I've written a patch to collect most symbols.

**PATCH:** https://github.com/authorNari/ruby/compare/4a91fb7a45f0e3c...symbol_gc.patch

**Summary**

- Most symbols in Ruby level are GC-able generated by #to_sym, #intern, etc.
- Exclude a symbol which is translated ID in C-level from GC-able symbols
- Keep Ruby's C extension compatibility
- Pass make test-all

**Benchmark**

A benchmark program is here.

```
obj = Object.new
100_000.times do |i|
  obj.respond_to?("sym#{i}".to_sym)
end
GC.start
puts "symbol : #{Symbol.all_symbols.size}"

% time RBENV_VERSION=ruby-r45059 ruby -v /tmp/a.rb
ruby 2.2.0dev (2014-02-20 trunk 45059) [x86_64-linux]
symbol : 102416
0.24s user 0.01s system 91% cpu 0.272 total

% time RBENV_VERSION=symgc ruby -v /tmp/a.rb
ruby 2.2.0dev (2014-02-20 trunk 45059) [x86_64-linux]
symbol : 2833
0.21s user 0.01s system 90% cpu 0.247 total
```

The total number of symbols is declined.
The total time of symgc version is improved because Full GC pressure has been reduced.

The result of make benchmark.

https://gist.github.com/authorNari/9359704

There is no significant slowdown.

(I would welcome to try an additional benchmark and report)

**Implementation Detail**

I classify Dynamic symbol and Static symbol.

- Static symbol
  - Generated by rb_intern()
  - A sequential unique number as in the past.
  - Not GC-able
LSB = 1
- Reserved IDs (147 and below) are exceptional cases

- Dynamic symbol
  - Generated by #to_sym, #intern in Ruby level
  - RVALUE
  - GC-able
  - LSB = 0
  - Pin down a dynamic symbol when it translates to ID (e.g. SYM2ID, rb_intern).
  - Pinned dynamic symbols are never collected.
  - I'd like to include ID in GC's roots only for CRuby internal in order to reduce pinned dynamic symbols.

Please read the patch if you want to know more information.

Acknowledgment

The idea of this symbol GC is invented by Sasada Koichi in Heroku, inc.
Thank you.

-- ja --
RubyレベルのシンボルをGC対象にするパッチを書きました。
https://github.com/authorNari/ruby/compare/4a91fb7a45f0e3c...symbol_gc

RubyレベルのほとんどのシンボルがGC対象（to_sym, internで作られたもの）
C側でIDに変換された場合はGC対象から除外（rb_intern、SYM2ID）
C-APIの互換性維持
make test-allが通る

ベンチマーク
以下のプログラムを実行。
obj = Object.new
100_000.times do |i|
  obj.respond_to?("sym#{i}".to_sym)
end
GC.start
puts "symbol : #{Symbol.all_symbols.size}"

% time RBENV_VERSION=symgc ruby -v /tmp/a.rb
ruby 2.2.0dev (2014-02-20 trunk 45059) [x86_64-linux]
symbol : 2833
0.21s user 0.01s system 90% cpu 0.247 total

% time RBENV_VERSION=ruby-r45059 ruby -v /tmp/a.rb
ruby 2.2.0dev (2014-02-20 trunk 45059) [x86_64-linux]
symbol : 102416
0.24s user 0.01s system 91% cpu 0.272 total

總シンボル数が減少していることがわかる。
シンボル数の現象でFull GCのプレッシャーが削減されたことにより、symgcの速度が向上した。
make benchmarkの結果。
https://gist.github.com/authorNari/9359704

大幅な速度低下は見られない。
（上記以外の追試を歓迎します）

（ちょっとした）詳細
05/06/2020
symbolをstatic symbolとdynamic symbolに分類。

● static symbol
  ○ rb_itern等で生成されたもの
  ○ 従来通り、連番の一意な数値
  ○ GC非対象
  ○ 下位1ビットにフラグとして1を立てる
  ○ 147以下の予約済みIDは例外ケース

● dynamic symbol
  ○ Rubyレベルの#to_sym,#internなどで生成されたもの
  ○ RVALUEとして生成
  ○ GC対象
  ○ 下位1ビットは0
  ○ CレベルでID変換(SYM2IDなど)された場合、pindownし、GCで解放される
  ○ Rubyレベルでpindownした場合、pindownする箇所をなくしたい

その他の詳細はパッチを読んでもらえると…。

謝辞
シンボルGCのアイデアはHeroku社のささだこういち様によるものです。

Associated revisions
Revision 90b70738 - 03/26/2014 04:57 AM - nari

● parse.y: support Symbol GC. [ruby-trunk Feature #9634]
  See this ticket about Symbol GC.

