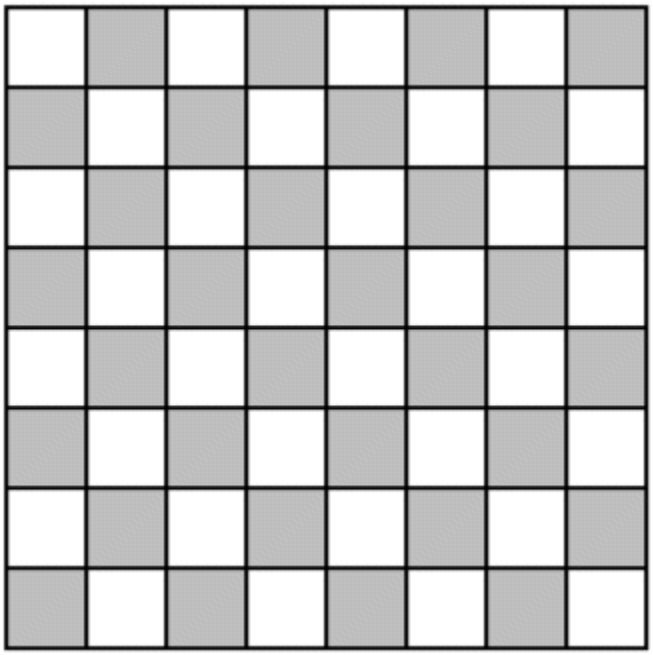
CS 498VR: Virtual Reality
In-class Worksheet: Texture Coordinates and Filtering

1. Magnification

Suppose we have the following 8x8 texture of greyscale values



- Texel (0,0) is located in the lower left hand corner.
- White texels have RGB values of (1,1,1)
- Grey texels have RGB values of (0.5, 0.5, 0.5)

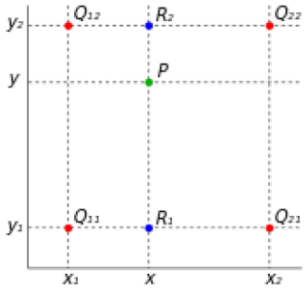
Suppose a fragment has (u,v) texture coordinates of (3/4, 19/32).

a. What fragment color is generated using nearest neighbor?
In nearest neighbor filtering you sample the texel (s,t):

$s = \text{round}(u \times width - 1/2)$ $\quad$ $t = \text{round}(v \times height - 1/2)$

with both u and v constrained to be in [0,1)

b. What fragment color is generated for T(5 ½, 4 ¼) using bilinear filtering? Recall that bilinear filtering takes the following form:



$$f(x, y_1) \approx \frac{x_2 - x}{x_2 - x_1} f(Q_{11}) + \frac{x - x_1}{x_2 - x_1} f(Q_{21}),$$

$$f(x, y_2) \approx \frac{x_2 - x}{x_2 - x_1} f(Q_{12}) + \frac{x - x_1}{x_2 - x_1} f(Q_{22}).$$

$$'(x, y) \approx \frac{y_2 - y}{y_2 - y_1} f(x, y_1) + \frac{y - y_1}{y_2 - y_1} f(x, y_2)$$

2. Minification

Create a mipmap for the greyscale texture shown here.

0.5	0.5	0.0	1.0
0.0	0.0	1.0	1.0
1.0	0.5	0.25	0.25
1.0	0.5	0.25	0.25

3. Size

If the original texture requires A bytes of storage, find an upper bound on how much space the mipmaps will require in terms of A. You may want to recall that for a number r where 0 < r < 1 we have

$$1 + r + r^2 + r^3 + \cdots = \frac{1}{1 - r},$$