Отладка Ruby приложений

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Коротко обо мне

Разработчик в Undev.ru
2 года пишу на Ruby
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Что делает нас хорошими инженерами?

Часть 1. Общая

(выводит список открытых файлов)

lsof

```
Lsof -Pnp <pid>
```

```
$> lsof -Pnp 4227

COMMAND PID    USER  FD TYPE DEVICE SIZE/OFF   NODE NAME
ruby   4227 vagrant mem REG     8,1   407307 404672 .../pango-2.1.0/pango.so
...
ruby   4227 vagrant  0u CHR   136,1      0t0      4 /dev/pts/1
ruby   4227 vagrant  1u CHR   136,1      0t0      4 /dev/pts/1
ruby   4227 vagrant  2u CHR   136,1      0t0      4 /dev/pts/1
ruby   4227 vagrant  3r FIFO    0,8      0t0  50370 pipe
...
ruby   4227 vagrant  9u 0000    0,9        0    548 anon_inode
ruby   4227 vagrant 10u IPv4  50391      0t0    TCP*:8085  (LISTEN)
ruby   4227 vagrant 11u IPv4  50392      0t0    TCP *:8086 (LISTEN)
ruby   4227 vagrant 12u IPv4  50400      0t0    TCP 10.0.2.15:8085->10.0.2.2:59542
(ESTABLISHED)
ruby   4227 vagrant 13u IPv4  50423      0t0    TCP 10.0.2.15:8086->10.0.2.2:38724
(ESTABLISHED)
```

```
$> lsof -Pni :8080

COMMAND PID USER FD TYPE DEVICE SIZE/OFF NODE NAME
ruby  7380 vagrant 9u IPv4 27118 0t0 TCP 127.0.0.1:8080 (LISTEN)
ruby  7383 vagrant 9u IPv4 27118 0t0 TCP 127.0.0.1:8080 (LISTEN)
ruby  7385 vagrant 9u IPv4 27118 0t0 TCP 127.0.0.1:8080 (LISTEN)
```

```
$> ps a | grep unicorn

7380 pts/0 Sl+ 0:00 unicorn master -c config/unicorn.rb
7383 pts/0 Sl+ 0:03 unicorn worker[0] -c config/unicorn.rb
7385 pts/0 Sl+ 0:03 unicorn worker[1] -c config/unicorn.rb
```

Для чего можно использовать?

- проверить что сервис слушает входящие соединения на заданном диапазоне портов
- выяснить кто занял порт
- посмотреть кто пишет в (заблокировал) файл

http://ph7spot.com/musings/leveraging-lsof

(показывает сетевой трафик)

tcpdump

```
tcpdump -i eth0 -s 0 -nqA <expr>
```

```
tcpdump -w <file> f. Wireshark
```

```
$> sudo tcpdump -c 3 -i en3 -nS host 23.63.125.15

18:31:29.140787 IP 10.0.1.6.52181 > 23.63.125.15.80: Flags [S], seq 1721092979,
  win 65535, options [mss 1460,nop,wscale 4,nop,nop,TS val 743929763 ecr 0,sackOK,eol],
  length 0

18:31:29.150866 IP 23.63.125.15.80 > 10.0.1.6.52181: Flags [S.], seq 673593777,
  ack 1721092980, win 14480, options [mss 1460,sackOK,TS val 1433256622 ecr 743929763,
  nop,wscale 1], length 0

18:31:29.150908 IP 10.0.1.6.52181 > 23.63.125.15.80: Flags [.], ack 673593778,
  win 8235, options [nop,nop,TS val 743929773 ecr 1433256622], length 0
```

```
$> sudo tcpdump -n dst port 8086
09:29:17.660075 IP 10.0.2.2.31293 > 10.0.2.15.8086: Flags [S], seq 51904001,
  win 65535, options [mss 1460], length 0
09:29:17.660284 IP 10.0.2.2.31293 > 10.0.2.15.8086: Flags [.], ack 2547948783,
  win 65535, length 0
09:29:17.662686 IP 10.0.2.2.31293 > 10.0.2.15.8086: Flags [P.], seq 0:1228, ack 1,
  win 65535, length 1228
09:29:17.663047 IP 10.0.2.2.31293 > 10.0.2.15.8086: Flags [P.], seq 1228:1466, ack 1,
  win 65535, length 238
09:29:18.502495 IP 10.0.2.2.31293 > 10.0.2.15.8086: Flags [.], ack 2921,
  win 65535, length 0
09:29:18.502671 IP 10.0.2.2.31293 > 10.0.2.15.8086: Flags [.], ack 5841,
  win 65535, length 0
```

