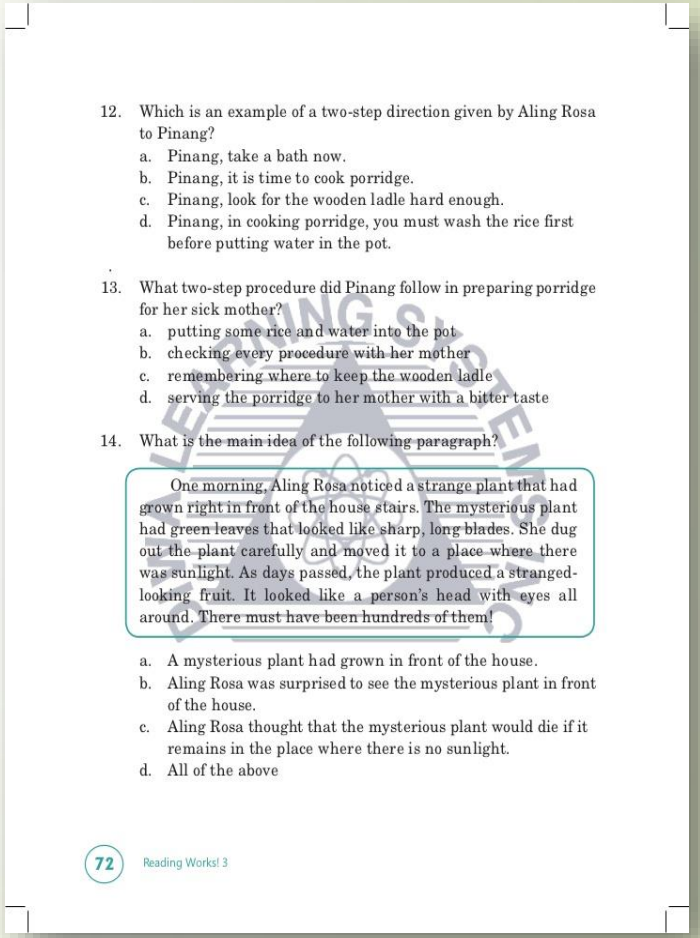
# Digital Watermarking

Multimedia Security

# What is the Watermark ?

- Paper Watermark
  - the technique of impressing into the paper a form, image, or text
    - to make forgery more difficult
    - to record the manufacturer's trademark

12. Which is an example of a two-step direction given by Aling Rosa to Pinang?
    a. Pinang, take a bath now.
    b. Pinang, it is time to cook porridge.
    c. Pinang, look for the wooden ladle hard enough.
    d. Pinang, in cooking porridge, you must wash the rice first before putting water in the pot.

13. What two-step procedure did Pinang follow in preparing porridge for her sick mother?
    a. putting some rice and water into the pot
    b. checking every procedure with her mother
    c. remembering where to keep the wooden ladle
    d. serving the porridge to her mother with a bitter taste

14. What is the main idea of the following paragraph?

> One morning, Aling Rosa noticed a strange plant that had grown right in front of the house stairs. The mysterious plant had green leaves that looked like sharp, long blades. She dug out the plant carefully and moved it to a place where there was sunlight. As days passed, the plant produced a stranged-looking fruit. It looked like a person's head with eyes all around. There must have been hundreds of them!

    a. A mysterious plant had grown in front of the house.
    b. Aling Rosa was surprised to see the mysterious plant in front of the house.
    c. Aling Rosa thought that the mysterious plant would die if it remains in the place where there is no sunlight.
    d. All of the above

72 Reading Works! 3

# Digital Watermark

- A digital watermark
  - a digital signal or pattern imposed on a digital document ( text, graphics, multimedia presentations )

- visible watermark
  - the more obvious means of discouraging unauthorized use by reducing the commercial value of a document
- invisible watermark
  - the watermark is imperceptible to the human eye
  - when the ownership of data is in question, the watermark will then be extracted to characterize the ownership

# Visible Watermarking

- A visible watermarking algorithm should satisfy some requirements, which are as follows:

(i) Embedded watermark should be perceptible in grey and colour host images.

