WRITING EFFICIENT R CODE

How do I find the bottleneck?

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Jumping Rivers & Newcastle University


Alice: “Where should I go?”
The Cheshire Cat: “That depends on where you want to end up.”

Code profiling

The general idea is to:

- Run the code
- Every few milliseconds, record what is being currently excuted
- `Rprof()` comes with R and does exactly this
    - Tricky to use
- Use **profvis** instead

IMDB data set

- From the **ggplot2movies** package

```
> data(movies, package = "ggplot2movies")
> dim(movies)
[1] 58788    24
```

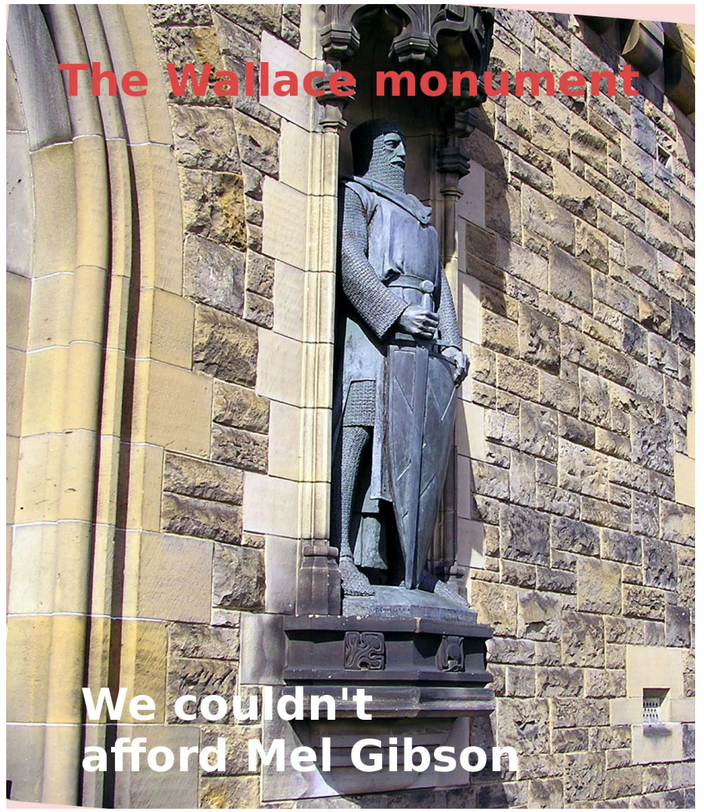
- Data frame: around 60,000 rows and 24 columns

