

Due on 6 October 2021

**M.Sc. Data Science**  
Analysis - Computing assignment 1

Note:

- Please submit your assignment in the following filename format: (first name)(assignment number).m or .py; for example, a student named xyz will submit assignment 1 using the filename xyz1.m;
- all assignment submissions should be uploaded on Moodle.
- For all the following exercises you may refer to the sympy, scipy and matplotlib documentations as well as Octave documentation on octave.org.
- You are encouraged to try all exercises in both Octave and Python. You may submit any one or both of them.

1. Graph the following functions (try using ‘fplot’ in Octave and matplotlib.pyplot in Python). Use your judgement and some experimentation to find an appropriate range of values for  $x$  so that the “main features” of the graph are visible.

- (a)  $\sin x$
- (b)  $\tan x$
- (c)  $\cosh x$
- (d)  $e^{-x^2}$

2. Let  $f(x) = x^3 - 4x^2 + 1$ .

- (a) Graph  $f$ .
- (b) Look up ‘finding roots’ for Octave and ‘solve’ in sympy to find the roots of  $f(x)$ .
- (c) Determine where  $f$  is increasing and where it is decreasing. Find the exact values where  $f$  has a relative maximum/minimum.

3. Compute the following limits using ‘limit’ in sympy and in Octave.

- (a)  $\lim_{x \rightarrow 1} \frac{x^2 + 3x - 4}{x - 1}$ .
- (b)  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ .
- (c)  $\lim_{x \rightarrow 0^+} x \ln x$ .

4. Compute the following derivatives:

- (a)  $\frac{d}{dx}(x^2 + 5x - 1)^{100}$ .
- (b)  $\frac{d}{dx} \left( \frac{x^2 e^x - 1}{x^2 + 2} \right)$ .
- (c)  $\frac{d}{dx}(\sin^5 x \cos^3 x)$ .
- (d)  $\frac{d}{dx}(\arctan e^x)$ .

5. Compute the following integrals:

(a)  $\int (x^2 + 5x - 1)^{10} (2x + 5) \, dx$

(b)  $\int_0^1 x^5 (1 - x^2)^{3/2} \, dx$

(c)  $\int_0^1 \sin(x^3) \, dx$