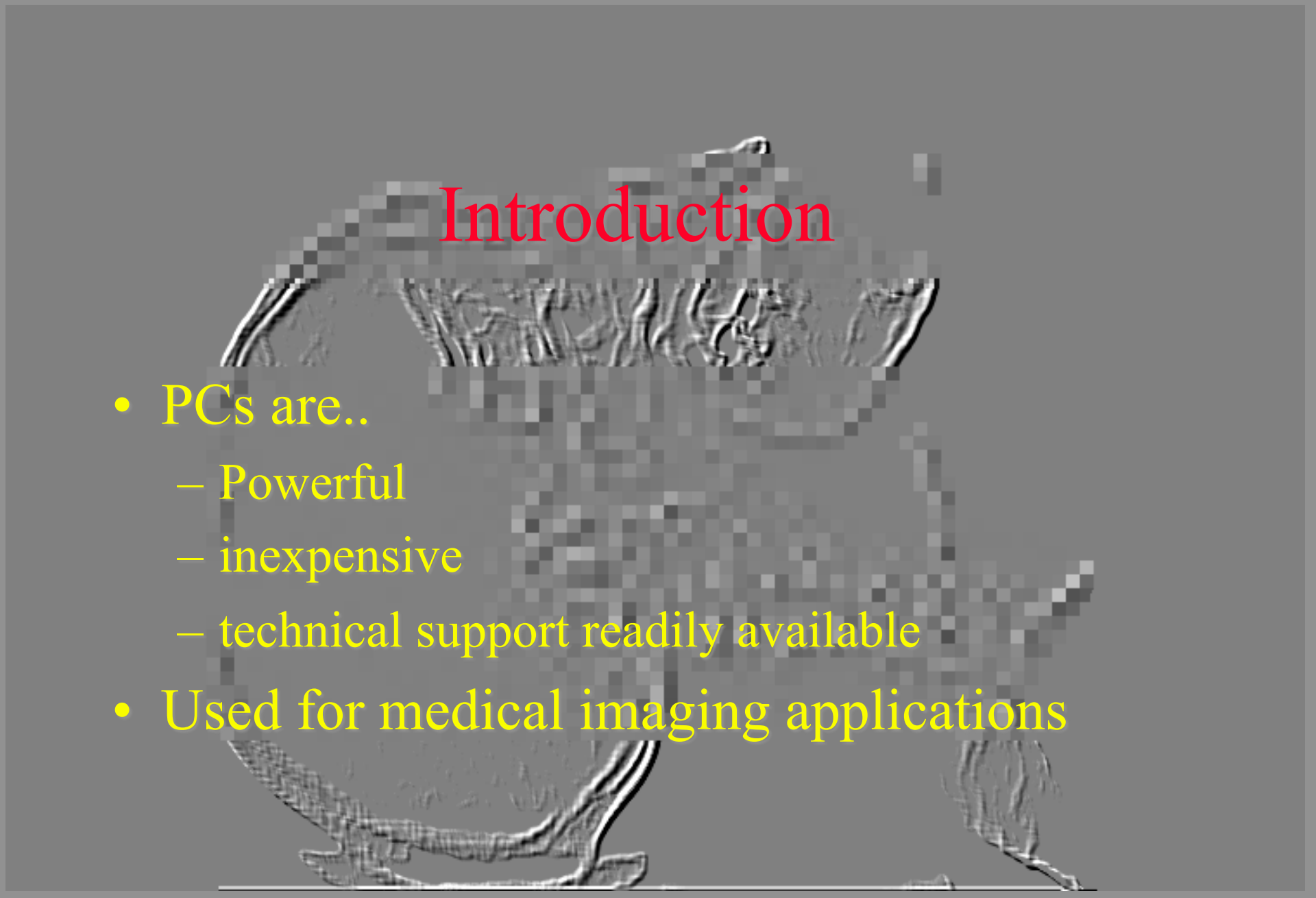
Making TIFF DICOM compatible

Ado van Rensburg



Introduction

- PCs are..
  - Powerful
  - inexpensive
  - technical support readily available
- Used for medical imaging applications

Introduction

- Possible to translate
- Retain both format compliance's
- Need to analyse DICOM elements
- Program developed to do this

