Inside Your Ruby Implementation

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Why Should You Care?

YARV

Ruby 1.9

JRuby

Ruby 1.8/1.9

Getting Started...

```
tar -xvf ruby-1.9.1-p378.tar
cd ruby-1.9.1-p378
./configure optflags=
make
# sudo make install
```

ruby-1.9.1-p378/

-> io.c

-> object.c

-> vm.c

-> parse.y

-> ... About 100 .c .h files

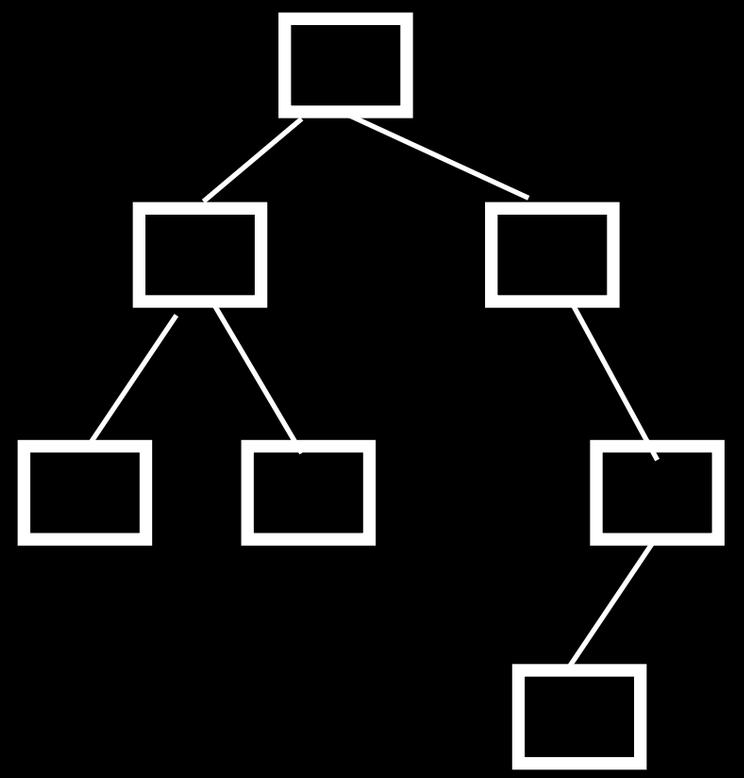
-> include/ruby/*.h

-> ext/openssl...

The Big Picture

```
if 1 > 2
  puts ‘yes’
else
  puts ‘no’
end
```

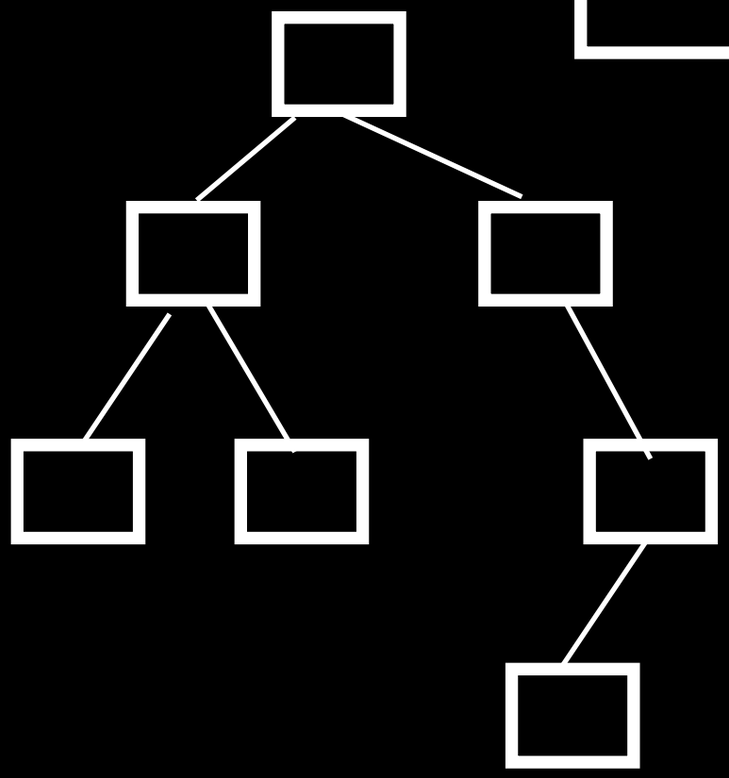
parse.y



The Big Picture

compile.c

vm_exec.c



```
0000 trace              1
0002 putspecialobject 1
0004 putspecialobject 2
0006 putobject :hello
```

