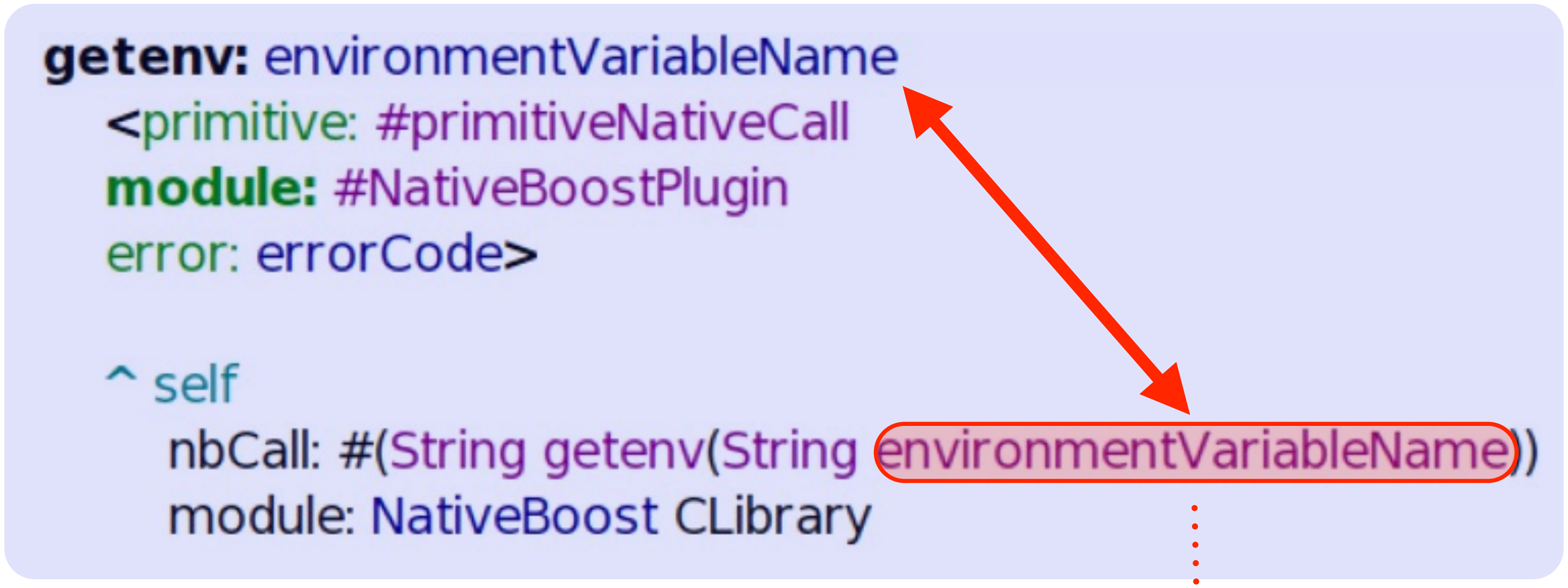
types annotation used

to generate **marshalling** code

NativeBoost Example



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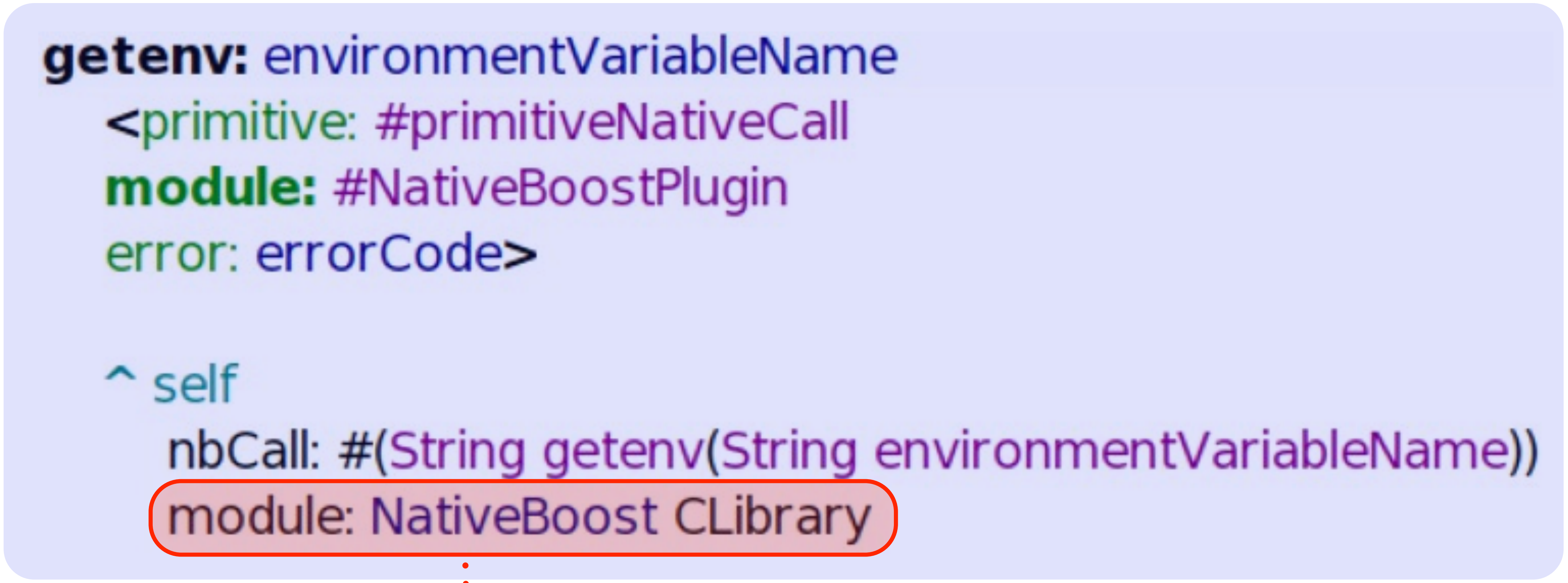
the value to be passed
when calling out