Introduction

DICOM SOP to store images

&

Commercial file format

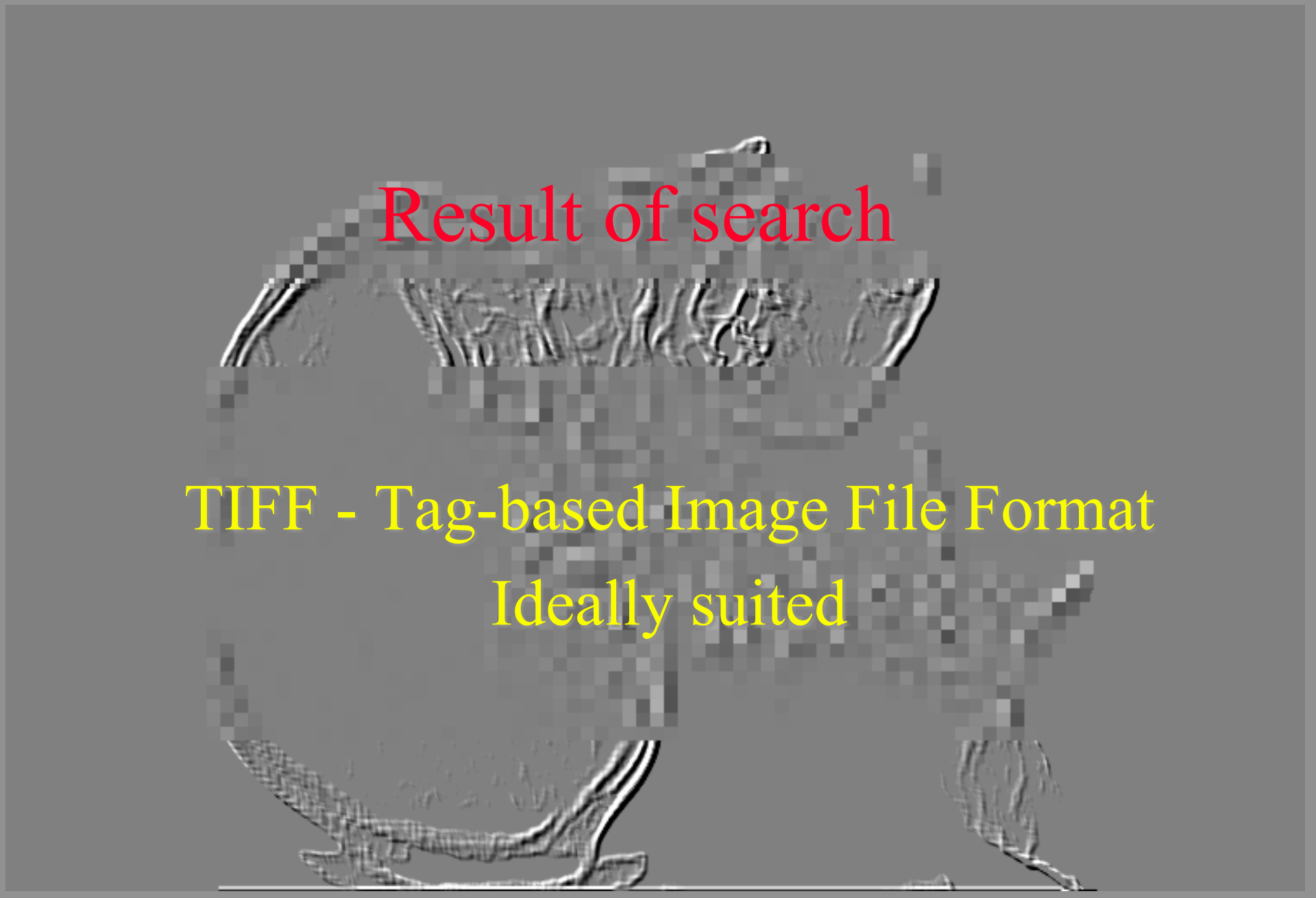
||

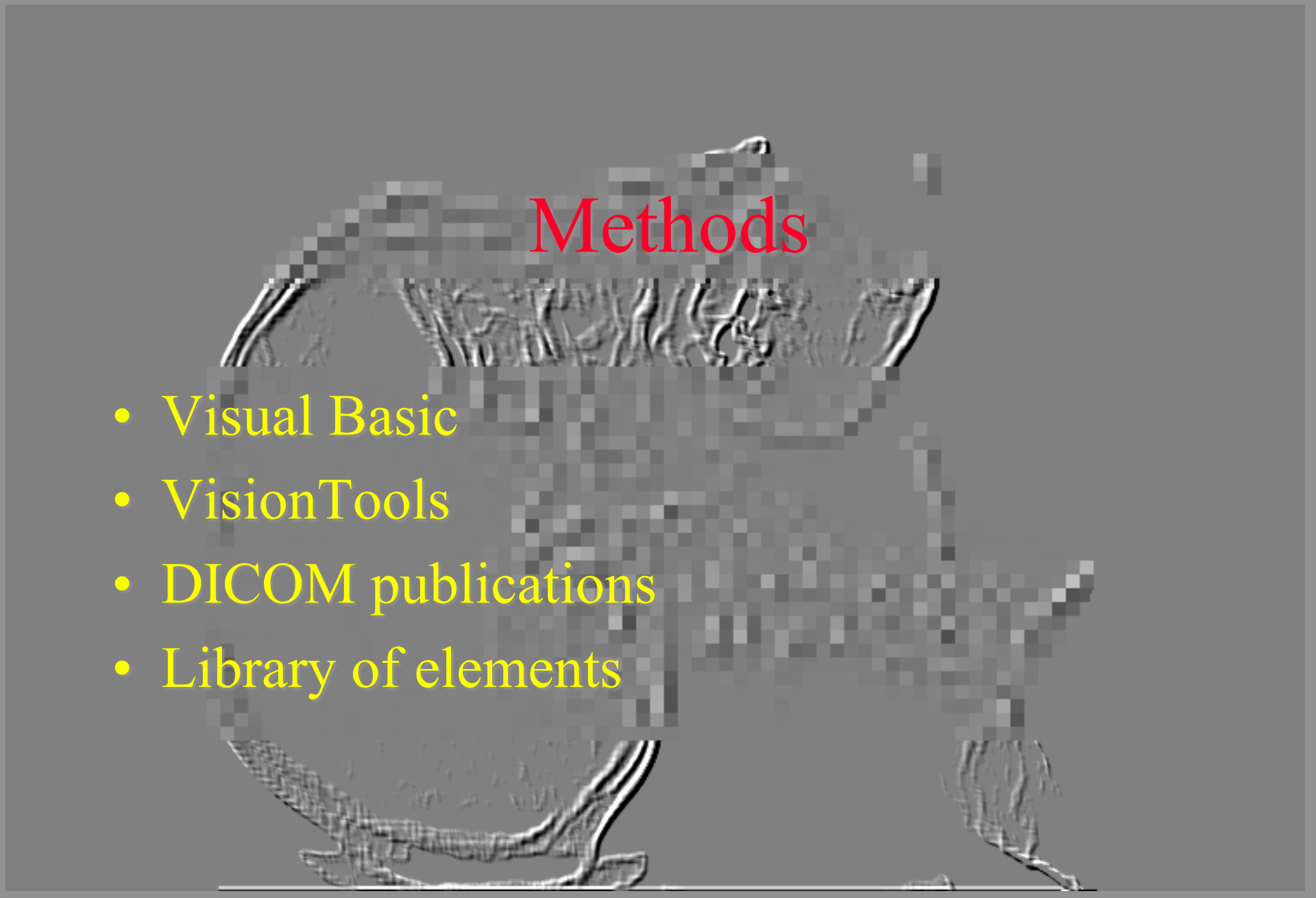
Combined seamlessly

Methods

- Studied DICOM requirements
- Studied commercial file formats
- Look for possible marriage

Making TIFF DICOM compatible





Methods

- Visual Basic
- VisionTools
- DICOM publications
- Library of elements

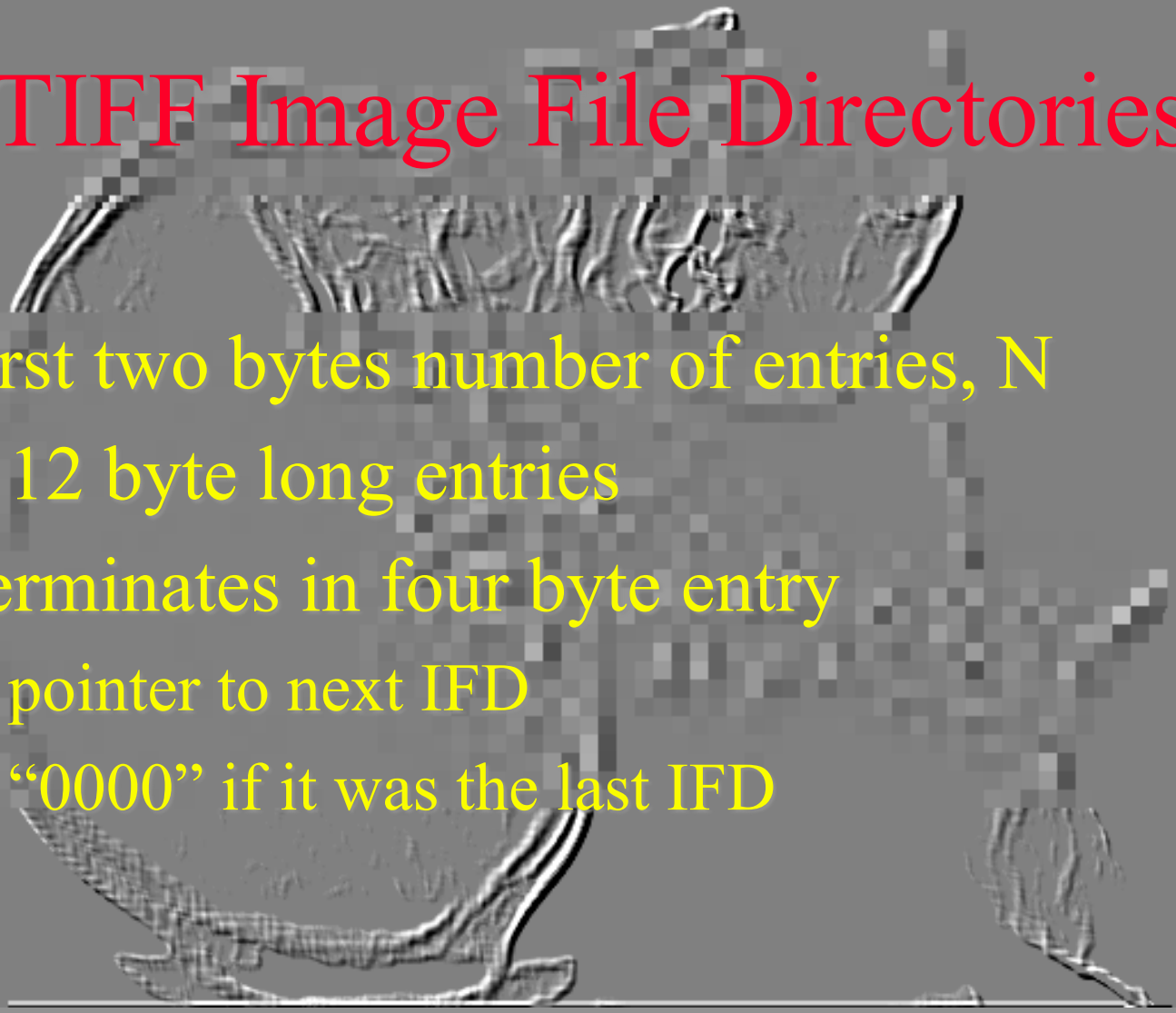
TIFF File format

- Raster images
- Independent of computer architecture, operating system and graphic hardware
- Compact, handles B&W and color
- Well documented and supported

TIFF file header

- Bytes 0-1
  - "II" little-endian least significant byte first
  - "MM" big-endian most significant byte first
- Bytes 2-3 the number "42"
- Bytes 4-7 offset in bytes to first IFD

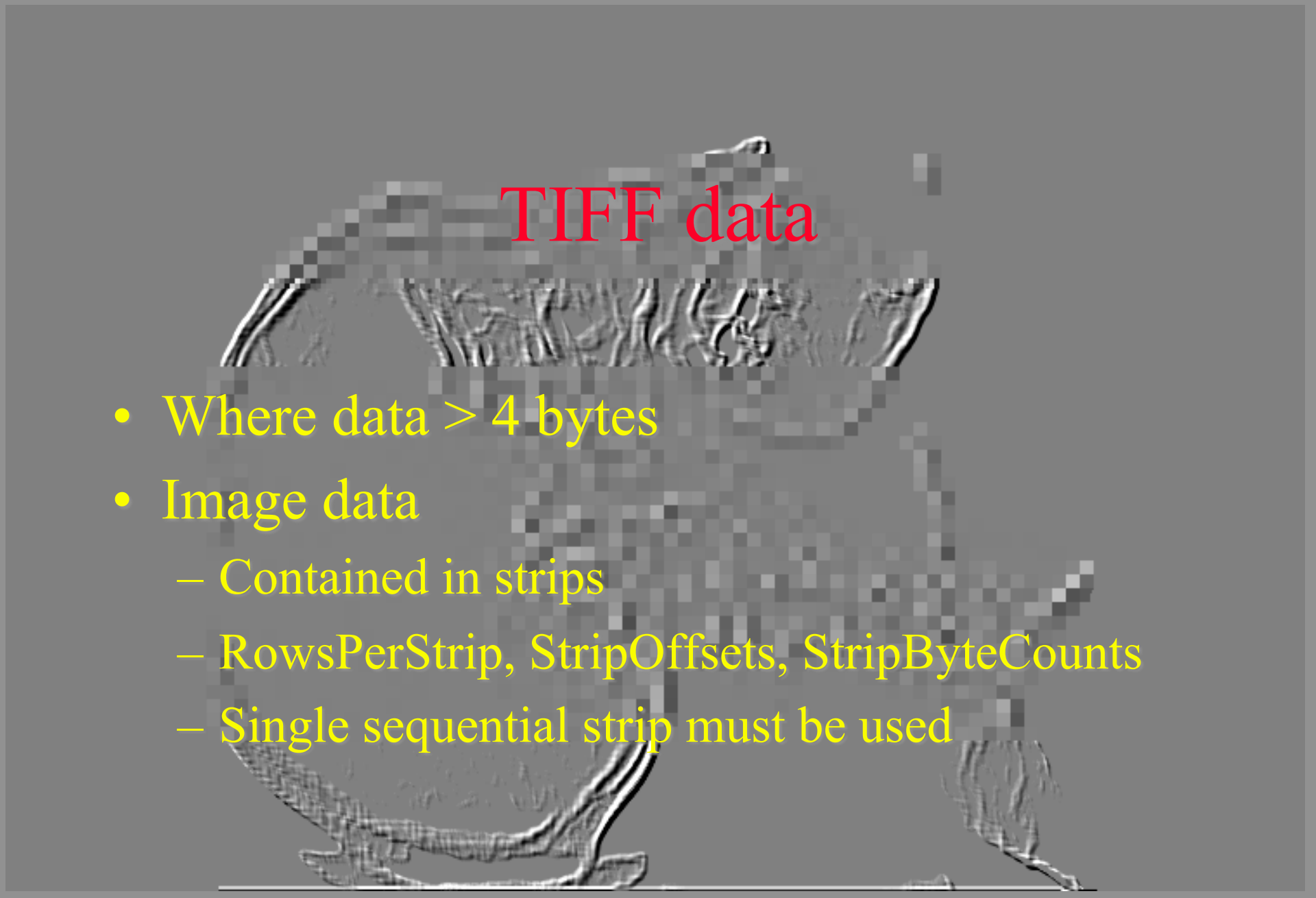
TIFF Image File Directories



- First two bytes number of entries, N
- N 12 byte long entries
- Terminates in four byte entry
  - pointer to next IFD
  - “0000” if it was the last IFD

