ruby2c

Automatic translation of ruby code to C.

by Seattle.rb's
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Overview

- Background information and Goals
- Introduction to metaruby
- Ruby2c Design
- Current Status
- ...some magic

Goals & Background

- The Problem
- A Proposed Solution
- Related Projects & Information

The Problem

- Simply put, writing ruby internals in C requires a mental context switch every time you go from ruby to C and back.
  - C sucks.
    - This makes the internals harder to understand.
      - Which makes it harder to recruit otherwise good coders to work on ruby internals.
        - Which slows down ruby's development.

A Proposal

- Implement the whole thing in ruby, and translate to C.
  - No more context switching.
  - Able to test changes live in the system.
  - More understandable internals.
  - More accessible to others.
  - Must be in a subset of ruby that is easily translatable to C.

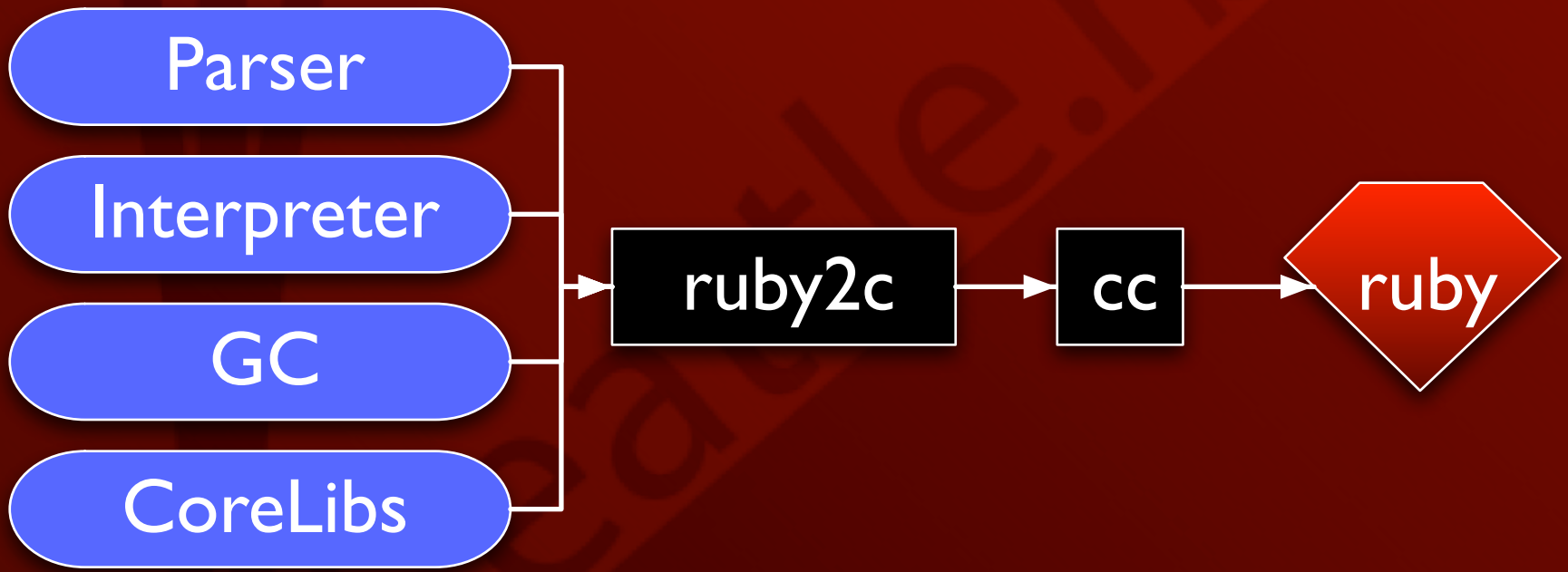
Related Projects & Info

- Projects outside of ruby-land:
  - Squeak Smalltalk is implemented in itself.
  - Newest version of Ungar's Self is as well.
  - Wirth's Pascal, Modula-2, and Oberon.
- Ruby-land projects:
  - YARV, jruby, Iypanov's rubydium. *others?*
  - Matju's metaruby project is similar to our core library module, but otherwise unrelated.

