Case Study 1

AKSTA Statistical Computing 107.258

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Ratio of Fibonacci numbers

Using a for Loop

```
fibonacci_for <- function(n) {
  f_i <- 1
  zahl1 <- 0
  zahl2 <- 1
  for(i in 0:(n-1)) {
    f_i = zahl1 + zahl2
    zahl1 = zahl2
    zahl2 = f_i
  }
  return(zahl2/zahl1)
}
```

Using a while Loop

```
fibonacci_while <- function(n) {
  i = 0
  f_i <- 1
  zahl1 <- 0
  zahl2 <- 1
  while(i <= (n-1)) {
    f_i = zahl1 + zahl2
    zahl1 = zahl2
    zahl2 = f_i
    i = i + 1
  }
  return(zahl2/zahl1)
}
```

Benchmark

```
library(microbenchmark)
n <- 100
m <- 1000
```

```
mbm_n <- microbenchmark(fibonacci_for(n), fibonacci_while(n))
mbm_n
```

```
## Unit: microseconds
##                expr   min    lq     mean median     uq       max neval
##    fibonacci_for(n) 4.971 5.366  30.3941  6.031  6.851  2426.431   100
##  fibonacci_while(n) 8.511 8.911 131.3288  9.381 10.346 12166.209   100
```

```
mbm_m <- microbenchmark(fibonacci_for(m), fibonacci_while(m))
mbm_m
```

```
## Unit: microseconds
##                expr    min     lq     mean median     uq     max neval
##    fibonacci_for(m) 49.201 54.166 56.93390 57.911 59.216  65.891   100
##  fibonacci_while(m) 83.601 88.526 92.67347 93.546 95.721 114.351   100
```

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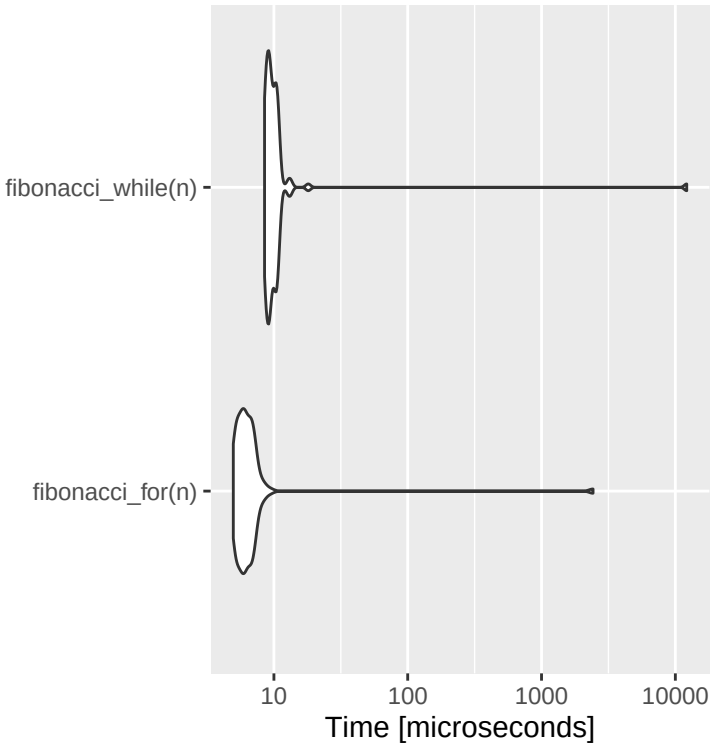
Plot

```
library(ggplot2)
```

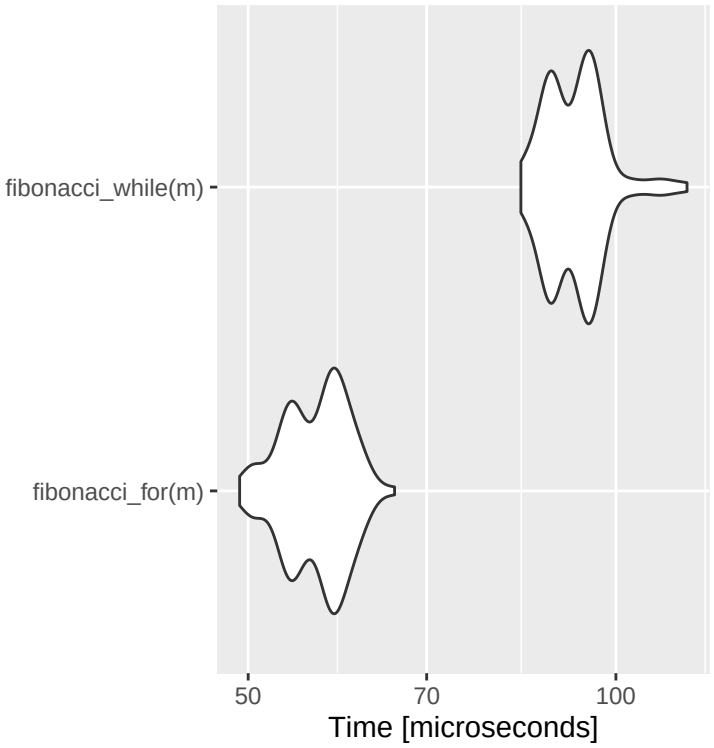
```
autoplot(mbm_n) #n = 100
```

```
## Coordinate system already present. Adding new coordinate system, which will replace the existing one
```



```
autoplot(mbm_m) #m = 1000
```

```
## Coordinate system already present. Adding new coordinate system, which will replace the existing one
```



