

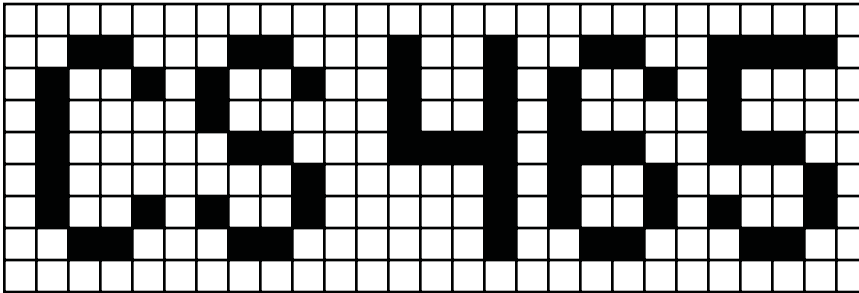
CS 465 Homework 3

(revised September 14, 2004)

out: Friday 10 September 2004
due: **Friday 17 September 2004**

Problem 4: Resampling

Consider this image:



(Treat the black pixels as 0.0 and the white pixels as 1.0.) Suppose we enlarge the image to 36 by 12 pixels (aligning the lower left-hand pixel) using each of the following filters.

1. A box of radius 0.5.
2. A tent of radius 1.
3. A B-spline filter of radius 2.

Take “radius” here to mean the distance beyond which the filter is zero.

For the box and tent filters, compute the 5 by 5 block of pixels centered at the pixel (8, 4) in the output; for the B-spline filter compute the 3 by 3 block centered at the same point. For this problem the bottom left pixel is (0,0).

Problem 5: Ripple

Suppose we take the one-dimensional constant sequence $[\dots, 1, 1, 1, \dots]$ and upsample by a factor of 5 using a tent filter. If we use radius 1.0 (call this case 1), the result is another sequence of 1's.

1. What is the result if we change the radius to 1.2 to try to get a bit more blurring? (Call this case 2.) Answer this question by computing the actual values of one repeat of the pattern.
2. Give a frequency domain analysis explaining how the result you observe in case 2 is caused by one frequency aliasing as another frequency. Your answer should also explain why it happens in case 2 but not case 1. *Hint 1: The notes have the Fourier transform of the tent filter. Hint 2: Think about the zeros of the Fourier transform.*
3. If we normalize the weights used to reconstruct each sample, what will the result be?
4. (*extra credit*) The process described in the previous part can still be expressed as a convolution filter. Give an expression for that filter, and graph it.