Mathematical Skills for Data Scientists
Lab Exercises 4 − 6 Marks (Due: 07/11/22)

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Note: Please add these two lines of code at the end of your matlab script

```
filename = which(mfilename('fullpath'))
fileInfo = dir(filename)
```

Exercise 1 (Newton's Method in Excel/Matlab- Example (no marks)). Do Newton's Method for $x \mapsto x^3 - 5$ ($f(x) = x^3 - 5$). Find a formula for the derivative by hand and use Excel for the iteration. You will find $f(1.709975947) = 0$.

Exercise 2 (Newton's Method in Excel). Do Newton's Method for $x \mapsto x^3 - 2$ ($f(x) = x^3 - 2$). Find a formula for the derivative by hand and use Excel for the iteration. (1 mark)

Exercise 3 (Newton's Method in MatLab). Try Newton's Method for $x \mapsto x^2$,$x \mapsto \sin(\cos x)$, $x \mapsto x^7 - 5$ and $x \mapsto \sqrt{(x)}$, all starting with $x_0 = 1$. Report (2 marks).

Exercise 4 (Gradient Descent in Excel/Matlab- Example (no marks)). Try to find the minimum of $x^2 + (y - 2)^2$ using gradient descent. You will find $f(0.0225, 1.9774) = 0.00101$.

Exercise 5 (Gradient descent in Excel). Try to find the minimum of $(1 - x)^2 + 100(y - x^2)^2$ using gradient descent. Is it working?(1 mark)

Exercise 6 (Gradient descent in Matlab). Implement a gradient descent routine in Matlab. Try it out on

1. $x^2 \cos y$
2. $x + y$
3. $x^2 + 2xy + y^2$

Vary the step size, and compare. You may start with $[1, 1]$(2 mark)

Exercise 7. Read https://en.wikipedia.org/wiki/Gradient_descent