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Week 11: Strings in Ruby and Algorithmic Exercises; Monte Carlo Problem

Exercise 1: What is the computational complexity of the function "match"?

OK, so this time I'm basing this off the example of the slides from the homework in week 9. Not planning on getting this wrong twice, after all.

So first, we must consider how many iterations of the initial variable there is. In the example, this is the variable "i". In this program we have the variable, w, which represents the # of iterations of array positions that we might use. As the exercise calls this variable, we will call "n" because it will be the length of the longer string "s". It helps eliminate some fringe exceptions to know that p is a subset of s. This means that m<n or m<=n-1 (in the worst case m = n-1). The while string is counting through m using function submatch. "Submatch" is a ruby method defined by the variable j, which acts as an ascending count variable of array positions delta'd from position 0. P itself is referenced as a comparison variable. This moves one position at a time, in a linear line. Finally, we come to the variable p itself, where we must compare the submatch found to the number of letters matched.

Hence, the complexity is similar to the example in week 9. We see that it is made from the #(iterations of array positions in s) [=n] x #(iteration of submatch function) [=(n+1)-m] x #(operations for the while) [=O(m)] → simply a linear comparison until a success occurs, as method match is written, it doesn't even have a failure-safe error message]

So, in short this becomes n * (n+1)-m * O (m). We then remember that constants do not count in computational complexity. So, in the worst case, we know that m = n-1. This means that I can replace the m in "(n+1) - m" as "(n+1)-(n-1)". This becomes the constant 2 and is always a constant in any other case anyways, but as constants are irrelevant in the first place, we will remove this part from the final calculation.

This leaves me with #(iterations of array positions in s) * #(operations for the while statement).

This is exactly n * O (m) = O (mn).

Hence, the complexity will be O (mn).

Exercise 2: The reverse of a string without using the reverse function

```
def reverse(s)
 result = "" # empty string(length 0)
i = s.length() – 1 #define variable I as one less than the
length of the string
 while i >= 0 do #while you have another string position
 print s[i] #print the string variable there
 i = i – 1 #take one step to the left, and as this in a while
block, repeat
end #formally 'ends' the 'while' block
 result # return the reversed string
end #ends all code 'reverse'
```

No. 11 Monte Carlo Exercise 1: Make a Ruby function average (t, n) that computes averages when performing the function montecarlo (n) for t times.

```
#This code is written by Alex T.W.
def montecarlo(n)
  m=0
  for i in 1..n
    x=rand() # random number in [0,1)
    y=rand()
    if x*x + y*y < 1.0
      m = m + 1
    end
  end
  return 4*m*1.0/n
end

def average(t,n)
     sum = 0
     for b in 0..t
          sum += montecarlo(n)
     end
x = sum / t
return x
end
     #An alternate method I am ambandoning
     # s = array.new(t)
     # for b in 0..t
          # s[b]=montecarlo(n)
     # end
    # v = 0
    # for i in s[1]..s[t]
       # v = v + i
    # end
    # v
     # c = v / t
     # c
     #end
```

__No. 11 Monte Carlo Exercise 2__: Make a Ruby function average (t, n) that computes averages when performing the function montecarlo (n) for t times.

```
#This code is written by Alex T.W.
```

```ruby
load("./montecarlo.rb")

def spherecarlo(n,r)
  m=0
  for i in 1..n
    x=rand() # random number in [0,1)
    y=rand()
    if x*x + y*y < 1.0
      m = m + 1
    end
  end
  return (4.0/3.0)*(4*m*1.0/n)*(r**3)
end

def savage(t,n,r)
     sum = 0
     for b in 0..t
          sum += spherecarlo(n,r)
     end
x = sum / t
return x
end
```

No.11. Monte Carlo Simulation

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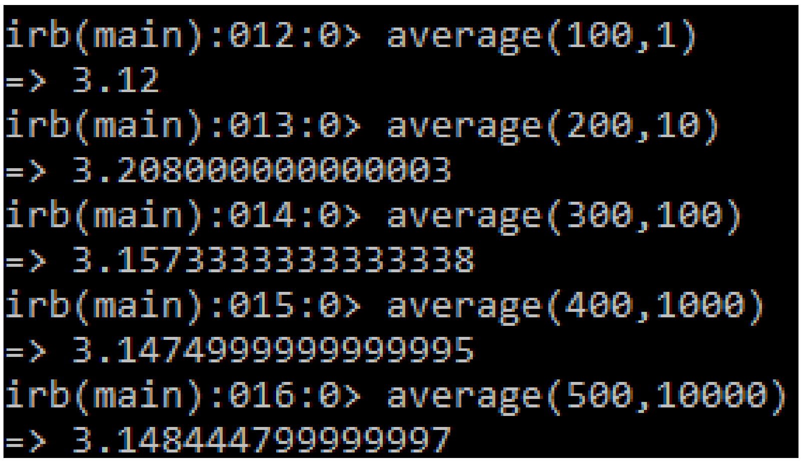
（1）Make a Ruby function average(t, n) that computes the average when performing the function montecalro(n) t times. Observe the performance of the Monte-Carlo Method taking a large t. Write anything you observed below.

```
def montecarlo(n)
    m = 0
    for i in 1..n
        x = rand() # random number in [0,1)
        y = rand()
        if x*x + y*y < 1.0 # (*)
            m = m + 1
        end
    end
    4*m*1.0/n
end
def average(t, n)
# repeat t times montecarlo(n)
# write here







end
```

