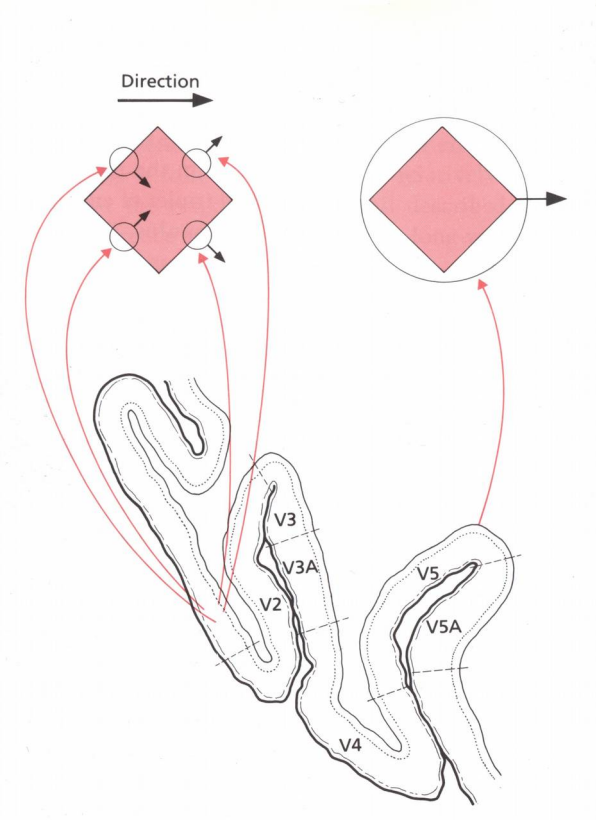
Maggie Cao

August 23, 2017

Proposal for Independent Project (CISC 4900)

The objective of the project is to create a neural network that can recognize simple 2D shapes. Image input will vary from a single image of the shape itself to a combination of these shapes. These simple shapes are rectangles, circles, squares and triangles. The neural network might be coded to account for both the implicit and explicit interpretation of these shapes. I want the neural network to learn these shapes based on how the human visual cortex (image to the right) reads images in the real world. Based on my previous research on the mechanisms in the visual cortex, the visual cortex learns from temporary and permanent memory nodes that are stored throughout the visual cortical fields spanning from V1-V5. I want to use the two specializations: V1 orientation selective and V5 motion as the foundation on guiding the neural network on how to learn the image versus just inputting the image via trial and error.



The neural network will learn based on motion and directional mechanisms of V1 and V5. For instance, as seen in the Kanizsa triangle (image to the left), the visual cortex will understand that the voided image is a triangle because the directionality of the points that form the void implies the image of a triangle. These directional points on the image visually move towards a particular location in space (up, down, right or

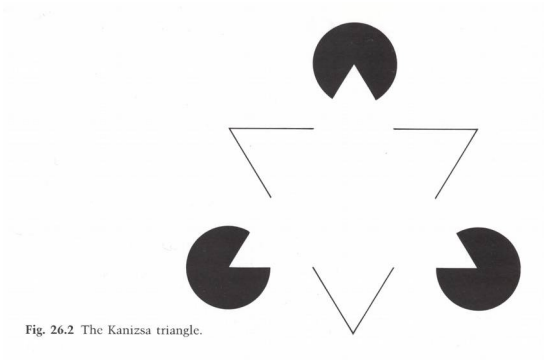


Fig. 26.2 The Kanizsa triangle.

left) so that the more points having the same directionality increases the chance of the implication of the image.

For example, a simple triangle has three points connected by three lines. The human visual cortex does not simply gather three points and three lines that are connected by these three points to conclude that the image seen is a triangle. The human visual cortex uses its specialization fields orientation selective V1 and motion V5 such that orientation selective V1 has directionality of the points to point to the upper vertex. Motion V5 organizes these points to find out the location that these directionalities are mainly pointing to, forming a line vector pointing at an angle of particular direction. By the directionalities and the implications of the motion where the line vectors are moving towards to, the visual cortex is able to conclude, based on the abstraction of the image, that the image is, or consists of a triangle.

Proposed Schedule:

1. Find the package for contemporary (multi-layered) neural network, which also deals with the probability of hidden units. Multi-layered network has built-in functions such as erasure.
2. Find biased (implicit and explicit) input image data (The definition of implicit refers to the voids of the simple shape and explicit refers the linear image of the shape itself.)
3. Understand how the neural network package will interact between the layers if this will be a multi-layered neural network. Figure out the functionality of the neural network package in terms of what the user can or cannot control (though this mainly like a computational black box experiment)
4. Input data, change the weights, etc. Train the neural network through supervised, unsupervised or reinforcement learning. If it doesn’t work, go back to step 1 (if package doesn’t fit the project) or step 2 if the input data isn’t sufficient for training.
5. Find the neural network to be the right size for the problem of learning simple shapes (not overfitting or underfitting the curve in terms of its learning statistics)