**1. What exactly is a feature?**

**Ans:** A feature, in the context of image processing or machine learning, refers to a distinctive or relevant piece of information extracted from data, often used to represent specific characteristics or patterns.

**2. For a top edge detector, write out the convolutional kernel matrix.**

**Ans:**

[-1, -1, -1]

[ 0, 0, 0]

[ 1, 1, 1]

**3. Describe the mathematical operation that a 3x3 kernel performs on a single pixel in an image.**

**Ans:** A 3x3 kernel performs a weighted sum of pixel values in the neighborhood of a central pixel, producing a new value. This operation emphasizes certain image features, like edges or textures.

**4. What is the significance of a convolutional kernel added to a 3x3 matrix of zeroes?**

**Ans:** Adding a convolutional kernel to a 3x3 matrix of zeroes is the initial step in convolving the kernel with an image. It prepares the matrix for the convolution operation, where the kernel slides over the image, and its weights are multiplied with corresponding pixel values.

**5. What exactly is padding?**

**Ans:** Padding involves adding extra pixels (usually zeroes) around the borders of an image. It's done to preserve spatial information during convolutions and prevent the output size from shrinking too much.

**6. What is the concept of stride?**

**Ans:** Stride refers to the step size with which the convolutional kernel moves across the input image. A larger stride reduces the spatial dimensions of the output feature map.

**7. What are the shapes of PyTorch's 2D convolution's input and weight parameters?**

**Ans:** The shapes of PyTorch's 2D convolution's input and weight parameters are:

Input shape: (batch\_size, in\_channels, height, width)

Weight shape: (out\_channels, in\_channels, kernel\_size, kernel\_size)

**8. What exactly is a channel?**

**Ans:** A channel in the context of image processing or neural networks represents a set of features or information. In RGB images, for example, there are three channels corresponding to the red, green, and blue color channels.

**9.Explain relationship between matrix multiplication and a convolution?**

**Ans:** Matrix multiplication and convolution share similarities. In convolution, the kernel is essentially a filter, and the convolution operation is a localized weighted sum, akin to a dot product in matrix multiplication. The sliding of the kernel over the image resembles the process of moving a smaller matrix (kernel) across a larger matrix (image) and computing element-wise products and sums.