EMPAC and Signals Proof of Concept

You will answer the following questions in detail in place of concepts #5 and #6 in Lab03. You will still need to submit proofs of concept for concepts #1 - #4.

1. Explain the difference between analog and digital signals. What types of signals exist naturally in our world: analog or digital?
2. Audio and images (and videos too, which are time-dependent images) are signals. Explain how they are both signals, but different types of signals. What does the data for each type of signal represent? In which domain are these signals typically recorded? (Hint: audio signals are recorded vs. time. What about images?)
3. Name some examples of signal processing. Why do we want to manipulate or modify signals?
4. Signal processing often involves working with signals in the frequency domain. Explain how signals are *transformed* into the frequency domain and why it is often beneficial to work with signals in the frequency domain. (Hint: take a look at the Fourier Transform and Fourier Series/Fourier Analysis and Fourier Synthesis).
5. Explain what frequency means in the context of both audio signals and images.
6. What does filtering an audio signal mean? How is the filtered signal different from the original signal? What does filtering an image mean? How is the filtered image different from the original?
7. How is signal processing used at EMPAC? Relate one of your applications from question #3 to something you saw on your tour of EMPAC.
8. Write a Plus, Delta, Kaizen (see Metacognition for definitions) for your EMPAC experience
9. Don't understand something? Want to know more? Make sure to fill out your Exploration Map

You will be graded according to the rubric below. Note that you still need to complete and submit Lab03 Proofs of Concept #1 - #4.

Lab03 EMPAC & Signals Proof of Concept Standards [Replaces #5 and #6 in Lab03]

1. **I can explain the following concepts:**
   - **The difference between analog and digital signals and which types of signals exist naturally in our world**
   - **How audio and video are both types of signals and which domains they are recorded in**
2. **I can answer the following questions:**
   - **What are some examples of signal processing applications?**
   - **Why do we want to manipulate or modify signals?**
3. **I can answer the following questions:**
   - **How are signals transformed from the time domain into the frequency domain?**
   - **What does frequency mean for time-domain signals and images?**
4. **I can answer the following questions:**
   - **What does filtering an audio signal mean? How is the filtered signal different from the original?**
   - **What does filtering an image mean? How is the filtered signal different from the original?**
5. **I can answer the following questions:**
   - **How is signal processing used at EMPAC?**
   - **How is the way signal processing is used at EMPAC related to one of the example applications you named?**
6. **Metacognition journal entry complete.**

EMPAC and Signals Presentation Requirements

Your presentation should contain sufficiently detailed answers to the following questions. This is how your presentation will be graded.

1. What different kinds of signals are there? Illustrate the differences between analog and digital signals and the difference between audio signals, images, and videos. Be sure to mention which variables audio signals, images, and videos are usually plotted against/viewed with respect to. What does frequency mean for each of these signals?
2. How can we change signals with signal processing and why would we want to? Show/discuss some examples of signal processing of audio signals, images, and videos.
3. Illustrate/explain how Fourier Series and Fourier Analysis work conceptually. Try to explain it in a way that makes most sense to you.
4. One common signal processing procedure is filtering. Illustrate the effect of filtering an audio signal and an image. Why would we want to filter these signals?
5. Choose something related to signal processing that you encountered on your EMPAC tour. Explain how it's related to or based on signal processing and why it's important at EMPAC.
6. What did you encounter that you didn't understand? List phrases, words, concepts, etc. that you came across during your EMPAC & signals exploration that you don't understand. You don't have to define them, but we want to see how far you explored and where you got stuck.

Your presentation will be graded according to the rubric below. Where the standard indicates that you should illustrate a concept, a graphical or mathematical representation should be included.

Lab03 EMPAC & Signals Presentation Standards

1. **I can illustrate the difference between analog and digital signals.**
2. **I can explain the difference between audio, image, and video signals and state the domain for each of the types of signals.**
3. **I can explain what "frequency" means for each type of signal.**
4. **I can explain how signals are changed via signal processing and why that can be advantageous in general.**
5. **I can illustrate examples of audio, image, and video processing and discuss them.**
6. **I can illustrate and explain how Fourier Series and Fourier Analysis work on a conceptual level.**
7. **I can illustrate the effect of filtering an audio and image signal and discuss why that can be advantageous in those specific cases.**
8. **I can explain how something I saw at EMPAC relates to signal processing and why it is important to what EMPAC does.**
9. **I can mention and discuss concepts that I didn't understand while exploring signal processing.**