TIFF IFD entries

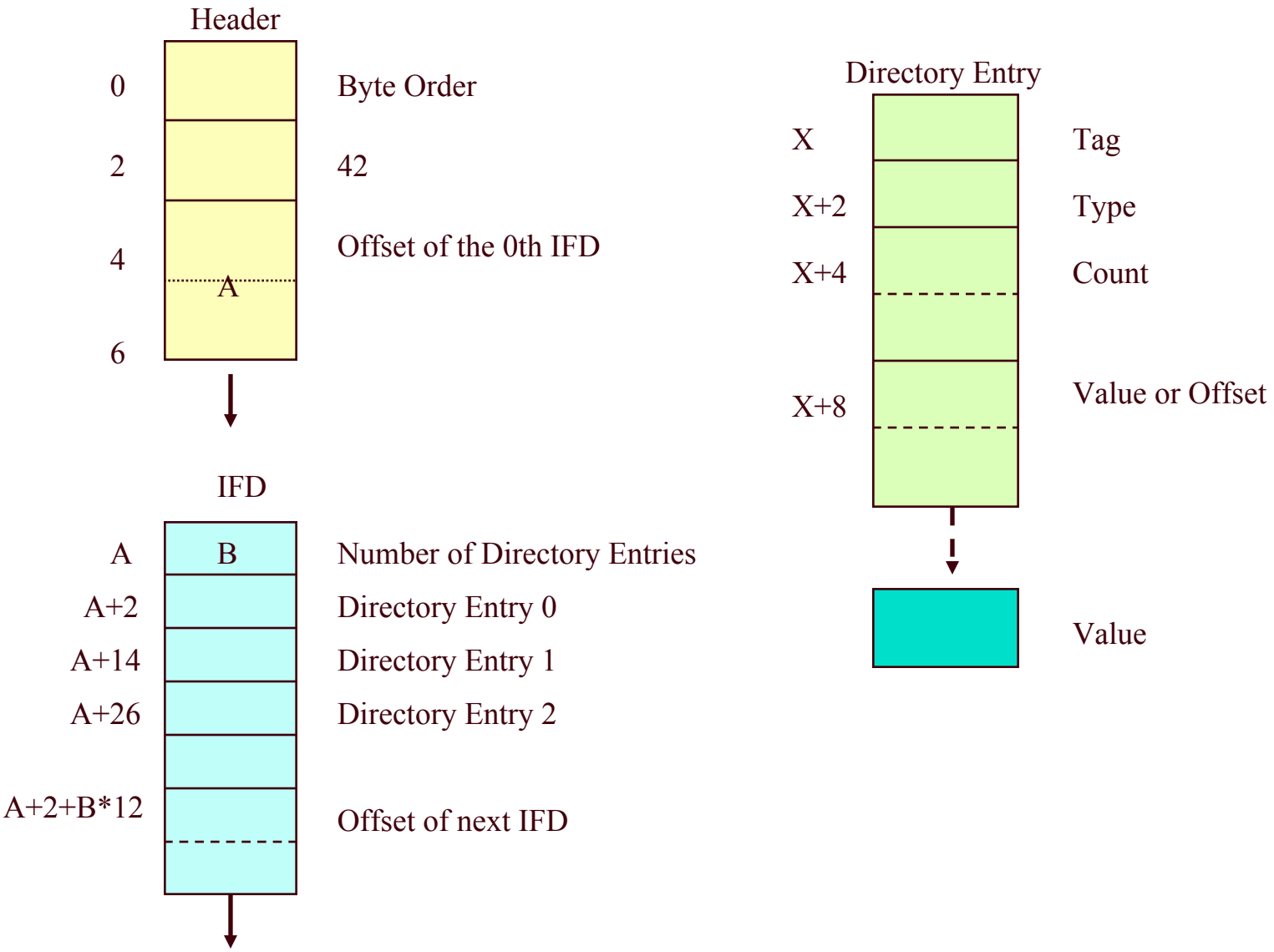
- Bytes 0-1 identification tag
- Bytes 2-3 data type e.g. ASCII, SHORT
- Bytes 4-7 count field
- Bytes 8-11 actual data or pointer to data

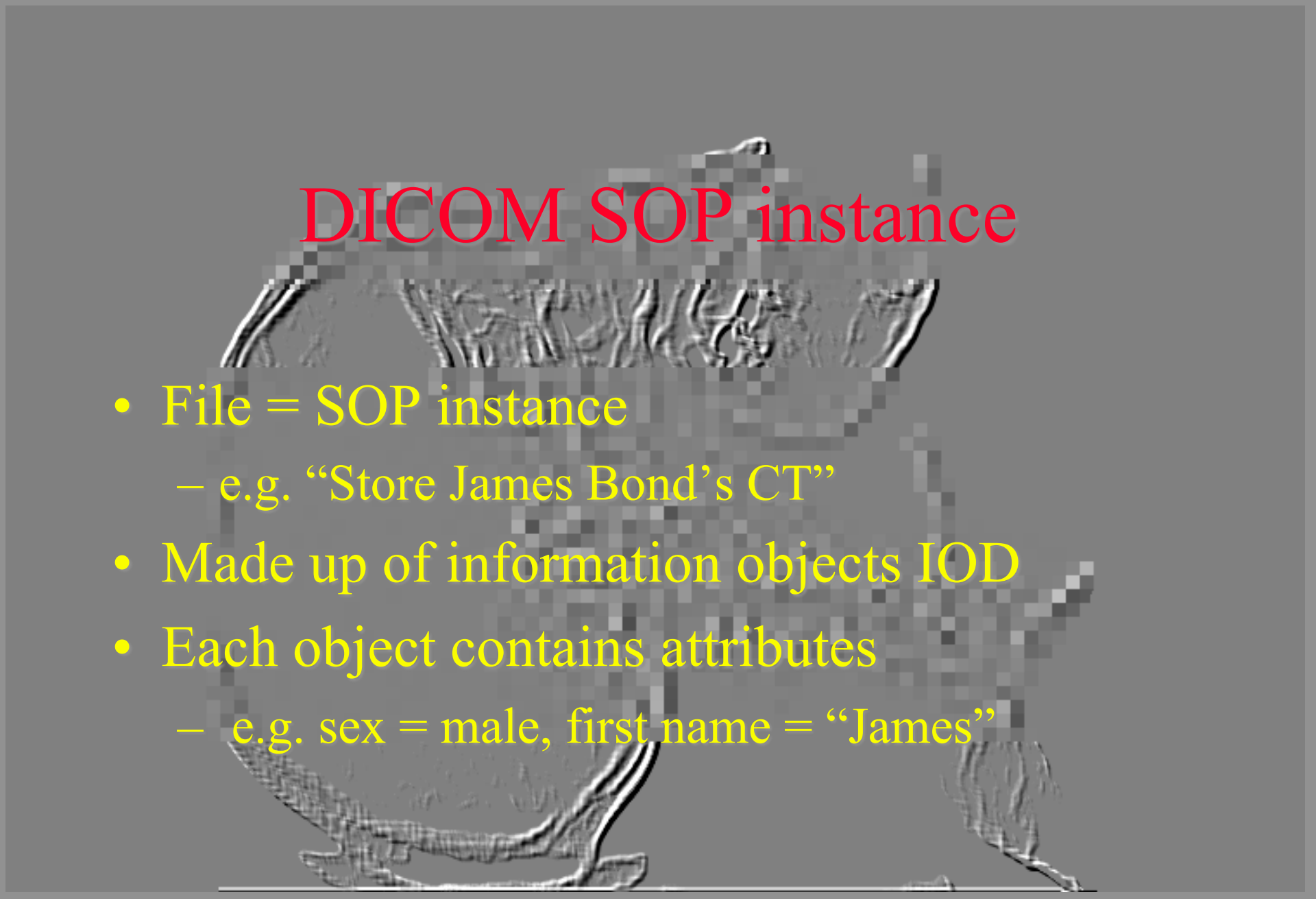


TIFF data

- Where data > 4 bytes
- Image data
  - Contained in strips
  - RowsPerStrip, StripOffsets, StripByteCounts
  - Single sequential strip must be used

TIFF structure





DICOM SOP instance

- File = SOP instance
  - e.g. “Store James Bond’s CT”
- Made up of information objects IOD
- Each object contains attributes
  - e.g. sex = male, first name = “James”