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The golden ratio

```
golden_ratio_fib_test <- function(n) {
  print(fibonacci_for(n)/fibonacci_for(n-1))
  print((fibonacci_for(n) + fibonacci_for(n-1)) / fibonacci_for(n))
}

golden_ratio <- (sqrt(5) + 1)/2

test_vals = c(1, 5, 10, 25, 40, 50, 100, 500, 1000)

check_golden_ratio_1 <- function(vals) {
  for(i in vals){
    print(paste("fibonacci(", i, "): ", fibonacci_for(i) == golden_ratio))
  }
}
```

```
check_golden_ratio_1(test_vals)
```

```
## [1] "fibonacci( 1 ):  FALSE"
## [1] "fibonacci( 5 ):  FALSE"
## [1] "fibonacci( 10 ):  FALSE"
## [1] "fibonacci( 25 ):  FALSE"
## [1] "fibonacci( 40 ):  TRUE"
## [1] "fibonacci( 50 ):  TRUE"
## [1] "fibonacci( 100 ):  TRUE"
## [1] "fibonacci( 500 ):  FALSE"
## [1] "fibonacci( 1000 ):  FALSE"
```

Game of craps

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```
game_of_craps <- function() {
  #First round
  round <- 1
  dice_1 <- sample(1:6, 1)
  dice_2 <- sample(1:6, 1)
  dice_sum <- dice_1 + dice_2
  first_x <- dice_1 + dice_2
  if(dice_sum == 7 || dice_sum == 11){
    return(paste("Game won in round ", round, "| x = ", dice_sum))
  }
  #Following rounds
  while(TRUE) {
    round = round + 1
    dice_1 <- sample(1:6, 1)
    dice_2 <- sample(1:6, 1)
    dice_sum <- dice_1 + dice_2
    if(dice_sum == first_x){
      return(paste("Game won in round ", round, "| x = ", dice_sum))
    }
    if(dice_sum == 7 || dice_sum == 11){
      return(paste("Game lost in round ", round, "| x = ", dice_sum))
    }
  }
}
```

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Readable and efficient code

foobar0

```
foobar0 <- function(x, z) {
  set.seed(1)

  if (sum(x >= .001) < 1) {
    stop("step 1 requires 1 observation(s) with value >= .001")
  }

  fit <- lm(x ~ z)
  r <- fit$residuals
  x <- sin(r) + .01

  if (sum(x >= .002) < 2) {
    stop("step 2 requires 2 observation(s) with value >= .002")
  }

  fit <- lm(x ~ z)
  r <- fit$residuals
  x <- 2 * sin(r) + .02
  if (sum(x >= .003) < 3) {
   stop("step 3 requires 3 observation(s) with value >= .003")
  }

  fit <- lm(x ~ z)
  r <- fit$residuals
  x <- 3 * sin(r) + .03

  if (sum(x >= .004) < 4) {
    stop("step 4 requires 4 observation(s) with value >= .004")
  }

  fit <- lm(x ~ z)
  r <- fit$residuals
  x <- 4 * sin(r) + .04

  return(x)
}
```

Rewrite

```
check_input <- function(x, step) {
  if (sum(x >= (step * .001)) < step) {
    stop(paste("step ", step, " requires ", step, " observation(s) with value >= ", (step * .001)))
  }
}
```

```
compute <- function(x, z, step) {
  fit <- lm(x ~ z)
  r <- fit$residuals
  x <- step * sin(r) + (.01 * step)
  return(x)
}

foobar <- function(x, z) {
  set.seed(1)
  check_input(x, 1)
  x <- compute(x, z, 1)
  check_input(x, 2)
  x <- compute(x, z, 2)
  check_input(x, 3)
  x <- compute(x, z, 3)
  check_input(x, 4)
  x <- compute(x, z, 4)
  return(x)
}
```

Equality

```
all.equal(foobar0(rnorm(100), rnorm(100)), foobar(rnorm(100), rnorm(100)))
```

```
## [1] TRUE
```