GK-12 Lesson Plan

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

SETTING THE STAGE	
Essential Question	How can we represent a set of points as a set of independent functions?
Content Objective(s) (Student-friendly)	We will learn how to represent a set of eight points as a combination of eight independent functions.
Connection to previous or future lessons	This is the second lesson.
Critical Thinking Questions	What does it mean to be an independent function?
Key Vocabulary	Basis functions, independent functions.
Materials Needed/Safety	DCT2.pdf
ACTIVE INSTRUCTION	
• Launch (Engage)	Show the set of N cosine basis functions that make up the transform. Show a set of N simple basis functions that each only have a single value. What does it mean for a set of functions to be independent? How can we represent a set of points in terms of a set of basis functions?
• Investigation (Explore)	Demonstration of a set of 3 independent functions. Draw on the board. Illustrate a fourth function that is not independent from the other three. Illustrate how any three out of the four can be picked to be independent through addition or subtraction. Have the students create their own set of eight independent functions.
TIME FOR REFLECTION	
• Summarization (Explain & Extend)	What did you independent functions look like? Are they truly independent? Does the value of the peaks matter? Explain any difficulties.
• Assessment (Evaluate)	Their responses and difficulties with this exercise will be evaluated.
• Homework	None

Teacher:

This lesson was a bit more difficult. The students had a bit of difficulty understand what independence was but after the illustration involving three independent functions they quickly became interested. Their results were very interesting and incredibly varied. Some got creative whereas most stayed with a simple set. The interaction between groups was also important as it allowed different groups to let each other know whether their sets were truly independent or not. More time should have been spent exploring independent and basis functions, but the explanation of what made functions independent took longer than planned. I believe the students are not used to seeing a function be made of two other functions. That is, a set of data is a combination of multiple functions. That connection took a little longer than planned but it worked out in the end.

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

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

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

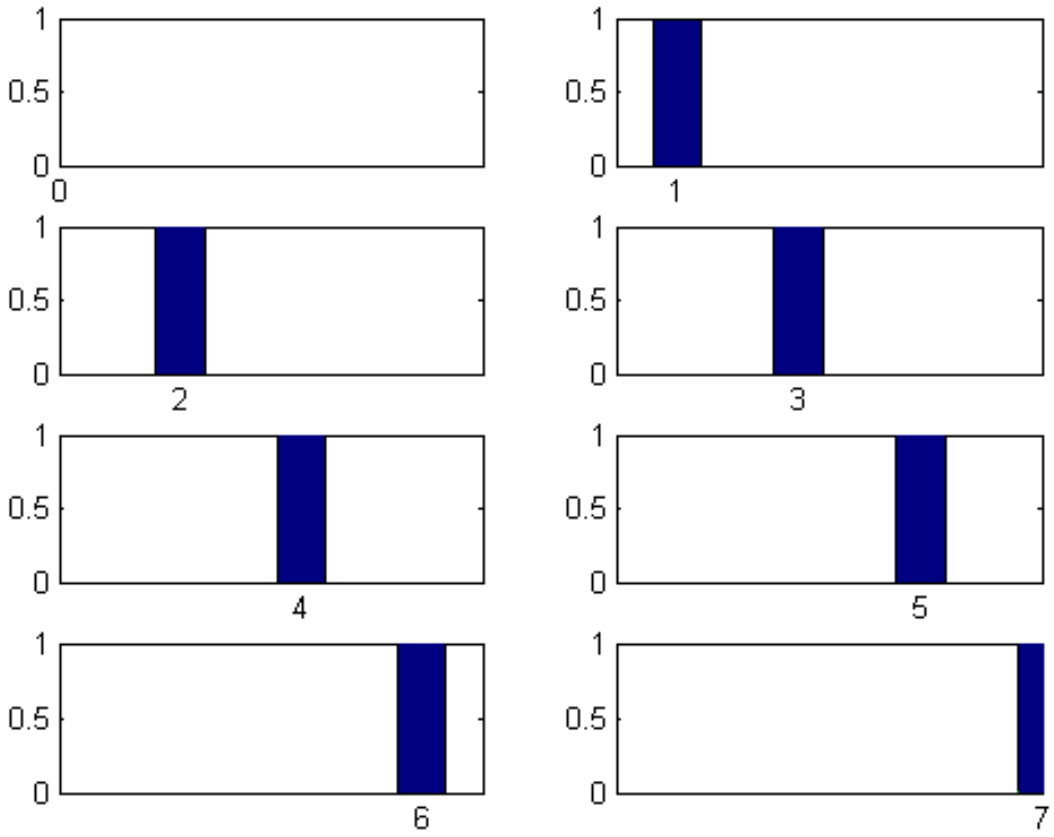
$$\alpha(u)=\sqrt{\left(\frac{2}{N}\right)}, u\neq 0$$