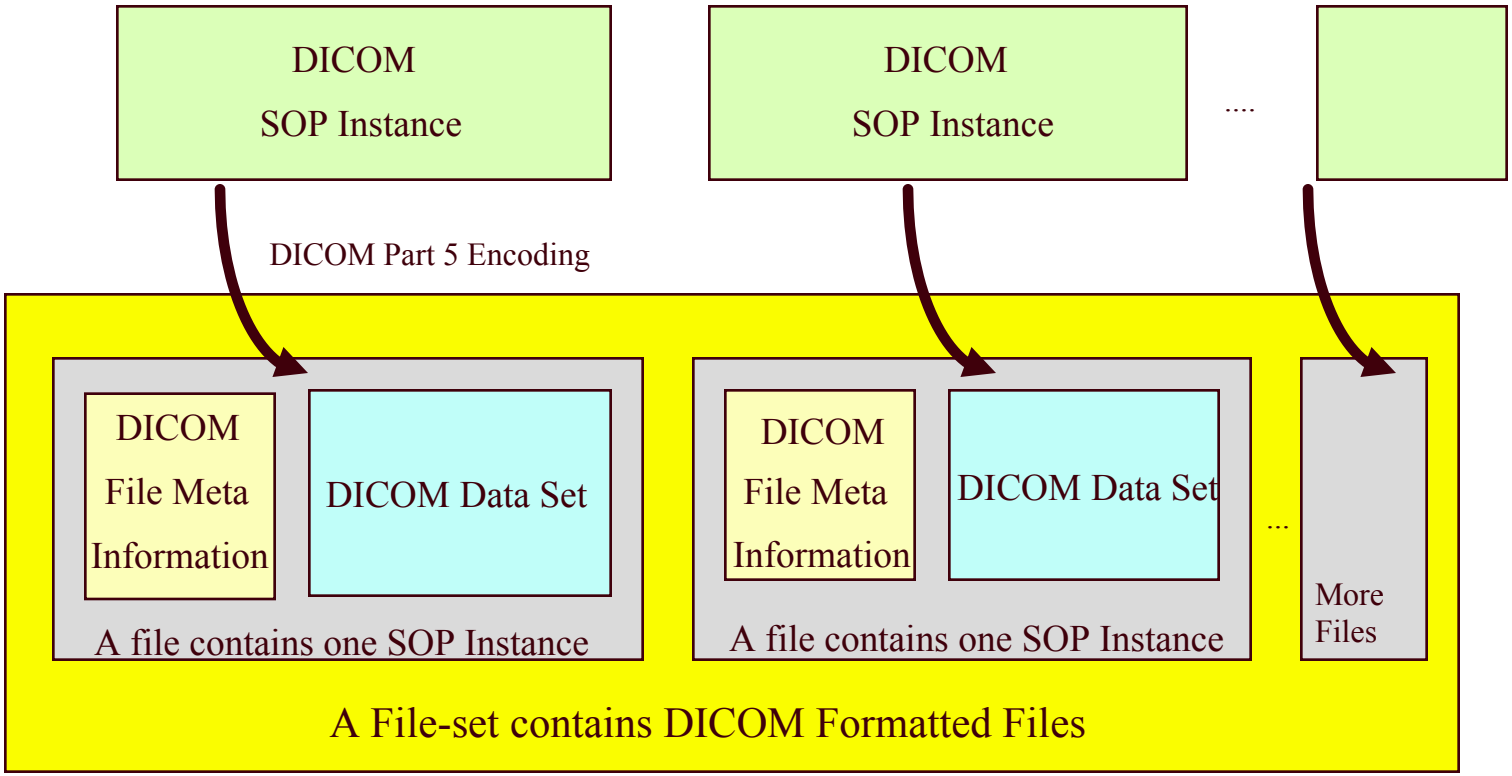
DICOM attributes

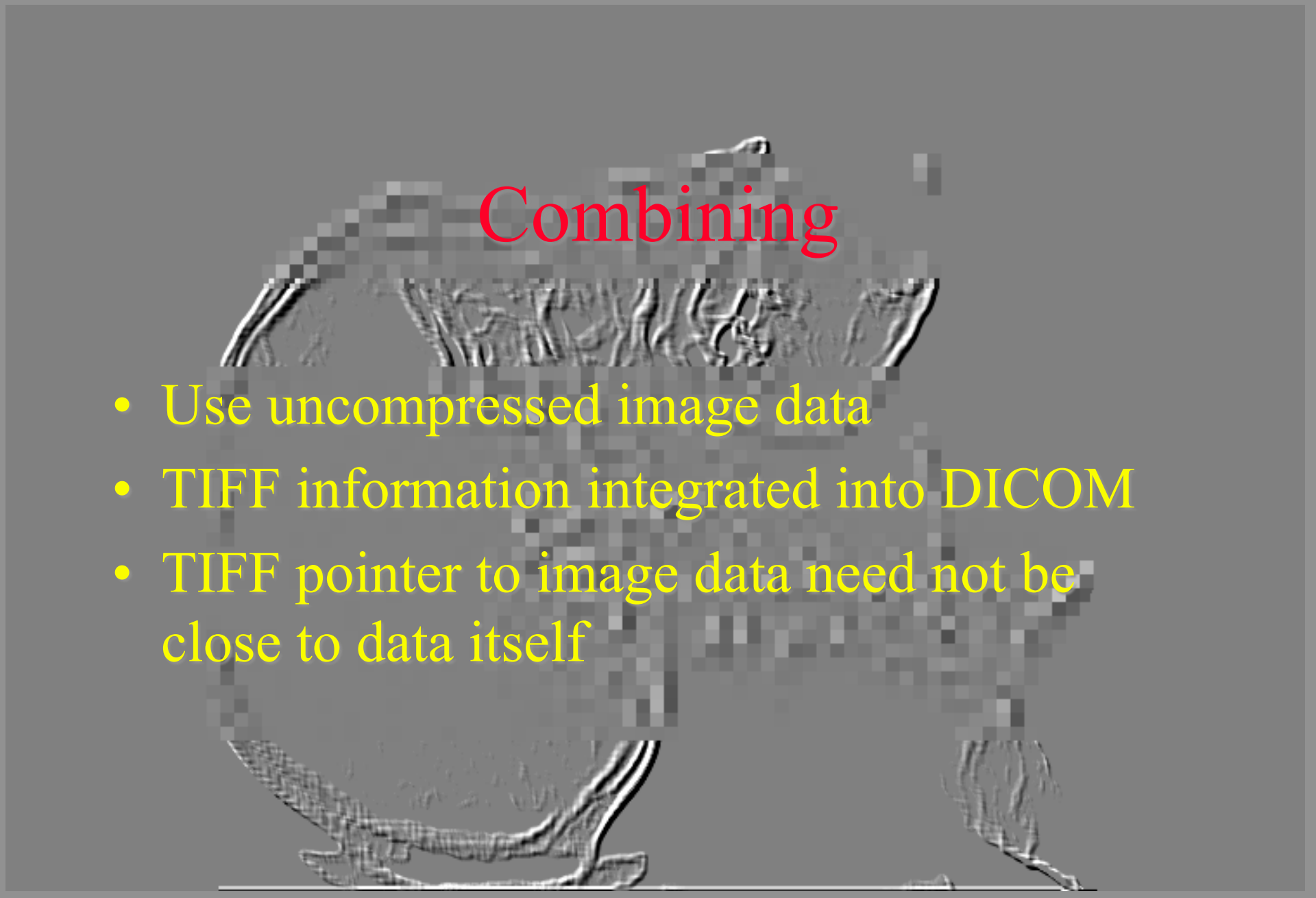
- Each attribute consists of
  - Tag:
    - group number (e.g. 0010 - patient)
    - element (e.g. 0010 - patient name)
  - length
  - value

DICOM file Meta inf. IOD

- 128 bytes File Preamble
- Four byte Prefix - “DICM”
- File Meta Element
  - group 0020 hex
  - UID’s, SOP instance, transfer syntax

The PC file


DICOM
SOP Instance
DICOM
SOP Instance
....
DICOM Part 5 Encoding
DICOM
File Meta
Information
DICOM Data Set
A file contains one SOP Instance
DICOM
File Meta
Information
DICOM Data Set
A file contains one SOP Instance
...
More
Files
A File-set contains DICOM Formatted Files

