

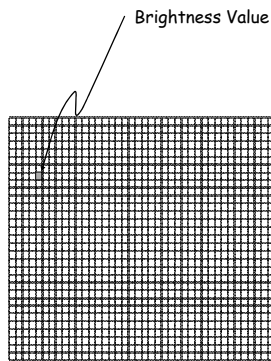
Image Storage

In this lecture

- ★ Image Size
- ★ Storage
- ★ Format
- ★ DICOM
- ★ PACS

Image Size

- Number of pixels
 - Spatial Resolution
- Range in each pixel
 - Contrast Resolution
- Computer Memory

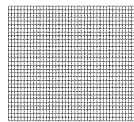


RECAP: Digital Signals

- Binary
 - Base two number system
 - Binary Integer
 - BITS
 - ON or OFF
 - 8 bit bytes
- | | 2 ⁸ | 2 ⁷ | 2 ⁶ | 2 ⁵ | 2 ⁴ | 2 ³ | 2 ² | 2 ¹ | decimal |
|-----|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| ... | . | . | . | . | . | . | . | . | . |
| ... | . | . | . | . | . | . | . | . | . |
| ... | . | . | . | . | . | . | . | . | . |
| 256 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 256 |

Matrix Size

- Image matrices used in radiography range from 32 X 32 to 2048 X 2048
- Example: 2048 x 2048
 - Approx 4M pixels
- 35 X 24 cm CR plate
- Pixels mm⁻¹ ?



Dynamic Range

- Range of values in each pixel *gray-scale range*, *dynamic range* or *Bit-depth*
- Numerical range in each pixel
- Visually: number of shades of gray that can be represented
- Number of levels = 2ⁿ
 - Where n = number of bits

Dynamic Range

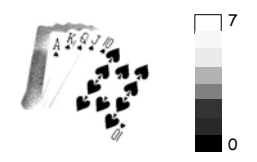
- 8-Bits

$2^8 \rightarrow 256$ shades



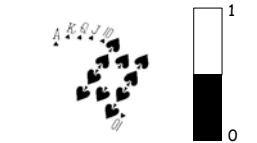
- 3-Bits

$2^3 \rightarrow 8$ shades



- 1-Bits

$2^1 \rightarrow 2$ shades



Dynamic Range

- Larger dynamic range
 - More gradual steps between max and min
 - Increased contrast resolution
- Imaging systems are characterised by their dynamic range
 - Determined by signal sampling hardware and image processing software
- Commonly 8-, 10- or 12-Bit

Image Size - Bytes

To calculate image size in Mb

1. Calculate total number of pixels in the image
2. Multiply by the bit-depth
3. Divide the result by 8 (8 'bits' in a 'byte')
4. Divide by 1,048,576 (bytes in a megabyte)

Example

2048 X 2048 24-bit digital camera image

2048 x 2048 pixels
 $2048 \times 2048 = 4,194,304$
 $= 4194304 \times 24$
 $= 100,663,296 \div 8$
 $= 12,582,912$ bytes or 12 mb

Image Storage

- Digital image: Grid of numbers
- Format

Image Storage



- Digital Image Communication in Medicine
- DICOM

Image Communication

- Picture Archiving and Communication System
- PACS

Summary

- ★Image Size
- ★Storage
- ★Format
- ★DICOM
- ★PACS