

Homework 4

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! Important

Please read the instructions carefully before submitting your assignment.

1. This assignment requires you to only upload a PDF file on Canvas
2. Don't collapse any code cells before submitting.
3. Remember to make sure all your code output is rendered properly before uploading your submission.

Please add your name to the author information in the frontmatter before submitting your assignment

We will be using the following libraries:

```
packages <- c(
  "dplyr",
  "readr",
  "tidyr",
  "purrr",
  "stringr",
  "corrplot",
  "car",
  "caret",
  "torch",
  "nnet",
  "broom"
)
```

```
# renv::install(packages)
sapply(packages, require, character.only=T)
```

Loading required package: dplyr

Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

filter, lag

The following objects are masked from 'package:base':

intersect, setdiff, setequal, union

Loading required package: readr

Loading required package: tidyr

Loading required package: purrr

Loading required package: stringr

Loading required package: corrplot

corrplot 0.92 loaded

Loading required package: car

Loading required package: carData

Attaching package: 'car'

The following object is masked from 'package:purrr':

some

The following object is masked from 'package:dplyr':

recode

Loading required package: caret

Warning: package 'caret' was built under R version 4.3.3

Loading required package: ggplot2

Loading required package: lattice

Attaching package: 'caret'

The following object is masked from 'package:purrr':

lift

Loading required package: torch

Warning: package 'torch' was built under R version 4.3.3

Loading required package: nnet

Loading required package: broom

dplyr	readr	tidyr	purrr	stringr	corrplot	car	caret
TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
torch	nnet	broom					
TRUE	TRUE	TRUE					

Question 1

💡 30 points

Automatic differentiation using `torch`

1.1 (5 points)

Consider $g(x, y)$ given by

$$g(x, y) = (x - 3)^2 + (y - 4)^2.$$

Using elementary calculus derive the expressions for

$$\frac{d}{dx}g(x, y), \quad \text{and} \quad \frac{d}{dy}g(x, y).$$

$$\# \text{ d/dx(g(x,y)) = 2x-6 d/dy(g(x,y)) = 2y-8}$$

Using your answer from above, what is the answer to

$$\left. \frac{d}{dx}g(x, y) \right|_{(x=3, y=4)} \quad \text{and} \quad \left. \frac{d}{dy}g(x, y) \right|_{(x=3, y=4)} \quad ?$$

$$\mathbf{d/dx(g(x=3,y=4)) = 23-6 = 0 \quad d/dy(g(x=3,y=4)) = 24-8 = 0}$$

Define $g(x, y)$ as a function in R, compute the gradient of $g(x, y)$ with respect to $x = 3$ and $y = 4$. Does the answer match what you expected? ::: {.cell}

```
library(pracma)
```

```
Warning: package 'pracma' was built under R version 4.3.3
```

```
Attaching package: 'pracma'
```

```
The following object is masked from 'package:car':
```

```
logit
```

```
The following object is masked from 'package:purrr':
```

```
cross
```