NativeBoost Example



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the external library address in
which the function is looked up

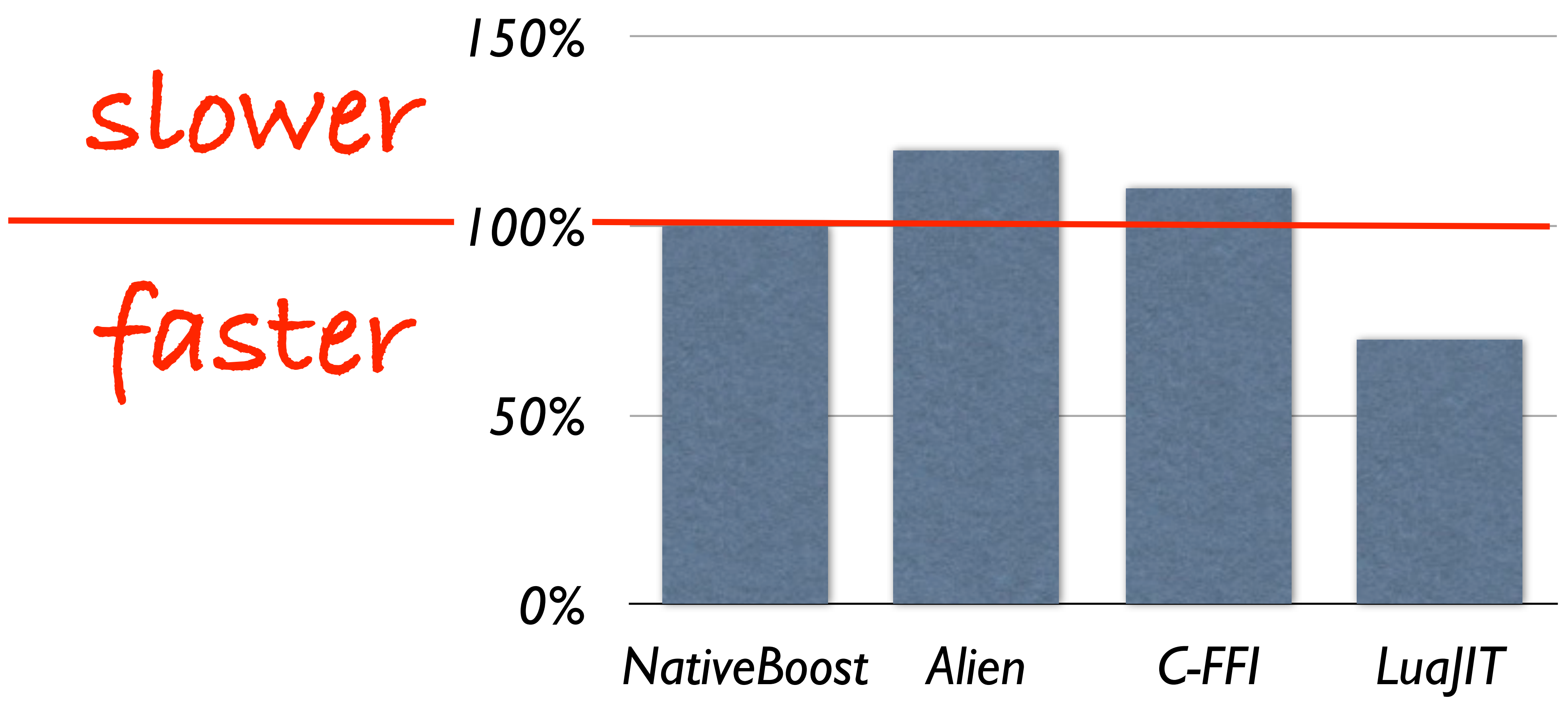