● include/ruby/ruby.h:
  Declare few functions.
  ○ rb_sym2id: almost same as old SYM2ID but support dynamic symbols.
  ○ rb_id2sym: almost same as old ID2SYM but support dynamic symbols.
  ○ rb_sym2str: almost same as rb_id2str(SYM2ID(sym)) but not pin down a dynamic symbol. Declare a new struct.
  ○ struct RSymbol: represents a dynamic symbol as object in Ruby's heaps. Add few macros.
  ○ STATIC_SYM_P: check a static symbol.
  ○ DYNAMIC_SYM_P: check a dynamic symbol.
  ○ RSYMBOL: cast to RSymbol

● gc.c: declare RSymbol. support T_SYMBOL.

● internal.h: Declare few functions.
  ○ rb_gc_free_dsymbol: free up a dynamic symbol. GC call this function at a sweep phase.
  ○ rb_str_dynamic_intern: convert a string to a dynamic symbol.
  ○ rb_check_id_without_pindown: not pinning function.
  ○ rb_sym2id_without_pindown: ditto.
  ○ rb_check_id_cstr_without_pindown: ditto.

● string.c (Init_String): String#intern and String#to_sym use
  ○ rb_str_dynamic_intern.

● template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.

● string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.
load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.

object.c: ditto.

sprintf.c: ditto.

struct.c: ditto.

thread.c: ditto.

variable.c: ditto.

vm_method.c: ditto.

Git-SVN ID: svn+ssh://ci.ruby-lang.org/ruby/trunk@45426 b2dd03c8-39d4-4d8f-98ff-823fe69b080e

Revision 45426 - 03/26/2014 04:57 AM - nari

parse.y: support Symbol GC. [ruby-trunk Feature #9634]
See this ticket about Symbol GC.

cinclude/ruby/ruby.h:
Declate few functions.

- rb_sym2id: almost same as old SYM2ID but support dynamic symbols.
- rb_id2sym: almost same as old ID2SYM but support dynamic symbols.
- rb_sym2str: almost same as rb_id2str(SYM2ID(sym)) but not pin down a dynamic symbol. Declare a new struct.
  - struct RSymbol: represents a dynamic symbol as object in Ruby's heaps. Add few macros.
  - STATIC_SYM_P: check a static symbol.
  - DYNAMIC_SYM_P: check a dynamic symbol.
  - RSYMBOL: cast to RSymbol

gc.c: declare RSymbol. support T_SYMBOL.

internal.h: Declate few functions.

- rb_gc_free_dsymbol: free up a dynamic symbol. GC call this function at a sweep phase.
- rb_str_dynamic_intern: convert a string to a dynamic symbol.
- rb_check_id_without_pindown: not pinning function.
- rb_sym2id_without_pindown: ditto.
- rb_check_id_cstr_without_pindown: ditto.

string.c (Init_String): String#intern and String#to_sym use rb_str_dynamic_intern.

template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.

string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.

load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.

object.c: ditto.

sprintf.c: ditto.

struct.c: ditto.

thread.c: ditto.

variable.c: ditto.

vm_method.c: ditto.
parse.y: support Symbol GC. [ruby-trunk Feature #9634]
See this ticket about Symbol GC.

include/ruby/ruby.h:
Declare few functions.

- rb_sym2id: almost same as old SYM2ID but support dynamic symbols.
- rb_id2sym: almost same as old ID2SYM but support dynamic symbols.
- rb_sym2str: almost same as rb_id2str(SYM2ID(sym)) but not pin down a dynamic symbol. Declare a new struct.
- struct RSymbol: represents a dynamic symbol as object in Ruby's heaps. Add few macros.
- STATIC_SYM_P: check a static symbol.
- DYNAMIC_SYM_P: check a dynamic symbol.
- RSYMBOL: cast to RSymbol

gc.c: declare RSymbol. support T_SYMBOL.

internal.h: Declare few functions.

- rb_gc_free_dsym: free up a dynamic symbol. GC call this function at a sweep phase.
- rb_str_dynamic_intern: convert a string to a dynamic symbol.
- rb_check_id_without_pindown: not pinning function.
- rb_sym2id_without_pindown: ditto.
- rb_check_id_cstr_without_pindown: ditto.

string.c (Init_String): String#intern and String#to_sym use rb_str_dynamic_intern.

template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.

string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.

load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.

object.c: ditto.
sprintf.c: ditto.
struct.c: ditto.
thread.c: ditto.
variable.c: ditto.
vm_method.c: ditto.
• gc.c: declare RSymbol. support T_SYMBOL.

