<ol> <li>Let's design some feedforward networks that can do some basic operations on their inputs. This could mean lowering their intensity, looking for strong changes, or one of many other possibilities. One nice way to build intuition for this sort of processing is to think of these networks as operating on images. Even though our networks will operate over</li> </ol>	
	2 points
only 5 pixels of image data, we can still build the same basic operations that we would for a regular image.  For the next four questions, we will start with the following image as input:	
Suppose we processed the image and it looked like this:	
Which of the following weight matrices $W$ would give us a feedforward network most closely approximating this image processing operation?	
image processing operation?	
$\begin{bmatrix} 0 & -0.75 & 0.75 & 0 & 0 \\ 0 & 0 & -0.75 & 0.75 & 0 \\ 0 & 0 & 0 & -0.75 & 0.75 \end{bmatrix}$	
$ \begin{bmatrix} 0.33 & 0.33 & 0.33 & 0 & 0 \\ 0 & 0.33 & 0.33 & 0.33 & 0 \\ 0 & 0 & 0.33 & 0.33 & 0.33 \\ 0.33 & 0 & 0 & 0.33 & 0.33 \\ \end{bmatrix} $	
$ \begin{bmatrix} 0.5 & 0 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 & 0 \\ 0 & 0 & 0.5 & 0 & 0 \\ 0 & 0 & 0 & 0.5 & 0 \end{bmatrix} $	
$\begin{bmatrix} 0 & 0 & 0 & 0.5 & 0 \\ 0 & 0 & 0 & 0.5 \end{bmatrix}$ $\bigcirc \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}$	
$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$	
2. Suppose we processed the image and it looked like this:	2 points
Which of the following weight matrices $W$ would give us a feedforward network most closely approximating this image processing operation? $ \begin{bmatrix} 0.33 & 0.33 & 0 & 0 & 0.33 \end{bmatrix} $	
$\begin{bmatrix} 0.33 & 0.33 & 0.33 & 0 & 0 \\ 0 & 0.33 & 0.33 & 0.33 & 0 \\ 0 & 0 & 0.33 & 0.33 & 0.33 \\ 0.33 & 0 & 0 & 0.33 & 0.33 \end{bmatrix}$	
$ \begin{bmatrix} 0.75 & 0 & 0 & 0 & -0.75 \\ -0.75 & 0.75 & 0 & 0 & 0 \\ 0 & -0.75 & 0.75 & 0 & 0 \\ 0 & 0 & -0.75 & 0.75 & 0 \end{bmatrix} $	
$\begin{bmatrix} 0 & 0 & 0 & -0.75 & 0.75 \end{bmatrix}$ $\bigcirc \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}$	
$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$	
$ \begin{bmatrix} 0 & 0.5 & 0 & 0 & 0 \\ 0 & 0 & 0.5 & 0 & 0 \\ 0 & 0 & 0 & 0.5 & 0 \\ 0 & 0 & 0 & 0 & 0.5 \end{bmatrix} $	
3. Suppose we processed the image and it looked like this:	2 points
Which of the following weight matrices $W$ would give us a feedforward network most closely approximating this image processing operation? $0.5$	
$ \begin{bmatrix} 0 & 0.5 & 0 & 0 & 0 \\ 0 & 0 & 0.5 & 0 & 0 \\ 0 & 0 & 0 & 0.5 & 0 \end{bmatrix} $	
$ \begin{bmatrix} 0 & 0 & 0 & 0 & 0.5 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} $	
$\begin{bmatrix} 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$ $\odot \begin{bmatrix} 0.75 & 0 & 0 & 0 & -0.75 \end{bmatrix}$	
$\begin{bmatrix} -0.75 & 0.75 & 0 & 0 & 0 \\ 0 & -0.75 & 0.75 & 0 & 0 \\ 0 & 0 & -0.75 & 0.75 & 0 \\ 0 & 0 & 0 & -0.75 & 0.75 \end{bmatrix}$	
$ \begin{bmatrix} 0.33 & 0.33 & 0 & 0 & 0.33 \\ 0.33 & 0.33 & 0.33 & 0 & 0 \\ 0 & 0.33 & 0.33 & 0.33 & 0 \\ 0 & 0 & 0.33 & 0.33 & 0.33 \end{bmatrix} $	
$\begin{bmatrix} 0.33 & 0 & 0 & 0.33 & 0.33 \end{bmatrix}$	
4. Suppose we processed the image and it looked like this:	2 points
Which of the following weight matrices $W$ would give us a feedforward network most closely approximating this image processing operation?	
$\begin{bmatrix} 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$ $\bigcirc \begin{bmatrix} 0.75 & 0 & 0 & 0 & -0.75 \\ -0.75 & 0.75 & 0 & 0 & 0 \end{bmatrix}$	
$\begin{bmatrix} -0.75 & 0.75 & 0 & 0 & 0 \\ 0 & -0.75 & 0.75 & 0 & 0 \\ 0 & 0 & -0.75 & 0.75 & 0 \\ 0 & 0 & 0 & -0.75 & 0.75 \end{bmatrix}$	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	
$ \begin{bmatrix} 0.33 & 0.33 & 0 & 0 & 0.33 \\ 0.33 & 0.33 & 0.33 & 0 & 0 \end{bmatrix} $	
$\begin{bmatrix} 0 & 0.33 & 0.33 & 0.33 & 0 \\ 0 & 0 & 0.33 & 0.33 & 0.33 \\ 0.33 & 0 & 0 & 0.33 & 0.33 \end{bmatrix}$	
5. In lecture 6.2, we encountered a process of conceptual abstraction, taking us from modeling individual neurons to modeling whole networks. By the middle of the lecture, we had abstracted away many of the interesting time dynamics of feedforward neural networks and arrived at a simple equation:	3 points
${f v_{ss}}=F(W{f u})$ We have to make a number of assumptions to get to this equation. Necessarily we lose some interesting information	
when we make these assumptions from the beginning of lecture 6.2 to the point where we first see this equation (roughly 10 min in). Which of the following holds true? (Check all that are true)  This model shows us the outputs the system will converge to, but no longer describes the time dynamics of that convergence.	
This model ignores the firing rates of the output cells.  This model ignores the firing rates of the input cells.	
<ul> <li>✓ This model cannot adequately represent many of the dynamics of individual cells, such as the effect of the refractory period.</li> <li>☐ This model does not allow differences in firing rates between different inputs.</li> </ul>	
<ul> <li>This model does not allow for synaptic connections where an input cell is inhibiting the firing of the output cell.</li> <li>Since this model does not use a detailed description of individual cells, it does not account for the strength of individual synaptic connections.</li> </ul>	
<ul> <li>This model ignores patterns in the input and output spike timings, opting instead to simply look at firing rates.</li> <li>This model ignores the effects of synchrony and correlation between the input neurons.</li> <li>This model assumes static, unchanging inputs, so it does not account for the dynamics resulting from constantly</li> </ul>	
changing inputs.	
6. The next three questions utilize the following code to model an integrate-and-fire neuron receiving input spikes through an alpha synapse: Matlab:	5 points
alpha_neuron  M File	
Python:  alpha_neuron	
PY File	
(NOTE ON DOWNLOADING CODE AND DATA: Currently, downloaded files are automatically renamed to begin with a long string of random characters (we hope to have this fixed soon). Sometimes the file type is also changed. In	
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