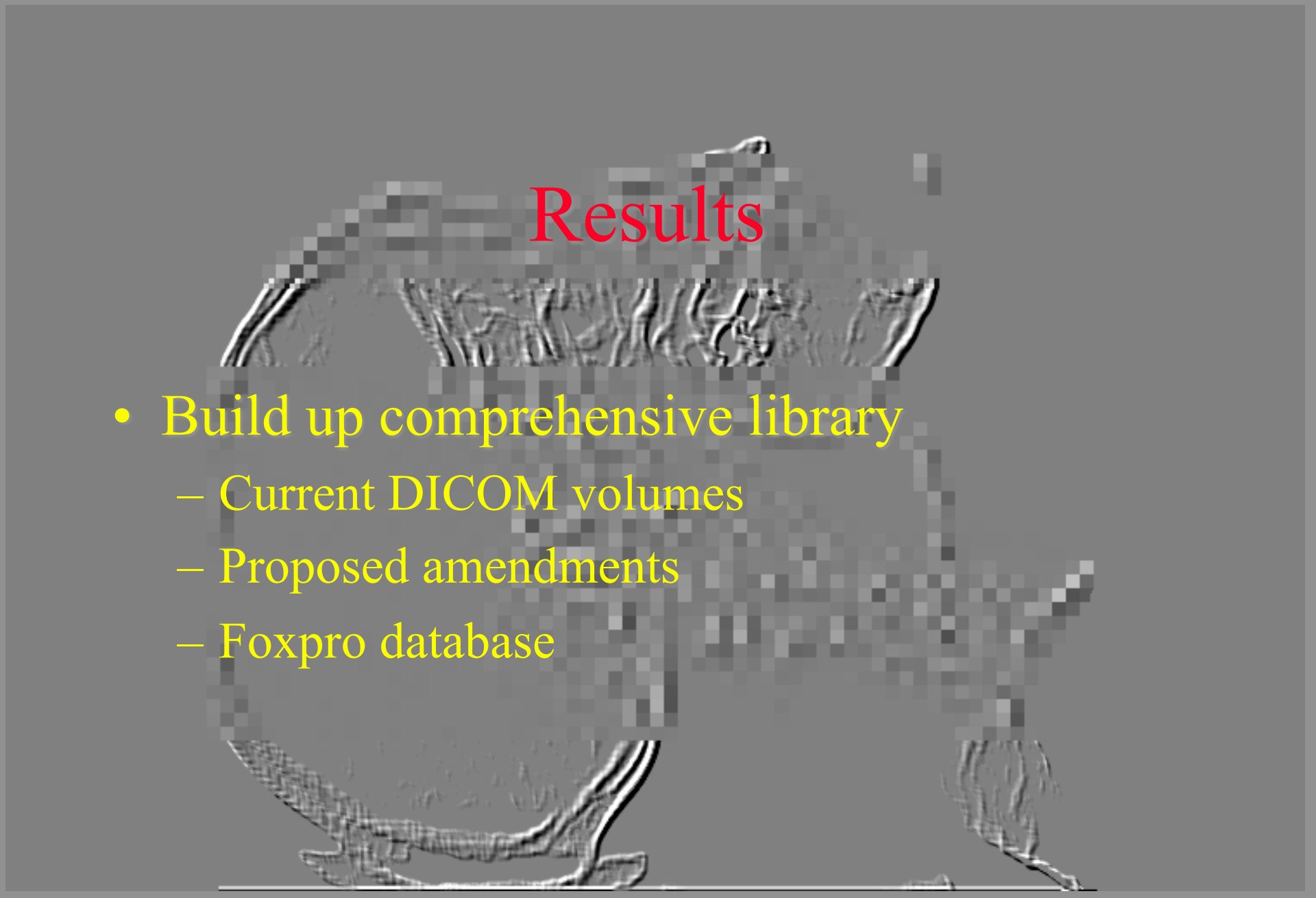


Combining

- Use uncompressed image data
- TIFF information integrated into DICOM
- TIFF pointer to image data need not be close to data itself

Combining strategy

- Only header and pointer to first IFD stored in Preamble
- IFD's embedded in DICOM section
  - Private Information in File Meta Information
  - Following private tag at the end of the file

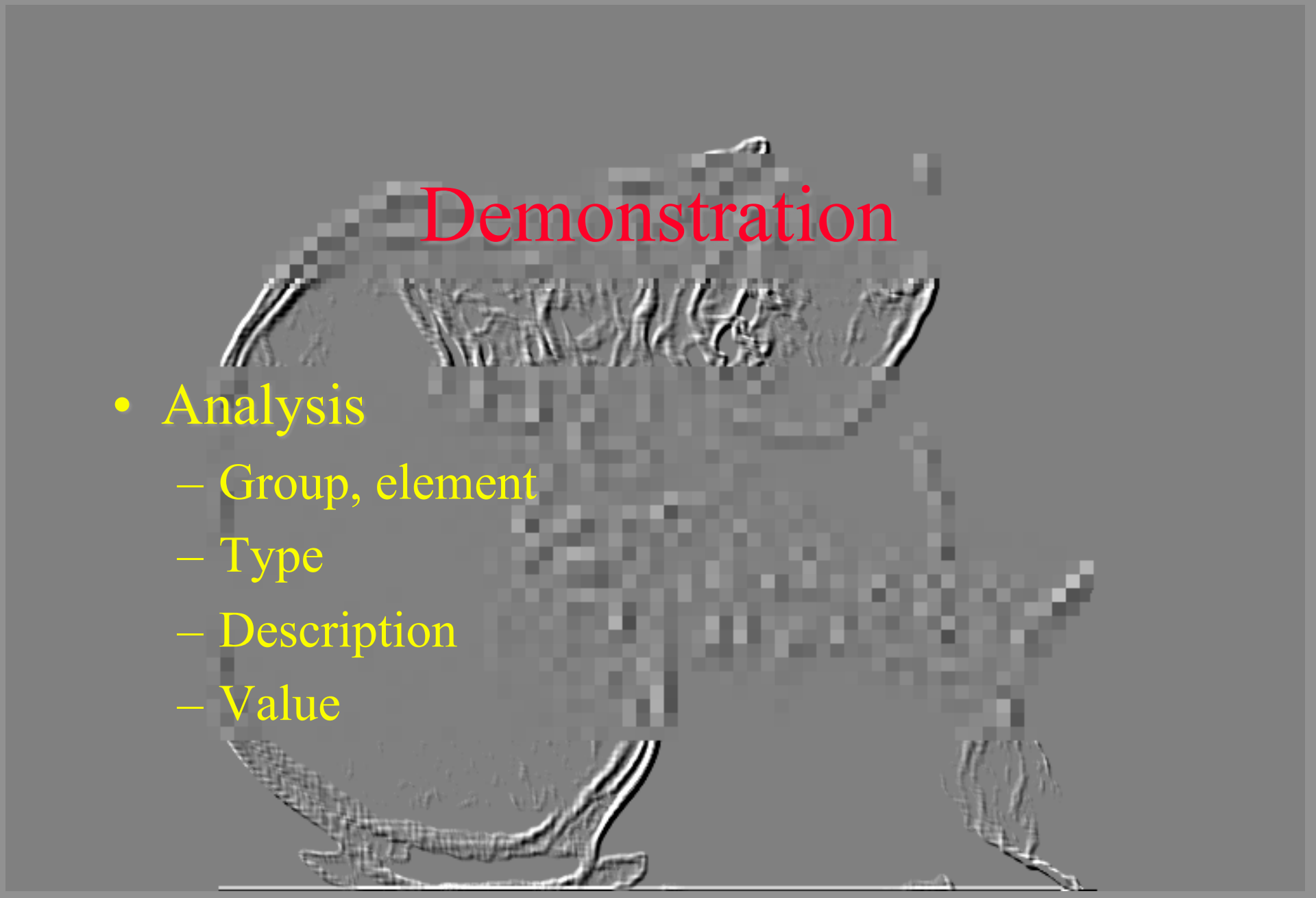


Results

- Build up comprehensive library
  - Current DICOM volumes
  - Proposed amendments
  - Foxpro database