http://linuxshare.ru/docs/net/tcpdump.html

(показывает системные вызовы и сигналы)

strace

```
strace -cp <pid>
strace -ttTp <pid> -o file
```

```
$> strace -cp 4391
```

```
% time seconds usecs/call calls errors syscall
------ ------- ---------- ----- ------ ----------------
24.76 0.075677        30   2555        ppoll
24.75 0.075664        14   5432    623 stat
15.45 0.047238        17   2817    172 read
10.06 0.030761        37    828        lstat
 9.75 0.029787        37    798    493 open
 5.38 0.016456        29    559        fstat
 3.50 0.010701         9   1209        rt_sigprocmask
 2.24 0.006857         4   1935        write
 1.92 0.005872        41    142    142 ioctl
 0.52 0.001586         9    176     17 epoll_ctl
 0.29 0.000876         3    254        getcwd
 0.27 0.000830         2    359        brk
 0.27 0.000821         3    314        epoll_wait
 0.21 0.000642         6    109        writev
 0.20 0.000604         2    328        close
```

```
open("<path-to-ruby>/gems/http_parser.rb-0.6.0/lib/sfk/bootstrap/views/pages.rb",
O_RDONLY) = -1 ENOENT (No such file or directory) <0.000264>

open("<path-to-ruby>/gems/undev-0.2.2/lib/sfk/bootstrap/views/pages.rb", O_RDONLY) = -1
ENOENT (No such file or directory) <0.000144>

...
13 попыток открыть несуществующий файл
...

open("<path-to-ruby>/gems/sfk-bootstrap-3.0.0/lib/sfk/bootstrap/views/pages.rb",
O_RDONLY) = 21 <0.0
```

```
09:51:34.864083 open("/projects/<name>/apps/main/controllers/channels_list/
menu_controller.rb", O_RDONLY) = 21 <0.001216>
...
09:51:34.868872 read(21, "# encoding: utf-8\nmodule Main::C"..., 8192) = 1251 <0.002250>
...
```

http://chadfowler.com/blog/2014/01/26/the-magic-of-strace/

(GNU отладчик)

gdb

```
gdb attach <pid>
gdb <executable>
```

```
$> gdb /path/to/ruby 9851
```

```
(gdb) ruby_eval "Kernel.caller"
=>
["/home/vagrant/.rvm/gems/ruby-2.0.0-p353/gems/unicorn-4.8.2/lib/unicorn/http_server.rb:
388:in `select'",
"/home/vagrant/.rvm/gems/ruby-2.0.0-p353/gems/unicorn-4.8.2/lib/unicorn/http_server.rb:
388:in `master_sleep'",
"/home/vagrant/.rvm/gems/ruby-2.0.0-p353/gems/unicorn-4.8.2/lib/unicorn/http_server.rb:
291:in `join'",
"/home/vagrant/.rvm/gems/ruby-2.0.0-p353/gems/unicorn-4.8.2/bin/unicorn:126:in `<top
(required)>'",
"/home/vagrant/.rvm/gems/ruby-2.0.0-p353/bin/unicorn:23:in `load'",
"/home/vagrant/.rvm/gems/ruby-2.0.0-p353/bin/unicorn:23:in `<main>'",
"/home/vagrant/.rvm/gems/ruby-2.0.0-p353/bin/ruby_executable_hooks:15:in `eval'",
"/home/vagrant/.rvm/gems/ruby-2.0.0-p353/bin/ruby_executable_hooks:15:in `<main>'"]
```

http://robots.thoughtbot.com/using-gdb-to-inspect-a-running-ruby-process

```
$> gdb /path/to/ruby 9851
```

программа должна быть собрана вместе с pry

```
(gdb) ruby_eval "self.pry"
=>
[1] pry(main)> ls
self.methods: inspect to_s
locals: _ __ _dir_ _ex_ _file_ _in_ _out_ _pry_ title
```