- Each row corresponds to a particular movie

Braveheart

```
> braveheart = movies[7288,]
```

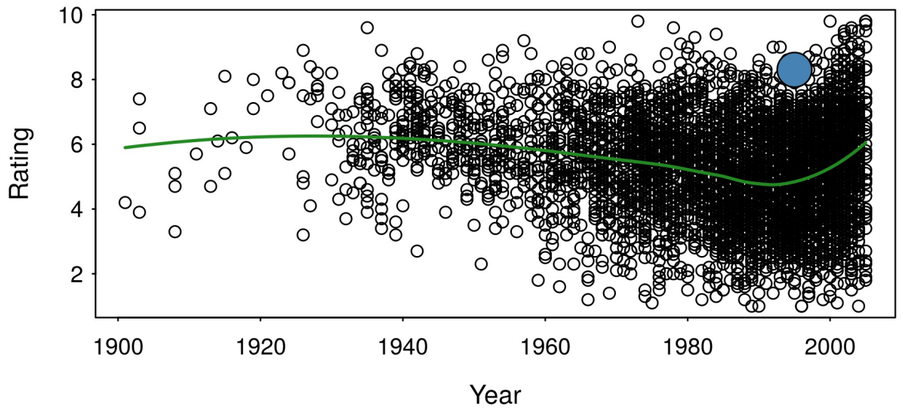
Year	Length	Rating
1995	177	8.3



Example: Braveheart

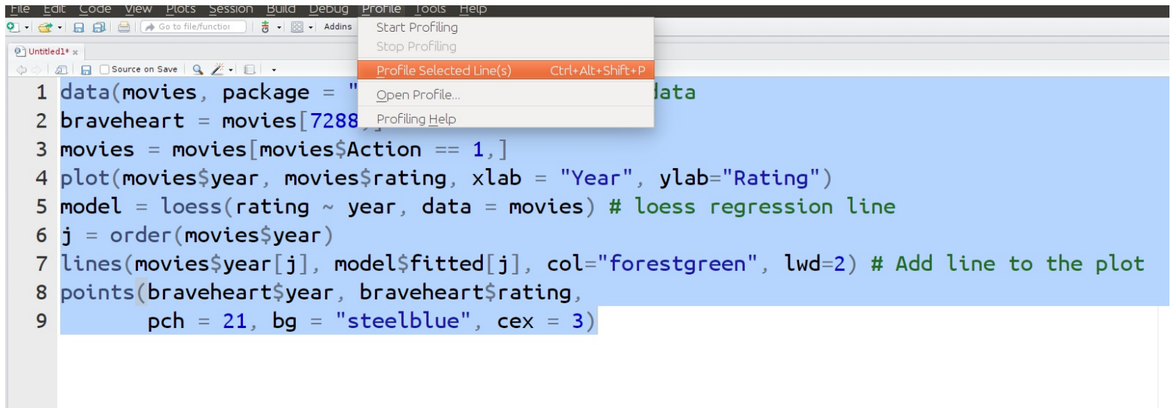
```
# Load data
> data(movies,
+      package = "ggplot2movies")
> braveheart <- movies[7288,]
> movies <- movies[movies$Action==1,]

> plot(movies$year, movies$rating,
+      xlab = "Year", ylab = "Rating")
```

```
> # loess regression line
> model <- loess(rating ~ year,
+                data = movies)
> j <- order(movies$year)
> lines(movies$year[j],
+       model$fitted[j],
+       col = "forestgreen")

> points(braveheart$year,
+        braveheart$rating,
+        pch = 21,
+        bg = "steelblue")
```



Profvis

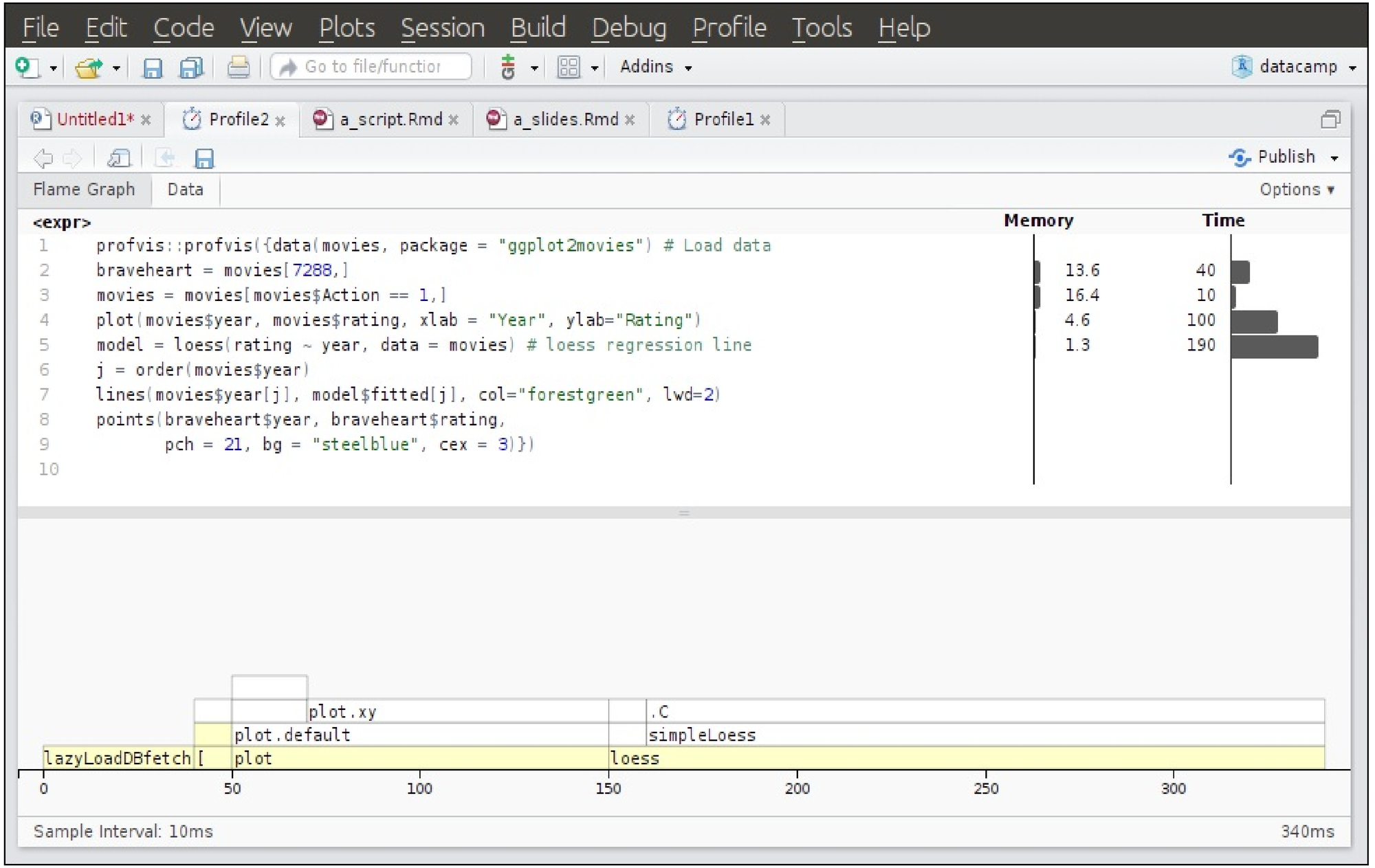
- RStudio has integrated support for profiling with profvis
- Highlight the code you want to profile
- Profile -> Profile Selected lines

