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**Bayesian models for scene-level Adelson illusion**

Introduction:

Can we model an optical illusion using Bayesian probabilistic programming? If so, would we then be able to create new illusions using the same mechanism? If these are possible, we could generate a program that effectively models human cognition of optical illusions. Ideally, this would then be able to run backwards and create new illusions that puzzle people. This would allow people to understand what they are seeing and why they are seeing it. A cognitive model of illusions can be a step to modeling more of our visual system. A better grasp on computer modeling of a human system is important to artificial intelligence research.

We will be using grayscale images throughout this project. To determine the difference between various shades of gray, we will be using pixel values. Pixel values are numbers 0 to 255 that represent the brightness of each given pixel. Zero represents the darkest black and 255 is the brightest white. The terms reflectance, illumination, and luminance will also be used frequently throughout the project. Reflectance, the proportion of light that is reflected off a surface, is the perceived color and what we see in our brain. We can also think of it as what we believe the pixel value to be. Illumination is how much light we perceive to be cast on the picture. We are treating luminance, the intensity of light emitted from a surface, as the actual pixel value of a pixel. Luminance will be understood as the product of illumination and reflectance.

Background:

The visual system is one of the most astonishing systems in human bodies with its power to process and interpret the information from physical light to a contextual representation of the surrounding world. However, it can sometimes be too elaborate and leave room for confusion from carefully designed illusions. The checker shadow illusion, discovered by Edward H. Adelson of MIT, is famous for using a shadow to trick the brain into thinking two of the same shaded squares are very differently colored. Often, we would utilize the information from shadows to make inferences of related properties automatically. This illusion provides insight into how the brain fills in missing or ambiguous information by shadows or information from neighbors, where both of them perform as a form of context. The Simultaneous Contrast Illusion also uses context to trick our minds. The varying background luminescence makes the inscribed shapes appear darker or lighter than the identical other. Adelson also determined that we cannot explain brightness with low level mechanisms because geometrical changes result in drastic changes in brightness reports. A possible way of solving this is taking images one step at a time and assessing reflectance, illumination, and transparency. We will start with grayscale illusions and eventually investigate other illusions by using grayscale as a model that can be built on in a future study. Vision research shows that perception is relative to every individual. Illusions like Adelson and Simultaneous Contrast are useful for testing how the brain perceives illumination and shading and uses them to build models to understand the environment. We think by using Bayesian modeling of grayscale illusions, we could not only shed light (no pun intended) on the underlying mechanism of brain integrating related information, but also provide an effective and generative model for making better and more illusions and to possibly explain related neural dynamics.