Metaruby

- Ruby2c is a subset of the metaruby project.
- Metaruby intends to implement ruby's internals in ruby itself.
- The metaruby implementation will use ruby2c to convert itself to C and bootstrap a new ruby binary.
- Metaruby should be fully compatible w/ Matz's ruby.

Basic Architecture



Parser

- The parser needs to be rewritten in the ruby2c subset.
- LL vs LR, shouldn't matter
- (but I prefer LL so you might want to beat me to it)
- *We are recruiting for this module!*

Interpreter

- Needs to be rewritten in the ruby2c subset.
- Should be able to run any valid AST.
- Eric has an experimental interpreter written.

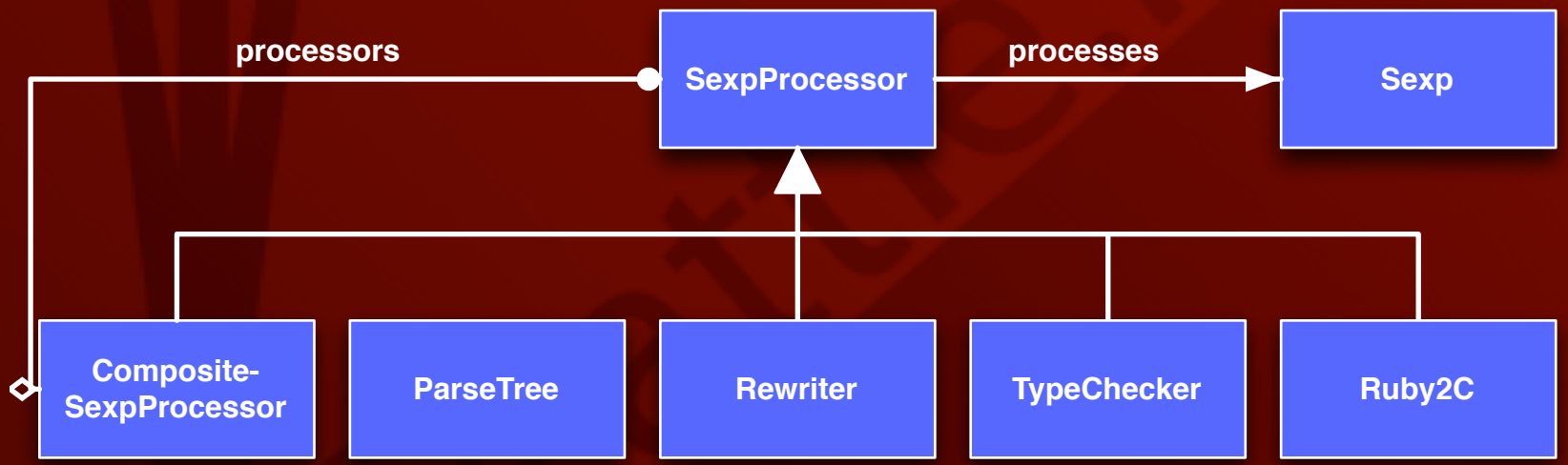
Garbage Collector

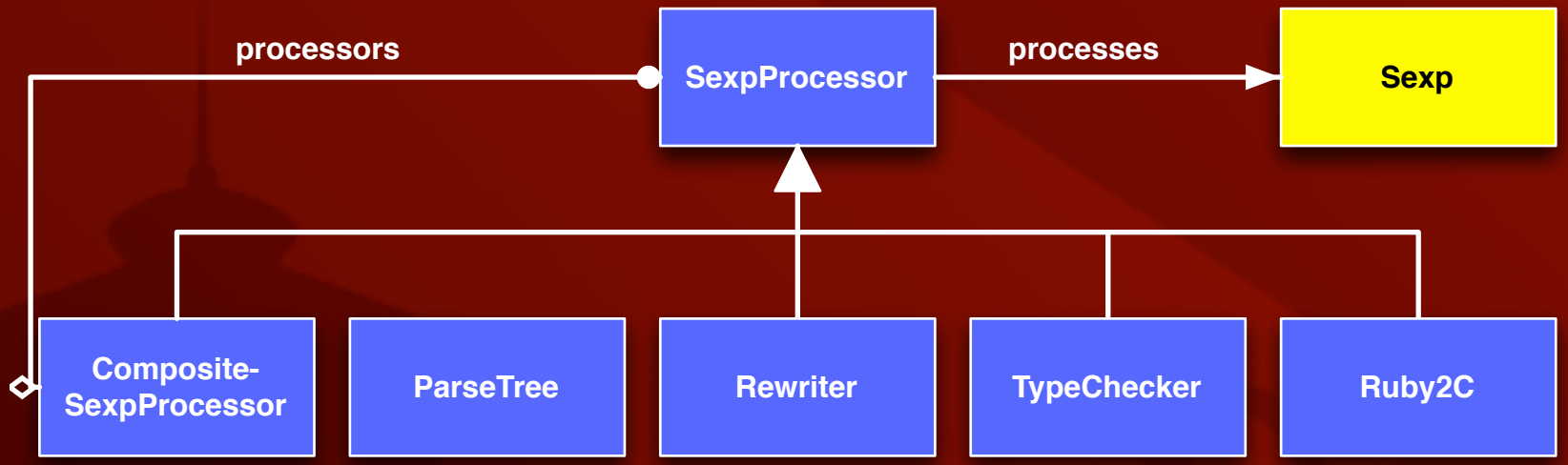
- Needs to be rewritten in the ruby2c subset.
- Probably the hardest part of our entire project.
- *We are recruiting for this module!*

Core Libraries

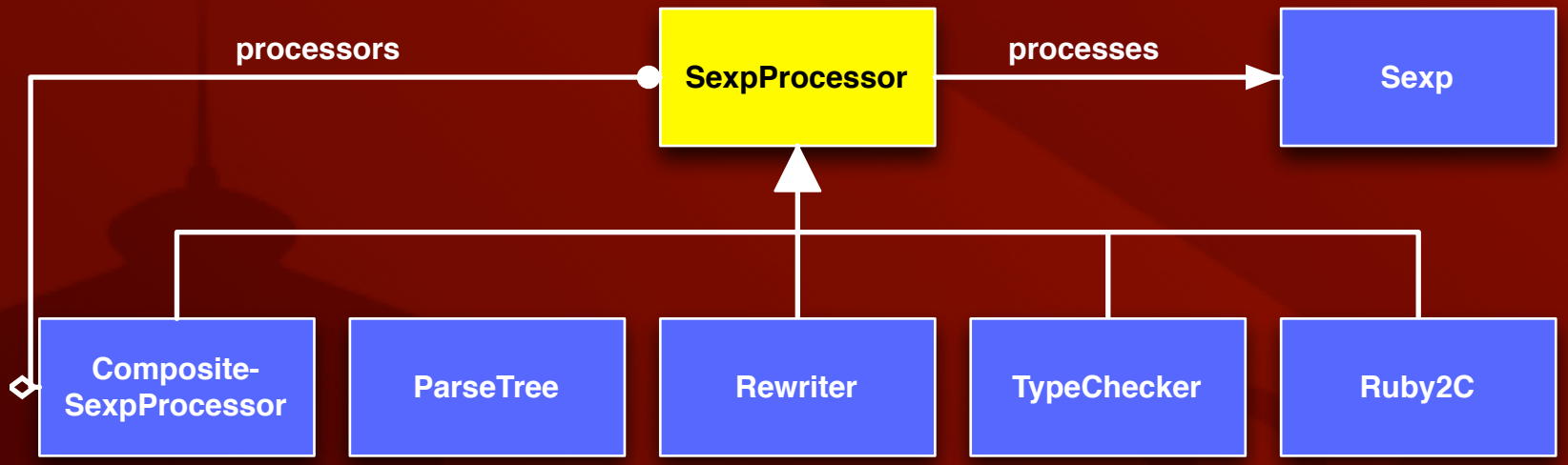
- Array, Hash, Time, etc... all need to be rewritten in the ruby2c subset.
- We've converted rubicon to help verify translation.
- Might be able to adopt other project's efforts on this one.
- *We are recruiting for this module!*

