Computer Vision HW9: General Edge Detection

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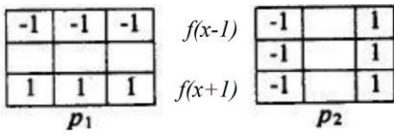
Implement the following edge detectors with thresholds:

- **Description**

  Since all of the edge detectors requires convolution over kernels, I wrote a general function to derive the results based on the kernel and threshold.

- **Method / Algorithm**

  1. Translate the kernels into list of tuples: for example, the kernels for Prewitt Operator will be translated from 

, to

```
prewittKernels = [(((-1, -1), -1), ((-1, 0), -1), ((-1, 1), -1),
                  ((1, -1), 1), ((1, 0), 1), ((1, 1), 1)),

                 (((-1, -1), -1), ((-1, 1), 1),
                 ((0, -1), -1), ((0, 1), 1),
                 ((1, -1), -1), ((1, 1), 1),)]
```

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     (Each element consists of the position (e.g. (1, 0)) and the weight (e.g., 1))
  2. Pad the input image based on the kernel size
     - For kernel size 2, do padding on the right and bottom boarders by 1
     - For kernel size 3, do padding on all four borders by 1
     - For kernel size 5, do padding on all four borders by 2
  3. Iterate over the padded image:
     - For each kernel, derive the corresponding convolution result
     - Record the results in a list
  4. Derive the gradient magnitude based on different operators:
     - For Roberts, Prewitt, Sobel, Frei & Chen: derive by summing the squares and then take the square root
     - For Kirsch, Robinson, Nevatia-Babu: derive by taking the maxima
  5. Compare the gradient magnitude with the threshold
     - Greater or equal: assign 0 (black pixel)
     - Lesser: assign 255 (white pixel)

- **Main Code Segment**

```
def DetectEdge(self, inPic, kernelLst, thr, method, ksize=3):
    retPic = np.zeros_like(inPic)
    paddedPic = None
    if ksize==3: paddedPic = cv2.copyMakeBorder(inPic, 1, 1, 1, 1, cv2.BORDER_REPLICATE)
```

```
    elif ksize==5: paddedPic = cv2.copyMakeBorder(inPic, 2, 2, 2, 2, cv2.BORDER_REPLICATE)
    elif ksize==2: paddedPic = cv2.copyMakeBorder(inPic, 0, 1, 0, 1, cv2.BORDER_REPLICATE)
    assert paddedPic is not None

    for i in range(inPic.shape[0]):
        for j in range(inPic.shape[1]):
            valLst = []
            for kernel in kernelLst:
                val = 0
                if ksize==3: val = self.ApplyKernel(paddedPic, kernel, i+1, j+1)
                elif ksize==5: val = self.ApplyKernel(paddedPic, kernel, i+2, j+2)
                elif ksize==2: val = self.ApplyKernel(paddedPic, kernel, i, j)
                valLst.append(val)
            if method == 'SQRT':
                grad = np.sqrt(np.sum(np.power(valLst, 2)))
            elif method == 'MAX':
                grad = np.max(valLst)
            if grad>=thr: retPic[i][j]=0
            else: retPic[i][j]=255
    return retPic
```

- **Results**

a) Robert's Operator: 12

b) Prewitt's Edge Detector: 24

c) Sobel's Edge Detector: 38

d) Frei and Chen's Gradient Operator: 30

e) Kirsch's Compass Operator: 135

f) Robinson's Compass Operator: 43

g) Nevatia-Babu 5x5 Operator: 12500