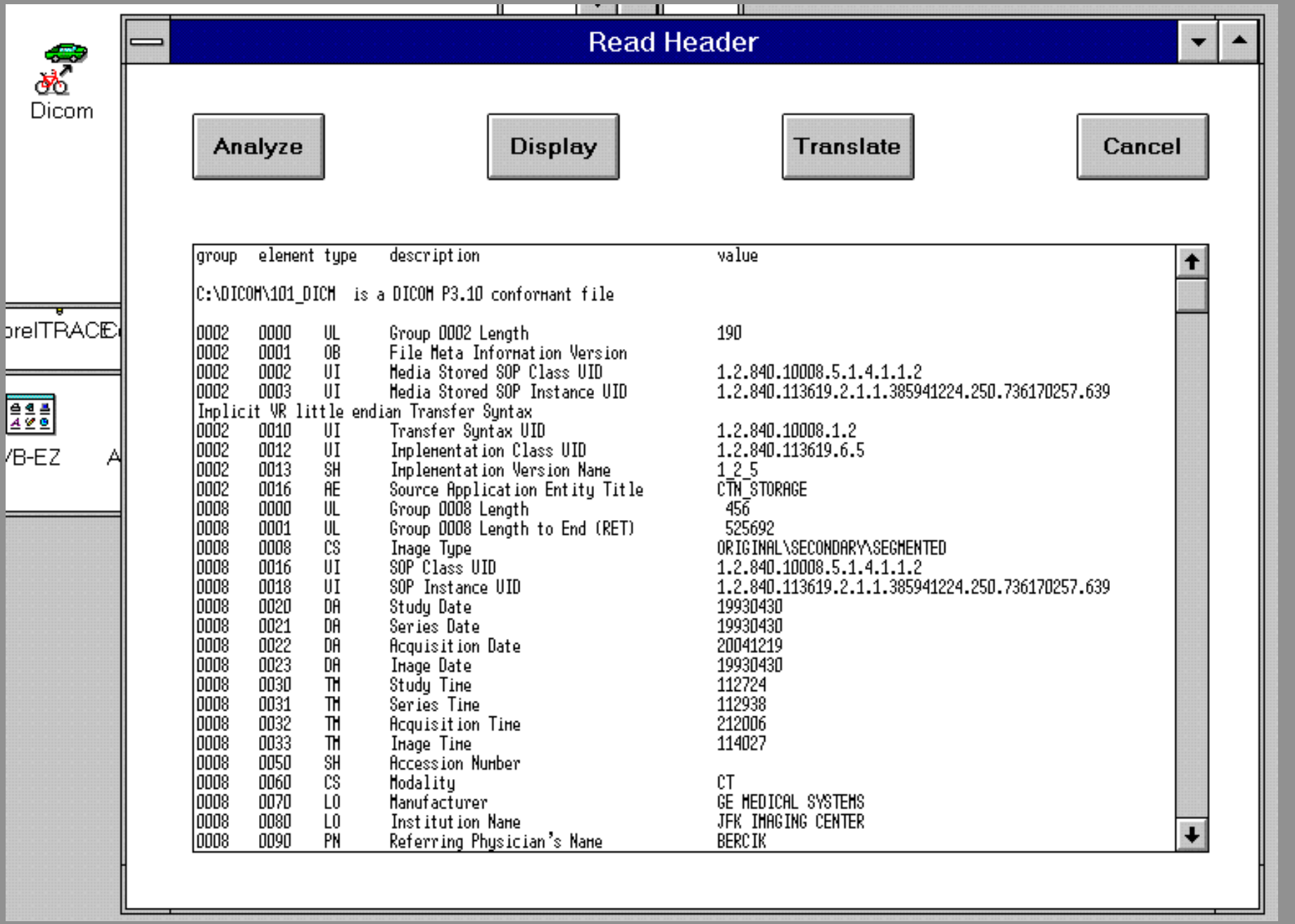
Results

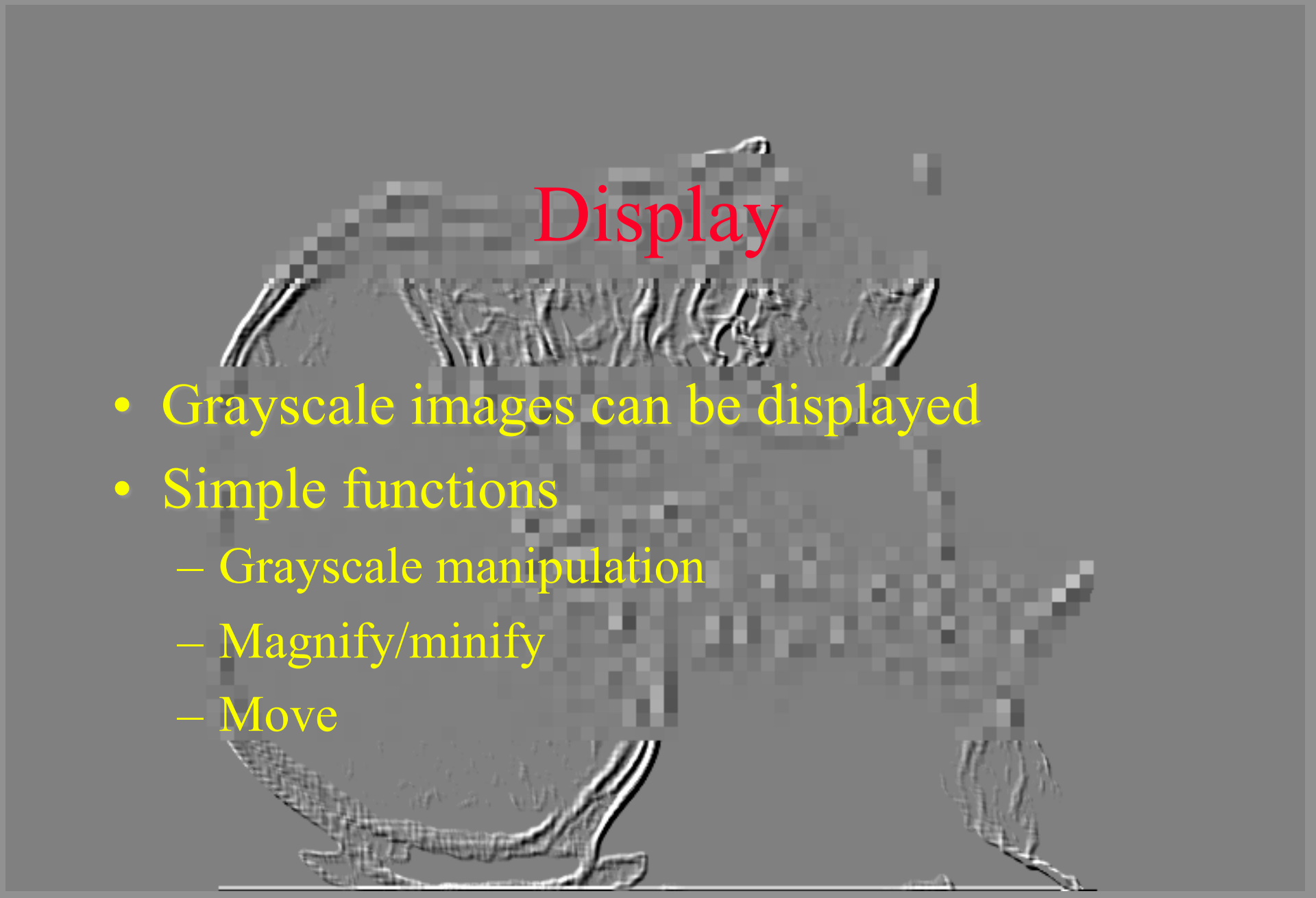
- Analyzed image files
  - ACR/NEMA files
  - Not P3.10 compliant
  - Other deviations from norm



Demonstration

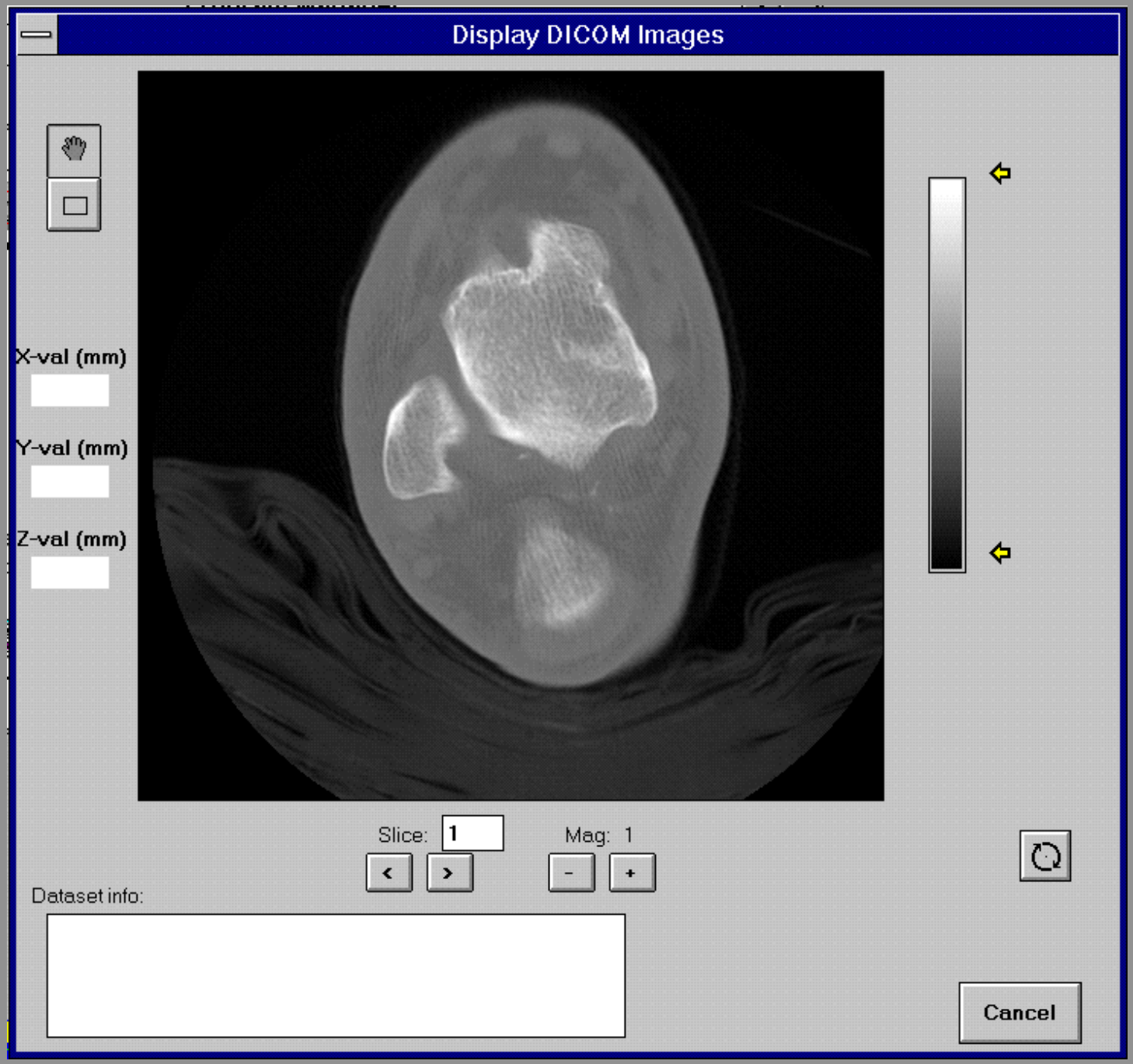
- Analysis
  - Group, element
  - Type
  - Description
  - Value


Dicom
Read Header
Analyze
Display
Translate
Cancel
group element type description value
C:\DICOM\101_DICM is a DICOM P3.10 conformant file
0002 0000 UL Group 0002 Length 190
0002 0001 OB File Meta Information Version
0002 0002 UI Media Stored SOP Class UID 1.2.840.10008.5.1.4.1.1.2
0002 0003 UI Media Stored SOP Instance UID 1.2.840.113619.2.1.1.385941224.250.736170257.639
Implicit VR little endian Transfer Syntax
0002 0010 UI Transfer Syntax UID 1.2.840.10008.1.2
0002 0012 UI Implementation Class UID 1.2.840.113619.6.5
0002 0013 SH Implementation Version Name 1_2_5
0002 0016 AE Source Application Entity Title CTN_STORAGE
0008 0000 UL Group 0008 Length 456
0008 0001 UL Group 0008 Length to End (RET) 525692
0008 0008 CS Image Type ORIGINAL\SECONDARY\SEGMENTED
0008 0016 UI SOP Class UID 1.2.840.10008.5.1.4.1.1.2
0008 0018 UI SOP Instance UID 1.2.840.113619.2.1.1.385941224.250.736170257.639
0008 0020 DA Study Date 19930430
0008 0021 DA Series Date 19930430
0008 0022 DA Acquisition Date 20041219
0008 0023 DA Image Date 19930430
0008 0030 TM Study Time 112724
0008 0031 TM Series Time 112938
0008 0032 TM Acquisition Time 212006
0008 0033 TM Image Time 114027
0008 0050 SH Accession Number
0008 0060 CS Modality CT
0008 0070 LO Manufacturer GE MEDICAL SYSTEMS
0008 0080 LO Institution Name JFK IMAGING CENTER
0008 0090 PN Referring Physician's Name BERCIK



