ECE 253a	Digital Image Processing	Handout #1	Pamela Cosman	9/26/08

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Course Requirements and Grading

6 Homeworks/Lab Exercises	30%
Midterm Exam	25%
Final Exam	45%

Note there will be no class on Wednesday October 1.
The exams will be in class, open book and open notes

Text: *Digital Image Processing* by Gonzalez and Woods. 3rd edition, Prentice Hall, 2008

Prerequisites: Familiarity with Unix and Matlab (or willingness to learn!) Basic knowledge of linear algebra, linear systems, Fourier Transforms. Read Chapter 1 in the textbook for a general overview of image processing.

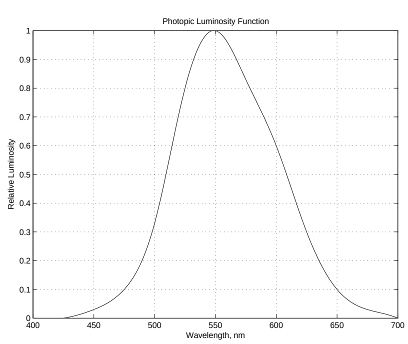
Course Content:

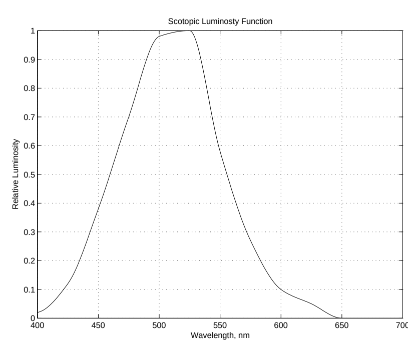
Topic	# lectures	Pages
Human visual perception	1	35–46, 52–65
Processing of binary images	3	68–70, 627–664
Contrast enhancement	2	105–144
Noise removal, edge sharpening	2	144–172, 311–329
Color coordinate systems, color image enhancement	3	394–442
Image Registration	4	87–92
2D sampling and interpolation	2	65–68
Lossless image coding	2	525–566
Transform and predictive coding, JPEG	5	566–614
Motion compensation, MPEG	2	589–596

Radiometric and Photometric Quantities and Units

from *Digital Pictures* by Netravali and Haskell, and *Digital Image Processing* by Pratt

Radiometry	is concerned with physical intensity measurements of electromagnetic energy.
Photometry	seeks to quantitatively describe the perceptual brightness of visible electromagnetic energy.
Radiant energy, Q,	is the energy propagating in the form of electromagnetic radiation and is measured in **joules**.
Radiant flux, Φ	is the radiant power or time rate of flow of radiant energy, and is measured in **Watts = Joules / sec**.
Radiant exitance, M,	is the density of radiant flux, measured in **Watts / meter**^{2}.
Irradiance, E	is a restricted case of exitance and denotes density of radiant flux incident on a surface.
Radiant intensity, I	is the radiant flux per unit solid angle in a given direction. It is measured in **Watts / steradian**.
Radiance, L	is the radiant flux per unit of projected area and per unit solid angle either leaving a point in a given direction, or arriving at a given point in a given direction. Its unit is **Watts / steradian-m**^{2}.
Relative luminous efficiency	$y(\lambda)$ specifies the spectral sensitivity of the human visual system to optical radiation as a function of wavelength for a typical person ("standard observer"). $y(\lambda)$ is dimensionless.





Luminous flux is a measure of the capacity of radiant flux to create a sensation of light. This is evaluated by multiplying by $y(\lambda)$ and integrating over the visible spectrum:

$$\Phi_v = \int_{380}^{780} \Phi(\lambda) y(\lambda) d\lambda$$

Φ_v can be measured in **watts**, or in **lumens** by using the scaling constant k_m = 680 lumens / Watt.

Luminous intensity, I_v is visible radiant intensity, and is given by

$$I_v = k_m \int_{380}^{780} I(\lambda) y(\lambda) d\lambda \qquad \text{in } \textbf{candelas}$$

Luminance, L_v (visible radiance) is the luminous intensity per unit projected area, and is given by

$$L_v = k_m \int_{380}^{780} L(\lambda) y(\lambda) d\lambda \qquad \text{in } \textbf{candelas / m}^2$$

Luminance is directional and determines the ability of a luminous object to produce an effect at a given point in space.

Luminous energy, Q_v or the quantity of light, is measured in **lumen-seconds**, also called **talbots**.

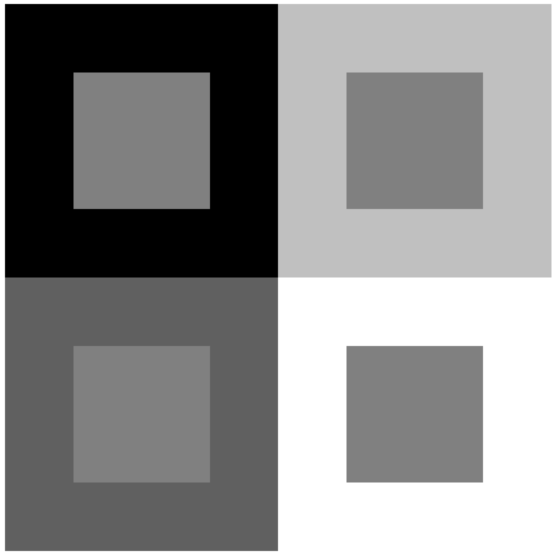
Illumination, $E(\lambda)$ is the density of luminous flux incident upon a surface. It is measured in **lux** = lumens / m^2 or in foot candles = lumens / ft^2.

Luminous exitance is the density of luminous flux emitted from a surface with no regard to direction. A common unit for it is the **lambert** = lumens / cm^2.

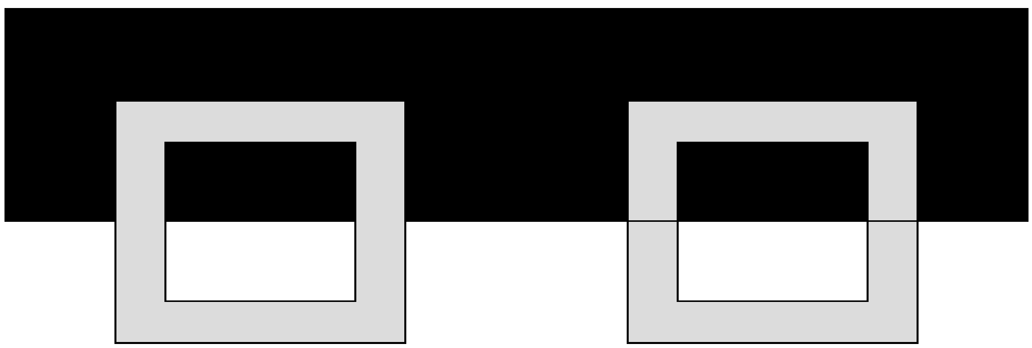
Brightness is a psychological term, referring to perceived luminance. It is a subjective descriptor.

Many of the terms above can be used for self-luminous sources, or for light reflected from an object, or for light transmitted through some translucent object. $r(\lambda)$ and $t(\lambda)$ are used to denote the wavelength dependent *reflectivity* and *transmissivity*.

Simultaneous contrast



The Benussi ring



Mach bands