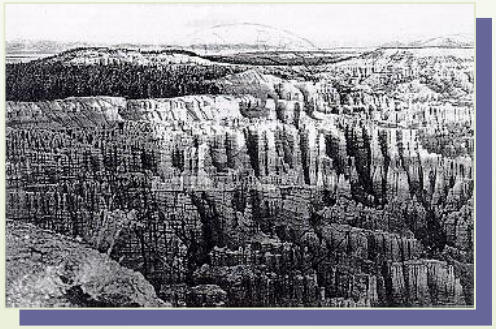
(ii) Embedded watermark should be perceptible in any image regions with different characteristics: texture, plain, and edge.

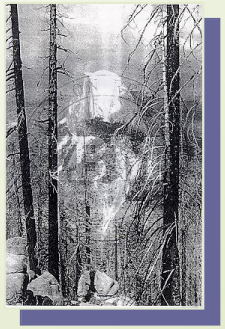
(iii) Embedded watermark should not be too obtrusive, so details of host image may be perfectly recognizable.

(iv) Watermark embedding should not obscure or brighten considerably the host image, the watermarked area should be sufficiently perceptible by the HVS, and the degradation of nonwatermarked area is almost nullified.

(v) Embedded watermark should be robust against several common attacks.

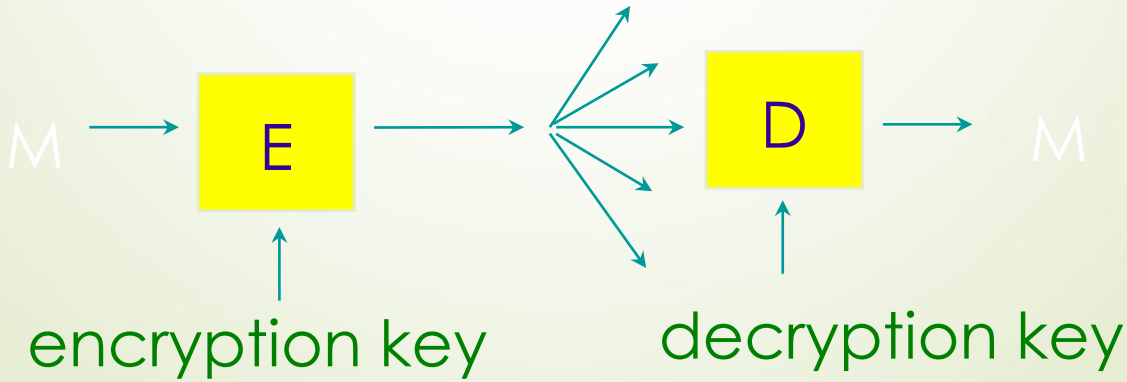
(vi) Watermark embedding process should be automatic for all kinds of images.





# Invisible Watermark

- Motivation
  - The distribution of digital media is becoming faster, easier and requiring less effort to make exact copies
    - How to protect the intellectual property?
- Conventional approaches
  - In analog world
    - signature, steel seal, embossed portrait, copyright label...
  - In digital world: cryptology



# Cryptology vs. Watermarking

- Cryptology
  - Once the data is decrypted, subsequent retransmission or dissemination is not encrypted
- Watermarking
  - Copyright information is hidden into digital data itself
  - Not restrict to access the data
  - Its objective is to permanently and unalterably reside in the data

# Watermarking Requirements

- Imperceptible
- Undeletable
- Statistically undetectable
- Robustness
  - resistant to lossy data compression
  - resistant to signal manipulation and processing operation
- Unambiguous

Watermarked Image

Transmission

Lossy Compression | Geometric Distortions | Signal Processing | D/A - A/D Conversion

