

Asan J & Image J 실무연수강좌

# Image Formats & Converting

심 우 현

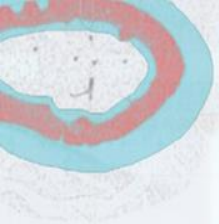
Biomedical Imaging Infrastructure

# CONTENTS

신약개발 융합 바이오이미징 센터  
Center for Bio-imaging of New Drug Development

- 이미지란?
- 이미지 **type** 및 **format** 종류?
- 이미지 format 변환 방법 및 주의사항





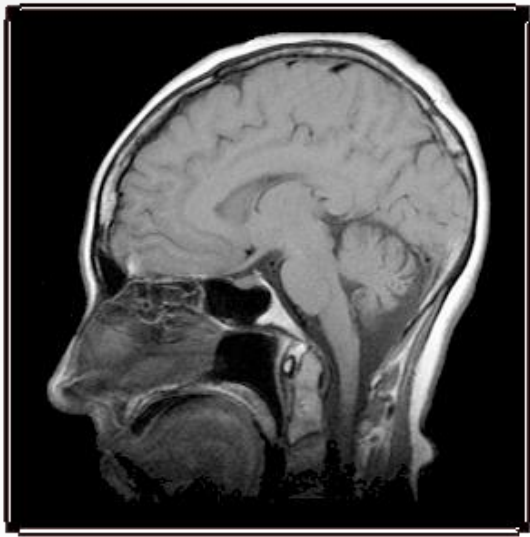
# CHAPTER

신약개발 융합 바이오이미징 센터  
Center for Bio-imaging of New Drug Development



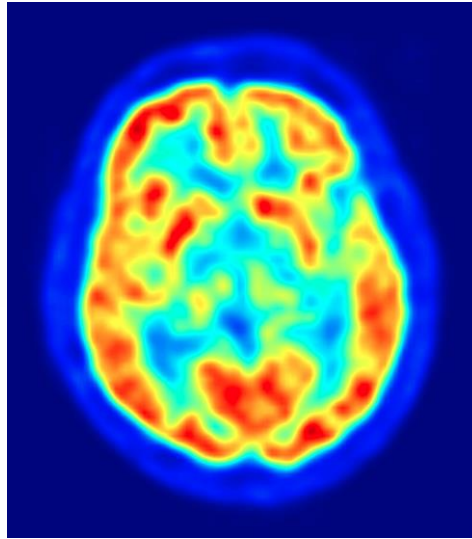
# WHAT IS IMAGE?

## MRI



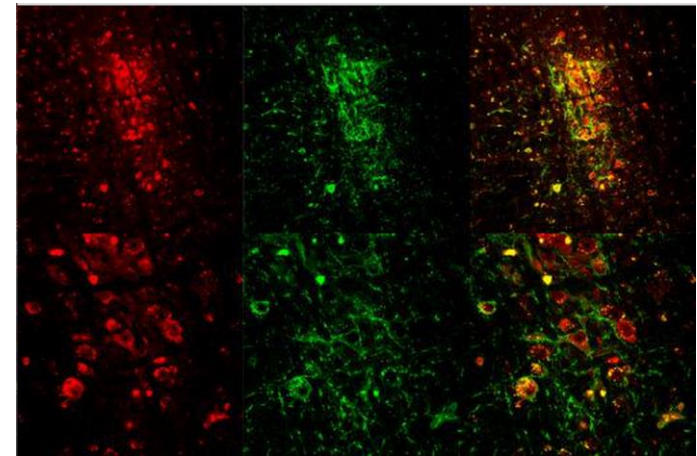
magnetic resonance

## PET



Positron emission

## Bio-Optics



reflected, refracted  
or diffracted light waves

# DEFINITION

- **The visual representation** of something (**information**)
- Pictures that has been created or copied and stored in **electronic form**

