GK-12 Lesson Plan

Teacher:
Period: **Class:**
Date(s):

SETTING THE STAGE	
Essential Question	What happens to the original data set when we delete one of the DCT coefficients?
Content Objective(s) (Student-friendly)	We will perform the DCT on 4 points, remove one coefficient, perform the IDCT, and analyze the results.
Connection to previous or future lessons	This is the third lesson.
Critical Thinking Questions	Same as essential question.
Key Vocabulary	None
Materials Needed/Safety	DCT3.pdf
ACTIVE INSTRUCTION	
• Launch (Engage)	Show the DCT equation. Explore the variables involved. Solve for the first row of the provided table, doing one cell at a time so students can see how to solve the function in discrete steps with two variables. Explain how the last column is the sum of the first four, illustrating the fact that it is a series.
• Investigation (Explore)	Have students solve for the rest of the table. Delete one coefficient. Perform the IDCT.
TIME FOR REFLECTION	
• Summarization (Explain & Extend)	What difficulties did you encounter in performing the DCT or IDCT? Did you notice any patterns? What does the set of data points look like after the IDCT now that we removed the last coefficient? Why does this happen?
• Assessment (Evaluate)	Ongoing.
• Homework	None.

*This template is available in electronic form.

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Teacher:

This lesson was by far the hardest and the longest. It took many more days than a single one for them to complete just the forward transform. Having no exposure to a function involving multiple variables the DCT equation alone was very intimidating for them. They had never seen the series symbol before. I should have illustrated how a long summation equation can be summarized by a series symbol. After illustrating how we would find the first row they seemed to quickly grasp the concept of how each cell was solving for one part of the series, but I am doubtful that they truly made this connection and could repeat it in the future. I think instead they were merely interested in solving the puzzle. Once they got rolling, however, they completed the whole table, even if it took quite a while. I will not be having them perform the IDCT as it will just take far too long to complete as they do not have the experience necessary to quickly perform the computation required to complete this in a timely manner. Instead I will modify the plan to show them how to quickly solve this using MATLAB and we will hopefully jump into that even sooner. In the future I need to remember that anything involving solving equations will take the students quite a bit of time as they do not have the experience to recognize patterns or how to quickly go through things and instead take things in very small steps, double checking themselves constantly. Regardless, it was good exposure for them.

Discrete Cosine Transform

Discrete Cosine Transform, Equation

DCT

$$C(u) = \alpha(u) \sum_{x=0}^{N-1} f(x) \cos\left(\frac{(\pi(2x+1)u)}{2N}\right), u = 0,1,2,\ldots,N-1$$

IDCT

$$f(x) = \alpha(u) \sum_{u=0}^{N-1} C(u) \cos\left(\frac{(\pi(2x+1)u)}{2N}\right), u = 0,1,2,\ldots,N-1$$

$$\alpha(u) = \sqrt{\left(\frac{1}{N}\right)}, u = 0$$

$$\alpha(u) = \sqrt{\left(\frac{2}{N}\right)}, u \neq 0$$

Instructions

We are going to do a 4 point DCT (N=4).

You can use my array or your own if you're feeling up to the challenge.

My array: [7 3 0 6] This is f(x).

Solve for C(u) row by row. Delete C(3). Find IDCT. Compare.

DCT

u\x	0	1	2	3	C(u)
0					
1					
2					
3					

IDCT

u\x	0	1	2	3	C(u)
0					
1					
2					
3					