Typical Distortions or Intentional Tampering

Transmission

Corrupted Watermarked Image

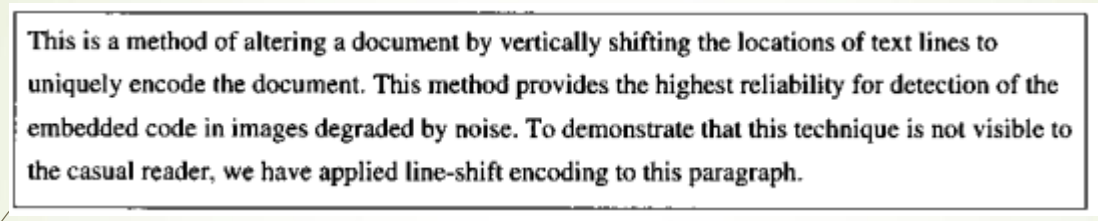
# Watermark Embedding

- Making the watermark robustness is not trivial
  - with complete knowledge
    - any watermark can theoretically be removed
  - with partial knowledge
    - the removal may interfere with the viewing of the data
    - the effort of removal is greater than the value of the data
- Challenges from data compression
  - Whatever hole one may find to fill with watermark is likely to be eliminated by data compression

# Watermarking for Text

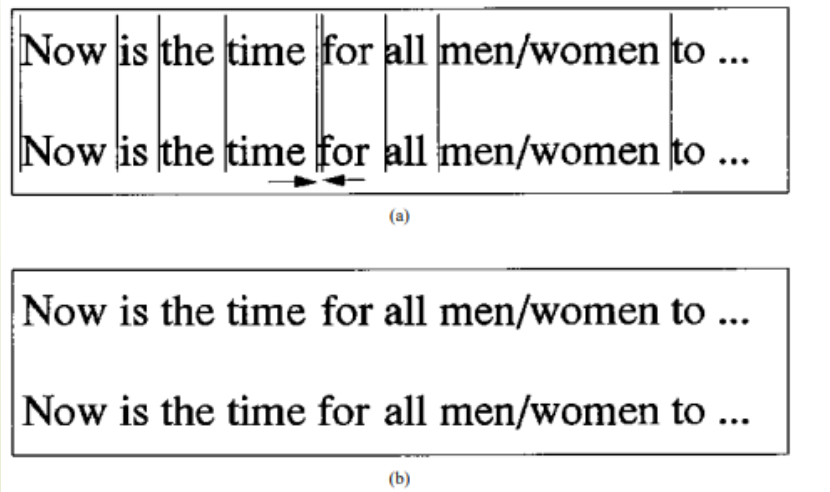
- **Line-Shift Coding**

Example of line-shift coding. The second line has been shifted up by 1/300 inch.




- **Word-Shift Coding**

Example of word-shift coding. **In (a)**, the top text line has added spacing before the "**for**", the bottom text line has the same spacing **after** the "for". **In (b)**, these same text lines are shown again without the vertical lines to demonstrate that either spacing appears natural.



