Understand code performance with the profiler

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RStudio

How do I make my R code faster?

Why is my R code slow?

Optimization: normalizing columns

```r
# First generate data with 400000 rows and 150 cols
data <- as.data.frame(
  matrix(rnorm(4e5 * 150, mean = 5), ncol = 150)
)


normCols <- function(d) {
  # Get vector of column means
  means <- apply(d, 2, mean)

  # Subtract mean from each column
  for (i in seq_along(means)) {
    d[, i] <- d[, i] - means[i]
  }
  d
}

normCols(data)
```

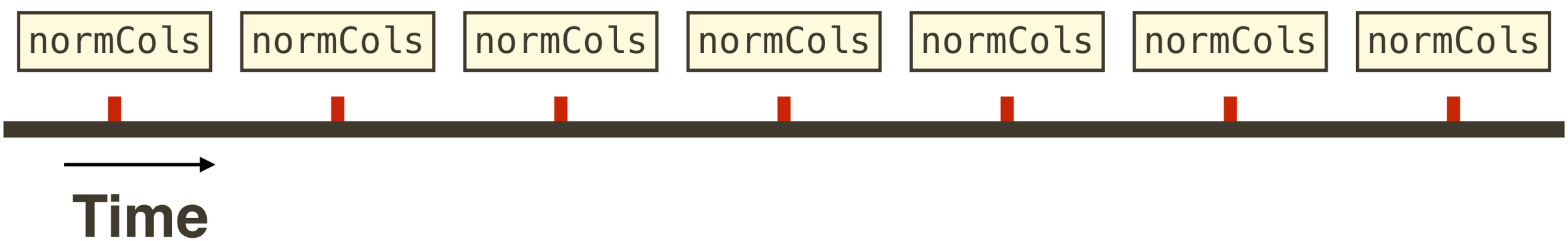
Optimization: normalizing columns

```
system.time({
  normCols <- function(d) {
    # Get vector of column means
    means <- apply(d, 2, mean)

    # Subtract mean from each column
    for (i in seq_along(means)) {
      d[, i] <- d[, i] - means[i]
    }
    d
  }

  normCols(data)
})
```

