Human Vision System

- Cones – colour
- Rods – intensity
- High intensity range – 10^{10}, achieved by sensitivity adaption
- Logarithmic sensitivity to light

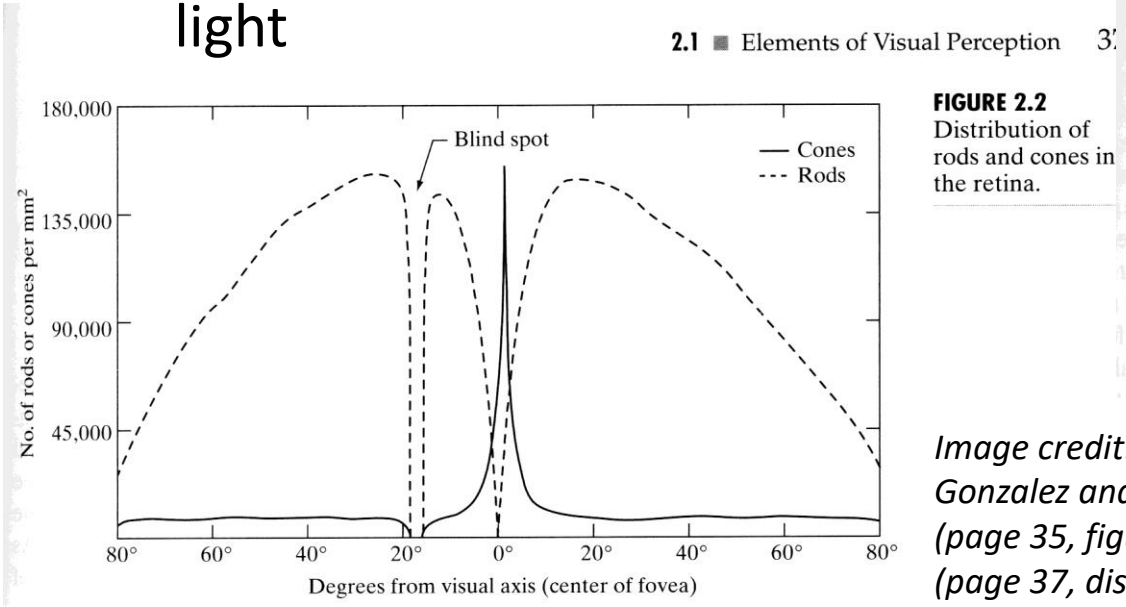


FIGURE 2.2 Distribution of rods and cones in the retina.

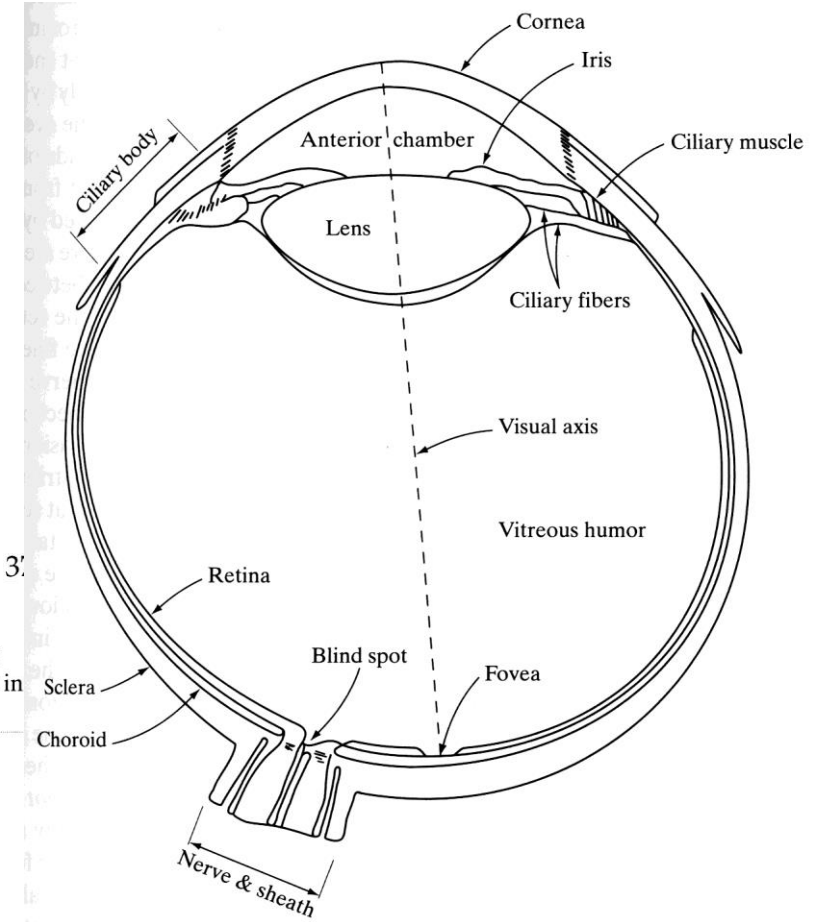


Image credit: Digital Image Processing 2nd Edition, Rafael Gonzalez and Richard Woods, Prentice Hall, 2002, Chapter 2, (page 35, figure of cross section from human eye from), (page 37, distribution of rods and cones in the retina)

