

Image Processing

HI 5323 Final Exam

Date:

Name:

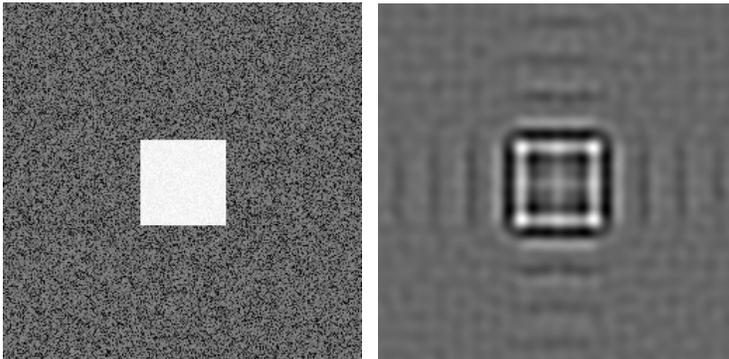
Problem 1: Which one of the following characterizations of noise is correct?

- noise is always structured
- noise is always random
- when averaging enough images, the ensemble mean approaches the original signal

Problem 2: Which of the following are *sharpening* operations:

- unsharp masking
- high-pass filtering
- deconvolution
- all of the above

Problem 3: What filter was applied to the left image to give the result on the right?



- low-pass filter
- band-pass filter
- high-pass filter

Problem 4: We sample an image below the Nyquist rate. What causes *aliasing*?

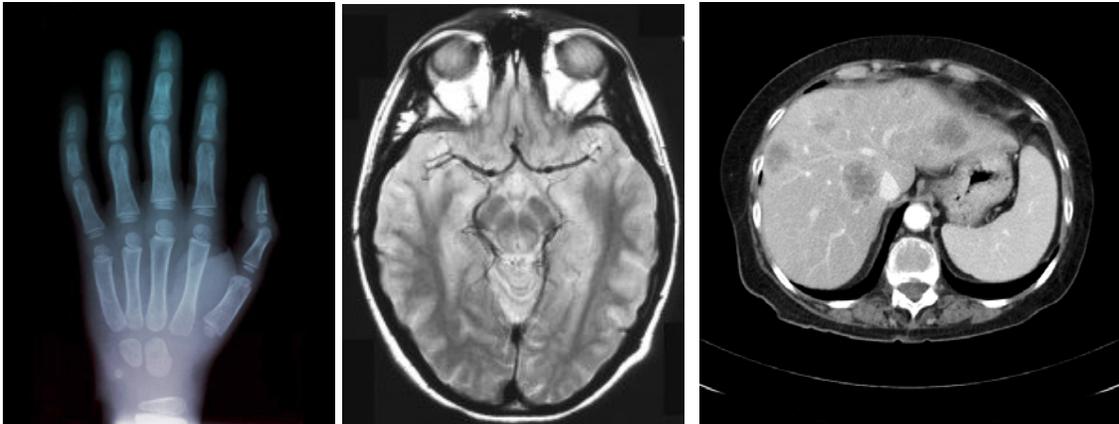
- high frequencies in the original image masquerading as low frequencies
- low frequencies in the original image masquerading as high frequencies
- finite extent clipping of the sinc function in reconstruction

Problem 5: How is the limiting Nyquist sampling rate $1/h$ defined?

- half the frequency of the highest frequency in the image
- the frequency of the highest frequency in the image
- twice the frequency of the highest frequency in the image

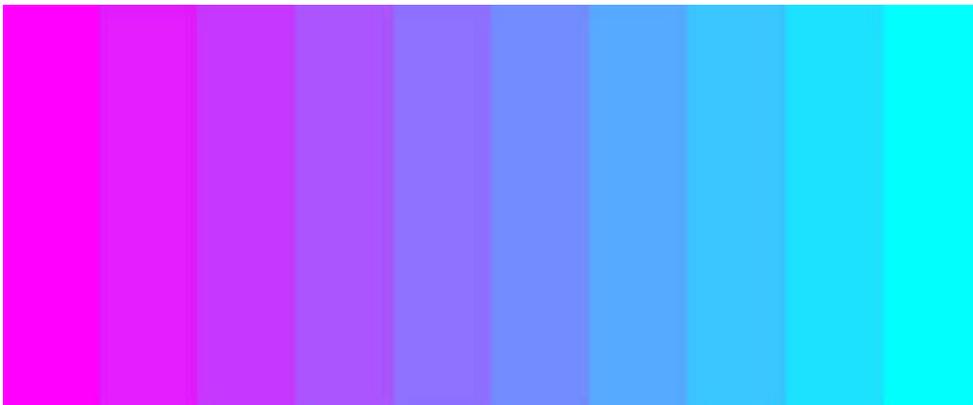
Problem 6: Which of the following medical imaging method does not correspond to the shown images (from left to right):

- x-ray
- magnetic resonance imaging
- ultrasound



Problem 7: The perceived striping at color boundaries in the following image is called?