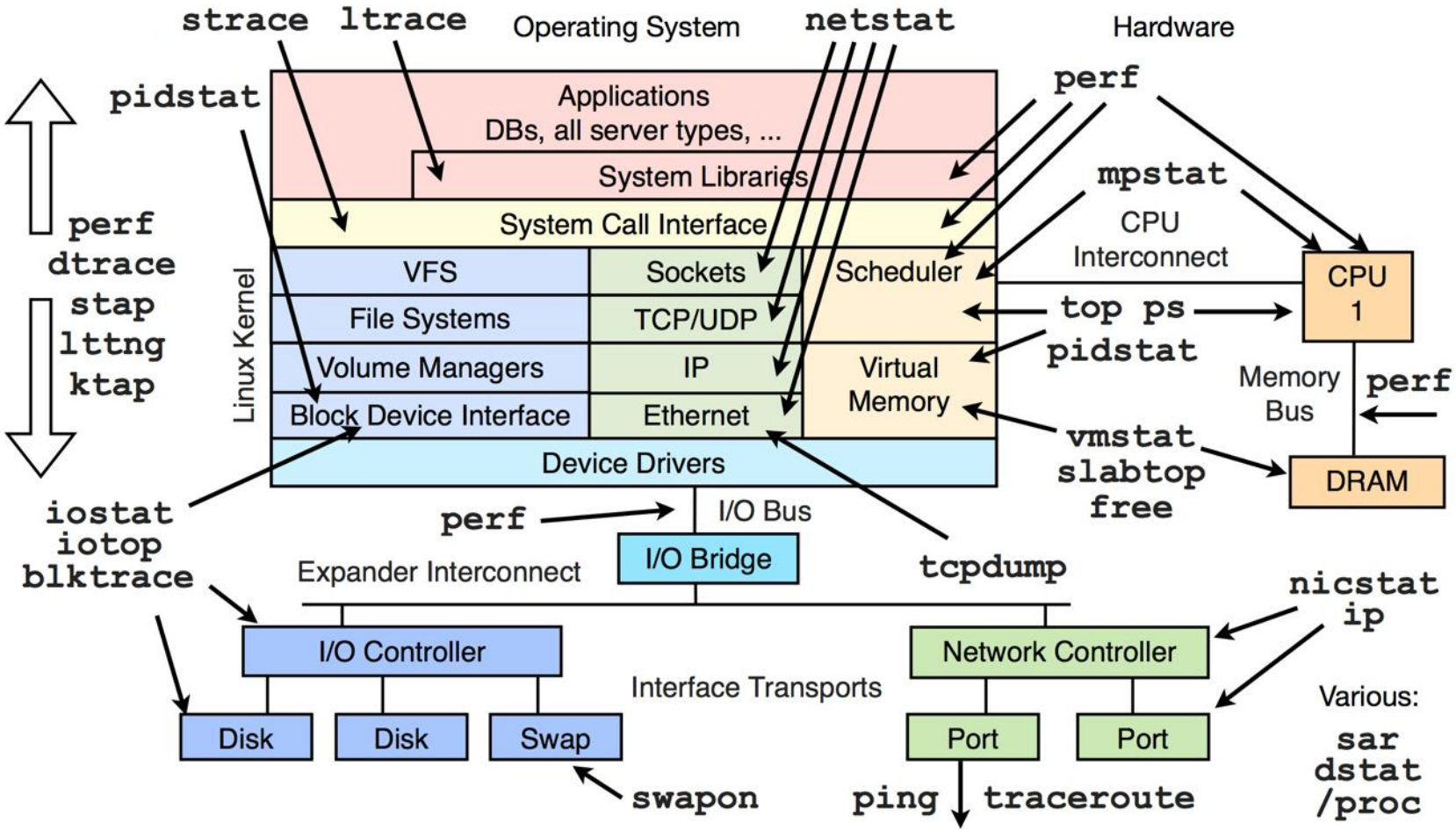
Как работает gdb

- системный вызов – ptrace()
- точки останова реализованы с помощью инструкции INT3

```
0000000000400508 <main>:
400508: 55              push  %rbp
400509: 48 89 e5        mov   %rsp,%rbp
40050c: bf 18 06 40 00  mov   $0x400618,%edi
400511: e8 12 ff ff ff  callq 400428 <puts@plt>
400516: bf 2a 06 40 00  mov   $0x40062a,%edi
…
```

http://aosabook.org/en/gdb.html
http://www.alexonlinux.com/how-debugger-works

Общая картина



http://www.brendangregg.com/linuxperf.html

Часть 2. Рубишная

(заменит perftools.rb)