Speed Comparisons

- NativeBoost
- Alien FFI
- C-FFI
- LuaJIT

- Callouts
- Marshalling
- Callbacks

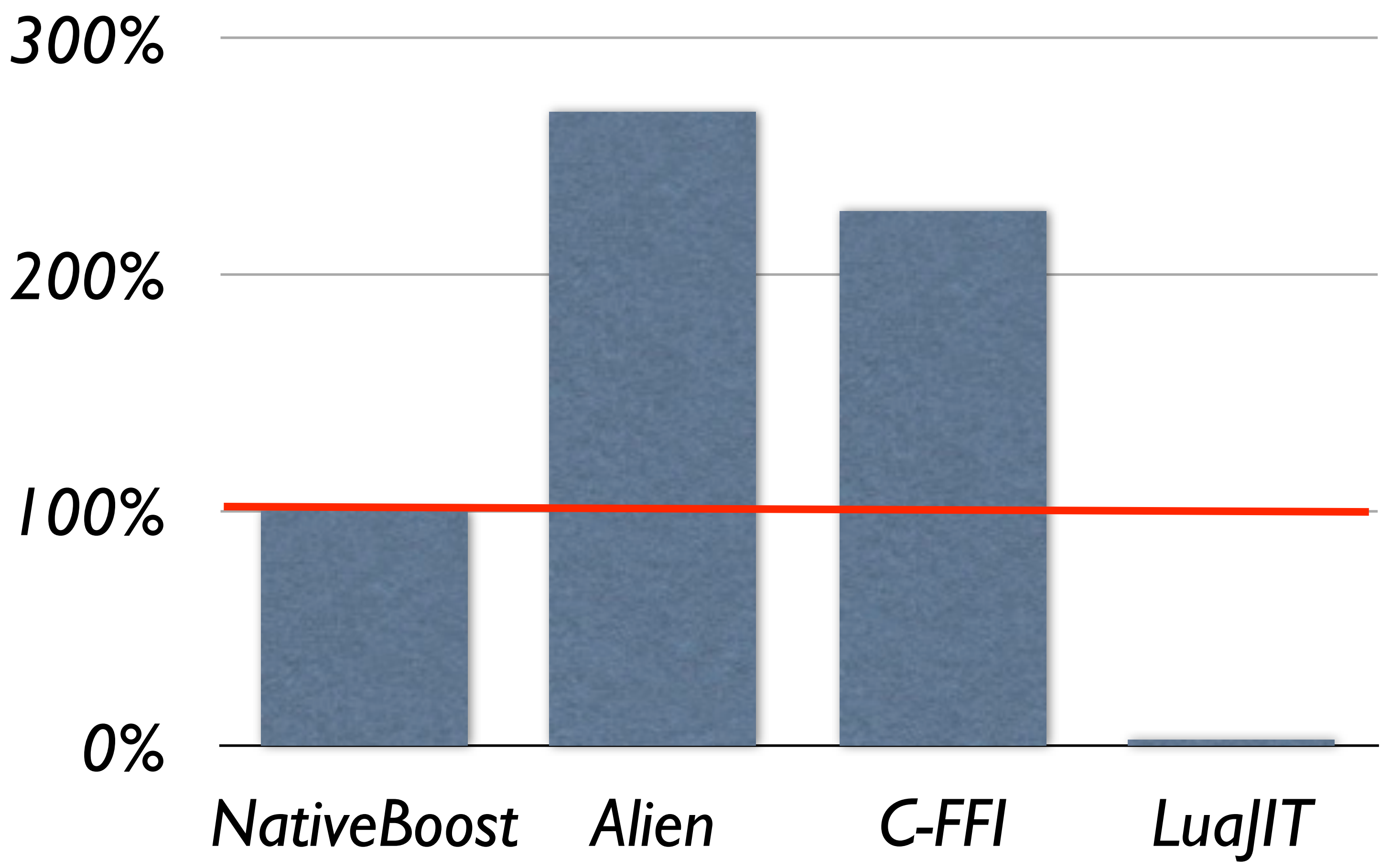
Callout Evaluation