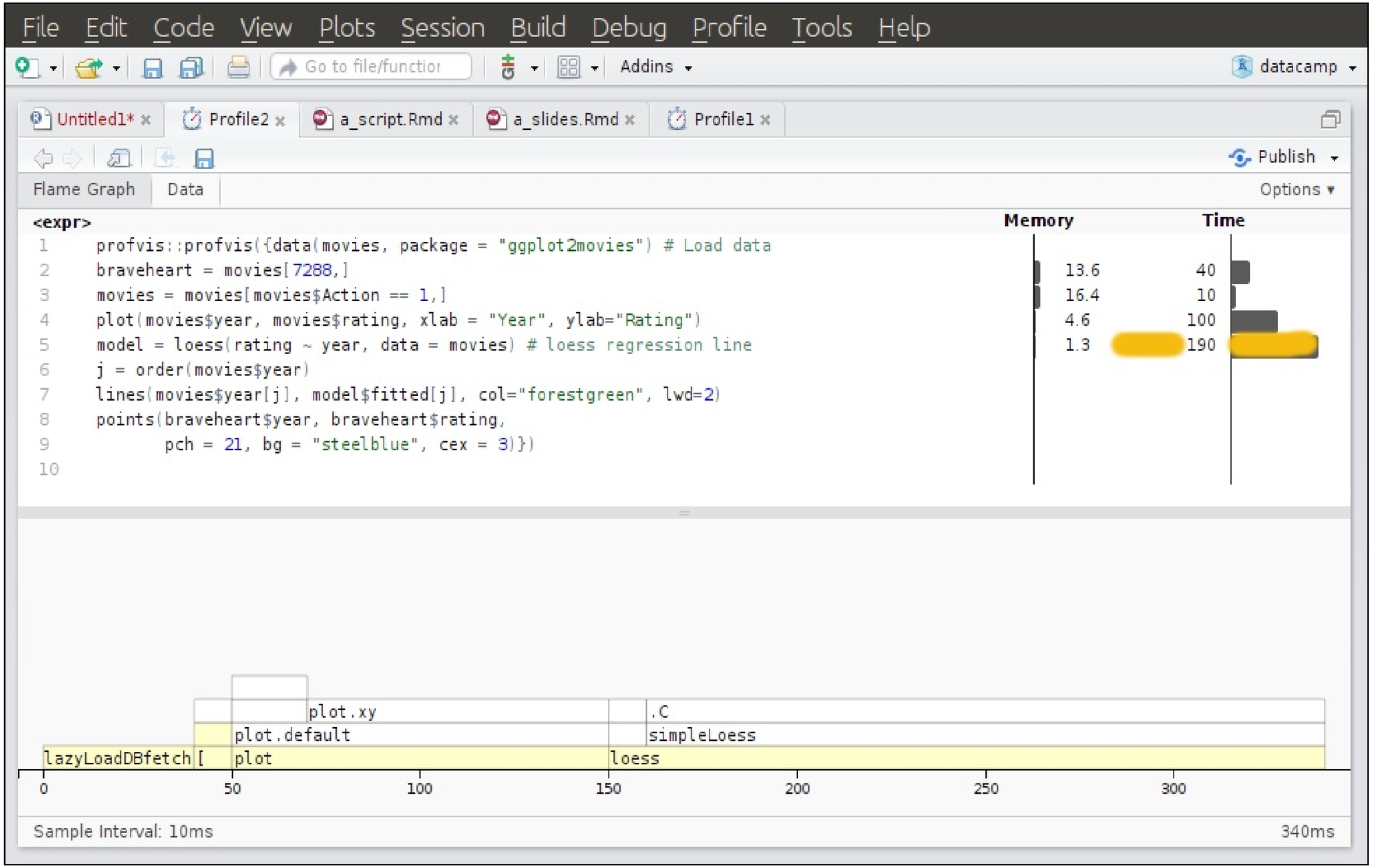


Command line

```
> library("profvis")

> profvis({

+  data(movies, package = "ggplot2movies") # Load data
+  braveheart <- movies[7288,]
+  movies <- movies[movies$Action == 1,]
+  plot(movies$year, movies$rating, xlab = "Year", ylab="Rating")
+  model <- loess(rating ~ year, data = movies) # loess regression line
+  j <- order(movies$year)
+  lines(movies$year[j], model$fitted[j], col="forestgreen", lwd=2)
+  points(braveheart$year, braveheart$rating,
+       pch = 21, bg = "steelblue", cex = 3)

+ })
```

Which line do you think will be the slowest?


File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/functior
Addins
datacamp
Untitled1*
Profile2
a_script.Rmd
a_slides.Rmd
Profile1
Publish
Flame Graph
Data
Options
<expr>
Memory
Time
1 profvis::profvis({data(movies, package = "ggplot2movies") # Load data
2 braveheart = movies[7288,]
3 movies = movies[movies$Action == 1,]
4 plot(movies$year, movies$rating, xlab = "Year", ylab="Rating")
5 model = loess(rating ~ year, data = movies) # loess regression line
6 j = order(movies$year)
7 lines(movies$year[j], model$fitted[j], col="forestgreen", lwd=2)
8 points(braveheart$year, braveheart$rating,
9 pch = 21, bg = "steelblue", cex = 3)})
10
13.6
40
16.4
10
4.6
100
1.3
190
plot.xy
.C
plot.default
simpleLoess
lazyLoadDBfetch
[
plot
loess
0
50
100
150
200
250
300
Sample Interval: 10ms
340ms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Let's practice!

