HW SET #7 (DUE BEFORE CLASS ON APR 7, WED)

Problem 1 (20 points) Please evaluate the shape-adaptive DCT (SA-DCT) of the following 8×8 image block

			56	50			
		80	70	40			
	40	50	77	74	43		
	21	60	70	40	50	30	
8	30	28	60	85	40		
		15	80	90			
				30			

where empty entries represent pels that are outside the object contour. Show the DCT coefficients as an 8×8 block. Note that not all the 64 coefficients will be present.

Note: The N -point DCT of $x(0), x(1), \ldots, x(N-1)$ is defined as

$$y(m) = k_m \sum_{n=0}^{N-1} \cos\left[\frac{(2n+1)mp}{2N}\right] x(n) \text{ where } k_m = \begin{cases} \sqrt{1/N} & \text{when } m = 0 \\ \sqrt{2/N} & \text{otherwise} \end{cases}$$

Problem 2 (80 points) Quantize (and dequantize) the DCT coefficients you get in Problem 1 by the stepsize Q without the dead zone, i.e., round each coefficient to the nearest multiple of Q. Apply the Inverse SA-DCT to the quantized DCT coefficients to reconstruct the pel values (with rounding to the nearest integer). For $Q = 4, 8, 16, \text{and } 32$, show the reconstructed pel values as an 8×8 block similar to the one above in Problem 1, and compute the resulting PSNR (only for pels inside the object contour).

Note: The N -point Inverse DCT of $y(0), y(1), \ldots, y(N-1)$ is defined as

$$x(n) = \sum_{m=0}^{N-1} k_m \cos\left[\frac{(2n+1)mp}{2N}\right] y(m) \text{ where } k_m = \begin{cases} \sqrt{1/N} & \text{when } m = 0 \\ \sqrt{2/N} & \text{otherwise} \end{cases}$$