Average time
calling out `uint clock(void)`



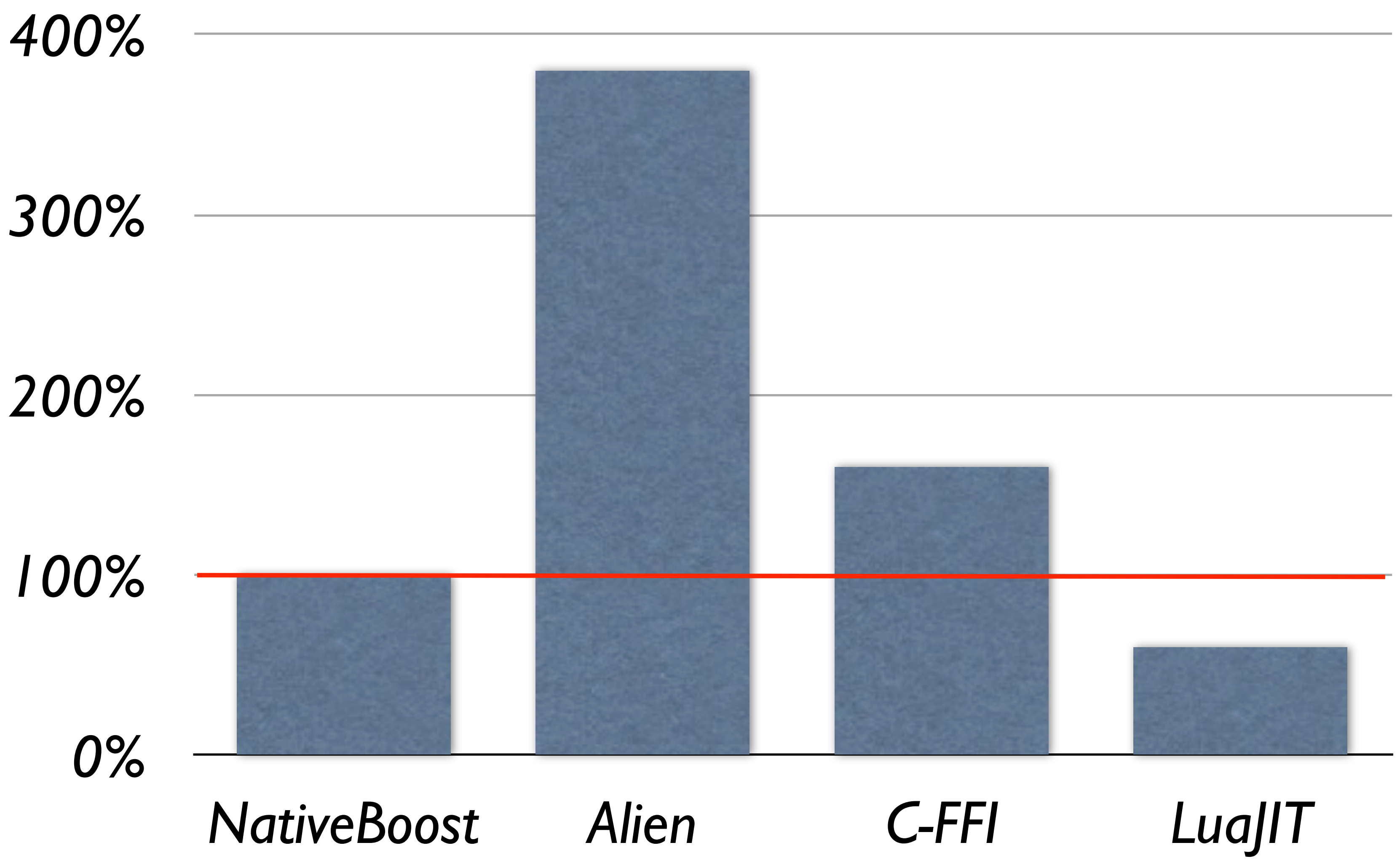
Marshalling int

`int abs(int)`



Marshalling char*/String

```
int printf(char*,int,int)
