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ФАКУЛЬТЕТ ИНФОРМАТИКА И СИСТЕМЫ УПРАВЛЕНИЯ

КАФЕДРА КОМПЬЮТЕРНЫЕ СИСТЕМЫ И СЕТИ (ИУ6)

НАПРАВЛЕНИЕ ПОДГОТОВКИ 09.03.01 Информатика и вычислительная техника

О Т Ч Е Т

по лабораторной работе № 6


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Москва, 2023

Часть 1

Задание

Решить задачу, организовав итерационный цикл с точностью $\xi = 10^{-4}, 10^{-5}$.
Вычислить сумму ряда:

$$S = 1 + \sum_{k=1}^{\infty} \frac{(-1)^k}{k!}, \text{ точное значение равно } \frac{1}{e}.$$

Код программы

Файл “main.rb”

```
# frozen_string_literal: true

require_relative 'utils'

eps = 1e-4
puts "#{solve(eps)} (eps = #{eps})"

eps = 1e-5
puts "#{solve(eps)} (eps = #{eps})"
```

Файл “utils.rb”

```
# frozen_string_literal: true

def _factorial(num)
  return 1 if num.zero?

  result = 1
  (1..num).each do |i|
    result *= i
  end

  result
end

def solve(eps)
  expected = 1 / Math::E

  sum = 1
  k = 0
  loop do
    sum += ((-1)**(k + 1)).to_f / _factorial(k + 1)
    k += 1
    break if (expected - sum).abs <= eps.to_f
  end

  sum
end
```

Файл “test_utils.rb”

```
# frozen_string_literal: true

require 'minitest/autorun'
require_relative 'utils'

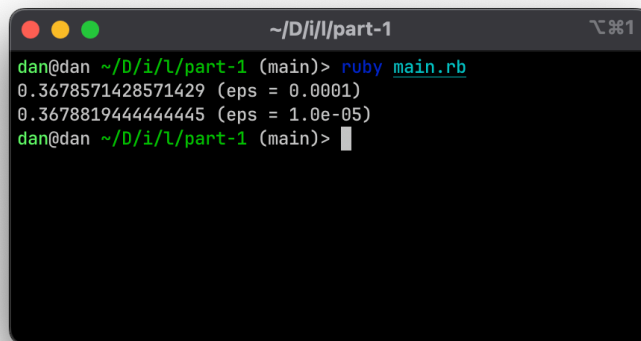
# Test '_factorial'
class TestFactorial < Minitest::Test
  def test_regular
    assert_equal 1, _factorial(0)
    assert_equal 1, _factorial(1)
    assert_equal 120, _factorial(5)
  end
end

# Test 'solve'
class TestSolve < Minitest::Test
  def test_regular
    expected = 1 / Math::E

    eps = 1e-4
    assert_in_delta expected, solve(eps), eps

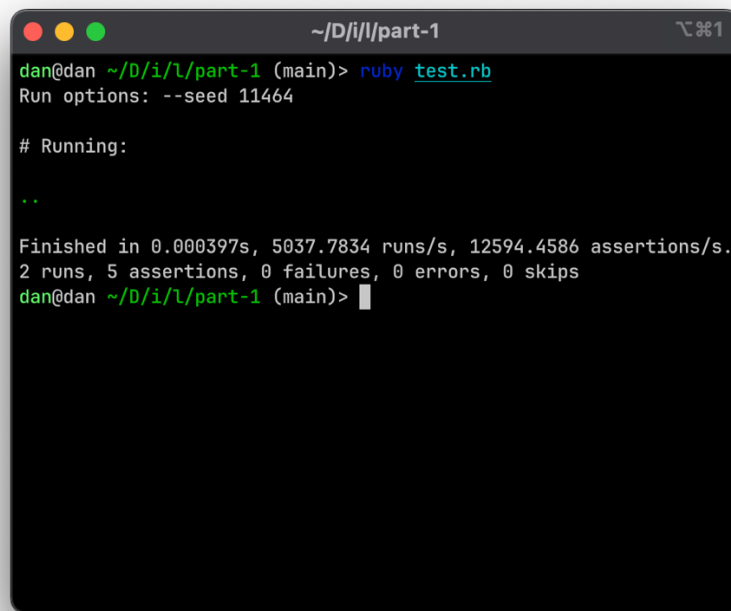
    eps = 1e-5
    assert_in_delta expected, solve(eps), eps
  end
end
```