Basic ruby2c Design

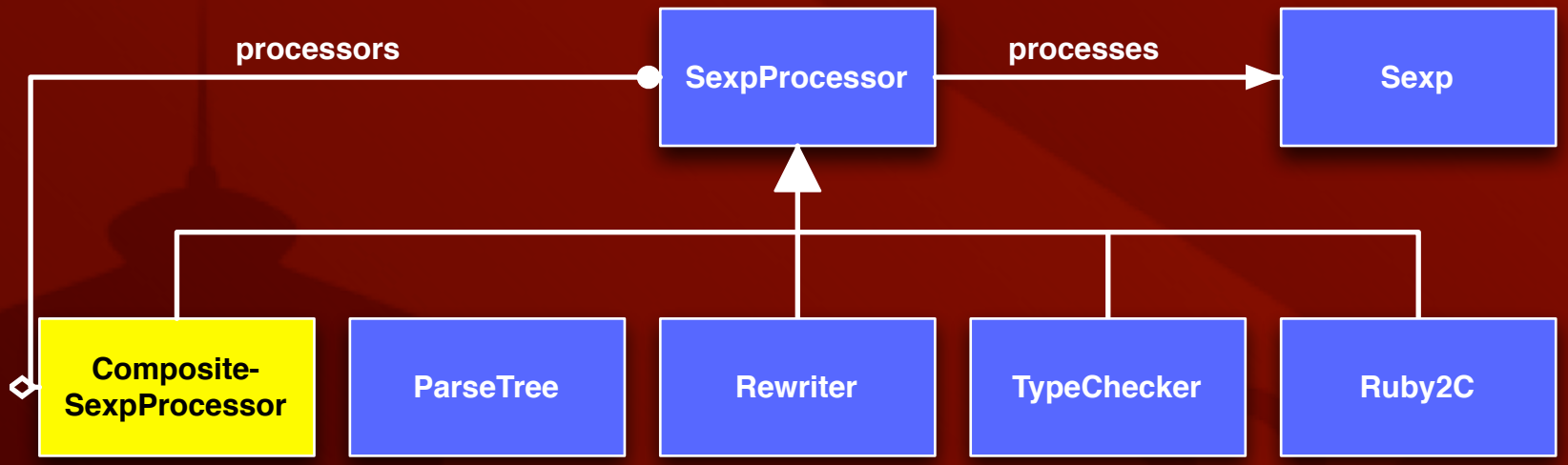




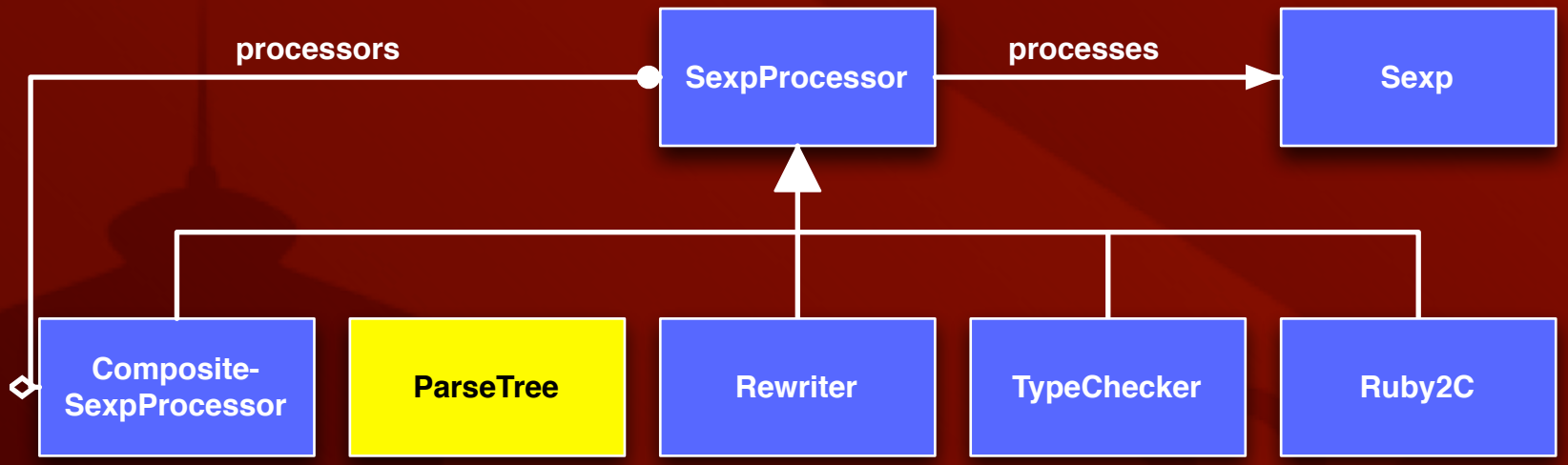
- Sexp subclasses Array.
- Contains an extra member: sexp_type.
- Has some extra (recursive) iterators like each_of_type(type).
- Nothing too spectacular here.