# Watermarking for Text

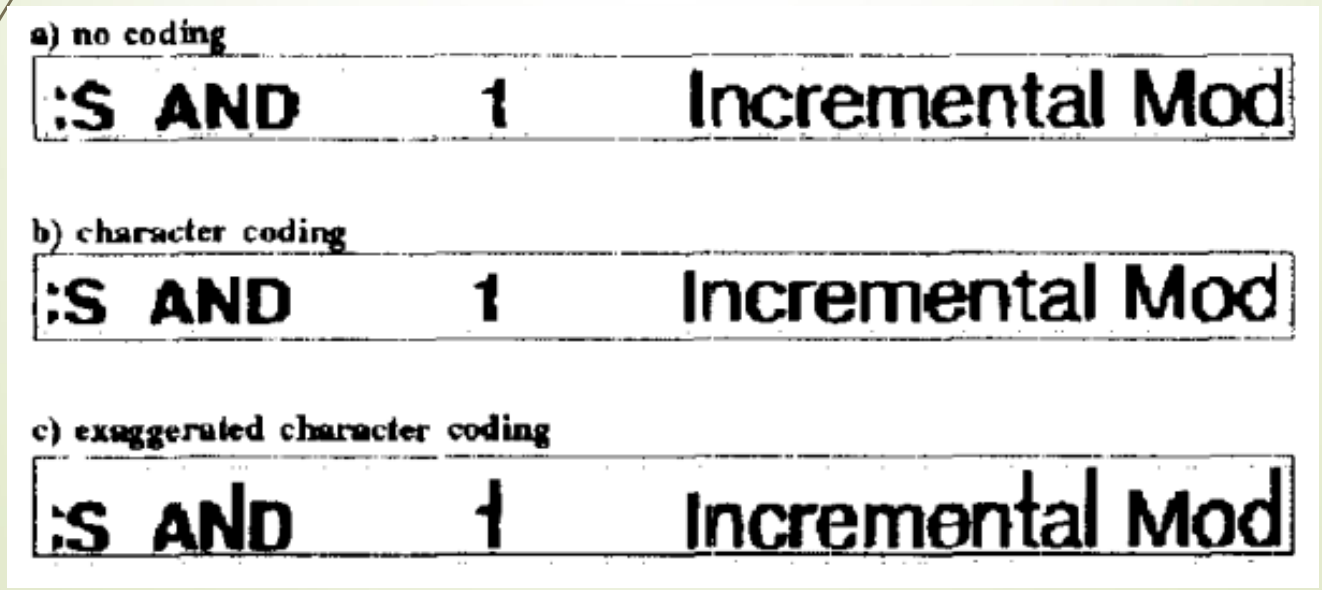
- **Feature Coding**

Example shows feature coding performed on a portion of text from a journal table of contents.

**In (a)**, no coding has been applied.

**In (b)**, feature coding has been applied to select characters.

**In (c)**, the feature coding has been exaggerated to show feature alterations.

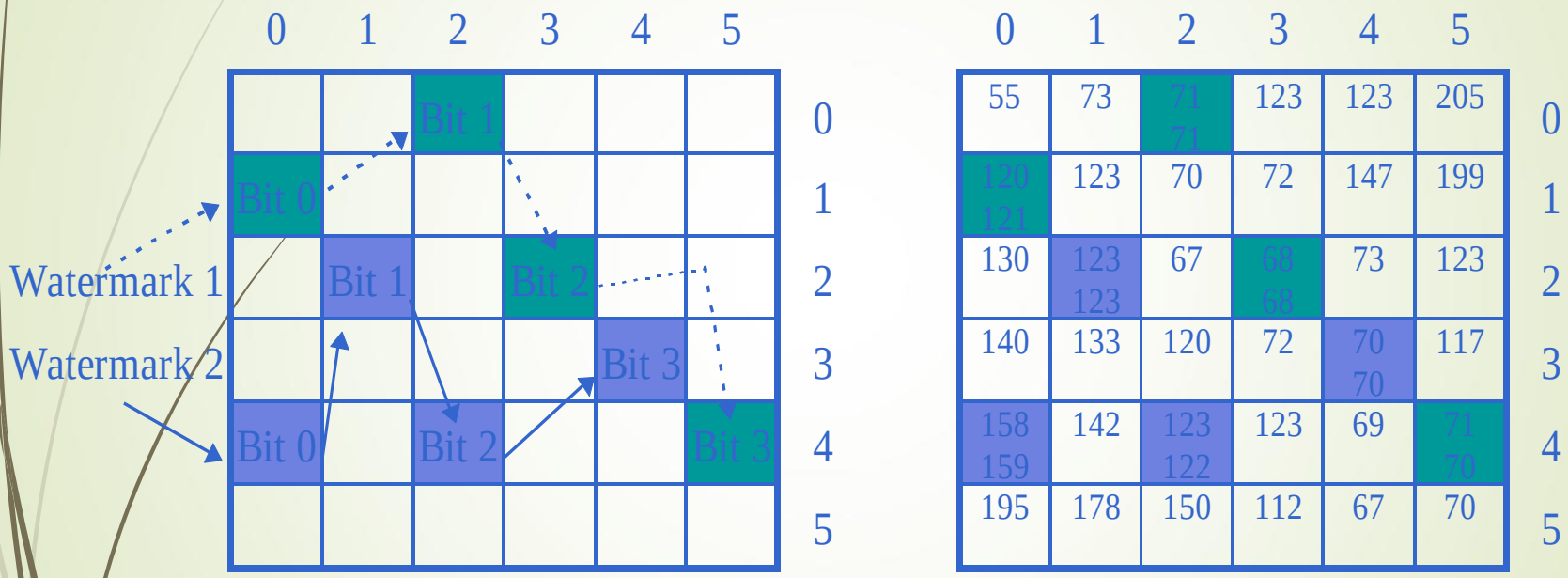


# Watermarking for Images & Videos



- Watermarking in { spatial domain / transform domain }
- Watermarking in { raw data / compressed data }
- Watermarking with { random number / visually recognizable pattern }
- Detection/extraction { with / without } the original data

