1. What exactly is a feature?

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

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

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

5. What exactly is padding?

6. What is the concept of stride?

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

8. What exactly is a channel?

9.Explain relationship between matrix multiplication and a convolution?

Answers

Here are the short answers to your questions:

1. **What exactly is a feature?**  
   A feature is a measurable property or pattern extracted from raw data, often used as input to machine learning models.
2. **For a top edge detector, write out the convolutional kernel matrix.**

[ -1, -1, -1 ]

[ 0, 0, 0 ]

[ 1, 1, 1 ]

1. **Describe the mathematical operation that a 3x3 kernel performs on a single pixel in an image.**  
   It computes the sum of element-wise multiplication between the kernel and a 3x3 patch of the image centered at that pixel.
2. **What is the significance of a convolutional kernel added to a 3x3 matrix of zeroes?**  
   It results in a zero output, showing the kernel detects no features in the region (e.g., uniform or blank area).
3. **What exactly is padding?**  
   Padding is adding extra pixels (usually zeros) around the image borders to control output size and preserve edge information.
4. **What is the concept of stride?**  
   Stride is the step size by which the kernel moves across the image during convolution.
5. **What are the shapes of PyTorch's 2D convolution's input and weight parameters?**
   * Input: (batch\_size, in\_channels, height, width)
   * Weight: (out\_channels, in\_channels, kernel\_height, kernel\_width)
6. **What exactly is a channel?**  
   A channel is a layer of data representing a specific type of information (e.g., RGB channels in images or learned features in CNNs).
7. **Explain relationship between matrix multiplication and a convolution?**  
   Convolution can be represented as matrix multiplication by rearranging image patches and kernels, though conceptually it's a sliding dot product.