Работа программы



```
~/D/i/l/part-1
dan@dan ~/D/i/l/part-1 (main)> ruby main.rb
0.3678571428571429 (eps = 0.0001)
0.3678819444444445 (eps = 1.0e-05)
dan@dan ~/D/i/l/part-1 (main)> █
```

Рисунок 1 – работа программы

A terminal window with a dark background and light-colored text. The window title is "~/D/i/l/part-1". The prompt is "dan@dan ~/D/i/l/part-1 (main)". The user enters "ruby test.rb". The output shows "Run options: --seed 11464", "# Running:", two dots, and then performance statistics: "Finished in 0.000397s, 5037.7834 runs/s, 12594.4586 assertions/s. 2 runs, 5 assertions, 0 failures, 0 errors, 0 skips". The prompt returns to "dan@dan ~/D/i/l/part-1 (main)".

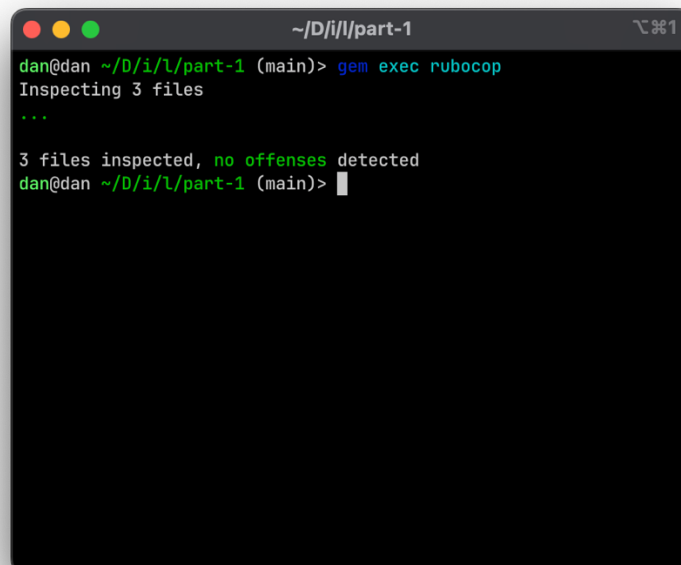
```
~/D/i/l/part-1
dan@dan ~/D/i/l/part-1 (main)> ruby test.rb
Run options: --seed 11464

# Running:

..

Finished in 0.000397s, 5037.7834 runs/s, 12594.4586 assertions/s.
2 runs, 5 assertions, 0 failures, 0 errors, 0 skips
dan@dan ~/D/i/l/part-1 (main)>
```

Рисунок 2 – выполнение unit-тестов

A terminal window with a dark background and light-colored text. The window title is "~/D/i/l/part-1". The prompt is "dan@dan ~/D/i/l/part-1 (main)". The user enters "gem exec rubocop". The output shows "Inspecting 3 files", three dots, and then "3 files inspected, no offenses detected". The prompt returns to "dan@dan ~/D/i/l/part-1 (main)".

```
~/D/i/l/part-1
dan@dan ~/D/i/l/part-1 (main)> gem exec rubocop
Inspecting 3 files
...

3 files inspected, no offenses detected
dan@dan ~/D/i/l/part-1 (main)>
```

Рисунок 3 – проверка кода rubocop'ом

Часть 2

Задание

Решить предыдущее задание с помощью Enumerable или Enumerator.

Код программы

Файл “main.rb”

```
# frozen_string_literal: true

require_relative 'utils'

eps = 1e-4
puts "#{solve(eps)} (eps = #{eps})"

eps = 1e-5
puts "#{solve(eps)} (eps = #{eps})"
```

Файл “utils.rb”

```
# frozen_string_literal: true

def _factorial(num)
  return 1 if num.zero?

  (1..num).inject(:*)
end

def solve(eps)
  expected = 1 / Math::E

  sequence = Enumerator.new do |x|
    sum = 1
    k = 0
    loop do
      sum += ((-1)**(k + 1)).to_f / _factorial(k + 1)
      x << sum
      k += 1
    end
  end

  sequence.find { |item| (expected - item).abs <= eps }
end
```