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Profvis

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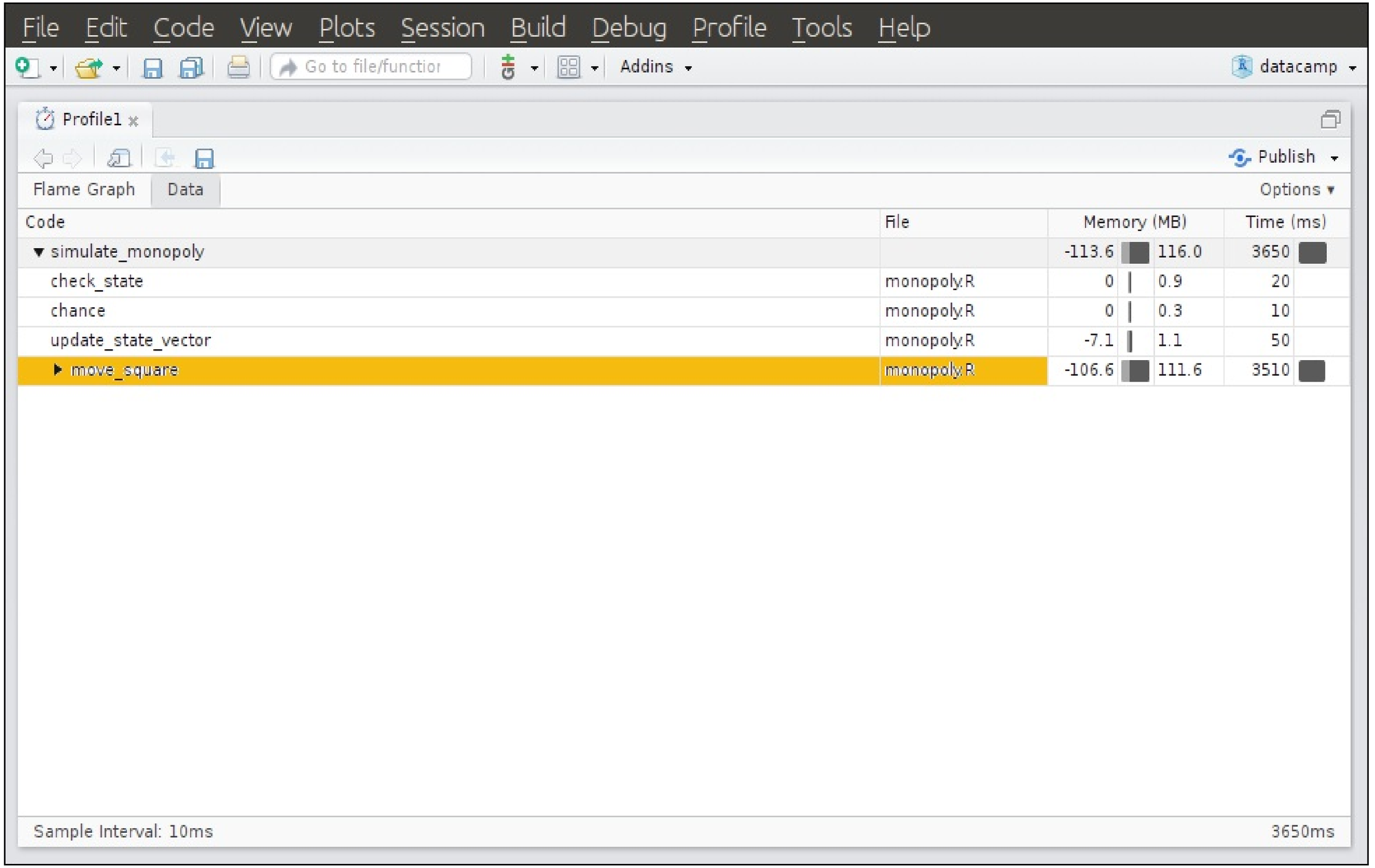
Monopoly

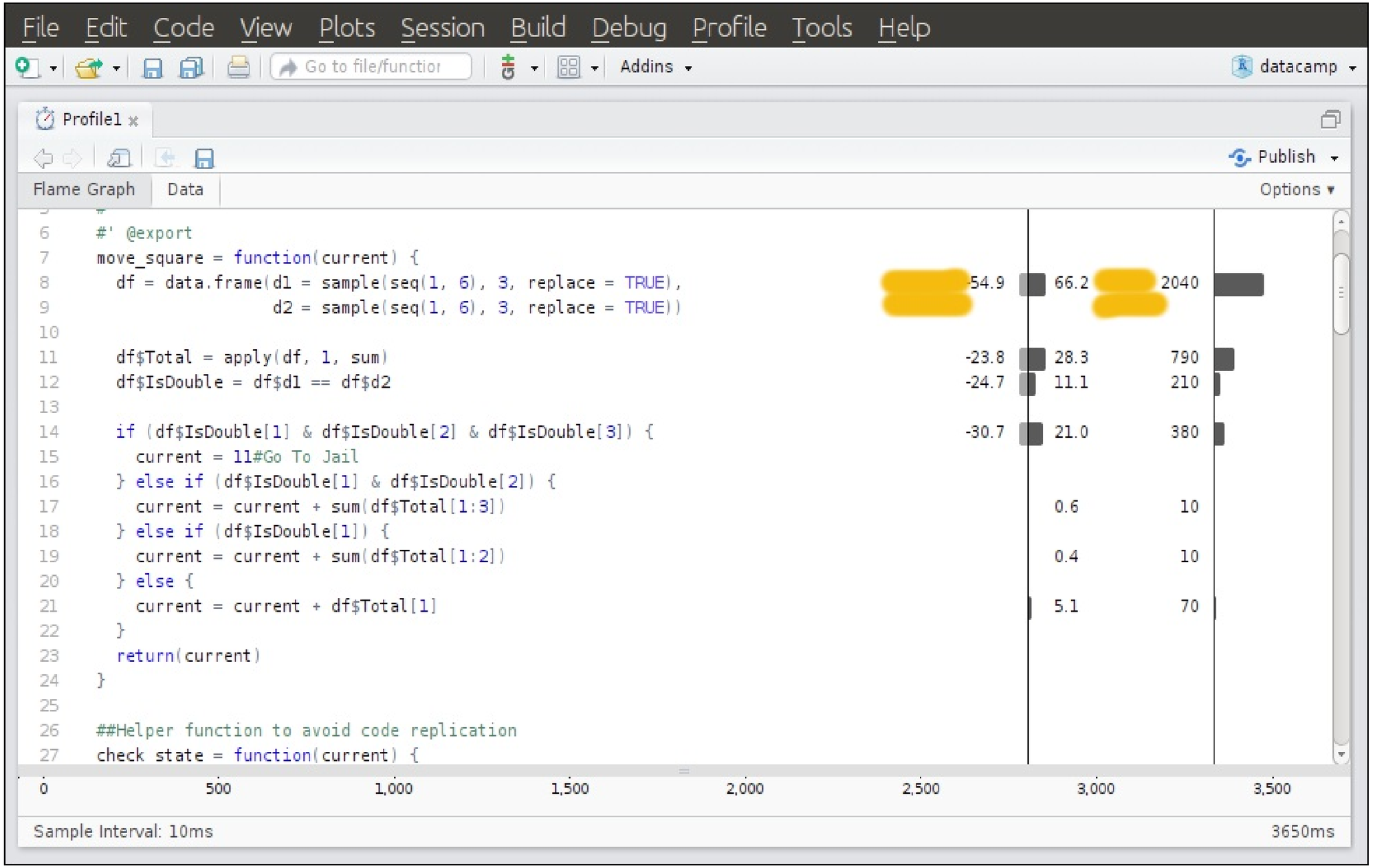
- 40 squares
  - 28 properties (22 streets + 4 stations + 2 utilities)
- Players take turns moving by rolling dice
  - Buying properties
  - Charging other players
- Sent to jail: three consecutive doubles in a single turn

