CSE 571 Midterm Review - Week 4 Module

1. The creative design team of a famous car company is looking to create new designs for their cars by using a prompt-based **image synthesis** tool. The underlying technology of this tool could be
    a. Convolutional Neural Networks (CNN)
    b. Long Short-Term Memory (LSTM)
    c. Generative Adversarial Networks (GAN)
    d. Recurrent Neural Networks (RNN)

Image segmentation is a pixel-level task, where each pixel in the image is classified into one of the classes. This is typically a multi-label problem where each pixel can belong to multiple classes (e.g., a pixel can be part of both a cat and a background).

In such cases, a more suitable activation function for the output layer would be the sigmoid function, which treats each pixel independently and can assign it multiple labels.

softmax function would output a probability distribution over these classes, helping to identify the most likely class for each input.

2. For which of the following problems would a **softmax activation** for the output layer be most applicable?
    a. Image segmentation for identifying objects within an image.
    b. Binary classification of spam vs. non-spam emails.
    c. Handwriting recognition to classify individual letters.
    d. Multiclass classification for images for animal species in a wildlife conservation project.

multiclass classification problem

each pixel can only belong to one class (a multi-class problem), a softmax activation function could be used, but it would be applied spatially across each pixel's set of class scores (often called "Spatial Softmax").

3. The use-case of Dropout in CNNs can be best described as?
    a. A technique for improving the accuracy of the model by increasing the number of convolutional layers.
    b. A method for reducing overfitting and enhancing generalization by randomly deactivating neurons during training.
    c. An approach for increasing the size of the receptive field in CNNs.
    d. A strategy for fine-tuning hyperparameters in CNN architectures.

4. We are going to develop a classification model for an image dataset. Among the following options, which would **NOT** be an appropriate pre-processing step for this process?
    a. Edge Detection
    b. Points of Interest Calculation
    c. Stop-Word Removal
    d. Denoising

5. What type of filter would the following 3x3 matrix represent:

$$\text{matrix} = \begin{bmatrix} 0.0625 & 0.125 & 0.0625 \\ 0.125 & 0.25 & 0.125 \\ 0.0625 & 0.125 & 0.0625 \end{bmatrix}$$

   a. Gaussian Blur Filter
   b. Image Sharpening Filter
   c. Denoising Filter

6. In Image Processing, a typical Image Sharpening Filter kernel would have
   a. The ability to reduce noise in the image.
   b. A kernel with a Gaussian distribution.
   c. Will have a high value at the center of the kernel to enhance the center pixel on each stride.
   d. A kernel characterized by a uniform, box-like structure.

7. Binary Cross-Entropy Loss Function would be an ideal choice for which of the following use-cases:
   a. Classifying digits from 0-9. `multi-class classification problem, categorical cross-entropy is better suited`
   b. Fitting a sine wave with varying phase and amplitude. `regression`
   c. Classifying the digits 0 and 1.
   d. Classifying Objects of a Video Stream.

   `multi-class classification problem, categorical cross-entropy is better suited`

8. The Flatten operation in Convolutional Neural Networks (CNN) is typically used for
   a. Increasing the spatial dimensions of the feature maps.
   b. Combining multiple convolutional layers into a single layer.
   c. Connecting the outputs from the convolution section into the classifier section (fully connected layers of the CNN).
   d. Applying a non-linear activation function to the feature maps

9. Which of the following problems is NOT a popular use-case of Convolutional Neural Networks?
    a. Image classification for recognizing objects in photographs.
    b. Sentiment Analysis of various news articles.
    c. Facial recognition to identify individuals from photos.
    d. Medical image analysis for detecting diseases in X-rays and MRI scans.

10. Consider the following matrix and kernel:

$$\text{matrix} = \begin{bmatrix} 210 & 130 & 120 & 140 & 50 \\ 110 & 60 & 130 & 25 & 130 \\ 115 & 10 & 170 & 240 & 30 \\ 190 & 180 & 240 & 150 & 210 \\ 120 & 130 & 160 & 130 & 205 \end{bmatrix} \quad \text{kernel} = \begin{bmatrix} -1 & 1 & 0 \\ 0 & 2 & 0 \\ 1 & 2 & -1 \end{bmatrix}$$

With no extra padding and stride-size = 2, what will be the value of the bottom-right pixel of the feature map after the convolution of the matrix with the kernel?

    a. 615
    b. 585
    c. 515
    d. 685

11. Consider the following matrix:

$$\text{matrix} = \begin{bmatrix} 130 & 560 & 10 & 180 \\ 30 & 40 & 60 & 130 \\ 80 & 95 & 125 & 100 \\ 190 & 180 & 240 & 150 \end{bmatrix}$$

With no extra padding and stride-size = 2, what will be the value of the top-right pixel of the feature map if an average-pooling layer of kernel size 2x2 is applied on the matrix?

a. 100
b. 92
c. 95
d. 110