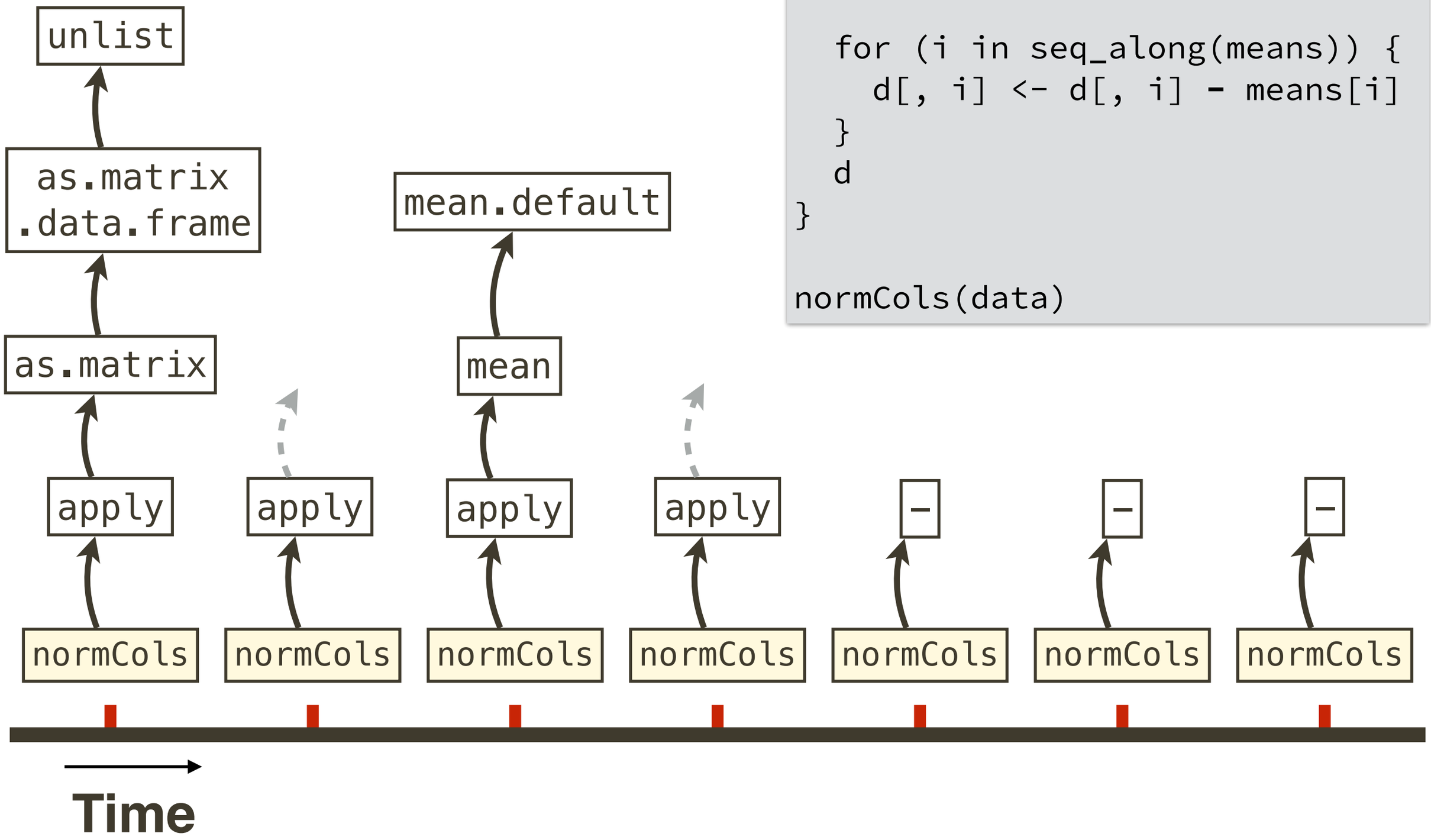
Profiling

Sampling profiler

```
Rprof()       # Start profiling
normCols(data)
Rprof(NULL)   # Stop profiling
```



Sampling profiler



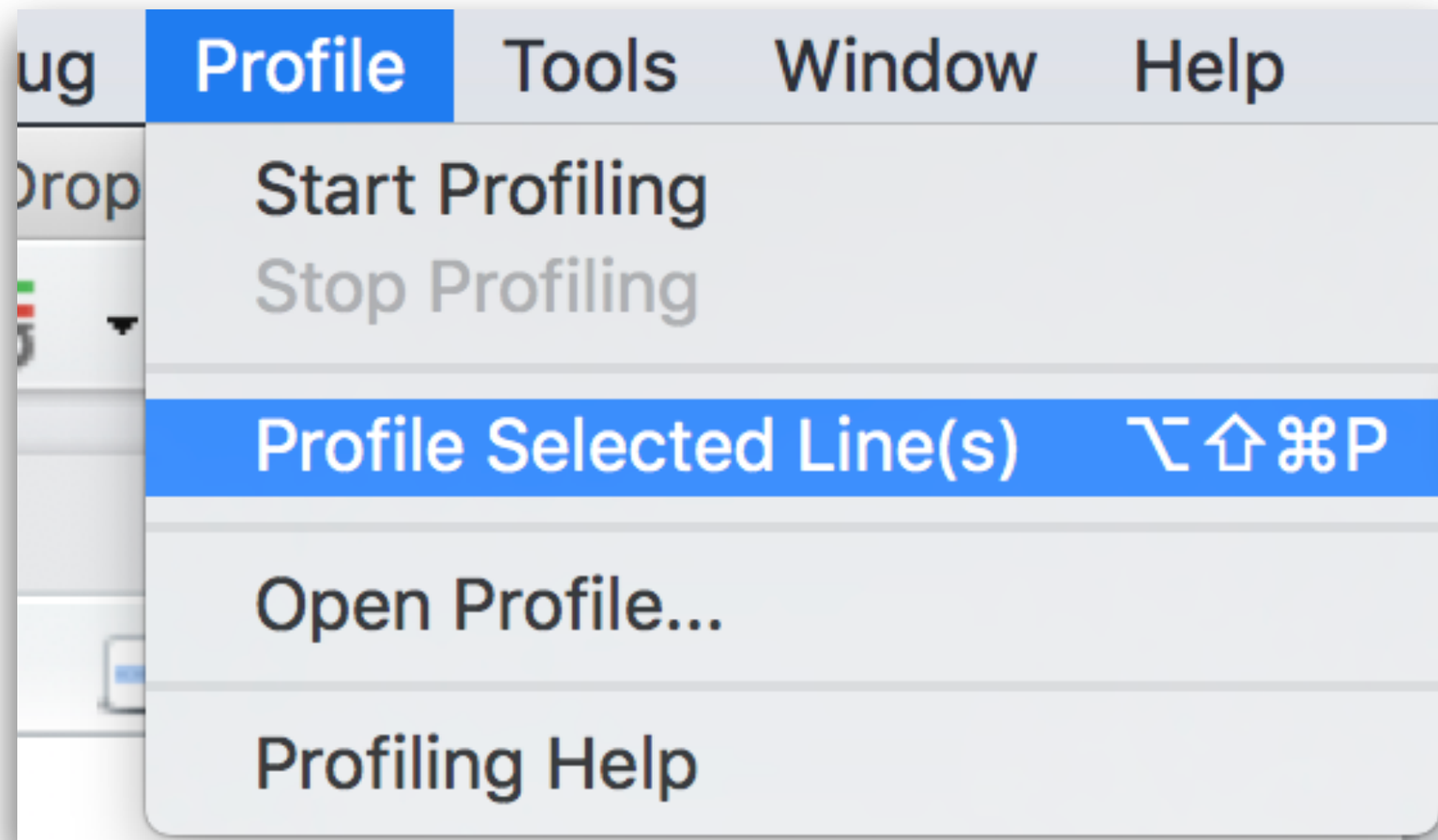

```
normCols <- function(d) {
  means <- apply(d, 2, mean)

  for (i in seq_along(means)) {
    d[, i] <- d[, i] - means[i]
  }
  d
}

normCols(data)
```

