

浙江大学



本科实验报告

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系： 生物医学工程

专业： 生物医学工程

学号：

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HW1 First order feature

- Given the image (a), calculate its energy, mean, range and 2th, 3th moment of mean.
- Write the histogram of the image and calculate the uniformity and entropy.

```

3 1 0 0 2
1 0 1 1 0
0 2 0 3 1
1 2 1 0 0
0 0 2 3 1
    
```

$$\begin{pmatrix} 3 & 1 & 0 & 0 & 2 \\ 1 & 0 & 1 & 1 & 0 \\ 0 & 2 & 0 & 3 & 1 \\ 1 & 2 & 1 & 0 & 0 \\ 0 & 0 & 2 & 3 & 1 \end{pmatrix}$$

| pixel | $P(i)$ |
|-------|--------|
| 0 | 10 |
| 1 | 8 |
| 2 | 4 |
| 3 | 3 |

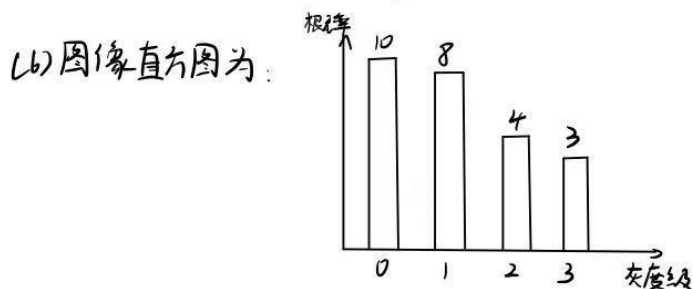
(1) 均值 (mean) = $\frac{1}{N} \sum_{i=0}^{L-1} i \cdot p(i) = \frac{1}{25} (0 + 8 + 4 + 3) = 1$

(2) 能量 (energy) = $\sum_{(x,y)} I(x,y)^2 = 10 \times 0^2 + 8 \times 1^2 + 4 \times 2^2 + 3 \times 3^2 = 51$

(3) 范围 (range) = $I_{\max} - I_{\min} = 3 - 0 = 3$

(4) 2阶动量 (second momentum) = $\frac{1}{N} \sum_{i=0}^{L-1} (i-\mu)^2 \cdot p(i) = \frac{1}{25} [1^2 \times 10 + 0 + 1^2 \times 4 + 2^2 \times 3] = \frac{26}{25}$

(5) 3阶动量 (third momentum) = $\frac{1}{N} \sum_{i=0}^{L-1} (i-\mu)^3 \cdot p(i) = \frac{1}{25} [-1^3 \times 10 + 0 + 1^3 \times 4 + 2^3 \times 3] = \frac{18}{25}$



(7) 均匀性 (uniformity) = $\sum_{i=0}^{L-1} P(i)^2 = 0.3024$

(8) 熵 (entropy) = $-\sum_{i=0}^{L-1} P(i) \log_2 P(i) \approx \frac{10}{25} \times 1.32 + \frac{8}{25} \times 1.64 + \frac{4}{25} \times 2.64 + \frac{3}{25} \times 3.06 \approx 1.84$

HW2 Co-occurrence matrix

- Find the co-occurrence matrix of a matrix pattern in the following cases.

- The position operator Q is defined as "one pixel to the right"
- The position operator Q is defined as "two pixels to the right"
- For 1. and 2.'s GLCM, calculate contrast and homogeneity.

0 1 2 1 0
1 2 1 2 1
0 1 2 1 0
1 2 1 2 1
0 1 2 1 0

Matrix pattern

| | 0 | 1 | 2 |
|---|---|---|---|
| 0 | | | |
| 1 | | | |
| 2 | | | |

GLCM pattern

$$\begin{pmatrix} 0 & 1 & 2 & 1 & 0 \\ 1 & 2 & 1 & 2 & 1 \\ 0 & 1 & 2 & 1 & 0 \\ 1 & 2 & 1 & 2 & 1 \\ 0 & 1 & 2 & 1 & 0 \end{pmatrix}$$

(1) $\theta=0^\circ$, $b=1$

统计像素对 (i,j) 出现次数:

$(0,0)$ 0 $(1,0)$ 3 $(2,0)$ 0
 $(0,1)$ 3 $(1,1)$ 0 $(2,1)$ 7
 $(0,2)$ 0 $(1,2)$ 7 $(2,2)$ 0

GLCM:

| | | |
|---|---|---|
| 0 | 3 | 0 |
| 3 | 0 | 7 |
| 0 | 7 | 0 |

然后进行归一化得到 $p(i,j)$

$$\text{对比度 (Contrast)} = \sum_i \sum_j (i-j)^2 p(i,j) = 1$$

$$\text{同质性 (Homogeneity)} = \sum_i \sum_j \frac{p(i,j)}{1+|i-j|} = 0.5$$

(2) $\theta=0^\circ$, $b=2$

$(0,0)$ 0 $(1,0)$ 0 $(2,0)$ 3
 $(0,1)$ 0 $(1,1)$ 7 $(2,1)$ 0
 $(0,2)$ 3 $(1,2)$ 0 $(2,2)$ 2

GLCM:

| | | |
|---|---|---|
| 0 | 0 | 3 |
| 0 | 7 | 0 |
| 3 | 0 | 2 |

然后进行归一化得到 $p(i,j)$

$$\text{对比度 (Contrast)} = \sum_i \sum_j (i-j)^2 p(i,j) = \frac{8}{5}$$

$$\text{同质性 (Homogeneity)} = \sum_i \sum_j \frac{p(i,j)}{1+|i-j|} = \frac{11}{15}$$

HW3 CNN

- Please calculate the following results in sequence, **showing the main calculation steps**:

1. **Convolution Output (C)**: Calculate the result after convolving the input matrix I with the kernel K
2. **ReLU Activation Output (R)**: Apply the ReLU activation function to the convolution output C
3. **Max Pooling Output (P)**: Apply the max pooling operation to the ReLU activation output R

1 0 2 1 3
 0 1 1 2 0
 2 0 3 0 1
 1 1 0 2 1
 3 2 1 0 0

Input Matrix I (5x5)

1 0 -1
 1 0 -1
 1 0 -1

Kernel K (3x3)

Convolution Layer Parameters:

- Stride: 1
- Padding: 0

Activation Function:

- ReLU (Rectified Linear Unit): $f(x) = \max(0, x)$

Max Pooling Layer Parameters:

- Window Size: 2x2
- Stride: 1

(1) 卷积核卷积输出 $C = \begin{pmatrix} -3 & -2 & 2 \\ -1 & -2 & 2 \\ 2 & 1 & 2 \end{pmatrix}$

(2) ReLU 激活函数 $f(x) = \max(0, x)$, $R = \begin{pmatrix} 0 & 0 & 2 \\ 0 & 0 & 2 \\ 2 & 1 & 2 \end{pmatrix}$

(3) 最大池化输出 $P = \begin{pmatrix} 0 & 2 \\ 2 & 2 \end{pmatrix}$