a digital image is a rectilinear array of samples of a continuous image

digital image example

| .38 | .22 | .1 | .009 |
| .28 | .17 | .18 | .58 |
| .99 | .99 | .99 | .98 |
| .97 | .07 | .07 | .009 |
| .5 | .48 | .38 | .21 |

digital image example

fidelity

• space discretization
• color quantization
Space discretization

Nyquist criteria

Sample at more than twice the highest frequency to avoid aliasing.

Aliasing in images

"Jaggies"

Fidelity

- Space discretization
- Color quantization

Color quantization

- Number of channels
- Bits per channel

Channels

1 channel 3 channel
**color models**

- RGB: red, green, blue
- HSV: hue, saturation, value

**bits per channel**

1 bit per channel

8 bits per channel

uniform quantization: 2 level

<table>
<thead>
<tr>
<th>input intensity</th>
<th>output level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1/2</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

uniform quantization: 4 level

<table>
<thead>
<tr>
<th>input intensity</th>
<th>output level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>2/3</td>
<td>2/3</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

uniform quantization: n level

- output levels:
  \[ L_i = \frac{i}{n-1}, \quad i = 0, \ldots, n-1 \]
- thresholds:
  \[ T_i = \frac{(L_{i+1} + L_i)}{2} = \frac{(2i-1)}{2(n-1)}, \quad i = 1, \ldots, n-1 \]
- quantization function:
  \[ Q_n: [0,1] \rightarrow \{0, \frac{1}{n-1}, \frac{2}{n-1}, \ldots, 1\} \]
  \[ Q_n(v) = \left\lfloor v(n-1) + 0.5 \right\rfloor (n-1) \]

digital image processing

- avoid/correct errors
- restore
- enhance
- analyze
- create