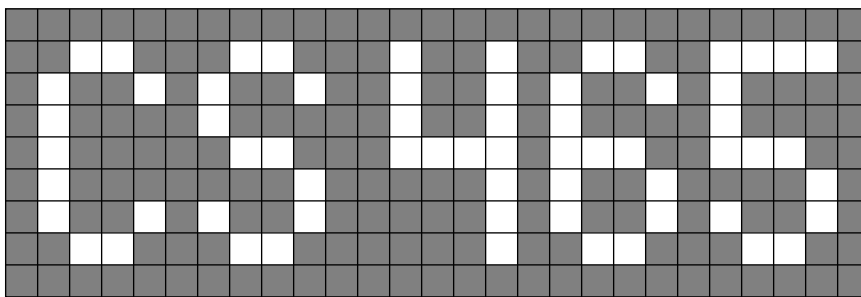


## CS 465 Homework 3: Upsampling

out: Friday 8 September 2006

**due: Friday 15 September 2006**



Suppose we enlarge this image to 63 by 21 pixels using each of the following filters.

1. A box with support radius 0.5.
2. A tent with support radius 1.
3. A Catmull-Rom filter with support radius 2.

Take “support radius” here to mean the distance from the center of the filter beyond which the filter’s value is zero. Remember that for upsampling the filter size is determined by the input grid rather than the output grid (otherwise think about what would happen if the output image was 450 by 150 pixels...).

For the box and tent filters, compute the 5 by 5 block of pixels centered at the pixel (17, 10) in the output; for the Catmull-Rom filter compute the 3 by 3 block centered at the same point. All three filters are defined in Chapter 4 of Shirley. Treat the gray pixels as 0 and the white pixels as 1.

The pixels are point samples located at the centers of the squares shown in the illustration; the boxes are just shaded in to show you the pixel values. To position the output samples relative to the input samples, keep the boundary of the grid fixed and space the output samples in the same way. Pixels are counted from zero starting at the bottom left. For example, see Figure 1; also see Shirley’s figures 4.37 and 3.1.

*Hint:* There is a lot of symmetry to take advantage of when computing filter values for this

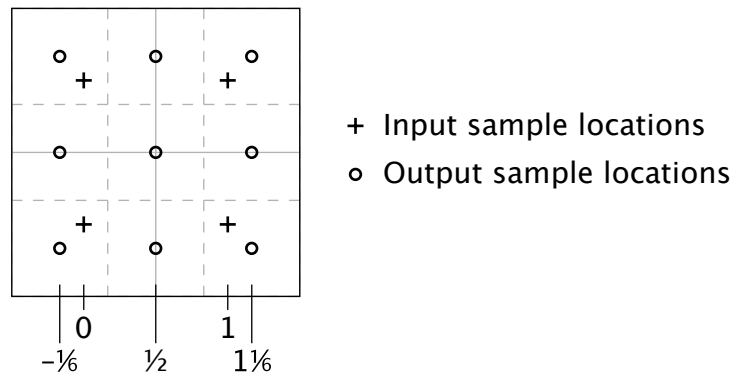


Figure 1: Sample positions for resampling a 2 by 2 image to 3 by 3 pixels.

particular neighborhood. If you don't find this to be the case, check that your output pixel grid is positioned correctly.

*Hint:* These filters are all separable.

*Hint:* Convolution with a tent filter is equivalent to linear interpolation.

If you take advantage of the hints, you do not need to do a lot of computation for this problem.