```



Marshalling char*/String

```
char* getenv( char* )
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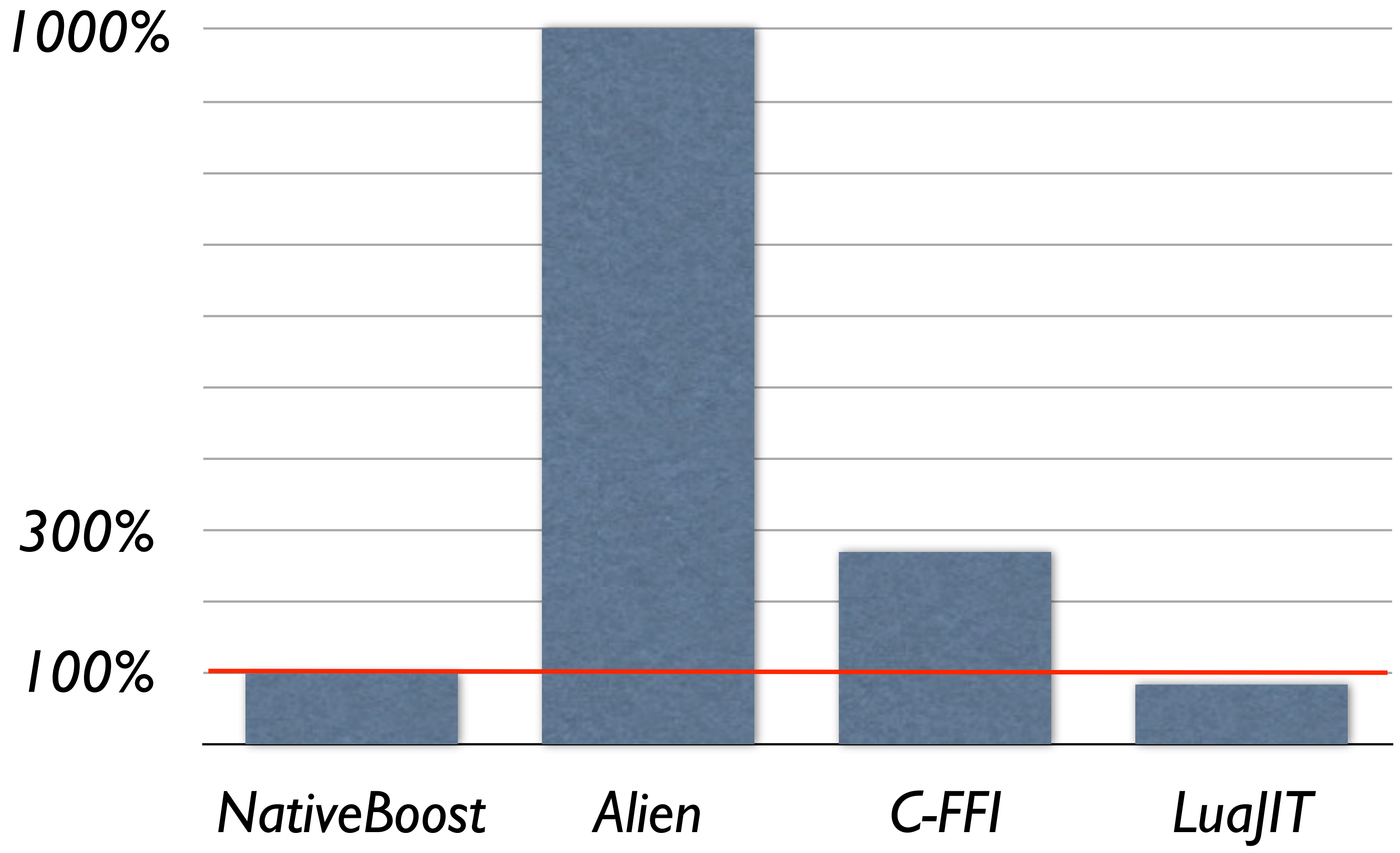