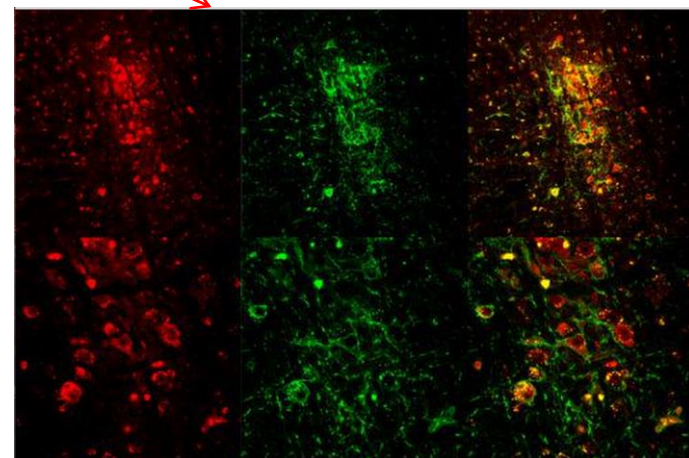
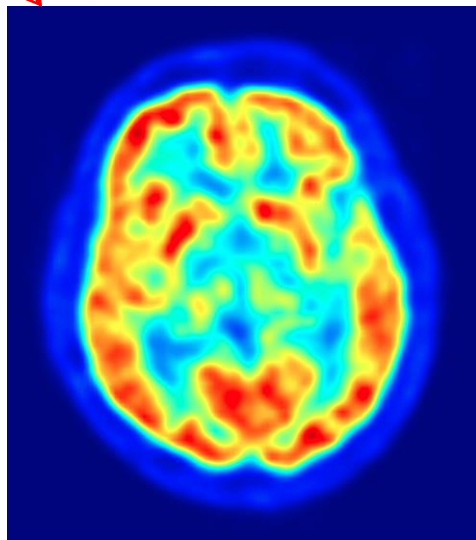
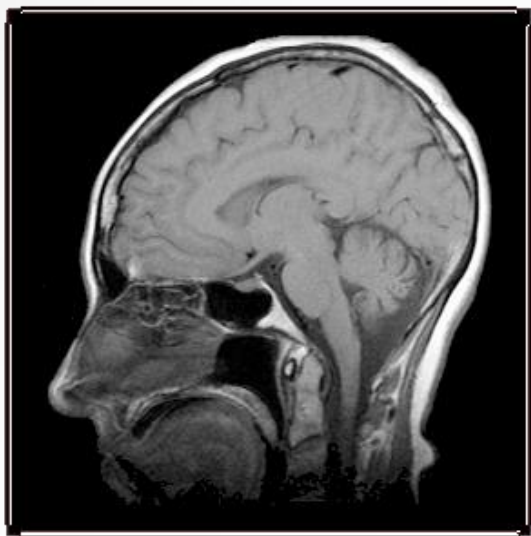


# Visual representation

MRI

PET

Bio-Optics



magnetic resonance

Positron emission

reflected, refracted  
or diffracted light waves

information

electronic form

.dcm, .nii, .par/.rec, .img/.hdr

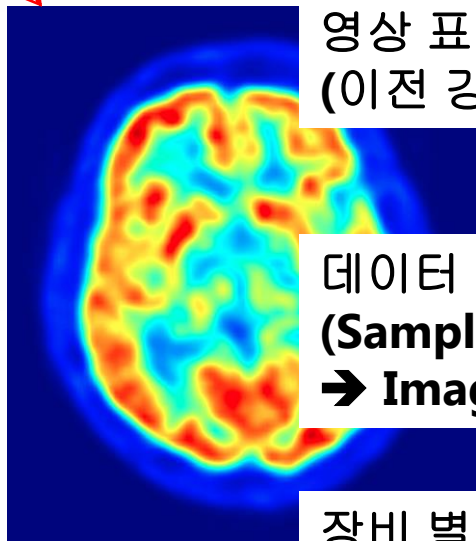
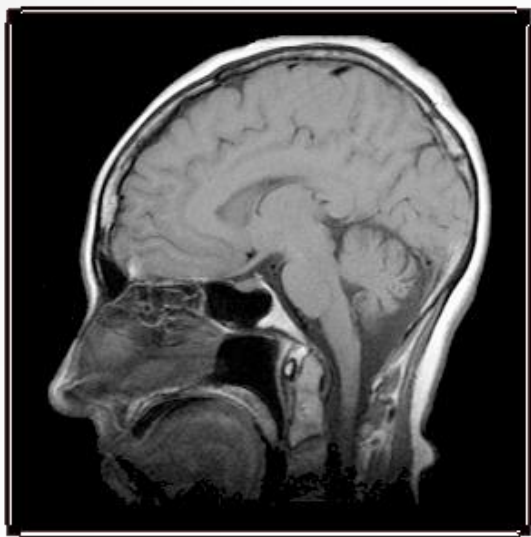
.tiff, .bmp