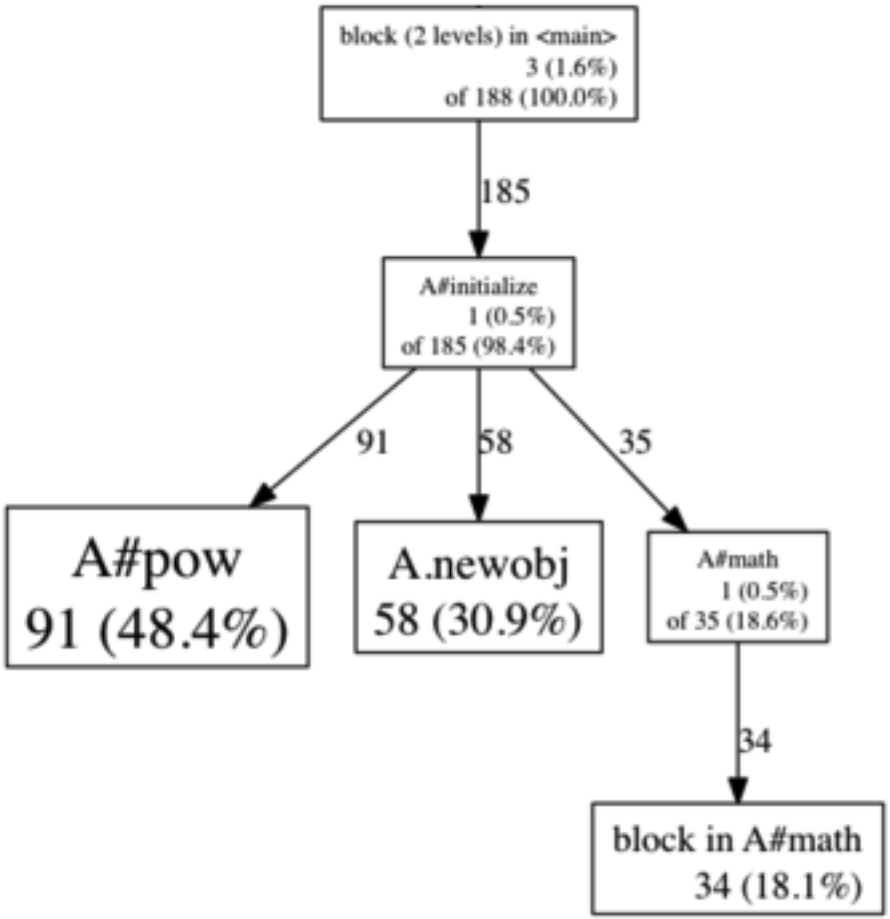
stackprof

```
stackprof <dump> --text
```

```
$> stackprof stackprof-cpu-6196-1393432908.dump --text
==================================
Mode: cpu(1000)
Samples: 545 (0.00% miss rate)
GC: 48 (8.81%)
==================================
TOTAL  (pct) SAMPLES  (pct) FRAME
   42 (7.7%)      39 (7.2%) #<Module:0x000000020550f8>.escape
   33 (6.1%)      23 (4.2%)
ActiveRecord::ConnectionAdapters::Column.new_time
   21 (3.9%)      21 (3.9%) Set#include?
   13 (2.4%)      13 (2.4%) block in
ActiveSupport::Dependencies#search_for_file
   13 (2.4%)      13 (2.4%) block in
ActiveSupport::Dependencies#autoloadable_module?
   26 (4.8%)       4 (0.7%) Channel::Telecast#cover_url
```

```
$> stackprof stackprof-cpu-6196-1393432908.dump --text
--method 'Channel::Telecast#cover_url'

Channel::Telecast#cover_url (/projects/undev/simpletv-backend/app/models/concerns/
coverable.rb:12)
samples: 4 self (0.7%) / 26 total (4.8%)
callers:
     26 ( 100.0%) Channel::TelecastSerializer#cover
callees (22 total):
     22 ( 100.0%) Channel::Telecast#cover
code:
                          | 12 | def cover_url(version = nil)
                          | 13 | if cover.file.nil? && external_cover
     26 (4.8%) / 4 (0.7%) | 14 | external_cover.gsub(configus.cdn_host, '/cdn‘)
```


block (2 levels) in <main>
3 (1.6%)
of 188 (100.0%)
185
A#initialize
1 (0.5%)
of 185 (98.4%)
91
58
35
A#pow
91 (48.4%)
A.newobj
58 (30.9%)
A#math
1 (0.5%)
of 35 (18.6%)
34
block in A#math
34 (18.1%)

4 способа сбора статистики

- wall (использует ITIMER_REAL и SIGALRM)
- cpu (использует ITIMER_PROF и SIGPROF) [по умолчанию]
- object (использует RUBY_INTERNAL_EVENT_NEWOBJ)
- custom (задается с помощью StackProf.sample)

(показывает «живые» объекты)

ObjectSpace

```
ObjectSpace.each_object
```

```
# diff will show what kind of objects are leaking
counts = Hash.new{ 0 }
ObjectSpace.each_object do |o|
  counts[o.class] += 1
end

# returns an array of objects that reference the object
ObjectSpace.find_references(
  ObjectSpace.each_object(MainController).first
)
```