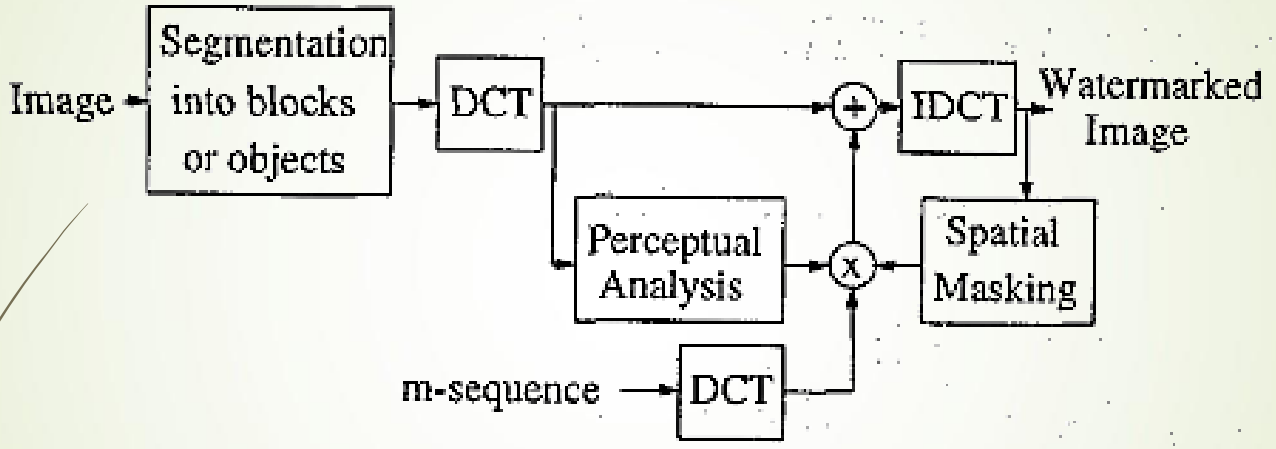
# LSB Flipping Method




- Generate the random walk sequence for each watermark (e.g.. $0011_2$)
- Force the LSB to match the watermark bit

This works will not survive any modification

# Perceptually Masking Method




- Detection

$H_0$ : $X = F^* - F = N$

$H_1$ : $X = F^* - F = W^* + N$

the hypothesis decision is obtained by

similarity = correlation (X,W)

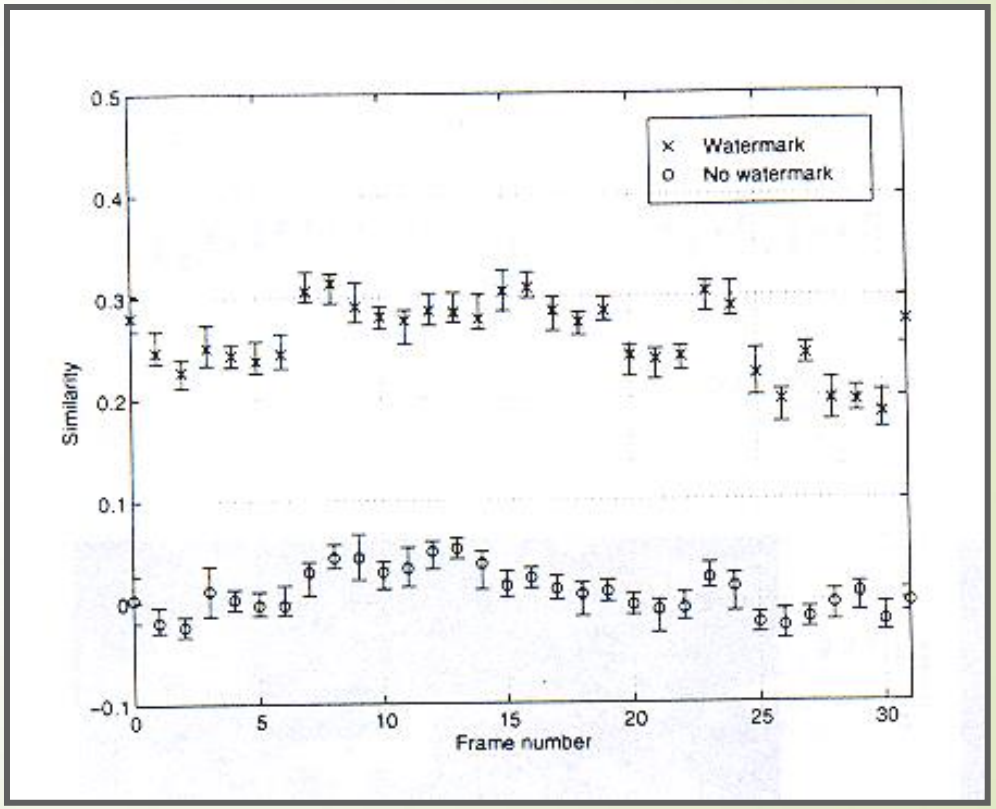
# Perceptually Masking Method (cont.)