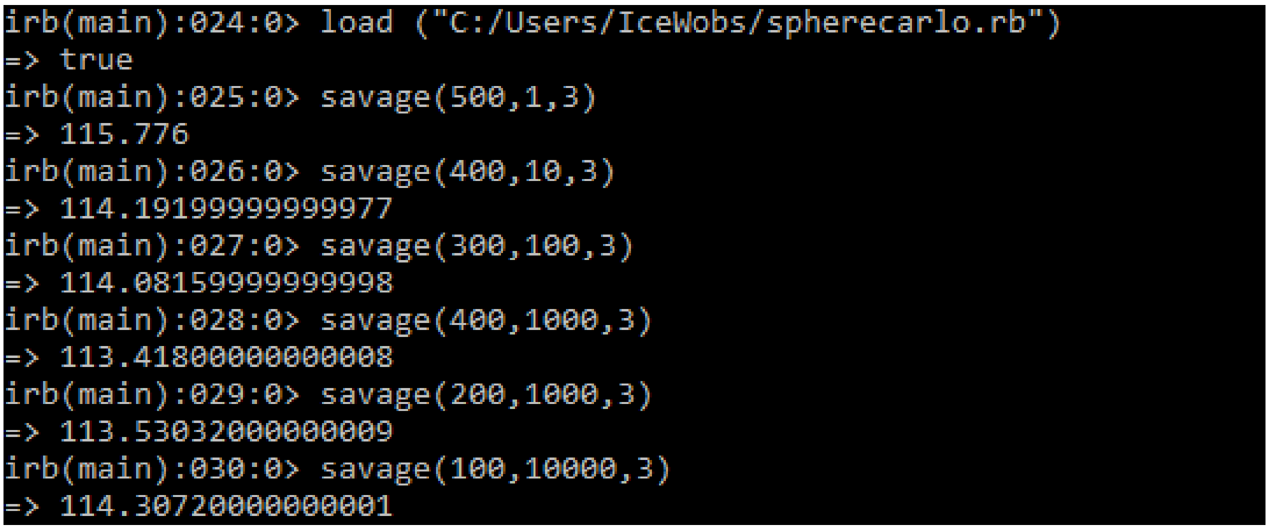
n	t	Average	# correct digits
1	100	3.12	2
10	200	3.208000000000003	1
100	300	3.1573333333333338	2
1000	400	3.1474999999999995	3
10000	500	3.148444799999997	3

2) (optional) Make a program that computes the volume of the 3-dimentional unit sphere, and do the same thing as in Question 1. I assume r (radius) = 3 units for the chart below. (Based off the expected answer from Google being "113.097335529)

n	t	Average ("savage" value)	# correct digits
1	500	115.776	2
10	400	114.19199999999977	2
100	300	114.08159999999998	2
1000	200	113.53032000000009	3
10000	100	114.30720000000001	2



```
irb(main):012:0> average(100,1)
=> 3.12
irb(main):013:0> average(200,10)
=> 3.2080000000000003
irb(main):014:0> average(300,100)
=> 3.1573333333333338
irb(main):015:0> average(400,1000)
=> 3.1474999999999995
irb(main):016:0> average(500,10000)
=> 3.1484447999999997
```



```
irb(main):024:0> load ("C:/Users/IceWobs/spherecarlo.rb")
=> true
irb(main):025:0> savage(500,1,3)
=> 115.776
irb(main):026:0> savage(400,10,3)
=> 114.19199999999977
irb(main):027:0> savage(300,100,3)
=> 114.08159999999998
irb(main):028:0> savage(400,1000,3)
=> 113.41800000000008
irb(main):029:0> savage(200,1000,3)
=> 113.53032000000009
irb(main):030:0> savage(100,10000,3)
=> 114.30720000000001
```