Your Code ...

```
if 1 > 2
  puts "true"
else
  puts "false"
end
```

Gets Parsed...

```
| k_if expr_value then
   compstmt
   if_tail
   k_end
     {
         ... Generate nodes for if ...
     }
| k_unless expr_value then
   compstmt
   opt_else
   k_end
     {
         ... Generate nodes for unless ...
     }
```

from parse.y

... into nodes

```
typedef struct RNode {
    unsigned long flags;
    char *nd_file;
    union {
        struct RNode *node;
        ID id;
        VALUE value;
        VALUE (*cfunc)(ANYARGS);
        ID *tbl;
    } u1;
    union {
       /* Stuff ... */
    } u2;
    union { /* More Stuff ... */ } u3;
} NODE;
```

from node.h

Each node has a type, and...

```
enum node_type {
    NODE_METHOD,
#define NODE_METHOD     NODE_METHOD
    NODE_FBODY,
#define NODE_FBODY      NODE_FBODY
    NODE_CFUNC,
#define NODE_CFUNC      NODE_CFUNC
    NODE_SCOPE,
#define NODE_SCOPE      NODE_SCOPE
    NODE_BLOCK,
#define NODE_BLOCK      NODE_BLOCK
    NODE_IF,
...
};
```

from node.h

... gets turned into bytecodes

```
== disasm:
<RubyVM::InstructionSequence:<main>@example.rb>==========
0000 trace            1                                   (   2)
0002 putobject        1
0004 putobject        2
0006 opt_gt
0007 branchunless     22
0009 trace            1                                   (   3)
0011 putnil
0012 putstring        "true"
0014 send             :puts, 1, nil, 8, <ic>
0020 leave                                                (   2)
0021 pop
0022 trace            1                                   (   5)
0024 putnil
```

... which get executed

```
INSN_ENTRY(branchunless){
{
  OFFSET dst = (OFFSET)GET_OPERAND(1);
  VALUE val = TOPN(0);
  DEBUG_ENTER_INSN("branchunless");
  ADD_PC(1+1);
  PREFETCH(GET_PC());
  POPN(1);
  ... Lot of stuff omitted ...
  {
    #line 1158 "insns.def"
    if (!RTEST(val)) {
        RUBY_VM_CHECK_INTS();
        JUMP(dst);
  } // ...
```

from vm.inc

puts

```
gdb ruby
(gdb) b rb_io_puts
(gdb) run -e 'puts "hello"'
...
(gdb) p argv[0]
```

```
/*
 *  call-seq:
 *     ios.puts(obj, ...)    => nil
 * ...
 */
VALUE
rb_io_puts(int argc, VALUE *argv, VALUE out)
{
   ...
}
```

from io.c

It's All About VALUEs

Question

A VALUE Is:

a) A Pointer To A Struct

b) A Number

c) A Bit Field

```
typedef unsigned long VALUE;
```

from include/ruby/ruby.h

Often A

VALUE Is A

*struct

VALUE

```
struct RFloat {
    struct RBasic basic;
    double float_value;
};
```

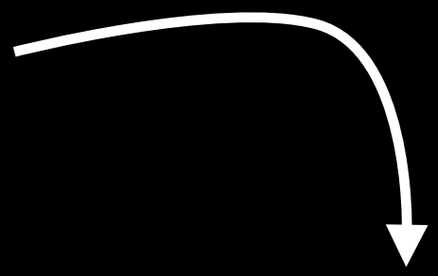
from include/ruby/ruby.h

VALUE

```
struct RString {
    struct RBasic basic;
    union {
        struct {
            long len;
            char *ptr;
            union {
                long capa;
                VALUE shared;
            } aux;
        } heap;
        char ary[RSTRING_EMBED_LEN_MAX+1];
    } as;
};
```