Файл “test_utils.rb”

```
# frozen_string_literal: true

require 'minitest/autorun'
require_relative 'utils'

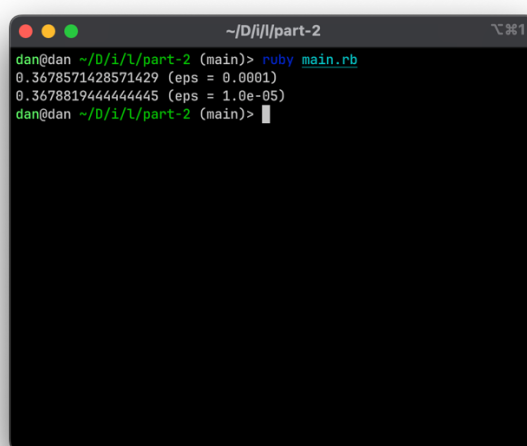
# Test '_factorial'
class TestFactorial < Minitest::Test
  def test_regular
    assert_equal 1, _factorial(0)
    assert_equal 1, _factorial(1)
    assert_equal 120, _factorial(5)
  end
end
```

```
# Test 'solve'
class TestSolve < Minitest::Test
  def test_regular
    expected = 1 / Math::E

    eps = 1e-4
    assert_in_delta expected, solve(eps), eps

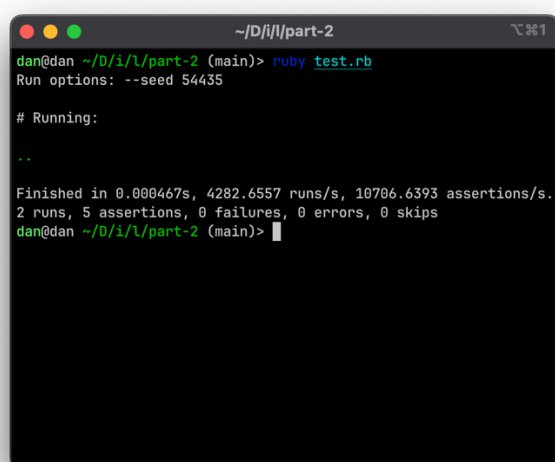
    eps = 1e-5
    assert_in_delta expected, solve(eps), eps
  end
end
```

Работа программы



```
~/D/i/l/part-2
dan@dan ~/D/i/l/part-2 (main)> ruby main.rb
0.3678571428571429 (eps = 0.0001)
0.3678819444444445 (eps = 1.0e-05)
dan@dan ~/D/i/l/part-2 (main)>
```

Рисунок 4 – работа программы



```
~/D/i/l/part-2
dan@dan ~/D/i/l/part-2 (main)> ruby test.rb
Run options: --seed 54435

# Running:

..

Finished in 0.000467s, 4282.6557 runs/s, 10706.6393 assertions/s.
2 runs, 5 assertions, 0 failures, 0 errors, 0 skips
dan@dan ~/D/i/l/part-2 (main)>
```

Рисунок 5 – выполнение unit-тестов

```
dan@dan ~/D/i/l/part-2 (main)> gem exec rubocop
Inspecting 3 files
..C

Offenses:

utils.rb:9:1: C: Metrics/MethodLength: Method has too many lines.
[11/10]
def solve(eps) ...
^^^^^^^^^^^^^^^^

3 files inspected, 1 offense detected
dan@dan ~/D/i/l/part-2 (main) [1]> |
```

Рисунок 6 – проверка кода rubocop’ом

Часть 3

Задание

Составить метод `neibr` проверки принадлежности точки плоскости с координатами (x, y) данной кривой $y = f(x)$. В основной программе использовать метод `neibr` для проверки принадлежности десяти различных точек кривым $y = \cos(x)$ и $y = \sin(x^2)$.

Реализовать вызов метода двумя способами: в виде передаваемого `lambda`-выражения и в виде блока.

Код программы

Файл “main.rb”

```
# frozen_string_literal: true

require_relative 'utils'

points = [
  [0, 1], [4, -0.76], [2, -0.42], [3, 0.41], [4, -0.65],
  [5, 0.28], [4, -0.28], [6, -0.99], [5, -0.13], [9, -0.91]
]

lambda_f1 = ->(x) { Math.cos(x) }
lambda_f2 = ->(x) { Math.sin(x**2) }

puts 'Lambdas:'

points.each do |x, y|
  result = neibr(x, y, &lambda_f1)
  puts "({x}, {y}) belongs to y = cos(x)? - #{result}"
end
```

```

end

puts '-' * 45

points.each do |x, y|
  result = neibr(x, y, &lambda_f2)
  puts "(#{x}, #{y}) belongs to y = sin(x^2)? - #{result}"
end

puts "\n\nBlocks:"

points.each do |x, y|
  result = neibr(x, y) { |value| block_f1(value) }
  puts "(#{x}, #{y}) belongs to y = cos(x)? - #{result}"
end

puts '-' * 45

points.each do |x, y|
  result = neibr(x, y) { |value| block_f2(value) }
  puts "(#{x}, #{y}) belongs to y = sin(x^2)? - #{result}"
end