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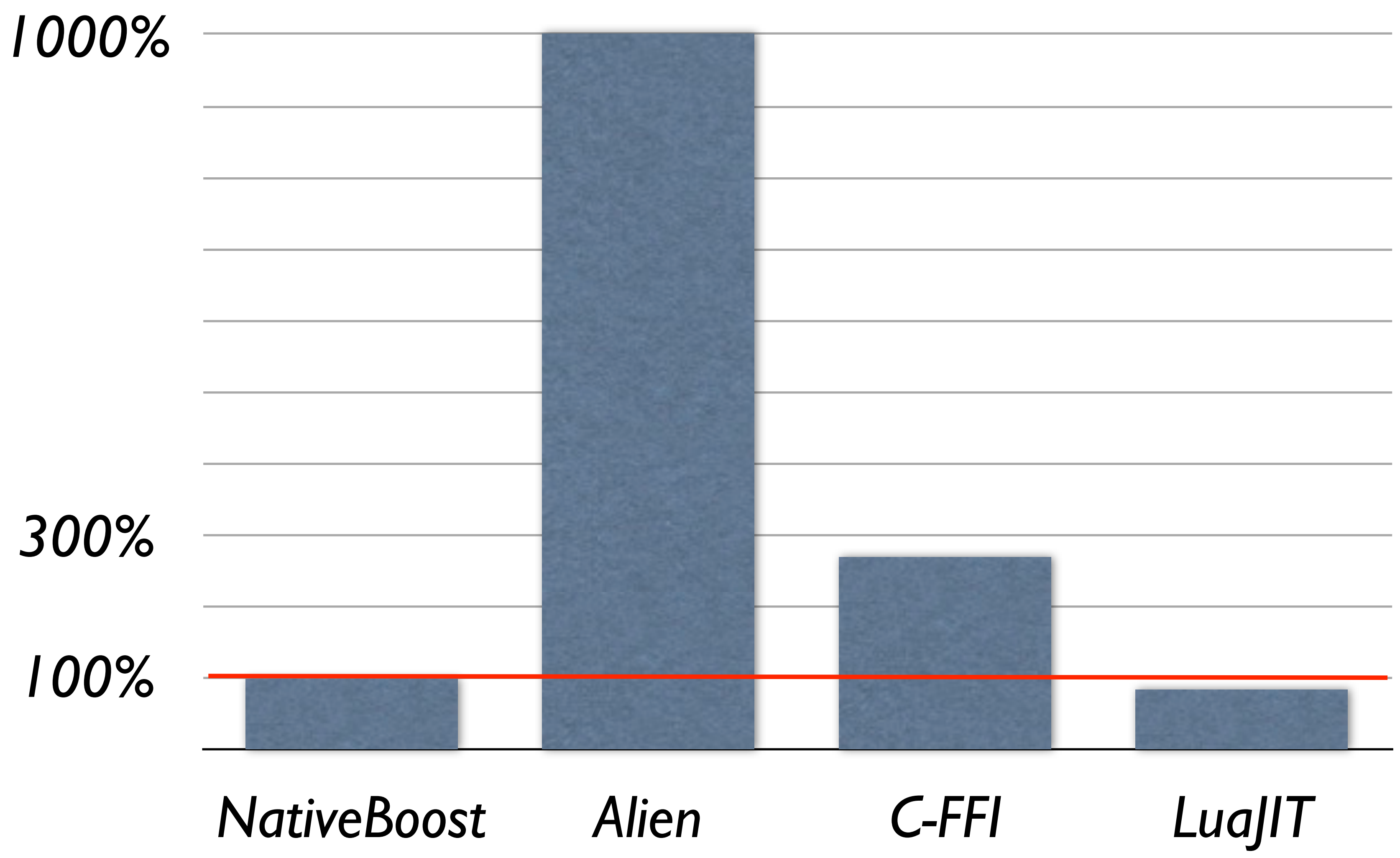
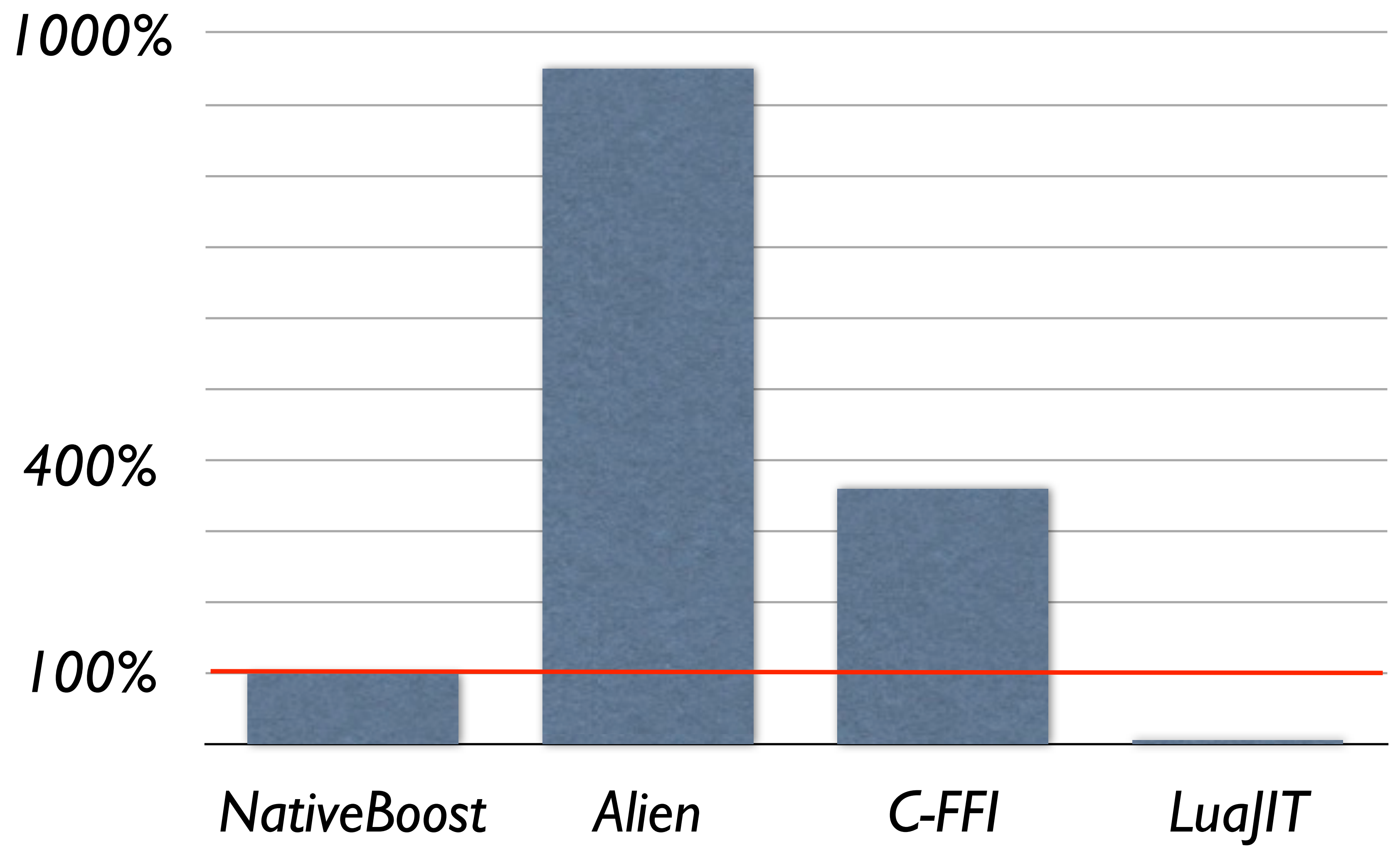


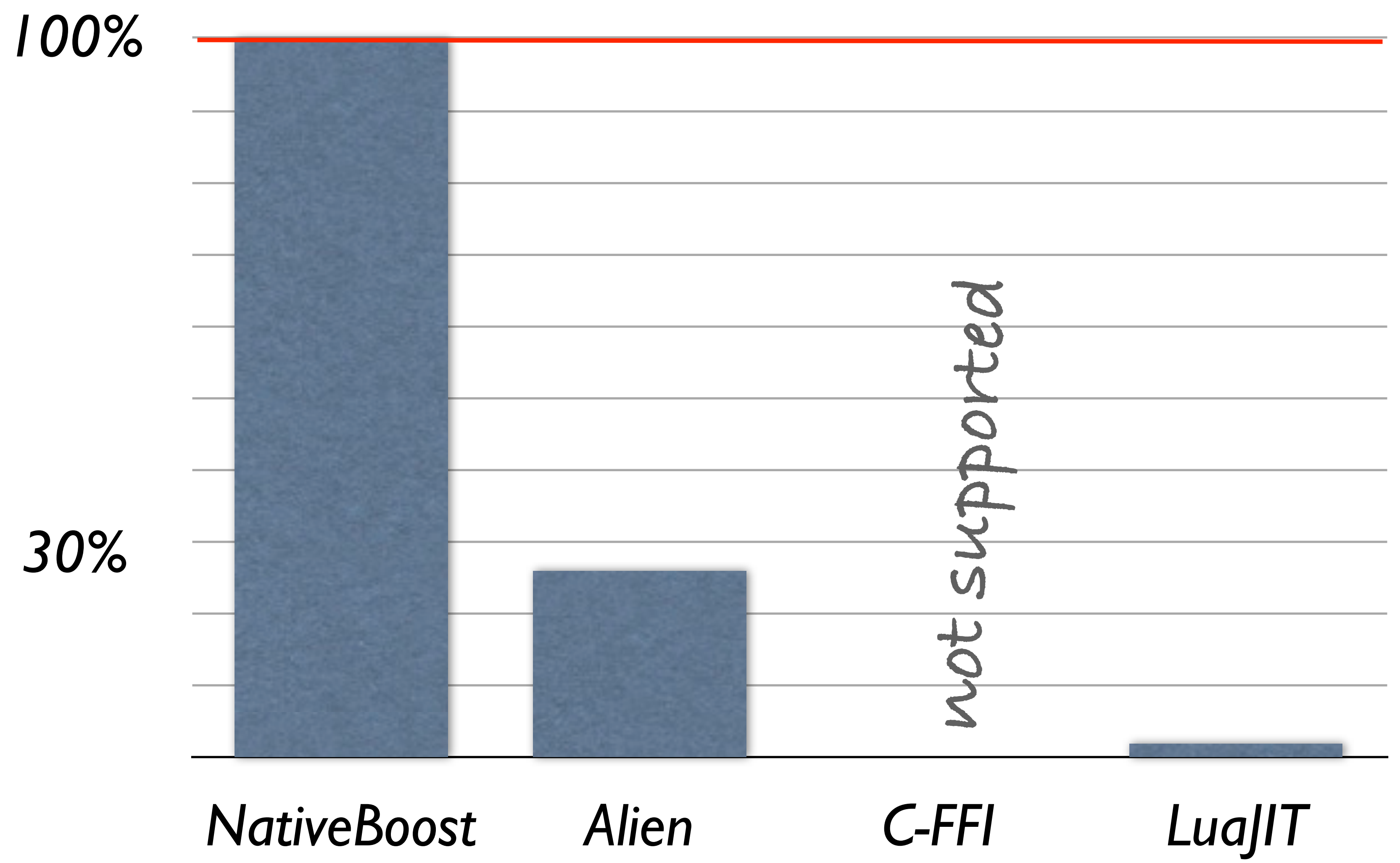
Marshalling structs

