1. Haar matrices

* What are haar matrices?
* What is a haar basis?

Haar matricesandthecorrespondingHaarwavelets,afundamentaltool insignalpro cessingandcomputergraphics. Before we explore their technical details, we start with a motivating example.

Let’s think about black-and-white images. A 512 512 image has an intensity–a number–for each pixel. (In a real image, the intensity is an integer, but we’ll treat the intensities as real numbers.) You might be familiar with the idea of downsampling an image. A 512 512 image can be downsampled to obtain a 256 256 image; the higher-dimensional image is divided into little 2 2blocks of pixels, and each block is replaced by a pixel whose intensity is the average of the intensities of the pixels it replaces. The 256 256 image can be further downsampled, and so on, down to a 1 1 image. The intensity is the average of all the intensities of the original image. This idea of **repeated subsampling** gives rise to the notion of wavelets.

The importance of the wavelets shines especially in long-signals where they enable compression into much shorter signals which still retain enough information to be indistinguishable from the original. We cannot see or hear any difference.

Example of a haar matrix:

More explicitly explain how we find the inverse here:

Transforming a signal to its coefficients:

Reconstructionofthesignalconsistsincomputingv=Wc. The trick for good compres sion is to throw awaysomeofthecoe cientsofc(setthemtozero),obtainingacompressed signal c,andstillretainenoughcrucial informationsothatthereconstructedsignalv=Wc looksalmostasgoodastheoriginalsignalv.Thus, thestepsare:



Give hand-drawn examples of how the singals look like. Choose a different v.

Multiresolution signal analysis with haar bases

* Low index= coarse info
* High index = fine information
  + What is coarse and fine here? Make it more explicit

Haar transform for audio?

Haar transform for digital images:

/// The perk? Of haar bases is they allow subsampling where very high and low? frequency signals get lost and the remaining signals stay the same. This is dubious.

. Wavelets playanimportantroleinaudioandvideosignal

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difference.

We’ll discuss standard and alternative representations of signals such as images and sound.

Four vectors, they are all pairwise orthogonal.

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AI-generated content may be incorrect.

1. Hadamard matrices
2. Affine maps