- SexpProcessor provides a single method: `process(sexp)`
- Uses reflection to dynamically dispatch to `process_something(sexp)`
- *something* is determined by the type of the sexp.
- Enforces basic rules and also provides a generic processor.



- A simple composite pattern as applied to SexpProcessor
- Allows for chains of processors to be easily hooked together.

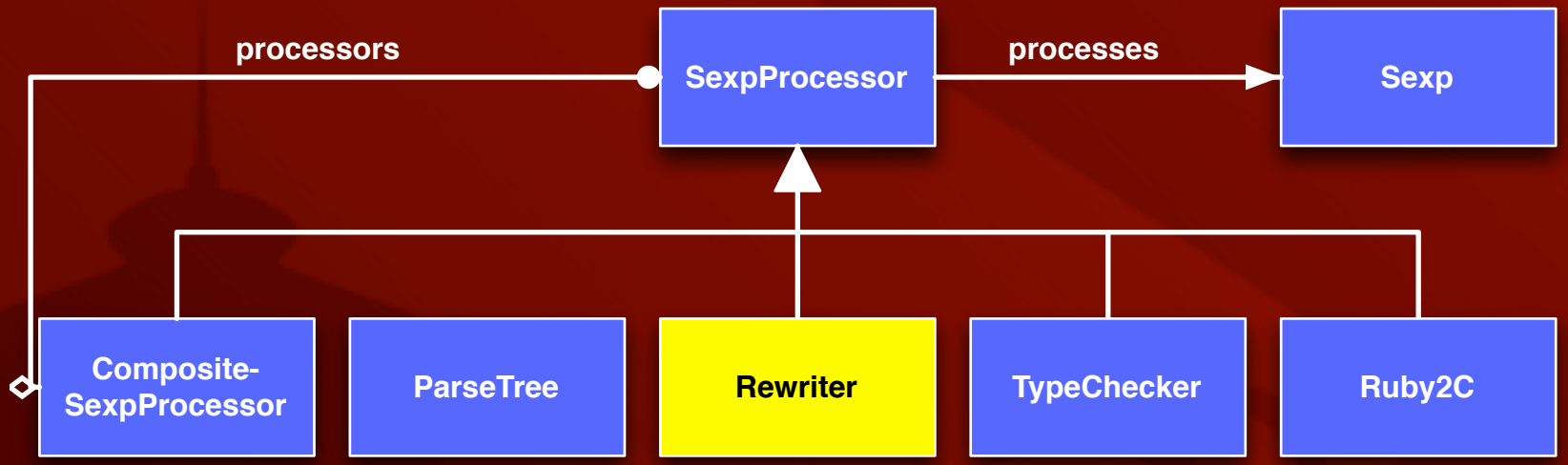


- ParseTree is a C extension via RubyInline.
- It returns a method's AST in sexp form.

```
def hello(n)
  1.upto(n) do
    puts "hello world"
  end
end
```

becomes:

```
[:defn,
  "hello",
  [:scope,
   [:block,
    [:args, "n"],
    [:iter,
     [:call,
      [:lit, 1],
      "upto",
      [:array, [:lvar, "n"]]],
     nil,
     [:fcall,
      "puts",
      [:array,
       [:str, "hello world"]]]]]]]
```