Distributing Intensity Levels

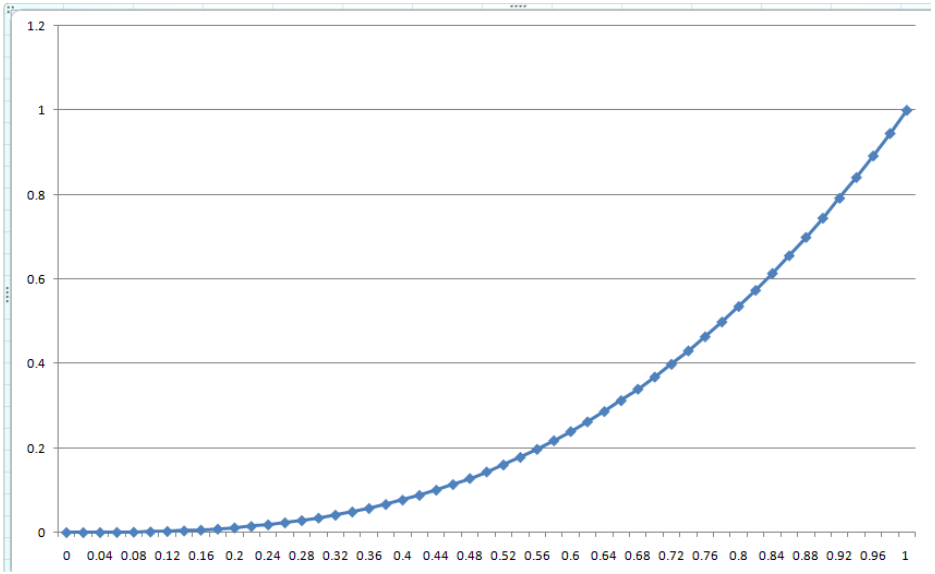
- Logarithmic sensitivity – e.g. perceived brightness increase of 20w-22w is same as 100w-110w
- Ratio important (in above example r=1.1)
- To display n+1 intensity levels (I_0-I_n) we should have: $I_1/I_0=I_2/I_1=...=I_n/I_{n-1}=r$ (the ratios, r, of each successive intensity are equal)
- Therefore, $I_k=r^kI_0$ and since $I_n=1.0$, $r=(1.0/I_0)^{1/n}$

Distributing Intensity Levels

- e.g. (from book)
- For 3 levels, and $l_0=1/8$, r=2
- $l_1=rl_0=1/4$
- $l_2=r^2l_0=1/2$
- $l_3=1.0$

Gamma Correction

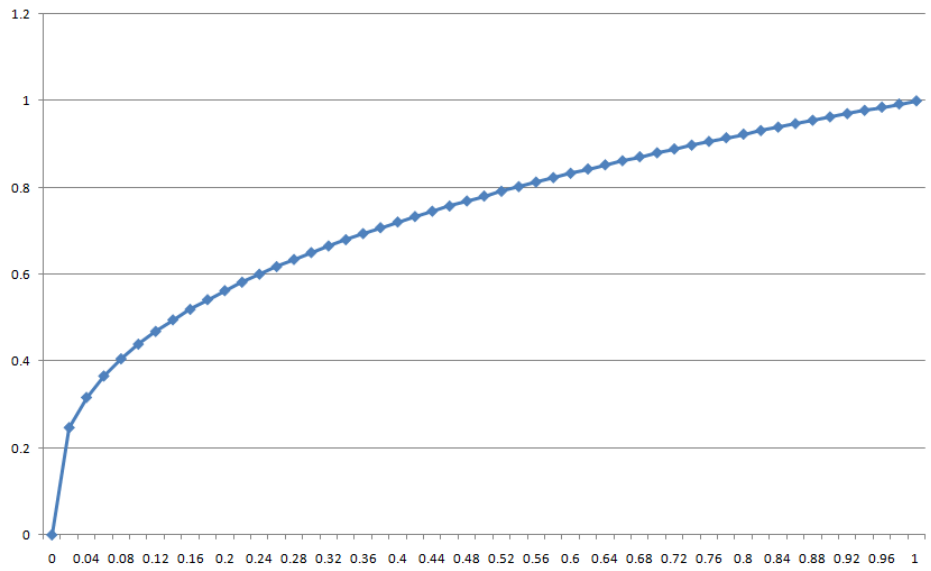
- Monitor response curve:
- $I=aV^{\gamma}$
- e.g. PAL specification has gamma=2.8