• internal.h: Declare few functions.
  • rb_gc_free_dsymbol: free up a dynamic symbol. GC call this function at a sweep phase.
  • rb_str_dynamic_intern: convert a string to a dynamic symbol.
  • rb_check_id_without_pindown: not pinning function.
  • rb_sym2id_without_pindown: ditto.
  • rb_check_id_cstr_without_pindown: ditto.

• string.c (Init_String): String#intern and String#to_sym use rb_str_dynamic_intern.

• template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.

• string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.

• load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.

• object.c: ditto.

• sprintf.c: ditto.

• struct.c: ditto.

• thread.c: ditto.

• variable.c: ditto.

• vm_method.c: ditto.

Revision 45426 - 03/26/2014 04:57 AM - nari

• parse.y: support Symbol GC. [ruby-trunk Feature #9634]
  See this ticket about Symbol GC.

• include/ruby/ruby.h:
  Declare few functions.
  • rb_sym2id: almost same as old SYM2ID but support dynamic symbols.
  • rb_id2sym: almost same as old ID2SYM but support dynamic symbols.
  • rb_sym2str: almost same as rb_id2str(SYM2ID(sym)) but not pin down a dynamic symbol. Declare a new struct.
  • struct RSymbol: represents a dynamic symbol as object in Ruby's heaps. Add few macros.
  • STATIC_SYM_P: check a static symbol.
  • DYNAMIC_SYM_P: check a dynamic symbol.
  • RSYMBOL: cast to RSymbol

• gc.c: declare RSymbol. support T_SYMBOL.

• internal.h: Declare few functions.
  • rb_gc_free_dsymbol: free up a dynamic symbol. GC call this function at a sweep phase.
  • rb_str_dynamic_intern: convert a string to a dynamic symbol.
  • rb_check_id_without_pindown: not pinning function.
  • rb_sym2id_without_pindown: ditto.
  • rb_check_id_cstr_without_pindown: ditto.

• string.c (Init_String): String#intern and String#to_sym use rb_str_dynamic_intern.

• template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.
• string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.

• load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.

• object.c: ditto.

• sprintf.c: ditto.

• struct.c: ditto.

• thread.c: ditto.

• variable.c: ditto.

• vm_method.c: ditto.

Revision 45426 - 03/26/2014 04:57 AM - nari

• parse.y: support Symbol GC. [ruby-trunk Feature #9634]
  See this ticket about Symbol GC.

• include/ruby/ruby.h:
  Declare few functions.
  • rb_sym2id: almost same as old SYM2ID but support dynamic symbols.
  • rb_id2sym: almost same as old ID2SYM but support dynamic symbols.
  • rb_sym2str: almost same as rb_id2str(SYM2ID(sym)) but not pin down a dynamic symbol. Declare a new struct.
  • struct RSymbol: represents a dynamic symbol as object in Ruby's heaps. Add few macros.
  • STATIC_SYM_P: check a static symbol.
  • DYNAMIC_SYM_P: check a dynamic symbol.
  • RSYMBOL: cast to RSymbol

• gc.c: declare RSymbol. support T_SYMBOL.

• internal.h: Declare few functions.
  • rb_gc_free_dsymbol: free up a dynamic symbol. GC call this function at a sweep phase.
  • rb_str_dynamic_intern: convert a string to a dynamic symbol.
  • rb_check_id_without_pindown: not pinning function.
  • rb_sym2id_without_pindown: ditto.
  • rb_check_id_cstr_without_pindown: ditto.

• string.c (Init_String): String#intern and String#to_sym use rb_str_dynamic_intern.

• template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.

• string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.

• load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.

• object.c: ditto.

• sprintf.c: ditto.

• struct.c: ditto.

• thread.c: ditto.

• variable.c: ditto.

