Università
della
Svizzera
italiana

Faculty
of Informatics

Numerical Algorithms

Fall 2020

Assignment 13 (only for students of the 6 ECTS course) December 10, 2020

Exercise 1 [5 points]

Find an analytic expression for the Fourier coefficients a_k, $k \geq 0$ and b_k, $k > 0$ of the function $f\colon [-\pi, \pi] \to \mathbb{R}$, $f(x) = x^3$.

Hand in your derivation and the resulting formulas.

Exercise 2 [5 points]

Write a program that computes the Fast Fourier Transform $\hat{f}_0, \ldots, \hat{f}_{n-1}$ of $n = 2^m$ data values $f_0, \ldots, f_{n-1}$ in $O(n \log n)$ time. Test your program by running it for the input data $f_j = f(j/n)$, $j = 0, \ldots, n-1$ with $n = 2^8$, sampled from the function $f\colon [0, 1] \to \mathbb{R}$, $f(x) = \frac{10}{1+(10x-5)^2}$.

Hand in your code and the output of your program.

Solutions must be returned online or in class on December 17, 2020