**Image Processing**

**Homework 1**

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**Question 1:**

**Section A:**

**There are a bunch of factors to take in mind, to mention some:**

1. **Sensor Size: the bigger the sensor the more pixels it can fit without compromising the image quality.**
2. **Processing power: higher resolution requires more processing power and faster processing for image capturing and rendering.**
3. **Storage capacity: the higher the resolution the larger the file size is, therefore it requires more storage.**
4. **Editing and compression: high resolutions require efficient algorithms for compression and post-processing.**
5. **Application: the need for a specific case dictates the requirements, for example if you are a professional photographer then you might need a better resolution than a person with a normal use for the camera.**

**Section B:**

**The strength of image quantization involves several considerations:**

1. **Bit count: older hardware supported fewer bits per pixel, therefore limiting the color representation.**
2. **Memory constraints: lower quantization reduces storage and processing requirements.**
3. **Processing power: limited computational capacity required simpler quantization to reduce rendering time.**
4. **Data transfer rates: lower quantization minimized data transfer overheads for slower connections.**

**Question 2:**

**Section a:**

**As we saw in the tutorial, the wave length is dependent on the frequency, and it is 1/f, where f is the frequency. Now in our case, we are given the function Sin(πkx). Recall tutorial 1 where we saw the k is the value of the frequency of the wave, therefore, in our case the frequency is k/2, and when we substitute in the equation we get: lambda = 1/ k /2 🡪 lambda = 2/k.**

**Section b:**

**According to Nyquist, in order to reconstruct the image, the sampling frequency much be twice the frequency of the signal. We inferred from the last section that the sampling frequency is k/n (since lambda = 1/f = 2/k), and also we can infer from the image that there is an alternation between white and black bars and each bar has the width of A, therefore the sampling frequency is 1/2A.**

**As we mentioned before, we need the sampling frequency to be greater than twice the signal frequency, meaning that: 1/2A >= k.**

**Now for case 1 where A = 0.25, we get: k<=2 and since k can’t be less than 0 therefore k should be between 0 and 2 (including).**

**As for case 2 where A = 2, we get k<=0.25 and similar to before k can’t be less than 0 therefore k should be between 0 and 0.25.**