from include/ruby/ruby.h

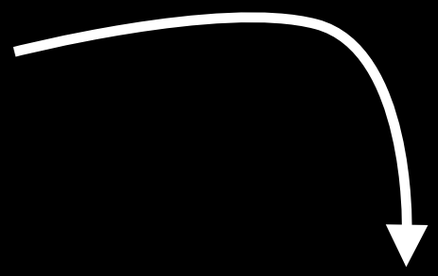
VALUE



```
struct RBasic {
    VALUE flags;
    VALUE klass;
};
```

from include/ruby/ruby.h

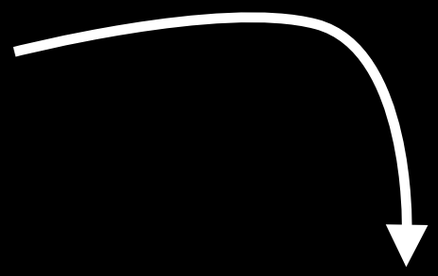
VALUE



```
struct truct RObject {
    struct RBasic basic;
    union {
        struct {
            long numiv;
            VALUE *ivptr;
            struct st_table *iv_index_tbl;
        } heap;
        VALUE ary[ROBJECT_EMBED_LEN_MAX];
    } as;
};
```

from include/ruby/ruby.h

VALUE



```
struct RClass {
    struct RBasic basic;
    rb_classext_t *ptr;
    struct st_table *m_tbl;
    struct st_table
    *iv_index_tbl;
};
```

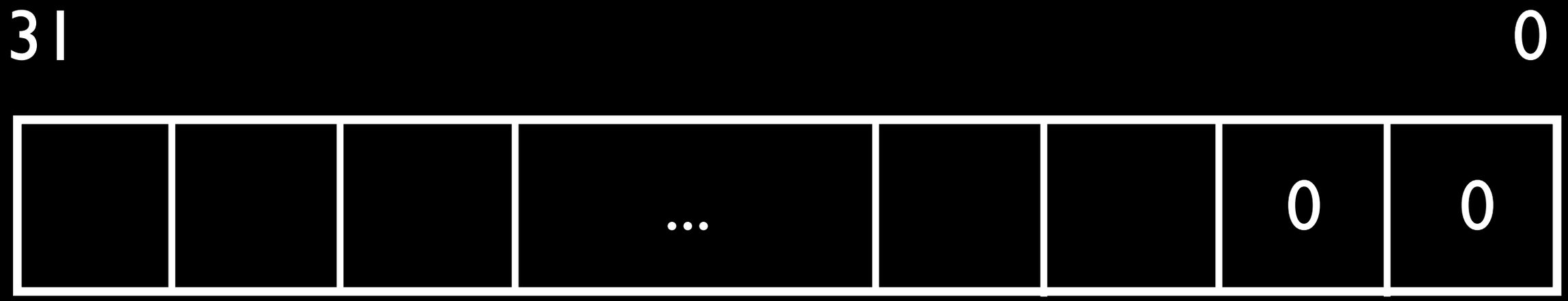
from include/ruby/ruby.h

Structs

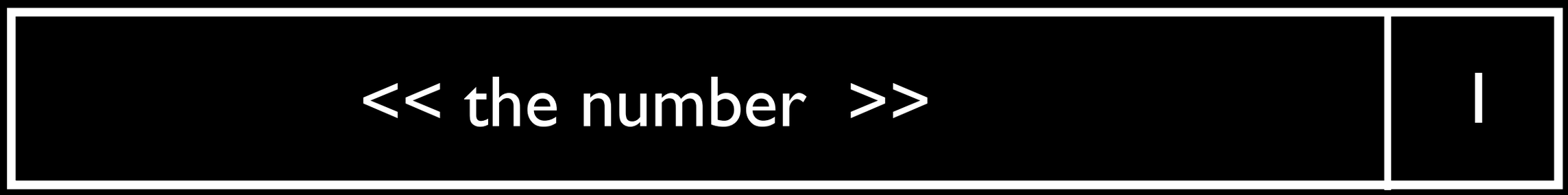
In Action

A Funny Thing About

Struct Pointers


31
0
...
0
0

Fixnum VALUE



Symbol VALUE

31 0

<< 24 bit index >>	0x0e

0	0	0	0	1	1	1	0

Special VALUEs

```
RUBY_Qfalse = 0
RUBY_Qtrue  = 2
RUBY_Qnil   = 4
RUBY_Qundef = 6
```

from include/ruby/ruby.h

Question

A VALUE Is:

a) A Pointer To A Struct

b) A Number

c) A Bit Field

d) All Of The Above!