# Visual representation

MRI

PET

Bio-Optics



영상 표시 방법 (Windowing, Contrast)  
(이전 강의 + 중급)

데이터 → 영상 변환 방식  
(Sampling, **quantization**)  
→ Image type



장비 별 데이터 저장 방법  
(파일 확장자)

→ Image format

refracted  
light waves

## information

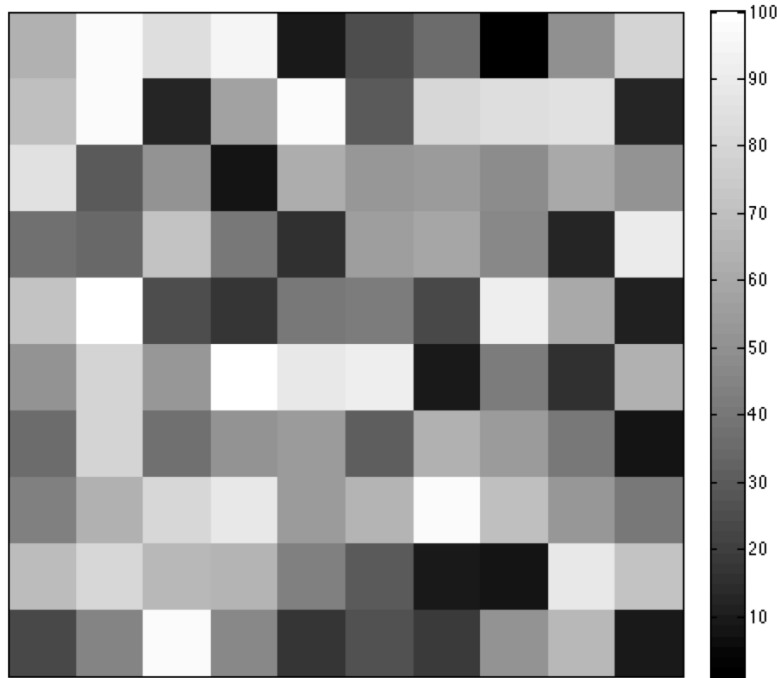
## electronic form

magnetic resonance    Positron  $\epsilon$

.dcm, .nii, .par/.rec, .img/.hdr

.tiff, .bmp

# Visual representation → Information



64	98	83	94	10	25	36	1	49	79
70	98	13	58	97	29	81	84	86	13
86	29	51	8	62	53	54	48	61	52
38	34	72	41	16	56	59	47	12	90
71	100	25	18	40	42	23	91	61	11
52	79	53	100	88	91	10	42	16	63
36	79	38	52	54	31	64	54	40	8
43	63	80	89	54	65	98	70	53	41
69	81	67	65	44	29	10	8	88	71
23	45	98	47	18	26	19	51	66	10

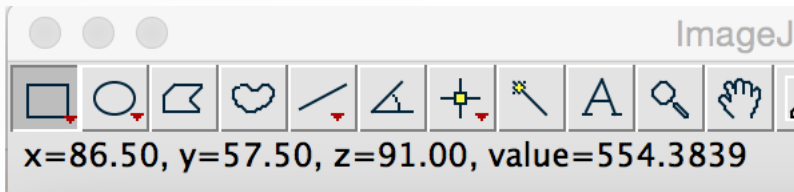
**Image란 숫자(signal strength)**  
를 보기 좋게 표현한 것 뿐이다.

Light waves strength



# Practice 1

- 이미지 오픈 (AuPbSN40.jpg, Clown.jpg, 3DT1.nii)
- 영상 위 마우스 커서를 올려, AsanJ 메뉴에서 좌표 및 value를 확인
- 이미지 별 숫자 표현 형태와 값의 범위를 살펴본다.