```
void
cairo_matrix_multiply (
    cairo_matrix_t *result,
    cairo_matrix_t *a,
    cairo_matrix_t *b)
```



Callbacks Evaluation

```
void qsort (
    void *base,
    size_t nel,
    size_t width,
    int (*compare)(const void*, const void*))
```



Insights into NativeBoost Internals

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NBExample getenv: 'PATH'
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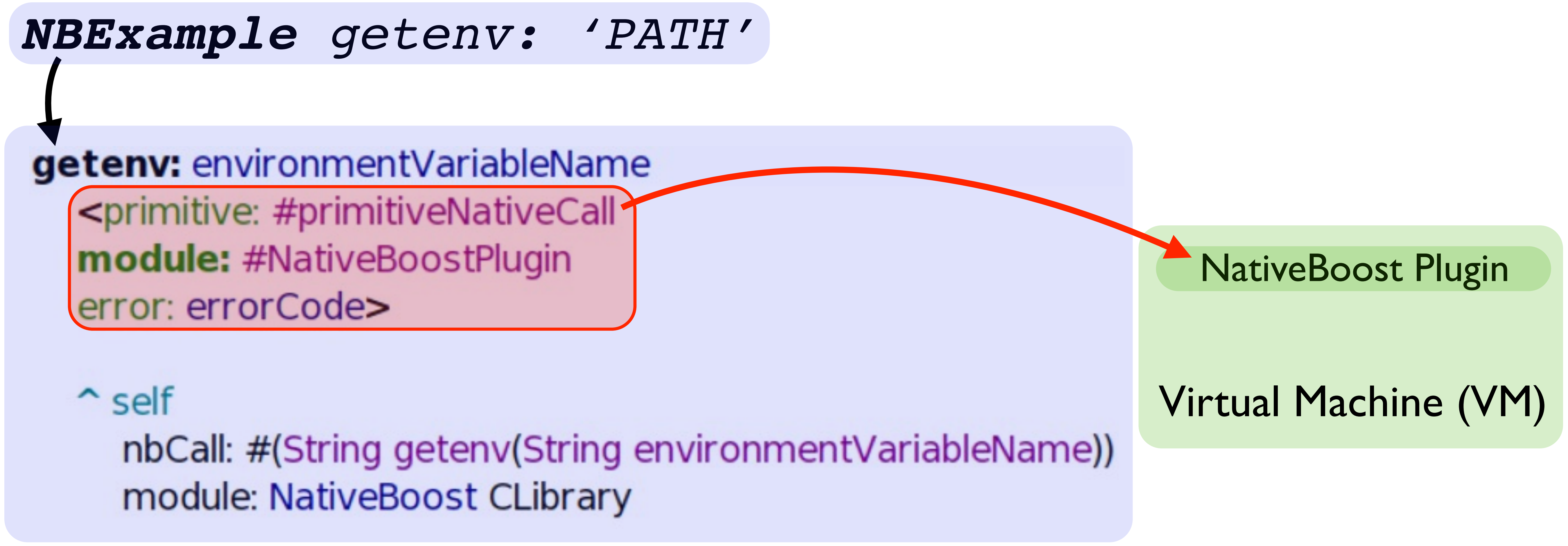

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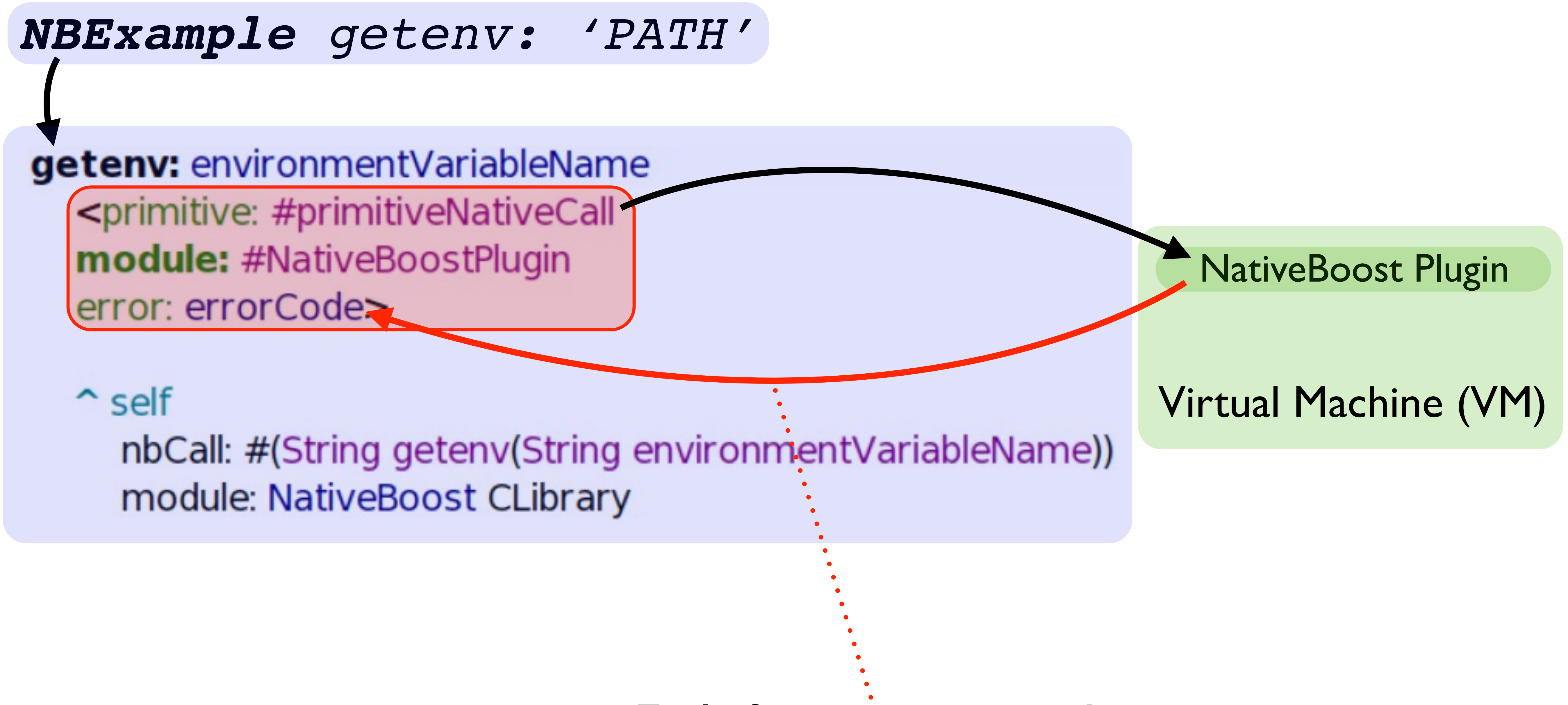

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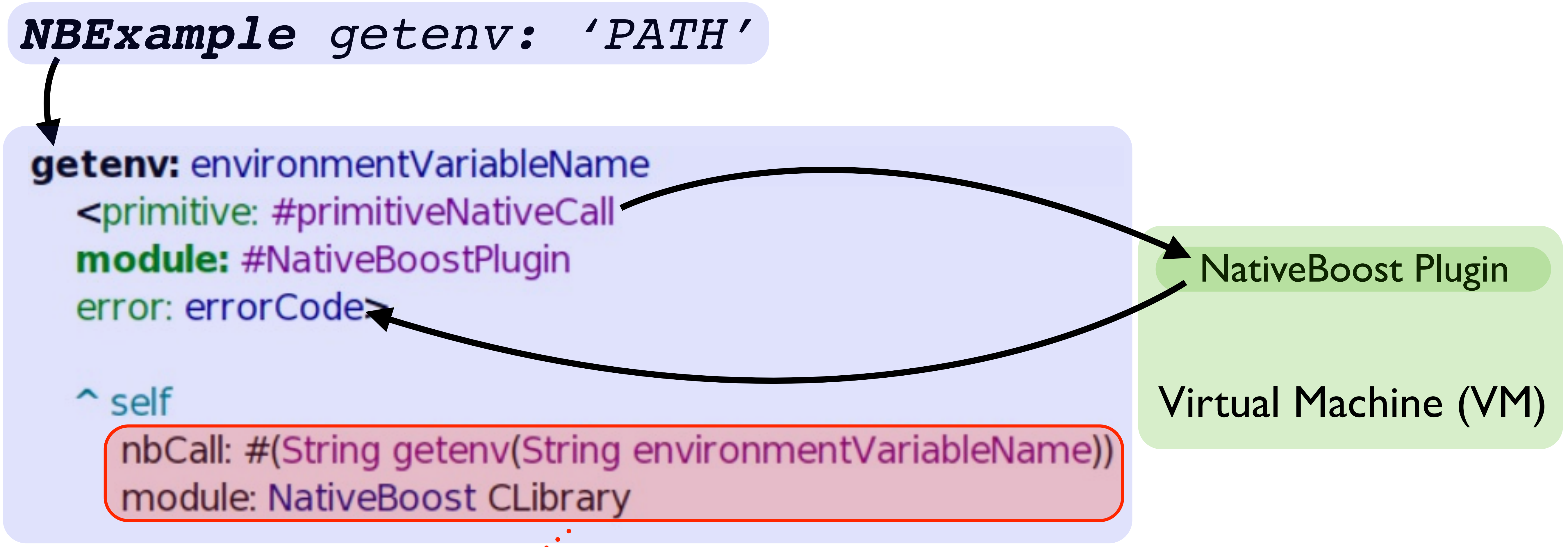
Fail if no native code associated with #getenv:

Insights into NativeBoost Internals