• vm_method.c: ditto.
parse.y: support Symbol GC. [ruby-trunk Feature #9634]
See this ticket about Symbol GC.

include/ruby/ruby.h:
Declare few functions.
- rb_sym2id: almost same as old SYM2ID but support dynamic symbols.
- rb_id2sym: almost same as old ID2SYM but support dynamic symbols.
- rb_sym2str: almost same as rb_id2str(SYM2ID(sym)) but not pin down a dynamic symbol. Declare a new struct.
- struct RSymbol: represents a dynamic symbol as object in Ruby's heaps. Add few macros.
- STATIC_SYM_P: check a static symbol.
- DYNAMIC_SYM_P: check a dynamic symbol.
- RSYMBOL: cast to RSymbol

gc.c: declare RSymbol. support T_SYMBOL.

internal.h: Declare few functions.
- rb_gc_free_dsym: free up a dynamic symbol. GC call this function at a sweep phase.
- rb_str_dynamicIntern: convert a string to a dynamic symbol.
- rb_check_id_without_pindown: not pinning function.
- rb_sym2id_without_pindown: ditto.
- rb_check_id_cstr_without_pindown: ditto.

string.c (Init_String): String#intern and String#to_sym use rb_str_dynamicIntern.

template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.

string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.

load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.

object.c: ditto.

sprintf.c: ditto.

struct.c: ditto.

thread.c: ditto.

variable.c: ditto.

vm_method.c: ditto.

History

#1 - 03/13/2014 09:41 AM - rosenfeld (Rodrigo Rosenfeld Rosas)
Wow, great work! Congrats :-)

#2 - 03/13/2014 02:20 PM - ktsj (Kazuki Tsujimoto)
- File test-all segfault.log added

make test-all sometimes causes segmentation fault.
I attached the backtrace log.

#3 - 03/14/2014 05:02 AM - authorNari (Narihiro Nakamura)
- Description updated
Kazuki Tsujimoto wrote:

make test-all sometimes causes segmentation fault.
I attached the backtrace log.

Thank you! I fixed it and rebased.
https://github.com/authorNari/ruby/commit/9cd060aabb6ca9cf55971b8d8881b30f0204f71be
https://github.com/authorNari/ruby/compare/4a91f0a3c_symbol_gc

Cool! I benchmarked your original version and it didn't notice obvious regressions.

I noticed rb_check_id_without_pindown still takes a volatile arg. Is this for GC-safety? Can we encourage RB_GC_GUARD instead for new APIs? volatile is not always enough, and tends to generate bad code. I realize this was probably for consistency with the old rb_check_id function.

Narihiro Nakamura wrote:

Thank you! I fixed it and rebased.
https://github.com/authorNari/ruby/commit/9cd060aabb6ca9cf55971b8d8881b30f0204f71be
https://github.com/authorNari/ruby/compare/4a91f0a3c_symbol_gc

New symbol_gc branch works fine. Thanks!

Eric Wong wrote:

It make sense for me.
I've removed the volatile declaration of rb_check_id_without_pindown.
https://github.com/authorNari/ruby/commit/3d5f9a63cc059433aa304a4af5

Applied in changeset r45426.

- parse.y: support Symbol GC. [ruby-trunk Feature #9634]
  See this ticket about Symbol GC.

- include/ruby/ruby.h:
  Declare few functions.
  
  - rb_sym2id: almost same as old SYM2ID but support dynamic symbols.
  - rb_id2sym: almost same as old ID2SYM but support dynamic symbols.
  - rb_sym2str: almost same as rb_id2str(SYM2ID(sym)) but not pin down a dynamic symbol. Declare a new struct.
    - struct RSymbol: represents a dynamic symbol as object in Ruby's heaps. Add few macros.
    - STATIC_SYM_P: check a static symbol.
    - DYNAMIC_SYM_P: check a dynamic symbol.
    - RSYMBOL: cast to RSymbol
  
  - gc.c: declare RSymbol. support T_SYMBOL.

- internal.h: Declare few functions.
- rb_gc_free_dsymbol: free up a dynamic symbol. GC call this function at a sweep phase.
- rb_str_dynamic_intern: convert a string to a dynamic symbol.
- rb_check_id_without_pindown: not pinning function.
- rb_sym2id_without_pindown: ditto.
- rb_check_id_cstr_without_pindown: ditto.

- string.c (Init_String): String#intern and String#to_sym use rb_str_dynamic_intern.
- template/id.h.tmpl: use LSB of ID as a flag for determining a static symbol, so we shift left other ruby_id_types.
- string.c: use rb_sym2str instead rb_id2str(SYM2ID(sym)) to avoid pinning.
- load.c: use xx_without_pindown function at creating temporary ID to avoid pinning.
- object.c: ditto.
- sprintf.c: ditto.
- struct.c: ditto.
- thread.c: ditto.
- variable.c: ditto.
- vm_method.c: ditto.

Files

<table>
<thead>
<tr>
<th>File</th>
<th>Size</th>
<th>Date</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>test-all_segfault.log</td>
<td>10 KB</td>
<td>03/13/2014</td>
<td>ktsj (Kazuki Tsujimoto)</td>
</tr>
</tbody>
</table>