Independent Functions

- What does it mean for a set of functions to be independent?

- How can we represent a set of points as a summation of functions?

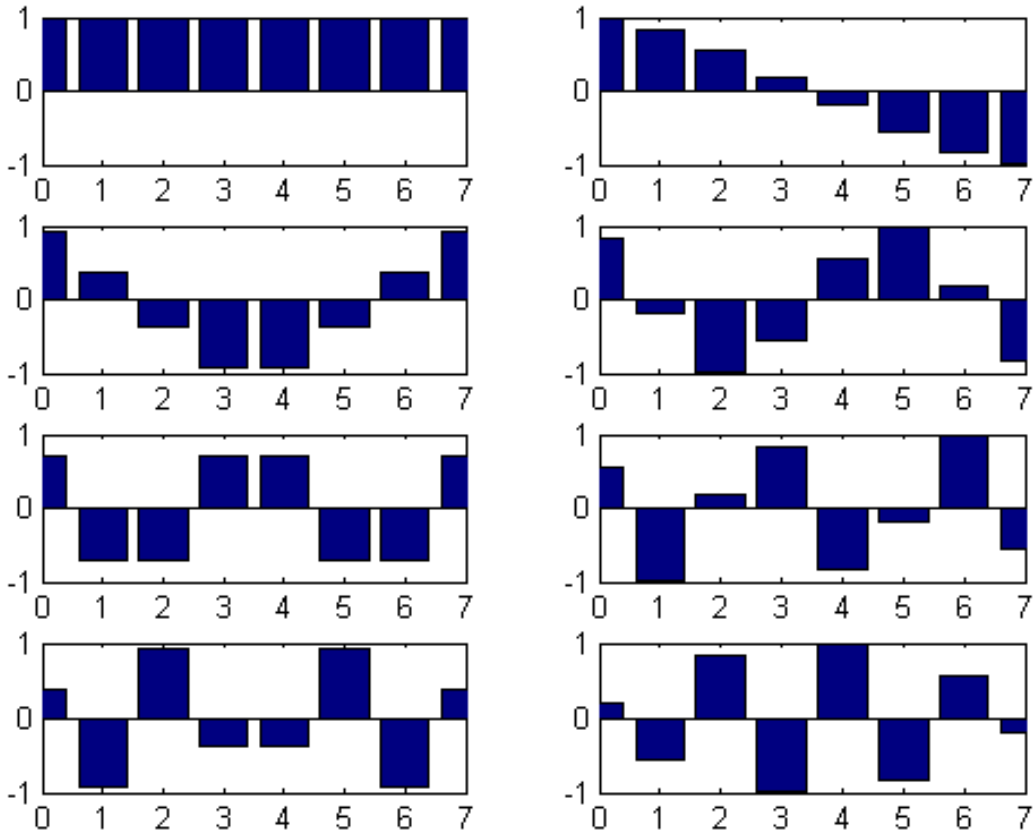
Example Basis Functions



Basis Functions

- Make a set of eight basis functions.
- No function can be a representation of any combination of the others.

Cosine Basis Functions



Discussion Points

- What happens if I just delete the last coefficient of the DCT? What would happen to our set of data points if we transformed back?

  [10 38 3 253 156 70 180 56]

- Try it with this set of eight points and see if you can get the DCT, and then perform the IDCT after setting the eighth coefficient to zero.