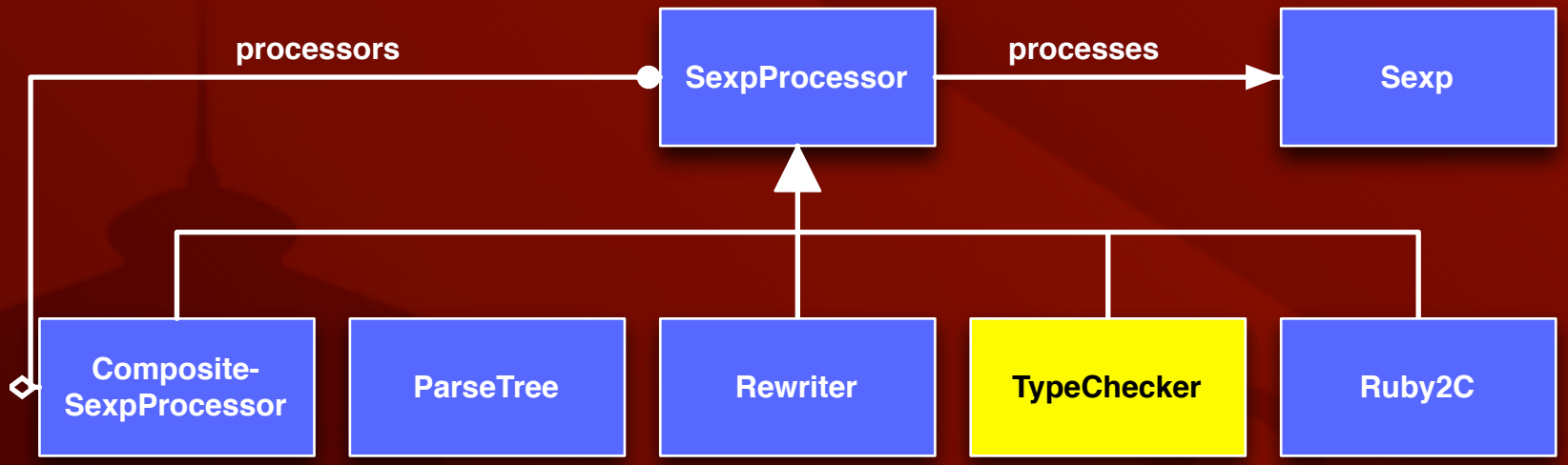
Rewriter cleans up sexps from ParseTree.
Makes it easier to deal with. More uniform.

```
[:defn,
  "hello",
  [:scope,
   [:block,
    [:args, "n"],
    [:iter,
     [:call,
      [:lit, 1],
      "upto",
      [:array, [:lvar, "n"]]],
     nil,
     [:fcall,
      "puts",
      [:array,
       [:str, "hello world"]]]]]]]
```

becomes:

```
[:defn,
 "hello",
 [:args, "n"],
 [:scope,
  [:block,
   [:lasgn, "temp_var1", [:lit, 1]],
   [:while,
    [:call, [:lvar, "temp_var1"],
     "<=", [:array, [:lvar, "n"]]],
    [:block,
     [:call, nil, "puts",
      [:array, [:str, "hello world"]]],
     [:lasgn,
      "temp_var1",
      [:call, [:lvar, "temp_var1"], "+",
       [:array, [:lit, 1]]]]]]]]]
```