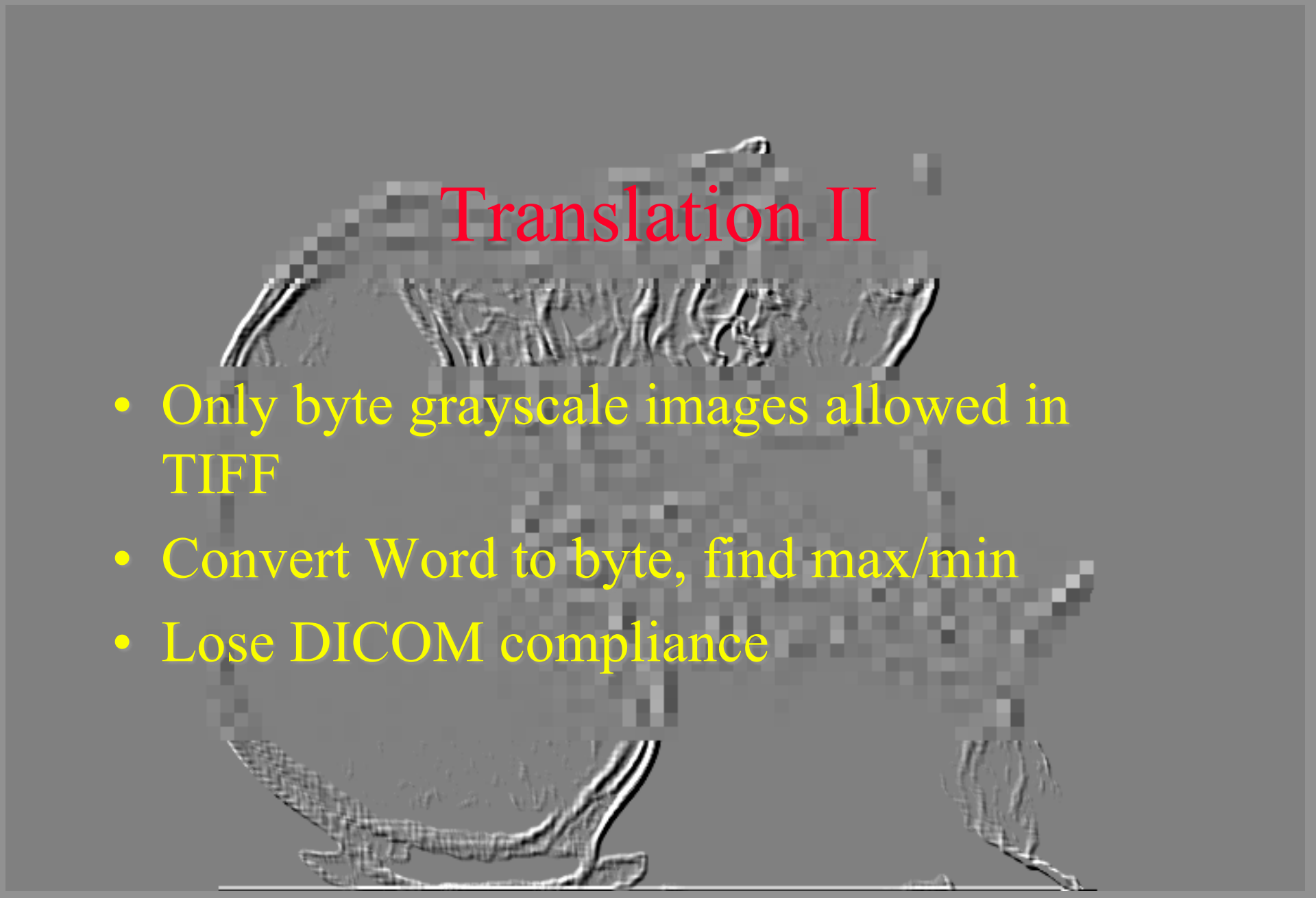
Display

- Grayscale images can be displayed
- Simple functions
  - Grayscale manipulation
  - Magnify/minify
  - Move


Display DICOM Images
X-val (mm)
Y-val (mm)
Z-val (mm)
Slice: 1
Mag: 1
<
>
-
+
Dataset info:
Cancel

Translation I

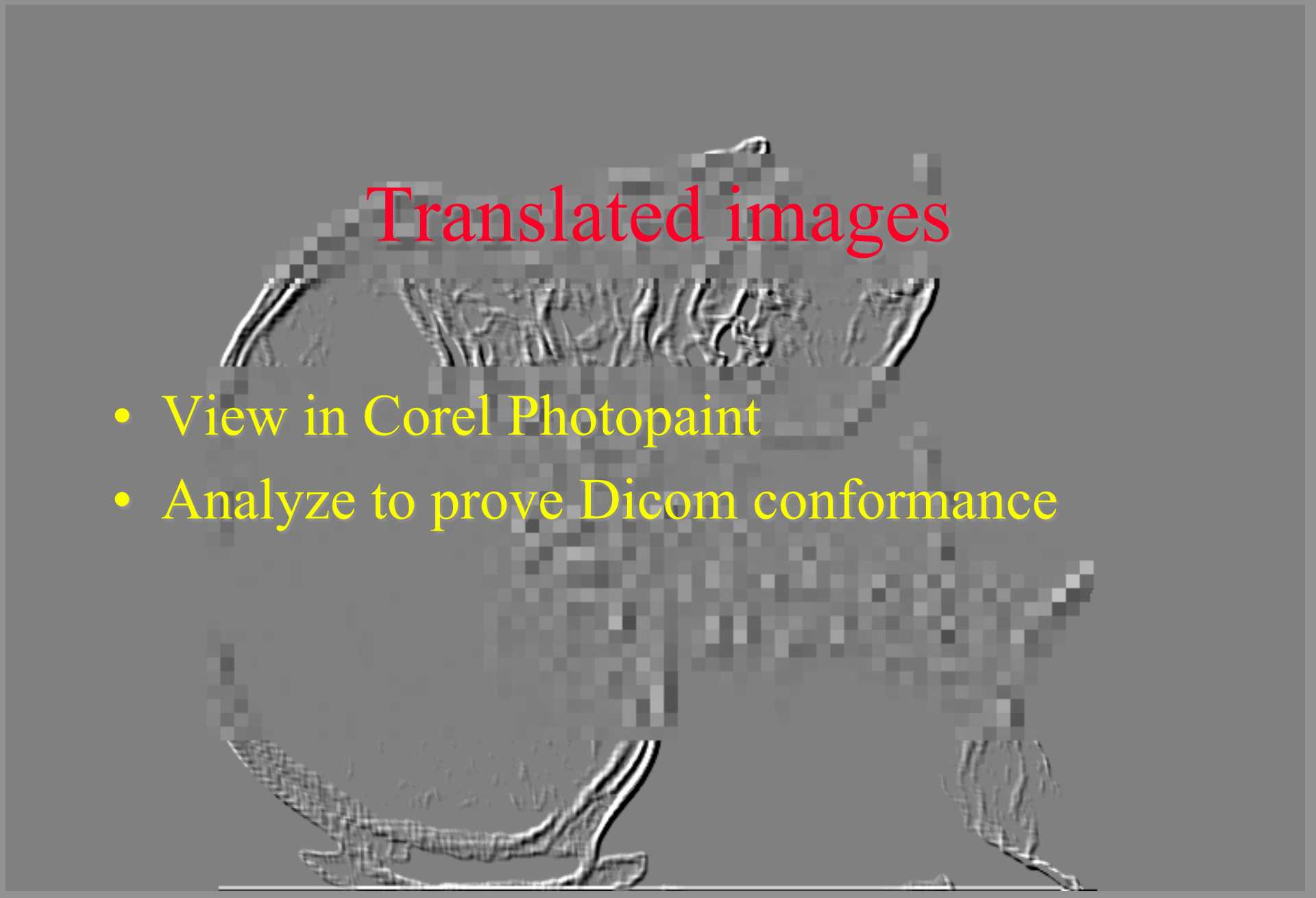
- Only header and pointer to first IFD stored in Preamble
- IFD's embedded in DICOM section
  - Private Information in File Meta Information
  - Following private tag at the end of the file