требуются патченные ruby

http://cirw.in/blog/find-references

```
$> diff objects_dump1.txt objects_dump2.txt
331,332c331,332
< "Main::Views::Banner::DomInterfaceClass"=>1,
< "Main::Views::Banner::TreeInterfaceClass"=>1,
---
> "Main::Views::Banner::DomInterfaceClass"=>2,
> "Main::Views::Banner::TreeInterfaceClass"=>2,
335c335
< "Nptv::Rectangle"=>1,
---
> "Nptv::Rectangle"=>2,
340,341c340,341
< "Nptv::Rectangle::InitChainInterfaceClass"=>1,
< "Nptv::Rectangle::PropsInterfaceClass"=>1,
---
> "Nptv::Rectangle::InitChainInterfaceClass"=>2,
> "Nptv::Rectangle::PropsInterfaceClass"=>2,
```

```
stats = AllocationStats.trace do
  y = YAML.dump(["one string", "two string"])
end

puts stats.allocations(alias_paths: true).group_by(:sourcefile, :class).to_text
```

```
sourcefile                                  class                                  count
------------------------------------------- -------------------------------------- -----
<RUBYLIBDIR>/psych/visitors/yaml_tree.rb                                     Array 12
<RUBYLIBDIR>/psych/visitors/yaml_tree.rb                                    String 20
<RUBYLIBDIR>/psych/visitors/yaml_tree.rb                                 MatchData 3
<RUBYLIBDIR>/psych/visitors/yaml_tree.rb                                    Method 5
<RUBYLIBDIR>/psych/nodes/node.rb                                             Array 3
(eval)                                                      Psych::Nodes::Sequence 1
<RUBYLIBDIR>/psych/tree_builder.rb                          Psych::Nodes::Document 1
<RUBYLIBDIR>/psych/tree_builder.rb                            Psych::Nodes::Stream 1
<RUBYLIBDIR>/psych/visitors/yaml_tree.rb                                     Proc 1
<RUBYLIBDIR>/psych/visitors/yaml_tree.rb                                RubyVM::Env 1
<RUBYLIBDIR>/psych/visitors/yaml_tree.rb                                     Hash 3
```

ObjectSpace

```
require 'objspace'

class C
  include ObjectSpace

  def foo
    trace_object_allocations do
      obj = Object.new
      p "#{allocation_sourcefile(obj)}:#{allocation_sourceline(obj)}"
    end
  end
end

C.new.foo #=> "objtrace.rb:8"
```

(показывает вызовы Ruby методов)

rbtrace

```
rbtrace -p <pid> -m <method>
rbtrace -p <pid> --slow=50
```

```
$> rbtrace -p 10788 --slow=500
```

```
                                Array#map <1.141959>
                              BasicObject#instance_exec <1.142354>
                            Proc#call <1.144842>
                          SFK::Http::Request#run_callback <1.144969>
                        Array#each <1.145001>
                      SFK::Http::Request#run_callbacks <1.145026>
                    SFK::Http::Request#parse_response <1.193339>
                  Proc#call <1.193364>
                EventMachine::Deferrable#set_deferred_status <1.201030>
              EventMachine::Deferrable#succeed <1.201062>
            EventMachine::HttpClient#unbind <1.202498>
          EventMachine::HttpClient#on_request_complete <1.202530>
        Proc#call <1.202781>
      HTTP::Parser#<< <1.202871>
    EventMachine::HttpConnection#receive_data <1.202889>
EventMachine::HttpStubConnection#receive_data <1.203051
```

(отладчик для Ruby 2.X)

byebug

byebug

$> byebug triangle.rb

```
[1, 10] in /home/davidr/Proyectos/byebug/old_doc/triangle.rb
    1: # Compute the n'th triangle number: triangle(n) == (n*(n+1))/2
 => 2: def triangle(n)
    3:   tri = 0
    4:   0.upto(n) do |i|
    5:     tri += i
    6:   end
    7:   tri
    8: end
    9:
   10: t = triangle(3)
(byebug)
```

TracePoint API

```
trace = TracePoint.new(:call) do |tp|
    p [tp.lineno, tp.defined_class, tp.method_id, tp.event]
end
#=> #<TracePoint:0x007f17372cdb20>

trace.enable
#=> #<TracePoint:0x007f17372cdb20>

puts "Hello, TracePoint!"
# ...
# [48, IRB::Notifier::AbstractNotifier, :printf, :call]
# ...
```

Не будьте только Rails разработчиками

Будьте хорошими инженерами

Изучайте новые инструменты

Спасибо! Вопросы?

github.com/akalyaev
twitter.com/AntonKalyaev