

# List of exercises

## 1 Lecture 1

### 1.1 Sampling random points within D- dimensional domains by hit and miss

Use the hit-and-miss method to estimate numerically the volume of an ellipsoid of parameters  $a=3, b=2, c=2$  and plot the deviation of the estimate from the analytic value as a function of the number of throws used.

Repeat the above procedure to estimate the volume of an ellipsoid of parameters  $a=3, b=1, c=1$ . Compare the two results and try to improve the second case if needed.

### 1.2 Sampling random numbers from a given distribution: inversion method

Use the inversion method to generate random numbers with the following PDF

1.  $\rho(x) = cx e^{-x^2}$ , for  $x \in \mathbb{R}^+$ .
2.  $\rho(x) = bx^4$  for  $x \in [0, 3]$

**Note.** First compute analytically the  $F$ ,  $F^{-1}$  and the map  $x_i = f(\xi_i)$  and then implement and run the corresponding numerical algorithm. In particular, compute the histogram of the sampled points and compare it with the expected PDF.

## 2 Lecture 2

### 2.1 Rejection method

Use the rejection method to generate random numbers that are distributed according to the pdf

$$f(x) = A_f e^{-8(x^2/2 + x^4/4)}.$$

where

$$\int_{-\infty}^{+\infty} f(x) dx = \frac{e}{\sqrt{2}} K_{1/4}(1)$$

and  $K_{1/4}$  denotes the Bessel function of the second kind.

Hint: One may use a Gaussian function.