Quasi-Random Sequences

1. What are the first two points generated by the 2-dimensional Hammersley Sequence $p_i = (\frac{i}{n}, \Phi_2(i))$ when we generate a set containing 10 points?

   $p_1 = \left( \frac{1}{10}, \frac{1}{2} \right)$
   $p_2 = \left( \frac{1}{5}, \frac{1}{4} \right)$

2. What are the first two points generated by the 2,3 Halton Sequence $p_i = (\Phi_2(i), \Phi_3(i))$?

   $p_1 = \left( \frac{1}{2}, \frac{1}{3} \right)$
   $p_2 = \left( \frac{1}{4}, 2/3 \right)$

   $\Phi_3(1) = 0.1 = 1 (3') = 1/3$

   $2.0 \Rightarrow 0.2 \Rightarrow 0.2 \cdot 3 = 2/3$
Filters

In ray-tracing, a filter will generate a value for a given pixel by taking a weighted average of samples around that pixel center. The weights used are usually generated by a function $w(d_i)$ of the distance $d_i$ from a sample location to the pixel-center: $p = \frac{\sum w(d_i)s(x_i,y_i)}{\sum w(d_i)}$

3. Suppose we use the following weight function:
\[ w(x,y) = \frac{1}{n} \text{ when filtering using } n \text{ samples.} \]
How would you categorize the filter?
- Box Filter
- Tent Filter
- Cubic Filter
- Gaussian Filter

Intersections

4. Derive a formula for intersecting a ray and a parabolic cylinder given by $x^2 = 4y$.
\[ x^2 - 4y = 0 \]
\[ (0_x + t_d_x)^2 - 4 \left( 0_y + t_d_y \right) = 0 \]
\[ 0_x^2 + 20_x d_x + t^2 d_x^2 - 40_y - 4t d_y = 0 \]