Monopoly Code

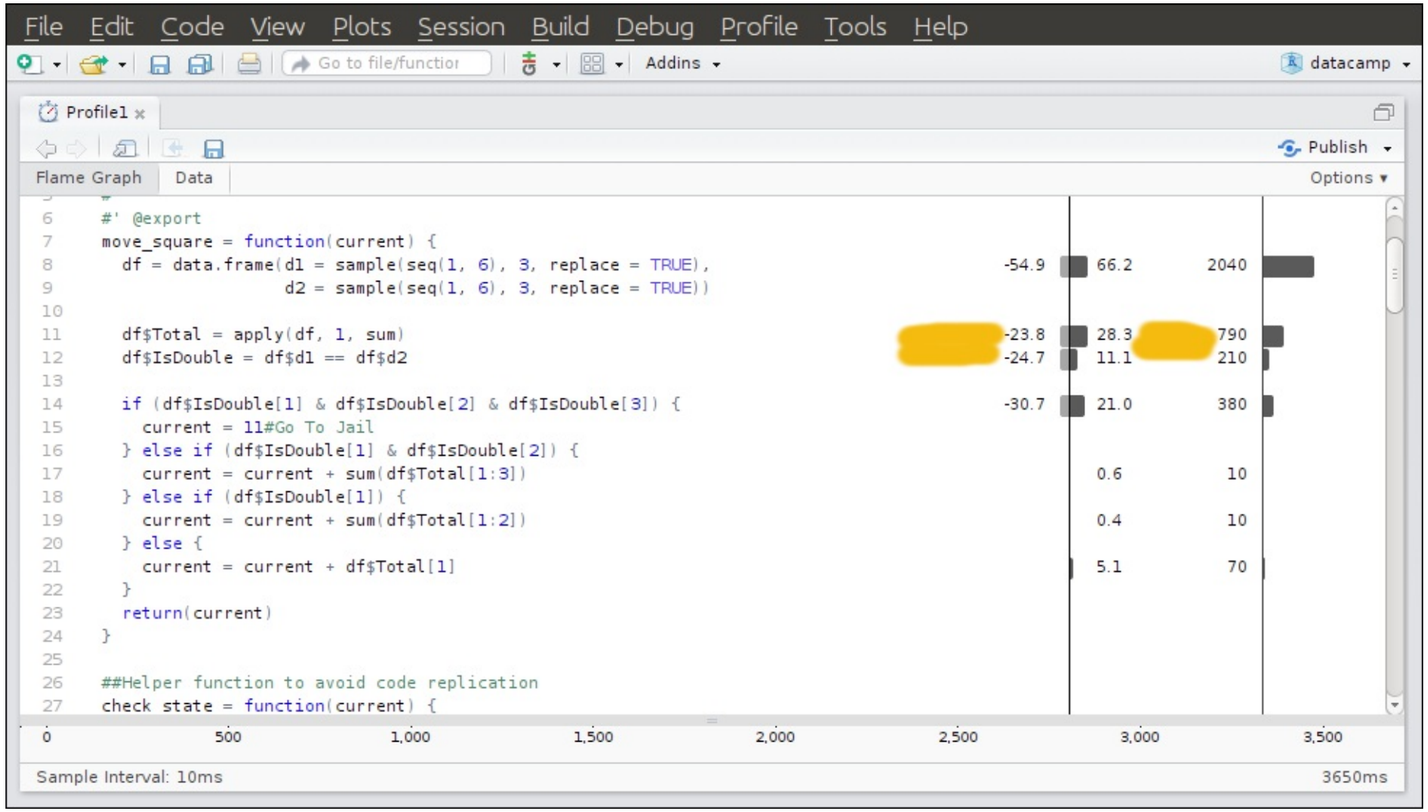
- Around 100 lines of code
- Simplified game
  - Reject the capitialist system:

    no money
  - No friends, only 1 player
- simulate_monopoly(no_of_rolls)


File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/functior
Addins
datacamp
Profile1
Publish
Flame Graph
Data
Options
Code
File
Memory (MB)
Time (ms)
simulate_monopoly -113.6 116.0 3650
check_state monopoly.R 0 0.9 20
chance monopoly.R 0 0.3 10
update_state_vector monopoly.R -7.1 1.1 50
move_square monopoly.R -106.6 111.6 3510
Sample Interval: 10ms
3650ms


File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/functior
Addins
datacamp
Profile1
Publish
Flame Graph
Data
Options
#' @export
move_square = function(current) {
df = data.frame(d1 = sample(seq(1, 6), 3, replace = TRUE),
d2 = sample(seq(1, 6), 3, replace = TRUE))
df$Total = apply(df, 1, sum)
df$IsDouble = df$d1 == df$d2
if (df$IsDouble[1] & df$IsDouble[2] & df$IsDouble[3]) {
current = 11#Go To Jail
} else if (df$IsDouble[1] & df$IsDouble[2]) {
current = current + sum(df$Total[1:3])
} else if (df$IsDouble[1]) {
current = current + sum(df$Total[1:2])
} else {
current = current + df$Total[1]
}
return(current)
}
##Helper function to avoid code replication
check state = function(current) {
-54.9 66.2 2040
-23.8 28.3 790
-24.7 11.1 210
-30.7 21.0 380
0.6 10
0.4 10
5.1 70
0 500 1,000 1,500 2,000 2,500 3,000 3,500
Sample Interval: 10ms
3650ms

Monopoly profvis



How would you optimise this code?

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Monopoly recap

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Jumping Rivers & Newcastle University

Data frames vs matrices

```
# Original
> rolls <- data.frame(d1 = sample(1:6, 3, replace = TRUE),
+                     d2 = sample(1:6, 3, replace = TRUE))
```

```
# Updated
> rolls <- matrix(sample(1:6, 6, replace = TRUE), ncol = 2)
```

- Total Monopoly simulation time: 2 seconds to 0.5 seconds
- Creating a data frame is slower than a matrix
- In the Monopoly simulation, we created 10,000 data frames

apply vs rowSums

```
# Original
> total <- apply(df, 1, sum)
```

```
# Updated
> total <- rowSums(df)
```

- 0.5 seconds to 0.16 seconds - 3 fold speed up

& vs &&

```
# Original
> is_double[1] & is_double[2] & is_double[3]
```

```
# Updated
> is_double[1] && is_double[2] && is_double[3]
```

- Limited speed-up
- 0.16 seconds to 0.15 seconds

Overview

Method	Time (secs)	Speed-up
Original	2.00	1.0
Matrix	0.50	4.0
Matrix + rowSums	0.20	10.0
Matrix + rowSums + &&	0.19	10.5