focus for next slide

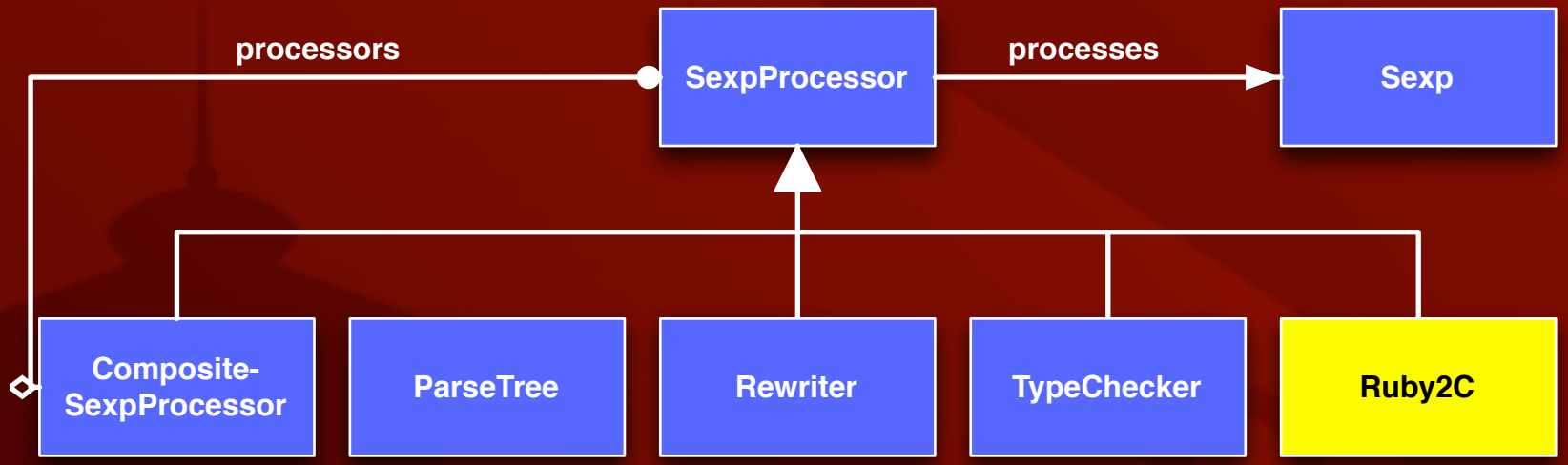


- TypeChecker infers and unifies types, adding them to the sexp.
- Starts to get very unreadable at this stage.
- Hence, the subset of last slide.

```
[:call,
  [:lvar, "temp_var1"],
  "<=",
  [:array, [:lvar, "n"]]],
```

becomes:

```
[:call,
  [:lvar, "temp_var1", Type.long],
  "<=",
  [:array,
    [:lvar, "n", Type.long]],
  Type.bool],
```




```
[:call,
  [:lvar, "temp_var1", Type.long],
  "<=",
  [:array,
    [:lvar, "n", Type.long]],
  Type.bool],
```

becomes:

```
temp_var1 <= n
```

finally:

```
  def hello(n)
    1.upto(n) do
      puts "hello world"
    end
  end
```

becomes:

```
void
hello1(long n) {
long temp_var1;
temp_var1 = 1;
while (temp_var1 <= n) {
puts("hello world");
temp_var1 = temp_var1 + 1;
}
}
```

Current Status

- *Everything* shown on these slides came from running real code.
- The design is *fully implemented*, we are expanding our supported subset of ruby.
- Simple ruby sexp interpreter for longs only was written in *one day*.
- We think this helps validate our design.

Extra Magic

- Integrated into RubyInline
- *13 lines of ruby!*
- Automatic optimization of ruby code!

13 Lines of Ruby

```
module Inline
  class Ruby < Inline::C
    def initialize(mod)
      super
    end

    def optimize(meth)
      src = RubyToC.translate(@mod, meth)
      @mod.class_eval "alias :#{meth}_slow :#{meth}"
      @mod.class_eval "remove_method :#{meth}"
      c src
    end
  end
end
```

Automatic Optimization:

```
class MyTest

  def factorial(n)
    f = 1
    n.downto(2) { |x| f *= x }
    return f
  end

  inline(:Ruby) do |builder|
    builder.optimize :factorial
  end
end
```

becomes:

```
static VALUE factorial(VALUE self,
                       VALUE _n) {
long n = NUM2INT(_n);
long f;
long x;
f = 1;
x = n;
while (x >= 2) {
f = f * x;
x = x - 1;
};
return INT2NUM(f);
}
```

and ***dynamically*** replaces the ruby version!

in this case, a 8.8x speed-up!

Want to Help?

- Contact either person on the title page.
- A ruby2c subset spec is coming soon.
- Lots to write, and much of it should be fun!