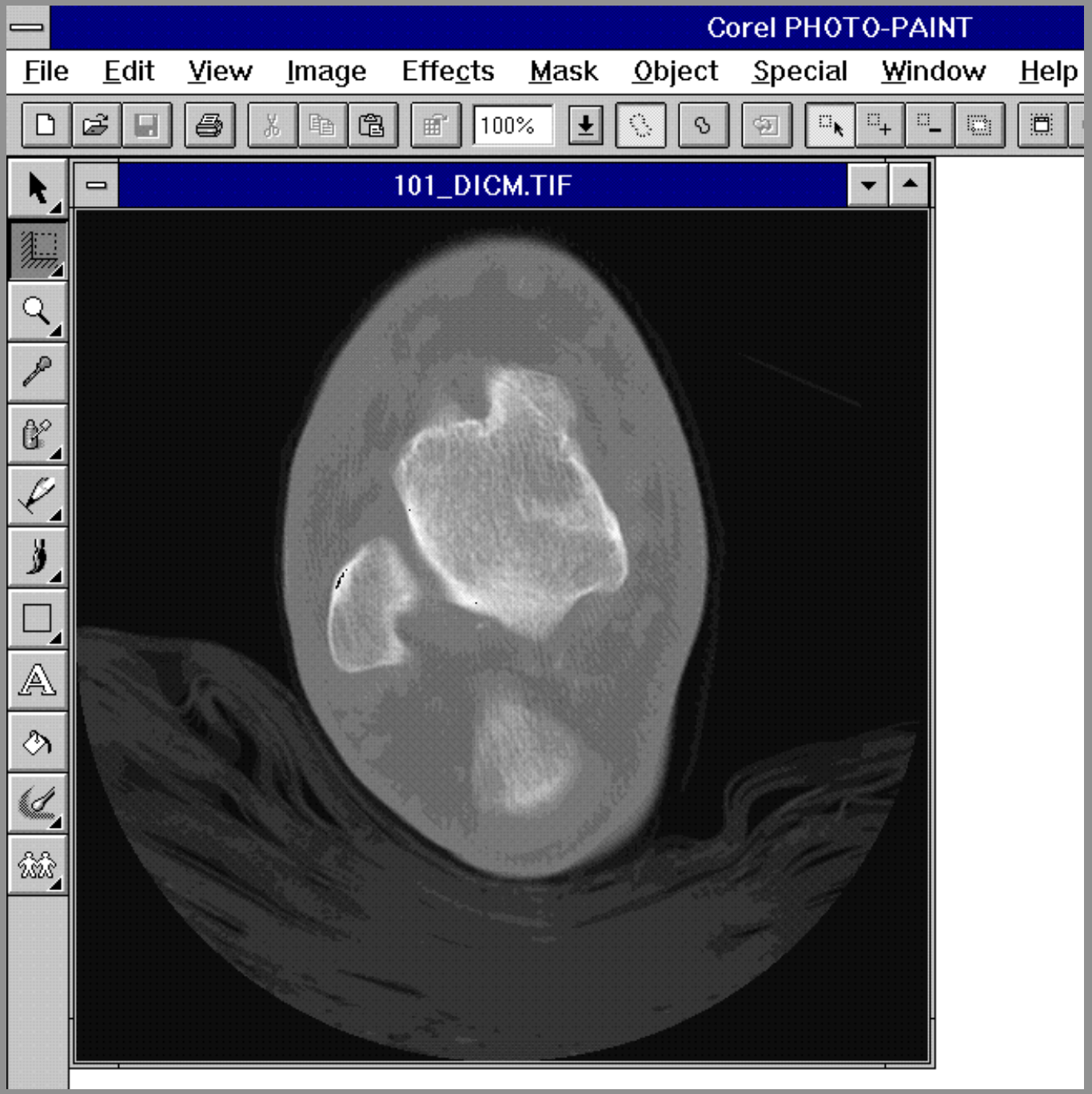
Translation II

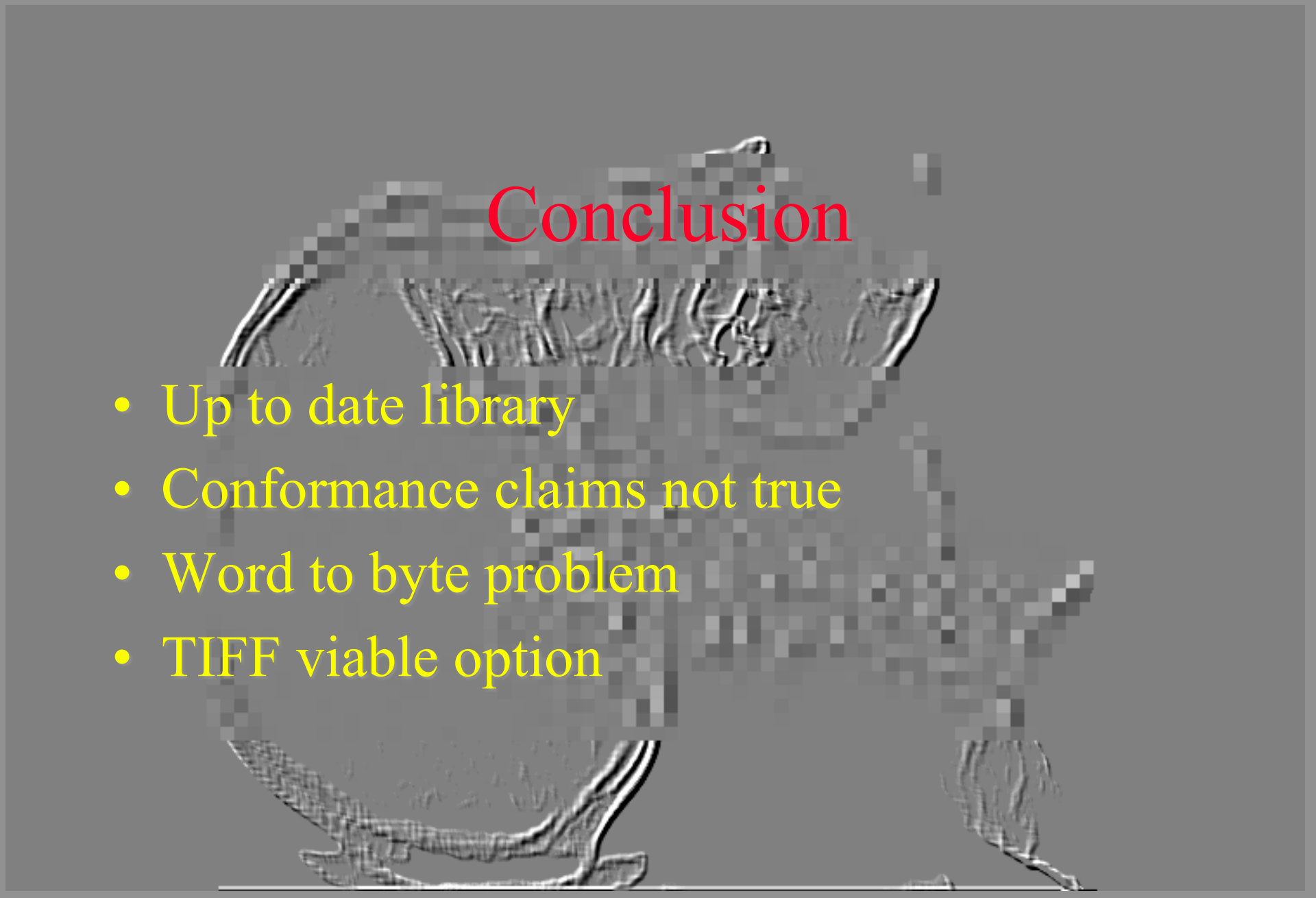
- Only byte grayscale images allowed in TIFF
- Convert Word to byte, find max/min
- Lose DICOM compliance

Translated images



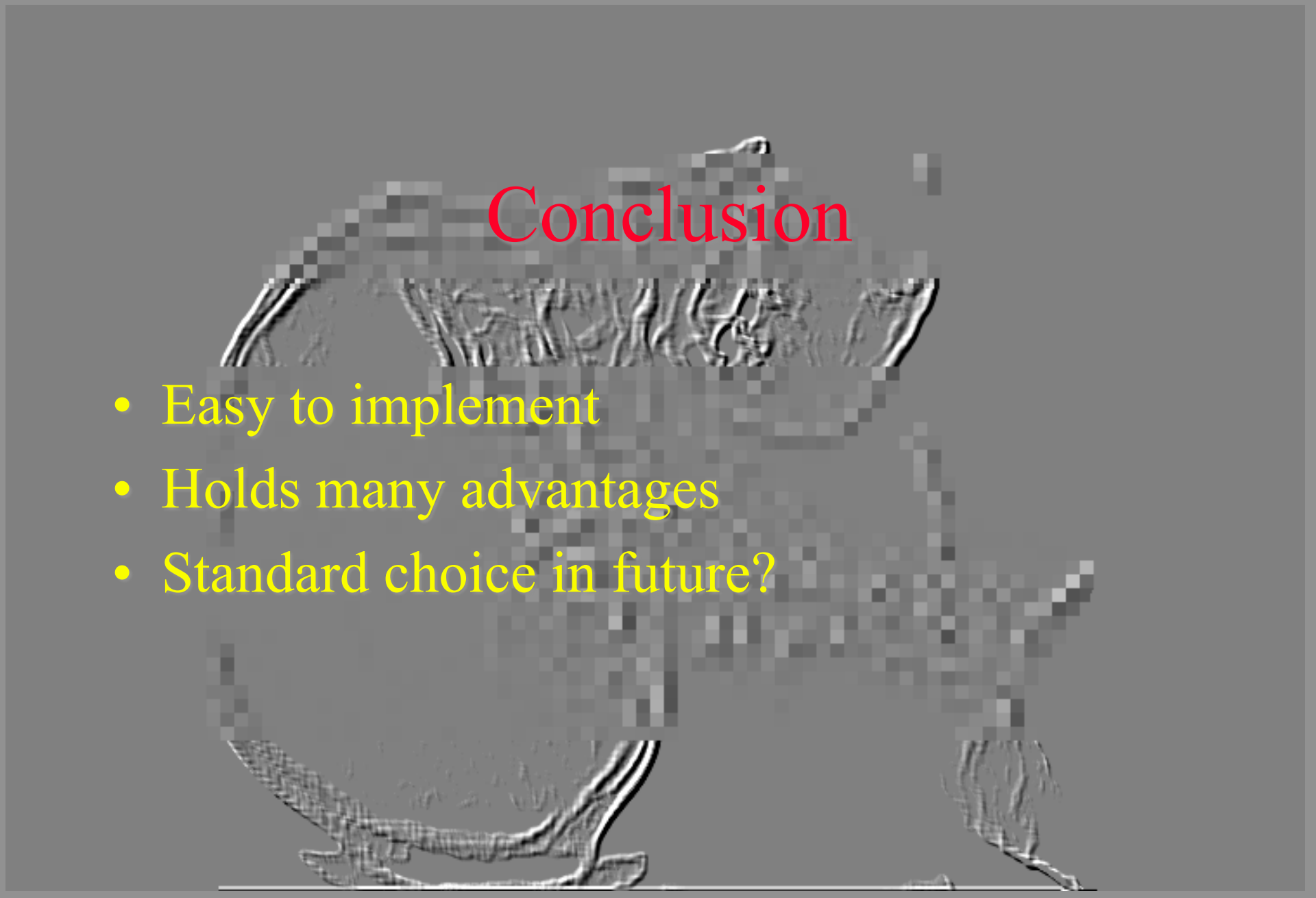
- View in Corel Photopaint
- Analyze to prove Dicom conformance


Corel PHOTO-PAINT
File Edit View Image Effects Mask Object Special Window Help
100%
101_DICM.TIF



Conclusion

- Up to date library
- Conformance claims not true
- Word to byte problem
- TIFF viable option



Conclusion

- Easy to implement
- Holds many advantages
- Standard choice in future?