- Frame from "pingpong"

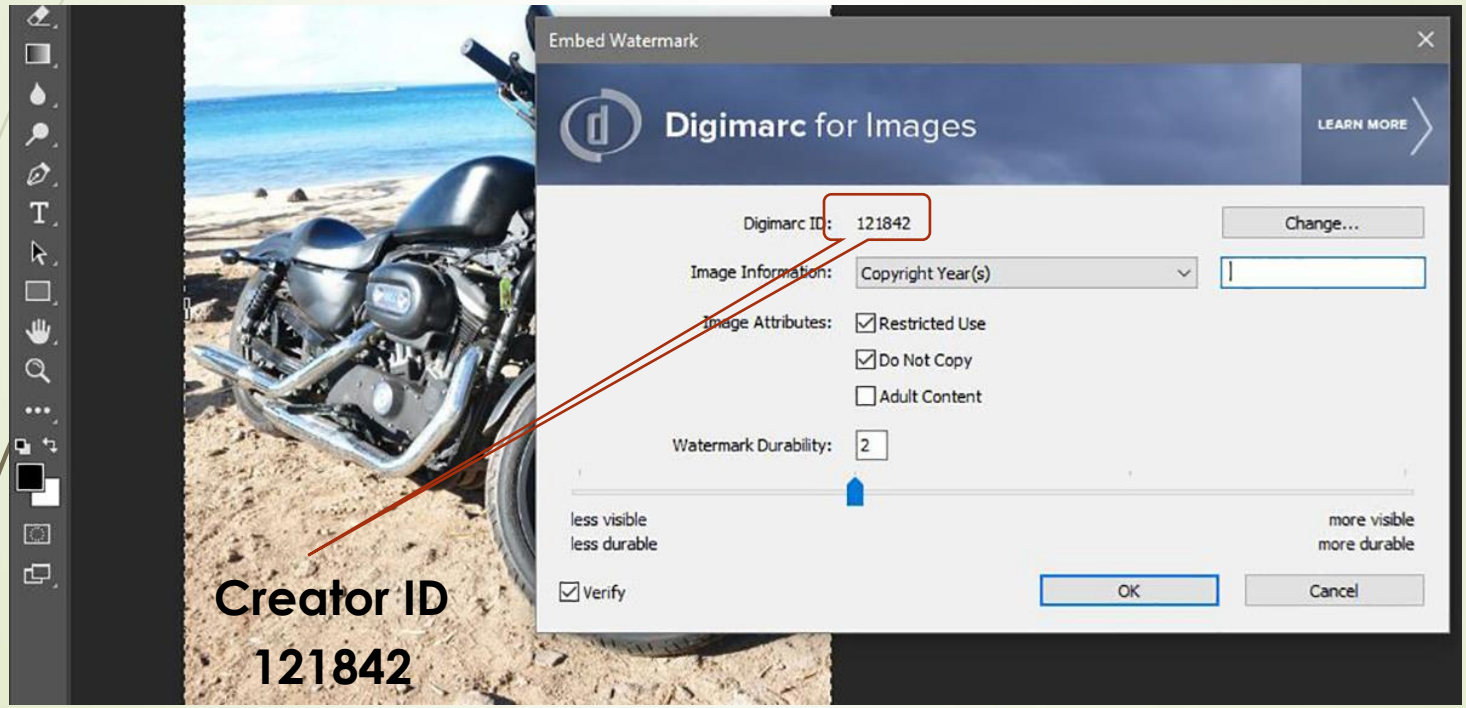
- The watermark

Similarity value

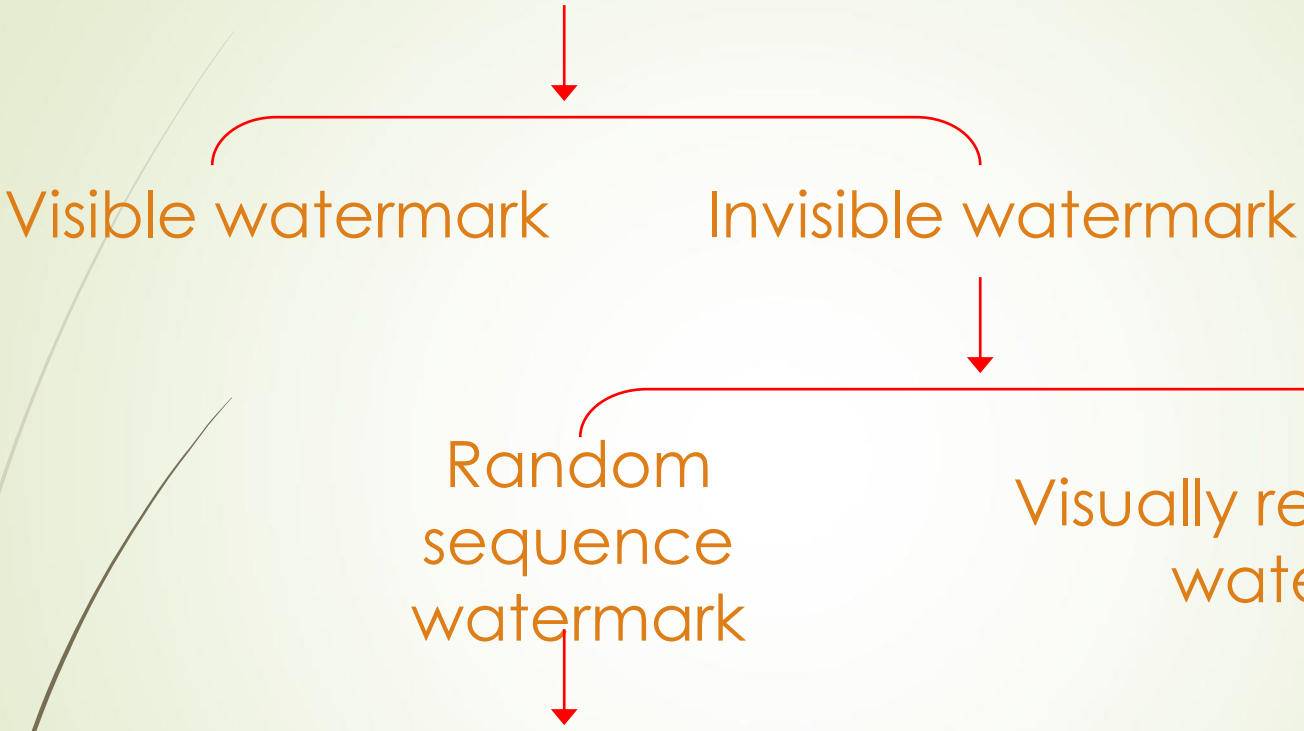


# Digimarc Watermarking

- A commercial watermarking software
  - http://www.digimarc.com



# Digital watermark




| | Random sequence watermark | Visually recognizable watermark |
|---|---|---|
| Watermark : | ID number (random number) | Visually recognizable pattern |
| Verification : | Quantitative measurement of the detection | Extracted pattern & Quantitative measurement |

# THANK YOU