```

Файл “utils.rb”

```

# frozen_string_literal: true

EPS = 1e-2

def block_f1(val)
  Math.cos(val)
end

def block_f2(val)
  Math.sin(val**2)
end

def neibr(x_val, y_val, &func)
  (y_val - func.call(x_val)).abs <= EPS
end

```

Файл “test_utils.rb”

```

# frozen_string_literal: true

require 'minitest/autorun'
require_relative 'utils'

# Test 'neibr'
class TestNeibr < Minitest::Test
  def test_f1_with_lambdas
    points = [
      [0, 1], [4, -0.76], [2, -0.42], [3, 0.41], [4, -0.65],
      [5, 0.28], [4, -0.28], [6, -0.99], [5, -0.13], [9, -0.91]
    ]

    lambda_f1 = ->(x) { Math.cos(x) }

```



```

expected = [
  true, false, true, false, true,
  true, false, false, false, true
]

current_result = []
points.each do |x, y|
  current_result << neibr(x, y, &lambda_f1)
end

assert_equal expected, current_result
end

def test_f2_with_lambdas
  points = [
    [0, 1], [4, -0.76], [2, -0.42], [3, 0.41], [4, -0.65],
    [5, 0.28], [4, -0.28], [6, -0.99], [5, -0.13], [9, -0.91]
  ]

  lambda_f2 = ->(x) { Math.sin(x**2) }

  expected = [
    false, false, false, true, false,
    false, true, true, true, false
  ]

  current_result = []
  points.each do |x, y|
    current_result << neibr(x, y, &lambda_f2)
  end

  assert_equal expected, current_result
end

def test_f1_with_blocks
  points = [
    [0, 1], [4, -0.76], [2, -0.42], [3, 0.41], [4, -0.65],
    [5, 0.28], [4, -0.28], [6, -0.99], [5, -0.13], [9, -0.91]
  ]

  expected = [
    true, false, true, false, true,
    true, false, false, false, true
  ]

  current_result = []
  points.each do |x, y|
    current_result << neibr(x, y) { |value| block_f1(value) }
  end

  assert_equal expected, current_result
end

def test_f2_with_blocks
  points = [
    [0, 1], [4, -0.76], [2, -0.42], [3, 0.41], [4, -0.65],
    [5, 0.28], [4, -0.28], [6, -0.99], [5, -0.13], [9, -0.91]
  ]

```

```

]

expected = [
  false, false, false, true, false,
  false, true, true, true, false
]

current_result = []
points.each do |x, y|
  current_result << neibr(x, y) { |value| block_f2(value) }
end

assert_equal expected, current_result
end
end
end

```

Работа программы

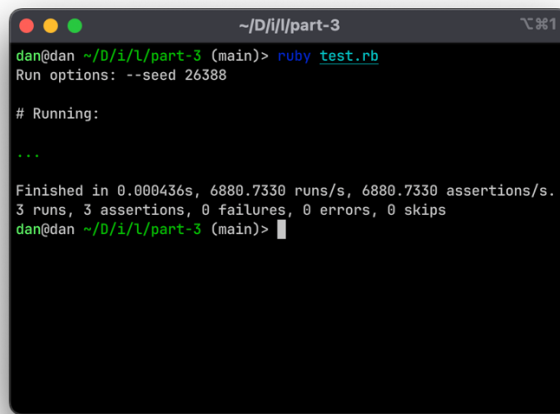
```

dan@dan ~/D/1/1/part-3 (main)> ruby main.rb
Lambdas:
(0, 1) belongs to y = cos(x)? - true
(4, -0.76) belongs to y = cos(x)? - false
(2, -0.42) belongs to y = cos(x)? - true
(3, 0.41) belongs to y = cos(x)? - false
(4, -0.65) belongs to y = cos(x)? - true
(5, 0.28) belongs to y = cos(x)? - true
(4, -0.28) belongs to y = cos(x)? - false
(6, -0.99) belongs to y = cos(x)? - false
(5, -0.13) belongs to y = cos(x)? - false
(9, -0.91) belongs to y = cos(x)? - true
-----
(0, 1) belongs to y = sin(x^2)? - false
(4, -0.76) belongs to y = sin(x^2)? - false
(2, -0.42) belongs to y = sin(x^2)? - false
(3, 0.41) belongs to y = sin(x^2)? - true
(4, -0.65) belongs to y = sin(x^2)? - false
(5, 0.28) belongs to y = sin(x^2)? - false
(4, -0.28) belongs to y = sin(x^2)? - true
(6, -0.99) belongs to y = sin(x^2)? - true
(5, -0.13) belongs to y = sin(x^2)? - true
(9, -0.91) belongs to y = sin(x^2)? - false

Blocks:
(0, 1) belongs to y = cos(x)? - true
(4, -0.76) belongs to y = cos(x)? - false
(2, -0.42) belongs to y = cos(x)? - true
(3, 0.41) belongs to y = cos(x)? - false
(4, -0.65) belongs to y = cos(x)? - true
(5, 0.28) belongs to y = cos(x)? - true
(4, -0.28) belongs to y = cos(x)? - false
(6, -0.99) belongs to y = cos(x)? - false
(5, -0.13) belongs to y = cos(x)? - false
(9, -0.91) belongs to y = cos(x)? - true
-----
(0, 1) belongs to y = sin(x^2)? - false
(4, -0.76) belongs to y = sin(x^2)? - false
(2, -0.42) belongs to y = sin(x^2)? - false
(3, 0.41) belongs to y = sin(x^2)? - true
(4, -0.65) belongs to y = sin(x^2)? - false
(5, 0.28) belongs to y = sin(x^2)? - false
(4, -0.28) belongs to y = sin(x^2)? - true
(6, -0.99) belongs to y = sin(x^2)? - true
(5, -0.13) belongs to y = sin(x^2)? - true
(9, -0.91) belongs to y = sin(x^2)? - false
dan@dan ~/D/1/1/part-3 (main)>