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1. generate native code for marshalling, ...
2. associate it with #getenv:
3. restart the method execution

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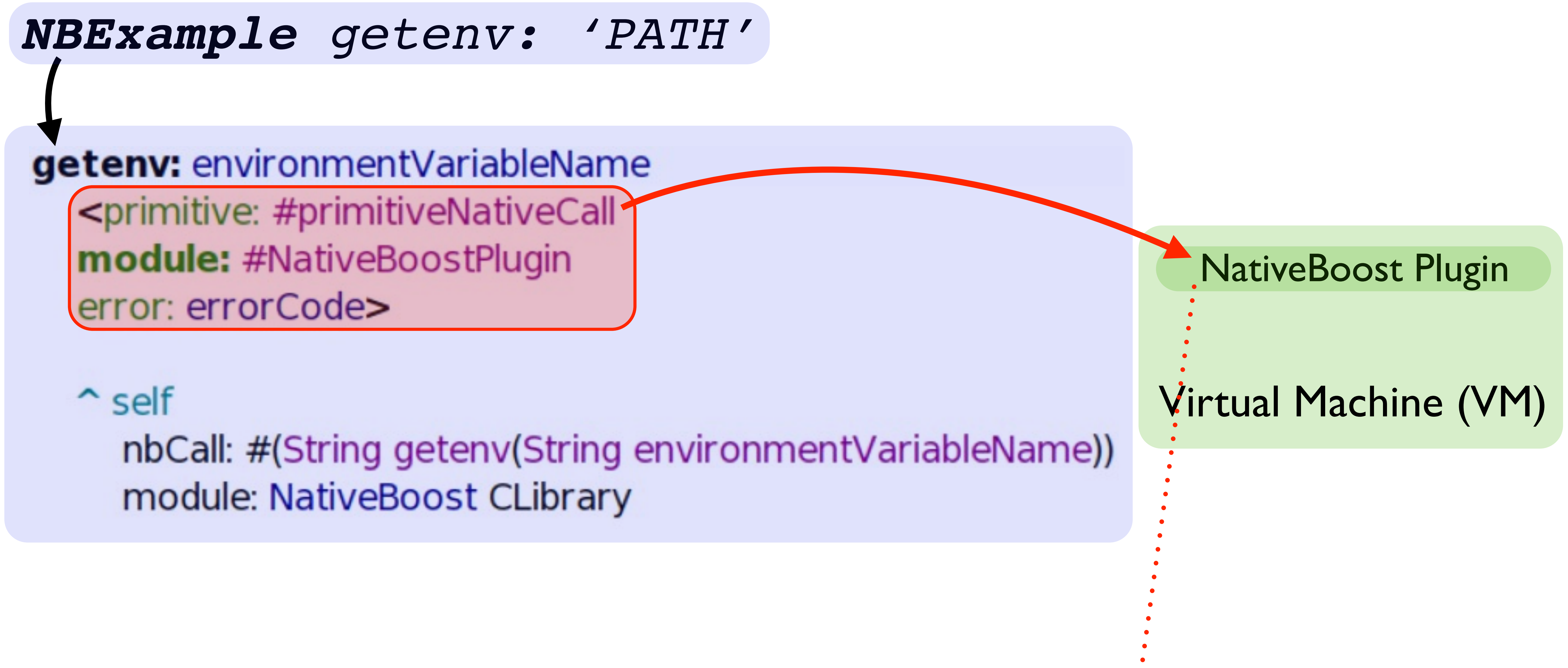

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activate the native code associated with #getenv:

Conclusion

- NativeBoost-FFI is:
  - Language-side: extensible, high-level code only
  - Fast compared to other Smalltalk FFI
    - Needs optimizations on Callbacks but that would require strong VM support

Future Work

- Improve NativeBoost Callback performance
    - Reuse Alien's VM Callback support?
- Better integration of NativeBoost with the JIT
    - Do not leave JIT-mode when activating a NB method

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