profvis

Getting started

```
install.packages("profvis")
library(profvis)

profvis({
  normCols <- function(d) {
    means <- apply(d, 2, mean)

    for (i in seq_along(means)) {
      d[, i] <- d[, i] - means[i]
    }
    d
  }

  normCols(data)
})
```

The easy way


ug
Profile
Tools
Window
Help
Drop
Start Profiling
Stop Profiling
Profile Selected Line(s) ⌥⇧⌘P
Open Profile...
Profiling Help

```r
profvis({
  # Four different ways of getting column means
  means <- apply(d, 2, mean)
  means <- colMeans(d)
  means <- lapply(d, mean)
  means <- vapply(d, mean, numeric(1))
})
```

```
profvis({
  normCols2 <- function(d) {
    means <- vapply(d, mean, numeric(1))

    for (i in seq_along(means)) {
      d[, i] <- d[, i] - means[i]
    }
  }

  normCols2(data)
})
```

Example: Text processing

```
"unlist" "as.matrix.data.frame" "as.matrix" "apply"
"unlist" "as.matrix.data.frame" "as.matrix" "apply"
"aperm.default" "aperm" "apply"
"aperm.default" "aperm" "apply"
[... 750 lines ...]
```

row	col	label
1	4	"unlist"
1	3	"as.matrix.data.frame"
1	2	"as.matrix"
1	1	"apply"
2	4	"unlist"
2	3	"as.matrix.data.frame"
2	2	"as.matrix"
2	1	"apply"
3	3	"aperm.default"
3	2	"aperm"
3	1	"apply"
4	3	"aperm.default"
4	2	"aperm"
4	1	"apply"

```r
lines <- readLines("output.prof")

proc_lines <- list()

for (i in seq_along(lines)) {
  line <- lines[i]
  line <- strsplit(line, " ")[[1]]

  linedata <- data.frame(
    row = i,
    col = rev(seq_along(line)),
    label = line
  )

  proc_lines[[i]] <- linedata
}

proc_data <- do.call(rbind, proc_lines)
```

For each line…

Create a data frame from input

Store the data frame in a list

Combine all data frames together

```
lines <- readLines("ou
```

List is not preallocated

```
proc_lines <- list()
```

for loop

```
for (i in seq_along(lines)) {
  line <- lines[i]
  line <- strsplit(line, " ")[[1]]

  linedata <- data.frame(
    row = i,
    col = rev(seq_along(line)),
    label = line
  )

  proc_lines[[i]] <- linedata
}
```

Growing list in a loop

```
proc_data <- do.call(rbind, proc_lines)
```

Intuition says these are the slow parts…
but profiling says otherwise

```r
lines <- readLines("output.prof")

proc_lines <- list()

for (i in seq_along(lines)) {
  line <- lines[i]
  line <- strsplit(line, " ")[[1]]

  # Put line data in a list instead of a data frame
  linedata <- list(
    row = rep(i, length(line)),
    col = rev(seq_along(line)),
    label = line
  )

  proc_lines[[i]] <- linedata
}

extract_vector <- function(x, name) {
  vecs <- lapply(x, `[[`, name)
  do.call(c, vecs)
}

proc_data <- data.frame(
  row   = extract_vector(proc_lines, "row"),
  col   = extract_vector(proc_lines, "col"),
  label = extract_vector(proc_lines, "label")
)
```

Profiling with RStudio

- Profiling menu
- Saving
- Publishing

Things to remember

- Understand how the sampling profiler works
- Understand profvis interface
- Sometimes performance bottlenecks are counterintuitive

rstudio.github.io/profvis/