ISTA 352

Lecture 2

What is an image?

Administrivia

Schedule PDF updated yesterday

HW1 still working on it.

Poll on TA office hours:
How about Tuesday and/or Thursday 3-4?

Review of proposed demo times for Thanksgiving week.
Monday 2:30-3:15
Tuesday 11-11:45
Wednesday 11-12:30 (two sessions)

What is an image?

There are a wide range of "kinds" of images. Can we make a good a list?

Within all the "things" we are happy calling images, is there a common theme?

Can we define concisely what an image is?

Can we specify attributes so that we can declare that something is an image or not?

Does light need to be involved? A physical scene? A viewer? (If a tree falls ...)

What does the mystery image demo tell us?

- If we mix up image data, we loose the essence
- Images are data where spatial coordinates matter
  - Contrast list of facts
  - Contrast recorded sound
- Two very concise definitions
  - An image is spatial data
  - An image is a spatial message

If you have forgotten what the mystery image demo was, see the movie file pointed to on the web page.

Quick aside on histogram representations

- Note that the mixed up image has the same histogram as the original.....

What does the random image demo say?

- The images you see (care to see) are very special
- There are very few of them in vast sea of possibilities

If you have forgotten what the randome image demo was, see the movie file pointed to on the web page.

What does the defective modem demo tell us?

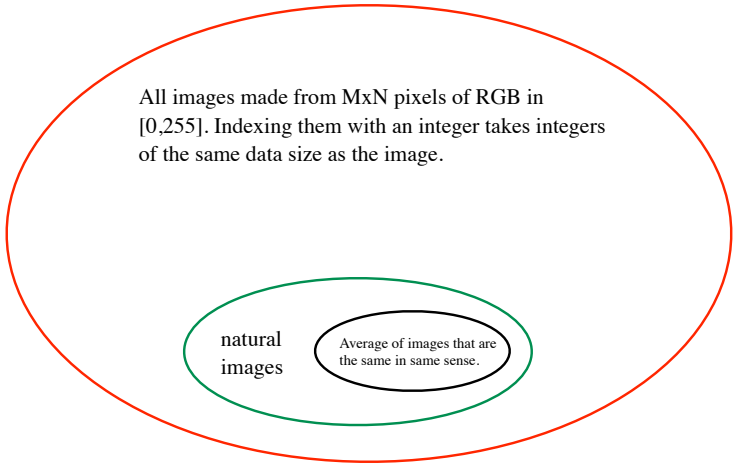
- A natural image is redundant
- You can predict what the defective modem did not send from rest of the data
  - The nearby parts are most useful.
  - Image data has spatial locality
- Based on this, which image will compress better?
  - 1) Kobus's photo
  - 2) The dumb graphics artist's invention

What does the defective modem demo tell us?

- A natural image is redundant
- You can predict what the defective modem did not send from rest of the data
  - The nearby parts are most useful.
  - Image data has spatial locality
- If we can predict the data from a smaller dataset, we can compress it
- The random image has the higher entropy (more information)
  - Recall that information theory does not tell you about the value or semantics of the message, just how expensive it is to transmit.

Quick hand wave about entropy

- Consider the example of an oracle telling us what a coin flip result would be, compared to a roll of a die, compared to which lottery number would be drawn.
- This suggests that (perhaps paradoxically) the random image carries more information content than (say) one of Kobus's photographs which is a random draw with far fewer outcomes.
- Technically, a sequence of random images has higher entropy than a sequence of photos which corresponds to more bandwidth needed to transfer the data faithfully.



Each ellipse is vastly smaller than the one that contains it!

Image types

- The canonical image example that we will study a lot is the world plus light sensor (camera or eyes)
- Another obvious example is a created image within a meaning system (visual art, a figure in a research paper).
- Another example is an ultrasound "image"
- Another example is whatever representation bats have for their surroundings
- Given the last two examples, it is clear that light does not need to be involved.

Image essence

- The information is spatial (two or more dimensions).
  - It is different than a list of facts
  - It is different than a linear sequence
- Natural images are special.
  - To be a worthy message, they have to be particular.
  - A random draw from a probability distribution is not special
- Any meaningful representation of spatial information can be considered an image.
- Light carries spatial information, and sensor arrays are efficient at recording it, but the concept of images is much broader than a digital photograph.