An Insight

JRuby

```
tar -xvf jruby-src-1.4.0.tar
cd jruby-1.4.0
ant
```

Good News:

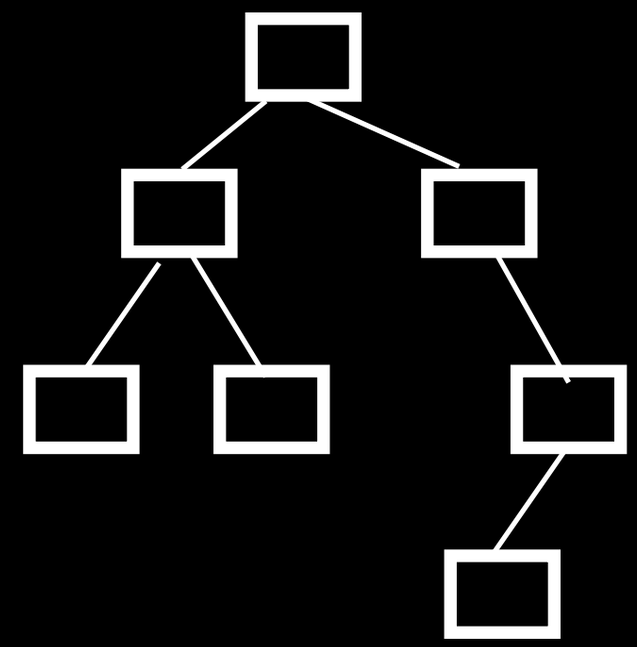
.project

Good News: nbproject

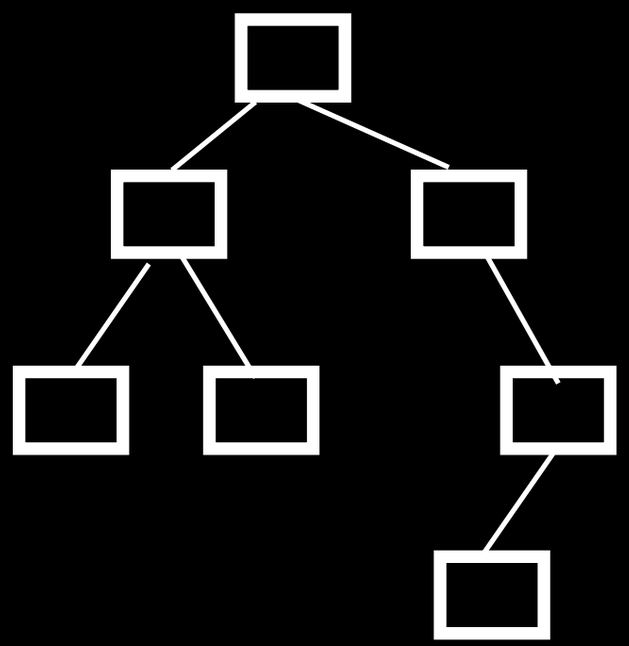
The Big Picture

```
if 1 > 2
  puts 'yes'
else
  puts 'no'
end
```

