Lecture 5: Signal processing – Review Questions

- Refer to Figure 4.1 of the Shirley text. What is the purpose of the lowpass filters? What would happen if we left the first one out? If we left the second one out?

- What is convolution? What does it mean to convolve a signal with a filter? For a 1D signal S = [1, 2, 1, 9, 1, 1] and a filter f = [⅓, ⅓, ⅓], compute the convolution S⋆f:

- What is the role of a sampling filter? What is the role of a reconstruction filter? Why would the Gaussian not be a very good choice as a reconstruction filter?

- What is a frequency domain representation of an image? How can one implement a low-pass filter in the frequency domain? A high-pass filter?.

- What is the convolution theorem? (Hint: this theorem relates multiplication in the spatial domain to convolution in the frequency domain and vice versa.)

- What is aliasing, and why does it have that name? You should use a frequency domain argument to answer this question. Draw a figure to illustrate your point.

- A theoretically ideal filter is the sinc filter. Explain why this filter prevents aliasing. Use a frequency domain argument and draw figures to illustrate your point.

- Given that the sinc function is ideal, why do we work with box, tent, cubic, and Gaussian filters? Give at least two practical difficulties associated with the sinc filter.

- Image manipulation packages like Photoshop have a "sharpen" feature, also known as "unsharp masking". How is it implemented? Why does it work?