# Practice 1 (Cond.)

- AuPbSN40.jpg
  - 0 ~ 255
- Clown.jpg
  - 0 ~ 255, 0 ~ 255, 0 ~ 255
- 3DT1.nii
  - 0.0 ~ 1900.0

# 왜? 이미지에 저장된 값이 다를까?

- Image:
  - **The visual representation** of something (**information**)
- **Information**의 범위가 다르기 때문

# 값 범위의 별

- BIT (**b**inary dig**its**)
- 0, 1 → 1 bit ( $2^1$ )
- 0 ~ 255 → 8 bit ( $2^8=256$ )
- 0 ~ 65,535 → 16 bit ( $2^{16} = 65,536$ )
  - 0 ~ 65,536 → unsigned 16 bit
  - -32,768 ~ 32,767 → signed 16 bit
- Only integer → Real number??

# 값이 실수일 때

- Float 32 bit
  - $-3.4 \times 10^{38} \sim +3.4 \times 10^{38}$
  - 유효 숫자 약 7자리까지만 정확
    - 예 > 0.00000112 →  $1.12 \times 10^{-6}$  으로 표시 (유효 숫자 3)

**32 bit → 16 bit or 8 bit**  
**16 bit → 8 bit**  
**변환 시 정보의 손실**



# 퀴즈

- 어떤 bit가 가장 많은 정보를 표시할 수 있나?
  - Float 32bit
- 8bit, 16bit 이미지에서 연산을 하여 소숫점 이하 값이 나온다면?
  - 버림연산
- 해결방법은?
  - Float 32로 변환 후 연산

# Practice 2

- 이미지 오픈 (AuPbSN40.jpg)
- Process → Add → 0.1
- 값의 변화가 있는지 체크
- Image → Type → 32 bit 선택하여 변환
- Process → Add → 0.1
- 값의 변화가 있는지 체크

**Image에 연산 및 처리 할 때는  
Float 32bit로 변환할 것**

# 값이 Color 일 때

- **RGB** (**R**ed, **G**reen, **B**lue)
  - 3 integer number (0~255, 0~255, 0~255)
- RGB stack
  - R, G, B 별 이미지를 분리
- HSB stack (**H**ue, **S**aturation, **B**rightness)
  - 색상, 채도, 명도
- 8bit color (256 color)
  - GIF (256개 색만으로 재구성) ➔ 거의 사용 안 함

# Practice 3 (RGB channel)

- 이미지 오픈 (FluorecentCells.tif)
- 각 채널 별 값 확인
- Image → Color → Channel tools
  - Composite
  - Color
  - Gray scale

# Practice 3 (RGB ↔ RGB Channel)

- Image → Type → RGB Color 변경
- 값 확인
- Image → Type → RGB Stack 변경
- Image → Color → Channel tools
  - Composite
  - Color
  - Gray scale
- RGB → Gray scale?

**Color를 Gray scale로 바꿀때는 정보의 손실**



# IMAGE DEFINITION

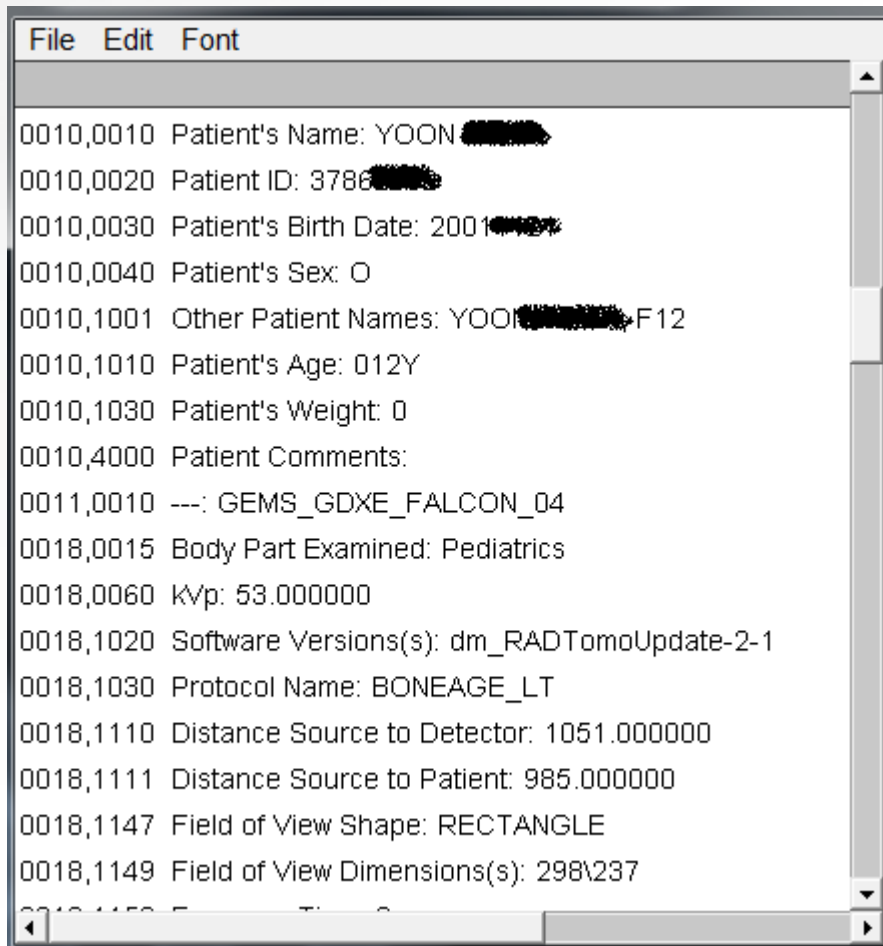
- The visual representation of something (**information**)
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# 파일 저장 형식