```

Рисунок 7 – работа программы



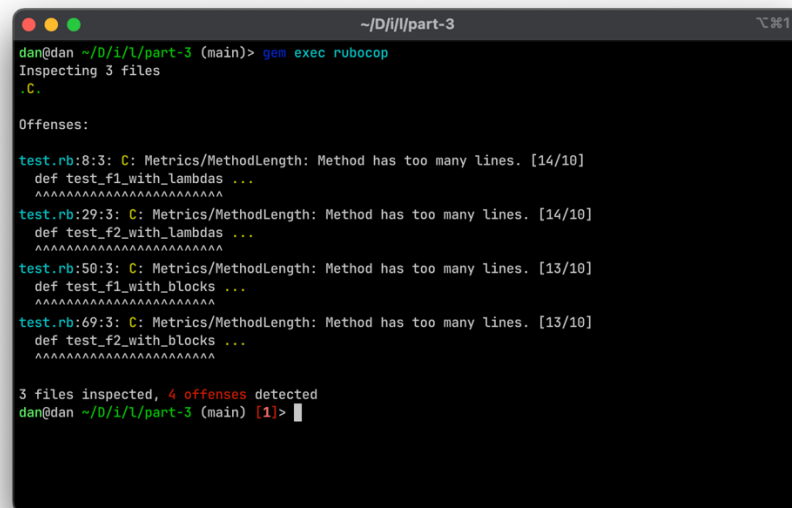
```
dan@dan ~/D/i/l/part-3 (main)> ruby test.rb
Run options: --seed 26388

# Running:

...

Finished in 0.000436s, 6880.7330 runs/s, 6880.7330 assertions/s.
3 runs, 3 assertions, 0 failures, 0 errors, 0 skips
dan@dan ~/D/i/l/part-3 (main)> 
```

Рисунок 8 – выполнение unit-тестов



```
dan@dan ~/D/i/l/part-3 (main)> gem exec rubocop
Inspecting 3 files
.C.

Offenses:

test.rb:8:3: C: Metrics/MethodLength: Method has too many lines. [14/10]
def test_f1_with_lambdas ...
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
test.rb:29:3: C: Metrics/MethodLength: Method has too many lines. [14/10]
def test_f2_with_lambdas ...
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
test.rb:50:3: C: Metrics/MethodLength: Method has too many lines. [13/10]
def test_f1_with_blocks ...
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
test.rb:69:3: C: Metrics/MethodLength: Method has too many lines. [13/10]
def test_f2_with_blocks ...
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^

3 files inspected, 4 offenses detected
dan@dan ~/D/i/l/part-3 (main) [1]> 
```

Рисунок 9 – проверка кода rubocop'ом

Вывод

Реализованы несколько программ на языке программирования ruby; функции всех программ проверена на unit-тестах; исходный код проверен линтером rubocop на наличие ошибок.