WRITING EFFICIENT R CODE

How do I find the bottleneck?

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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
```

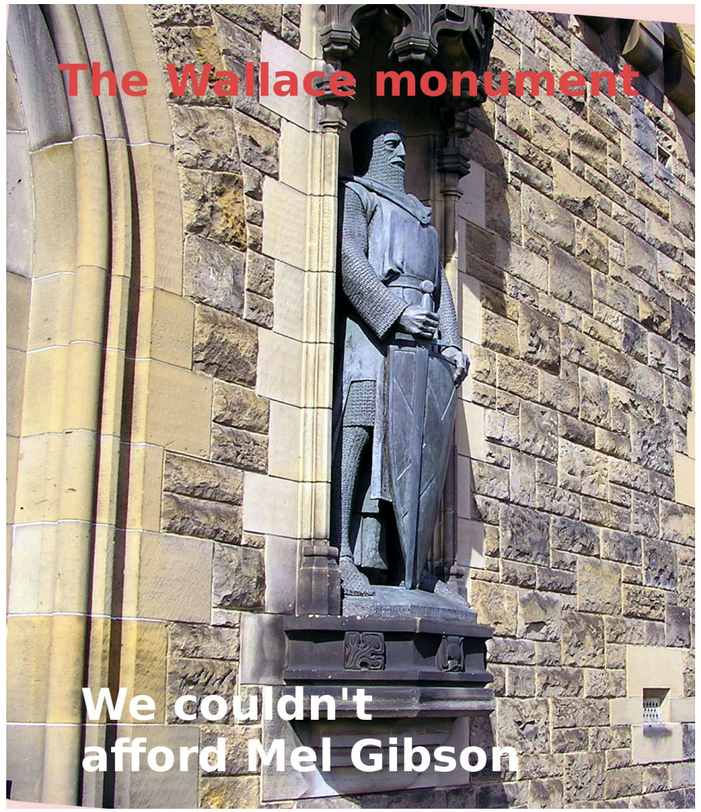
- Data frame: around 60,000 rows and 24 columns

- Each row corresponds to a particular movie

Braveheart

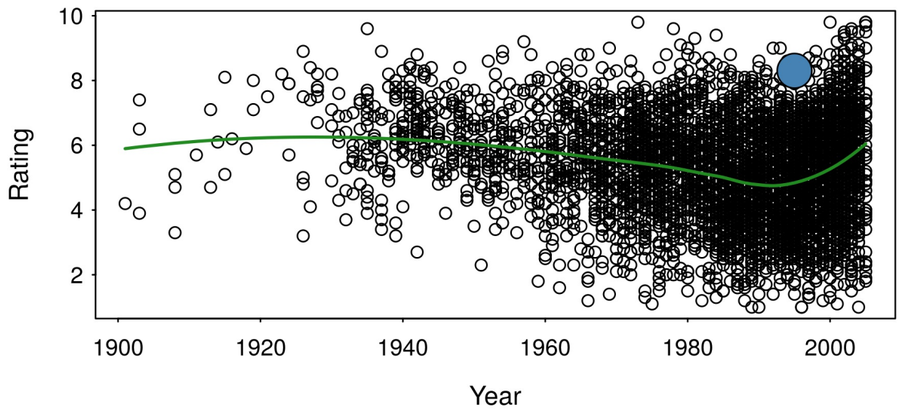
```
braveheart = movies[7288,]
```

Year	Length	Rating
1995	177	8.3



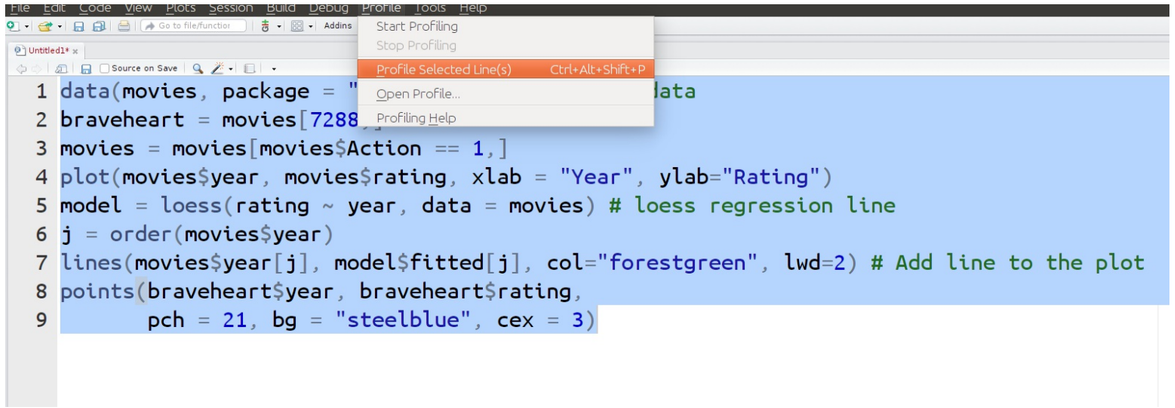
Example: Braveheart

```
# 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?

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Go to file/function Addins datacamp

Untitled1* Profile2 a_script.Rmd a_slides.Rmd Profile1

Publish

Flame Graph Data Options

<expr>

```
profvis::profvis({data(movies, package = "ggplot2movies") # Load data
braveheart = movies[7288,]
movies = movies[movies$Action == 1,]
plot(movies$year, movies$rating, xlab = "Year", ylab="Rating")
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points(braveheart$year, braveheart$rating,
       pch = 21, bg = "steelblue", cex = 3)})
```
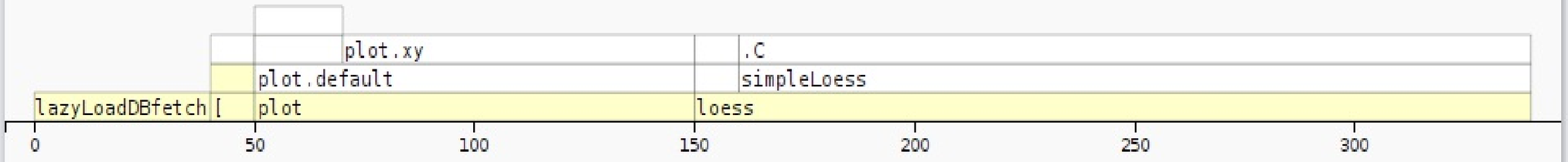

Memory	Time
13.6	40
16.4	10
4.6	100
1.3	190



Sample Interval: 10ms 340ms

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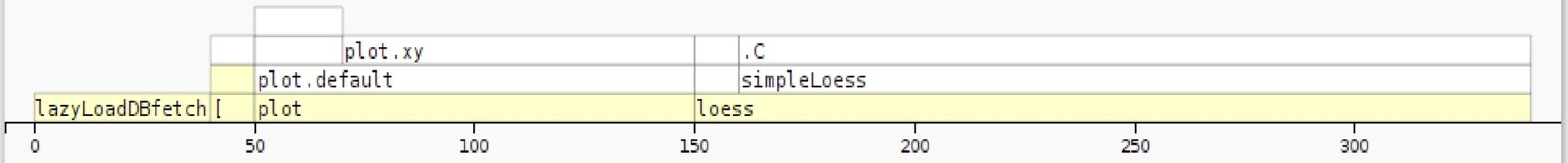

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Let's practice!

WRITING EFFICIENT R CODE

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)

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Profile1

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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

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Go to file/function 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

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Profile1

Publish

Flame Graph Data Options

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#' @export
move_square = function(current) {
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	0.6	10
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Sample Interval: 10ms 3650ms

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Monopoly recap

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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