- 하드디스크에 저장할 때
- 저장 방법에 따라 용량 및 정보 손실 정도가 상이
- 확장자로 구분 (.jpg, .gif, .png ...)

# Main Image formats

- **DICOM** (Digital Imaging and Communications in Medicine)
  - **Standard** for handling, storing, printing and transmitting information in **medical imaging**
  - Used in scanner, server, workstations, printers and PACS
- **TIFF** (Tagged Image File Formats)
  - Scanning, faxing, word processing, OCR



- .dcm files
- Header & Images
  - 개인정보가 있을 수 있다.
- 저장시
  - Tudor Plugin 필요

# DCM to Other formats

- **ANALYZE**

- Functional neuroimaging (SPM, FreeSurfer, MRICro etc.)
- .img / .hdr

- **NIFTI-1** (Neuroimaging Informatics Technology Initiative)

- ANALYZE 7.5 + alpha
- Affine coordinate
- Spatio-temporal slice ordering
- Single(.nii) storage



# TIFF

- .tif / .tiff
- 주로 Color image (RGB, HSB, CMYK)

# Other image formats

- BMP
  - Bitmap
  - Large size
- JPG
  - Lossy compression
- GIF
  - 24-bit RGB color space (lossy)
  - animation
- PNG
  - Non-patented replacement for GIF
  - Lossless with LZW compression

# Other image formats(cont.)

- PSD (Photoshop Document)
- EPS (vector)
- Bruker NMR (.fid, .2dseq)
- ...

# All supporting image formats

Format (extension)	Full format name	Native?	Plugins
<u>TIFF</u> (.tiff, .tif)	Tagged Image File Format	RW	RW:  JIMI W:  JIMI Writer RW: <a href="#">Bio-Formats</a>
<u>JPEG</u> (.jpeg, .jpg)	Joint Photographic Experts Group	RW	RW:  JIMI W:  JIMI Writer RW: <a href="#">Bio-Formats</a>
BMP (.bmp)	BitMap	RW	RW:  JIMI W:  JIMI Writer W:  BMP Writer R: <a href="#">Bio-Formats</a>
<u>FITS</u> (.fits)	Flexible Image Transport System	R	-
PGM (.pgm) PPM (.ppm) PBM (.pbm)	Portable Gray Map Portable Pixmap Portable Bitmap	RW	W:  PGM/PPM/PNM_Writer R: <a href="#">Bio-Formats</a>
<u>GIF</u> (.gif)	Graphics Interchange Format	RW	R: <a href="#">Bio-Formats</a>
Animated <u>GIF</u> (.gif)	Animated <u>GIF</u>	no	W:  Gif Stack Writer R:  Animated GIF Reader R: <a href="#">Bio-Formats</a>
<u>PNG</u> (.png)	Portable Networks Graphics	RW	RW:  JIMI W:  JIMI Writer W:  PNG Writer RW: <a href="#">Bio-Formats</a>
DICOM (.dic, .dcm, .dicom)	Digital Imaging and Communications in Medicine	R	RW: <a href="#">Tudor DICOM Toolkit</a> R:  Import Dicom Sequence RW:  Dicom Rewriter RW:  Dicom Sort R:  Query Dicom Header R:  Dicom Directory Analyzer RW:  Dicom Import/Export R: <a href="#">Bio-Formats</a>
PICT (.pict, .pic, .pct)	Apple PICTure	no	RW:  JIMI W:  JIMI Writer R: <a href="#">Bio-Formats</a>
PSD (.psd)	Photoshop Document	no	RW:  JIMI W:  JIMI Writer

