

CS 6810/7810: Wavelets and Wavelet Algorithms

Assignment 1

Step Approximations and Basic HWT

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Learning Objectives

1. Step Approximations
2. Basic Haar Wavelet Transform
3. Shifts and Dilations of Basic Haar Wavelet Transform

Introduction

In this assignment, you will familiarize yourselves closer with step approximations and the Basic Haar Wavelet Transform (HWT). It will lay a deeper conceptual foundation for your subsequent implementation of the 1D HWT. This assignment has three problems. These are all conceptual problems. Use your favorite math editor to type and edit your solutions. Use your favorite plotting package (my personal favorites are Octave and matplotlib) to plot your graph for Problem 1.

Problem 1 (1 pts)

Consider the signal in equation (1):

$$s = (t_0, 10), (t_1, 8), (t_2, 9), (t_3, 5), (t_4, 3), (t_5, 3), (t_6, 4), (t_7, 6) \quad (1)$$

In equation (1), the first element in each pair, i.e., $t_i, 0 \leq i \leq 7$, is a time point and the second element is the value of the signal sampled at that time. Write a formula for the step approximation function \tilde{f} for this signal and plot it.

Problem 2 (2 pts)

This problem illustrates that the interval $[0, 1[$ is sufficient to express steps (and, consequently, wavelets) over arbitrary intervals. Try to show that the two formulas in equations (2) and (3) are correct for every number r . If you are not comfortable with formal proofs, you can use either algebraic manipulation or argue case by case.

$$\phi_{[0,w[}(r) = \phi_{[0,1[}(r/w) \quad (2)$$

$$\phi_{[u,w[}(r) = \phi_{[0,1[}\left(\frac{r-u}{w-u}\right) \quad (3)$$

Problem 3 (2 pts)

Compute the Basic HWT of the signal $(8, 6, 7, 3, 1, 1, 2, 4)$.

What To Submit

Save your solution in hw01.pdf and submit via Canvas.