DefaultRubyParser.y



The Big Picture



JITCompiler.java

```
0 iload_1
1 iload_2
2 iadd
3 istore_3
```

The parser turns Ruby...

```
| kIF expr_value then compstmt if_tail kEND {
    $$ = new IfNode(getPosition($1),
          support.getConditionNode($2), $4, $5);
}

| kWHILE {
        lexer.getConditionState().begin();
    } expr_value do {
        lexer.getConditionState().end();
    } compstmt kEND {
    Node body = $6 == null ? NilImplicitNode.NIL : $6;
    $$ = new WhileNode(getPosition($1),
              support.getConditionNode($3), body);
}
```

from org/jruby/ast/IfNode.java

... into Java nodes

```
public class IfNode extends Node {

  private final Node condition;
  private final Node thenBody;
  private final Node elseBody;

  // ...
}
```

from org/jruby/ast/IfNode.java

... which are interpreted

```
public class IfNode extends Node {

  private final Node condition;
  private final Node thenBody;
  private final Node elseBody;

  // ...

   public IRubyObject interpret(Ruby runtime,
       ThreadContext context, IRubyObject self,
       Block aBlock)
   {
     // Evaluate condition; if it is true, evaluate
     // thenBody. If it false, evaluate elseBody.

   }
}
```

from org/jruby/ast/IfNode.java

... or compiled

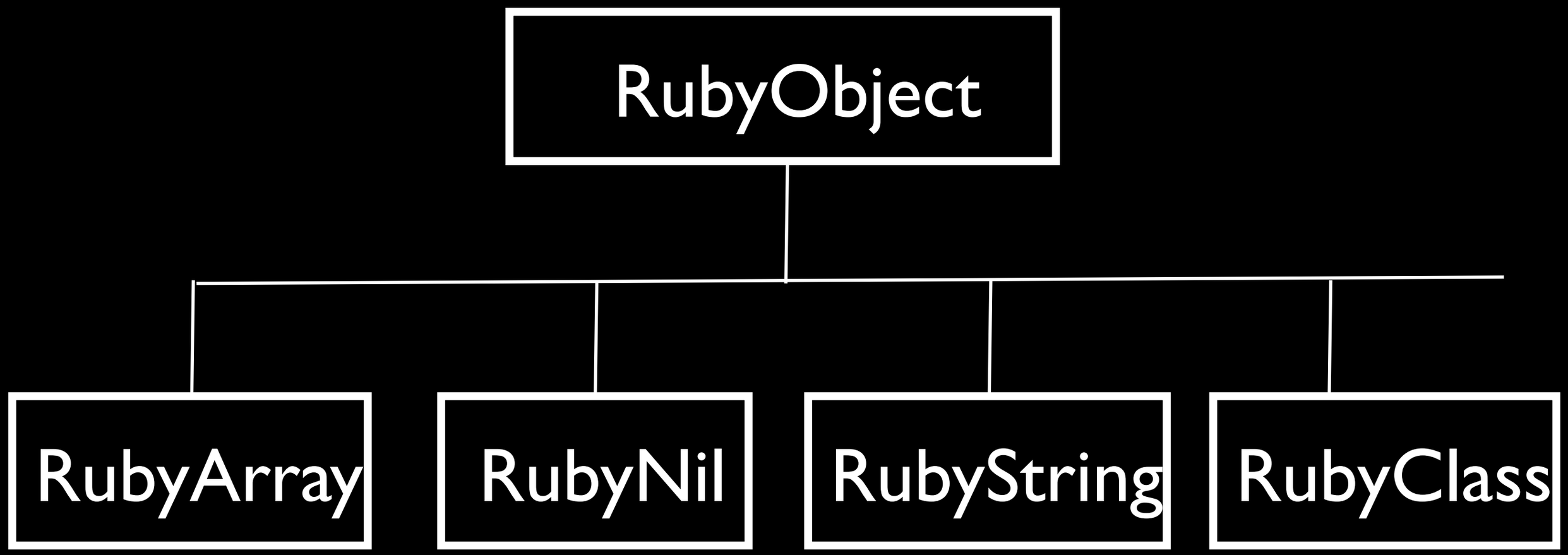
```
public class ASTCompiler {
    // ...

    public void compile(Node node, BodyCompiler context,
      boolean expr) {

        // ...

        switch (node.getNodeType()) {
            case ALIASNODE:
                compileAlias(node, context, expr);
                break;
            case ANDNODE:
                compileAnd(node, context, expr);
                break;
            // ...
            case IFNODE:
                compileIf(node, context, expr);
                break;
            // ...
        }
    }
```

from org/jruby/ast/IfNode.java

Java

Good!

Easy Objects



Ruby Is Yours

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Own It!

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