Zoo400 Quiz 5: Apr 22, 1999

NAME: _____

There is only 1 best answer per question. (1 pt each)

1. Which of the following would be a most reasonable as the 4th row of the connectivity matrix for a limulus simulation with wrap-around and no self-connectivity.

   (A) (-3,-2,-1,0,-1,-2,-3,0,0)
   (B) (-1,-2,-3,0,-3,-2,-1,-0.5,-0.2,-0.5)
   (C) (-1,-2,0,0,0,-2,-1,-0.5,0)
   (D) (-1,-2,-3,0,-3,-2,-1,-2,-2)
   (E) (-2,-3,0,-3,-2,-1,0,0,-1)

2. The original limulus equation algorithm involves an unrealistic "instantaneous" simulation. All of the following are steps in this algorithm EXCEPT:

   (A) Multiply weight matrix times state vector.
   (B) Add input vector to product of weight times state.
   (C) Multiply by a small number epsilon.
   (D) Squash result with a piece-wise linear activation function.
   (E) Initialize state vector equal to input vector (or iterate twice).

3. Consider a connectivity matrix for an 7 unit limulus simulation with symmetrical inhibition but without wrap-around with a maximal projection distance for any given unit of 3 units to either side. All of the following are locations of 0s in this matrix except: [hint: draw the matrix, row and column numbering starts with **1**]

   (A) 1,7
   (B) 7,1
   (C) 7,3
   (D) 7,4
   (E) 6,2

4. In many simple artificial neural networks, the input to each unit comes only from the weights multiplied by the states from the previous iteration. This will not produce Mach bands for the basic limulus simulation because:

   (A) The weight matrix has too many zeros.
   (B) The activation function guarantees that the state vector will be non-negative.
   (C) Units do not connect to themselves.
   (D) of wraparound.
   (E) All of the above.

5. Linearity has been demonstrated in different aspects of limulus eye function including

   (A) Summation of inhibition from 2 light spots activating different receptors measured from a 3rd receptor
   (B) Response of firing frequency for a given generator potential
   (C) Decrease in firing frequency for one fiber with increase firing frequency for another fiber
   (D) None of the above
   (E) All of the above

6. Which of the following is true of the human retina:

   (A) Photoreceptors are located closest to the center of the eye so that the light strikes them first
   (B) Lateral inhibition does not exist
   (C) All output cells (ganglion cells projecting to thalamus) increase firing with an increase in light at the center of their receptive field
   (D) Light must pass through other neurons before reaching the photoreceptors
   (E) Photoreceptors send axons directly to visual cortex

7. Which of the following is true in the limulus compound eye

   (A) Lateral inhibition shows wrap-around from one edge to the opposite edge of the eye
   (B) Lateral inhibition is mostly one way with central units inhibiting the more lateral units
   (C) Firing frequency is a strictly linear function of stimulating light intensity
   (D) Firing frequency in response to a constant stimulus is constant from the beginning to the end of the stimulus period
   (E) The limulus ommatidium uses 2 nerve cells: a nonspiking photoreceptor and a spiking eccentric cell

The following 2 questions pertain to the limulus equation $s_{next} = f(W * s + i)$ using the standard piece-wise linear activation function and the following connection matrix and input vector:

$$\begin{pmatrix} 0 & -2 & -1 & -2 \\ -2 & 0 & -2 & -1 \\ -1 & -2 & 0 & -2 \\ -2 & -1 & -2 & 0 \end{pmatrix} \begin{pmatrix} 10 \\ 10 \\ 50 \\ 50 \end{pmatrix}$$

8. The weight times state product will be:

   (A) -20,-20,-50,-50
   (B) 170,170,130,130
   (C) -170,-130,-170,-130
   (D) 170,130,170,130
   (E) -170,-170,-130,-130

9. Which of the following is true for this simulation:

   (A) It demonstrates Mach bands.
   (B) The connection strengths are too weak to produce Mach bands.
   (C) The connection strengths are too strong to produce Mach bands.
   (D) The units of the input are units of luminance.
   (E) The units have self connections.

The following question pertains to the limulus equation ($s_{next} = f(W * s + i)$) using the following connection matrix and input vector:

$$\begin{pmatrix} 0 & -0.2 & 0 & 0 \\ -0.2 & 0 & -0.2 & 0 \\ 0 & -0.2 & 0 & -0.2 \\ 0 & 0 & -0.2 & 0 \end{pmatrix} \begin{pmatrix} 10 \\ 10 \\ 50 \\ 50 \end{pmatrix}$$

10. If the activation function is piece-wise linear and squashs between 0 and 50 Hz (ie no negative firing and no firing greater than 50), the absolute amplitude (ie not relative to the input) of the CENTRAL Mach band (no wraparound) is:

    (A) 50
    (B) -12
    (C) 38
    (D) 40
    (E) 32