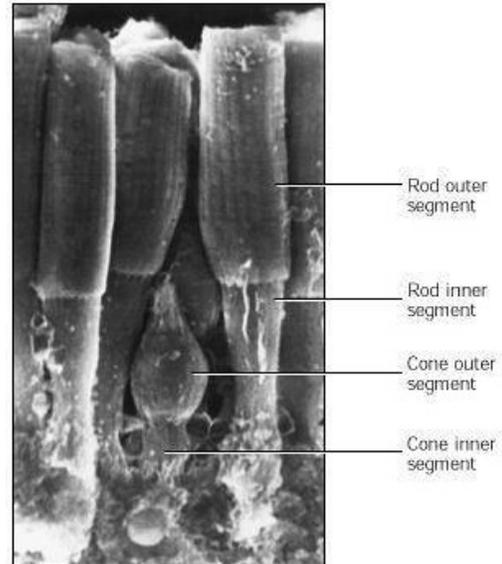
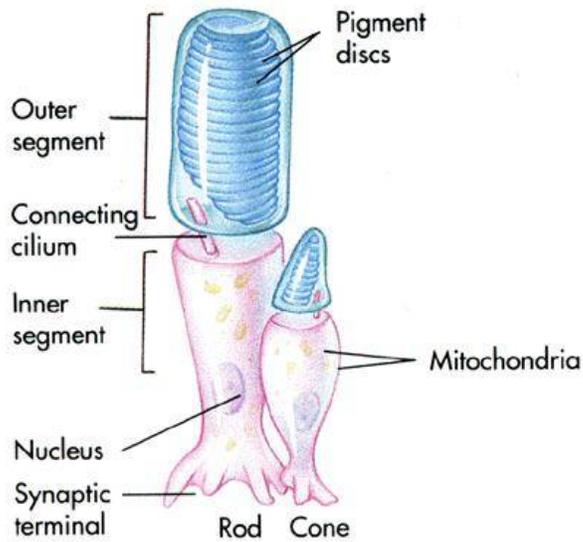
- contrast encoding
- Mach effect
- pseudo color



Problem 8: What is the approximate wavelength range of visible light?

- 400 to 700 nm
- 700 to 4000 nm
- 4000 to 7000 nm

Problem 9: Explain in your own words (2-3 sentences) how a retinal photoreceptor works (use space below).

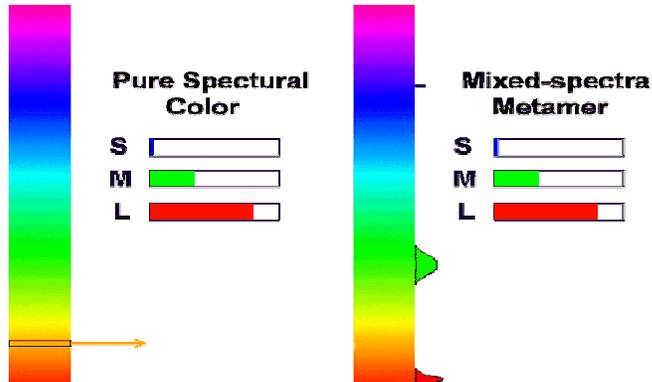


- Outer segments contain the photopigment rhodopsin
- Light absorption induces conformational changes in rhodopsin
- Second messenger cascade (reduced cGMP concentration)
- Closing of cation channels leads to hyperpolarization of photoreceptor
- Receptor currents evoked by decreased neurotransmitter at synaptic terminals

Problem 10: Which of the following is correct:

- O cones are more sensitive than rods
- X rods measure light intensity
- O cone density increases with distance from fovea

Problem 11: Explain (in 1-2 sentences using the following diagram) how it is possible that two light sources may have different spectra, yet they appear to us as identical colors:



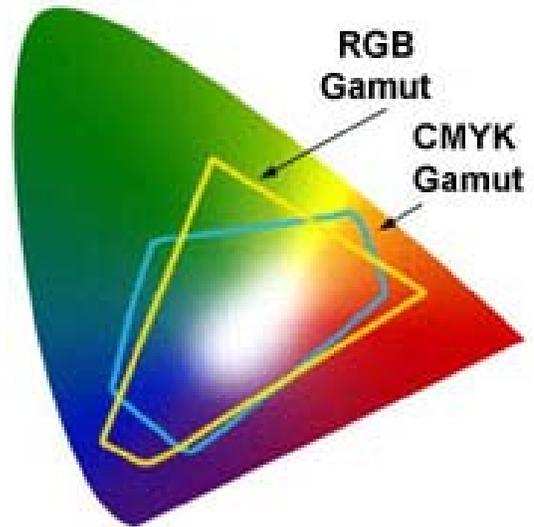
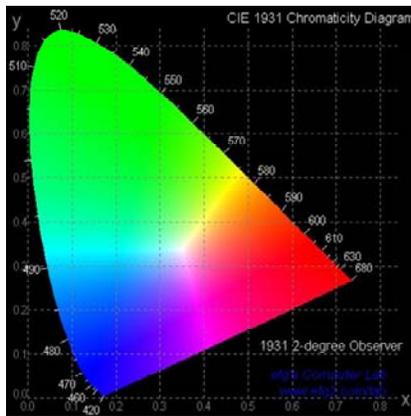
We have only 3 types of cones (SML) that encode color information, therefore any combination of light frequencies that excite the three cones exactly the same way (depending on their sensitivity curve) leads to the same perception of color.

Problem 12: Which terms refer to the *light-dark properties* of an image?

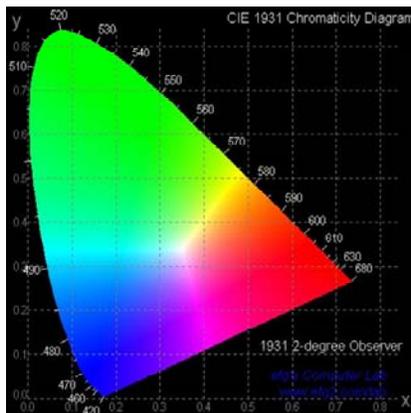
- luminance
- intensity
- lightness
- brightness
- value
- all of the above

Problem 13: Sketch the RGB and CMY gamuts in the following CIE diagrams

The CIE Chromaticity Diagram

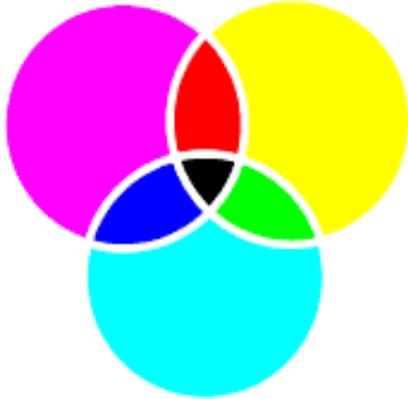


The CIE Chromaticity Diagram



Problem 14: Which color mixing scheme is used here?

- additive
- subtractive



Problem 15: Feed forward neural networks use:

- supervised learning
- unsupervised learning

Problem 16: How many *hidden* layers are required in feed forward networks to approximate a regular function:

- one
- two
- three

Problem 17: Which of the following properties is not used in recurrent networks?

- multi-directional information flow
- continuous input space
- sense of time and memory

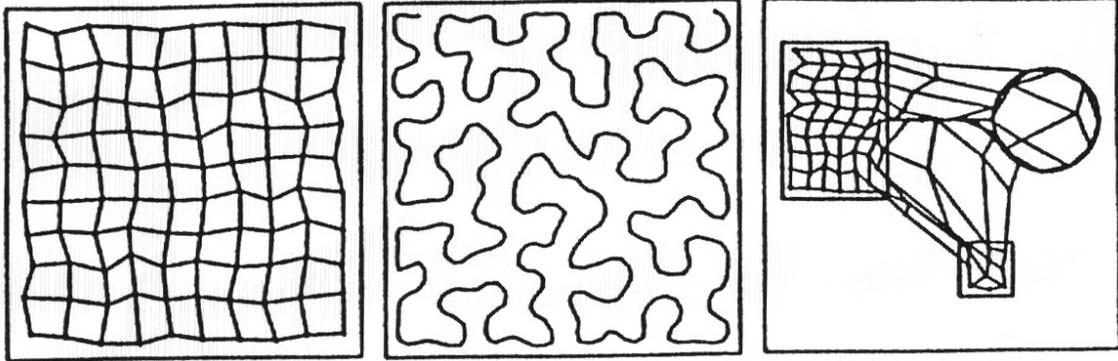
Problem 18: Which of the following criteria is most effective for color quantization?

- color popularity
- median cut
- k-means

Problem 19: Which yields the statistically most reproducible vector quantization?

- Kohonen self-organizing map
- neural gas
- k-means

Problem 20: What is going on in these images of Kohonen networks mapped into the input signal space? Explain in your own words the change from (a) to (b) and from (a) to (c).



(a)

(b)

(c)

(b) one-dimensional output space

(c) inhomogeneous distribution of input signals