- RGB=(64, 64, 64) should be half the intensity of (128, 128, 128), but under PAL is not.
- Need gamma correction

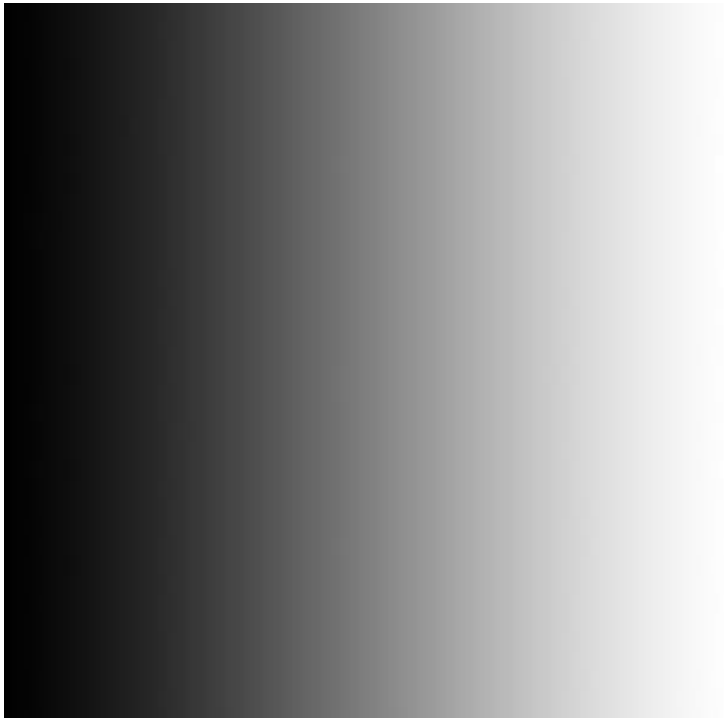
Gamma Correction Equation

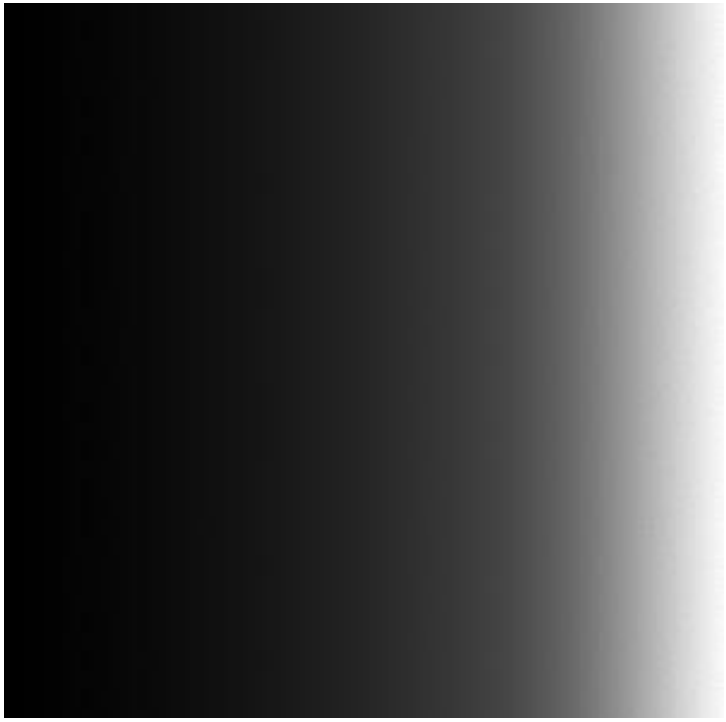
- $V=(I/a)^{1/\gamma}$ (assume a=1 for this course)
- Implementation: divide pixel by 255 (get I, a number between 0 and 1)



- Find power(I, 1.0/gamma)
- Multiply by 255 to get new intensity
- (Do for each colour channel, for each pixel)

Example





- Input: Grey Scale
- Monitor displays
- This matches gamma=2.8, so correct with gamma=2.8 (i.e. $I=V^{1/2.8}$)

Further Reading

- https://en.wikipedia.org/wiki/Gamma_correction