

0/7 Questions Answered

Lab 4

Q1 Bases for N-Dimensional Vectors

10 Points

Assume we consider all `audio(n)` signals of length N , use $\delta(n)$ to define a basis for \mathbb{R}^N . How do you write this basis in matrix form? Define this matrix as \mathbf{A} in `script1.m` in Matlab.

Submit both your explanation and your code here.

Explanation:

Enter your answer here

Matlab Code Snippet:

Enter your answer here

Save Answer

Q2 Standard Basis for N-Dimensional Vectors

5 Points

Find the representation of `audio(n)` in terms of the standard basis (the Identity matrix, with dimension $N \times N$). In other words, if \mathbf{b} is our

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audio signal, and \mathbf{A} is our standard basis for \mathbb{R}^N , what is \mathbf{x} if we have $\mathbf{Ax} = \mathbf{b}$?

Enter your answer here

Save Answer

Q3 DCT Matrix as a Basis

15 Points

In the section provided in `script1.m`, generate the DCT matrix \mathbf{A}_{DCT} of size N using `dctmtx()`. Next, write code to prove that \mathbf{A}_{DCT} is a basis for \mathbb{R}^N . Finally, write out your justification for your procedure.

Submit both your justification and your code here.

Explanation:

Enter your answer here

Matlab Code Snippet:

Enter your answer here

Save Answer

Q4 DCT Vectors as Elementary Audio Signals

20 Points

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The DCT vectors can be viewed as elementary audio signals, each representing some elementary audio frequency. They are ordered by frequency, with the first column in the matrix \mathbf{A}_{DCT} corresponding to the lowest frequency. Write code to play back each of the basis vectors to show that they lead to increasing frequency.

Submit your code here.

Matlab Code Snippet:

Enter your answer here

Save Answer

Q5 Representing Signals in Terms of a New Basis

20 Points

We are given a signal `audio(n)`: find its representation in terms of the DCT basis (the columns of \mathbf{A}_{DCT}) by formulating and solving a linear system of equations.

Submit your code here.

Matlab Code Snippet:

Enter your answer here

Save Answer

Q6 Audio Processing

25 Points

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Design an audio processor that removes the higher frequencies from `audio` and plays it back. For example, since the given audio signal has length $N = 2000$ you could remove the largest $K = 1000$ frequencies. Next, repeat the experiment by removing the lowest K frequencies. Provide code for both versions of this experiment.

Describe your findings by listening to the processed audio signal with different amounts of low or high frequencies removed (in other words, change K and repeat for each of the two versions of the experiment). Compare your results between removing the low or the high frequency vectors.

Submit both your observations and your code here.

Explanation:

Enter your answer here

Matlab Code Snippet:

Enter your answer here

Save Answer

Q7 Code Submission

5 Points

Submit your completed `script1.m` code here. Please make sure you've answered each question in the appropriate section and used meaningful variable names and comments to help us understand what you did.

 Please select file(s)

Select file(s)

Save Answer

Save All Answers

Submit & View Submission ➤