- [http://imagejdocu.tudor.lu/doku.php?id=faq:general:which\\_file\\_formats\\_are\\_supported\\_by\\_imagej](http://imagejdocu.tudor.lu/doku.php?id=faq:general:which_file_formats_are_supported_by_imagej)

# Bio Format Plugin install

- <http://www.openmicroscopy.org/site/support/bio-formats5/users/imagej/>

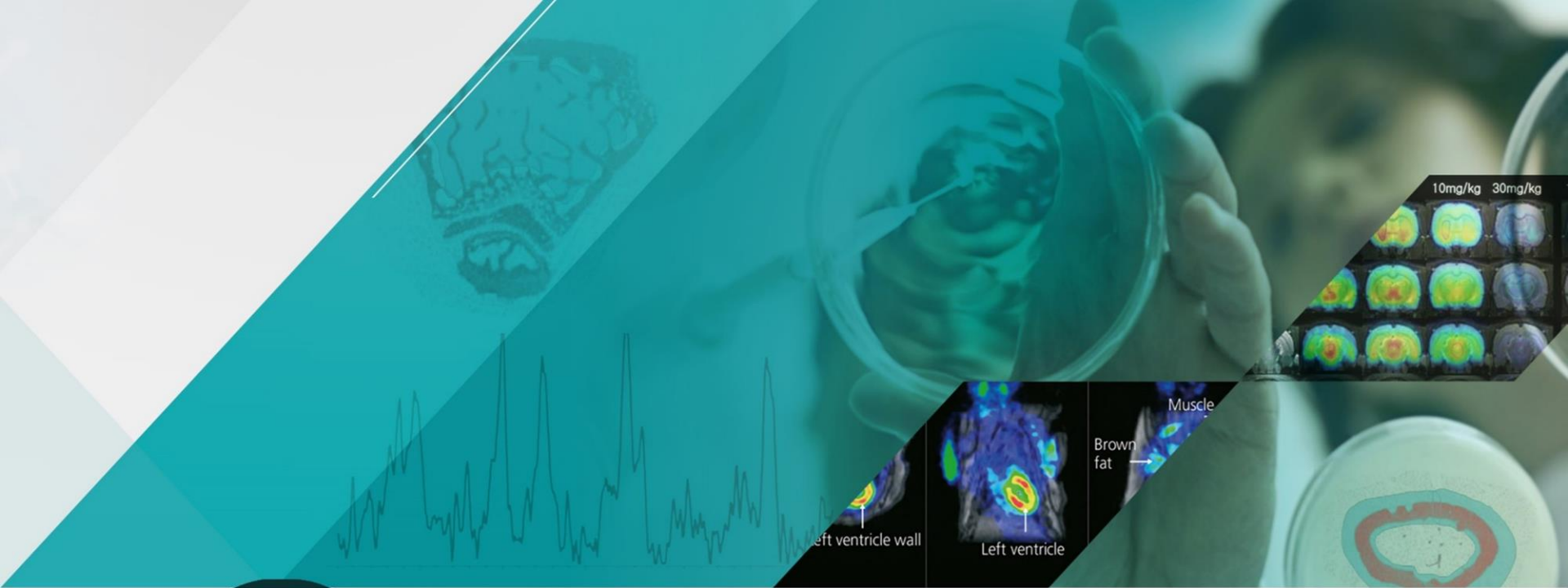


# Image Converting

- 정보가 많은 형태 → 적은 형태 (X)  
→ 데이터 손실이 일어남
- 정보가 적은 형태 → 많은 형태 (O)

# 이미지 저장시 주의사항

- Lossy type 사용금지
  - jpg, gif
- Converting 할 때 정보의 손실에 유의
- DCM에는 개인정보가 있을 수 있다. (개인정보 보호법 위반 주의)
- LUT 과 converting은 다르다. (중급과정에서 설명) ➔ PET 은 color image가 아니다.



# Thank you