

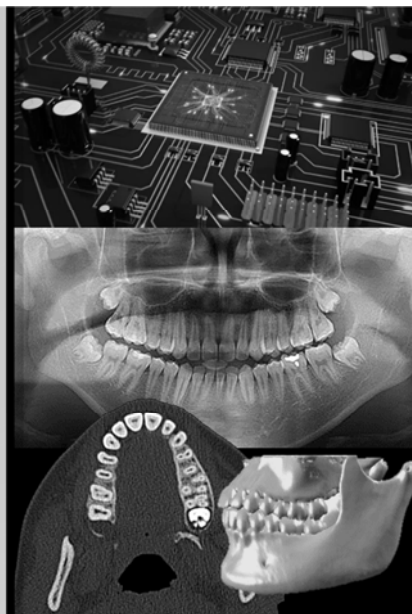
計算機概論 *for Dentist*

DENTAL DICOM IMAGES (DICOM FORMAT AND IMPORT)

盧家鋒 助理教授
台北醫學大學轉譯影像研究中心
台北醫學大學醫學系

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請先下載本週上課資料

- 下載網址 http://www.ym.edu.tw/~cflu/CFLu_course_DoDCompArch.html
- 下載第11週 [上課資料] [CAmaterials_L11.zip](#)

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影像讀取、處理、3D模型



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DICOM簡介

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- Data query
- Image Information
- Communication

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DICOM (1993)

- Digital Imaging and COmmunication in Medicine



<http://dicom.nema.org/>

NEMA, Suite 1752
1300 North 17th Street
Rosslyn, VA 22209
Ph: (703) 941-3205
<http://dicom.nema.org>

- ACR & NEMA formed a committee in 1983
 - American College of Radiology
 - National Electrical Manufacturers Association

“The Common Language of Medical Equipment”

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SUPPORTED IMAGING MODALITIES

- Computed Tomography (CT)
- Magnetic Resonance Imaging (MRI)
- Nuclear Medicine (PET/SPECT)
- Ultrasound (US)
- Digital X-Ray & X-Ray Angiography
- Electron Microscope
- Digital Microscopy
- And a good bit more...

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DEVICES WITH DICOM SUPPORT

- Picture Archiving and Communication System (PACS)
- Printers
- Monitors/Projectors
- Film digitizers
- CD-R drives

Which medical specialties rely on DICOM?

DICOM is used in:

- radiology
- cardiology
- oncology
- dentistry
- surgery
- neurology
- breast imaging
- radiotherapy
- ophthalmology
- pathology
- veterinary
- pneumology

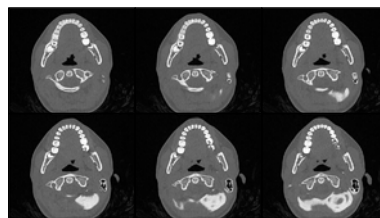
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DICOM FILE FORMAT

- Header and image data stored in the same file (so the important info can't be lost)
- Stores hundreds of pieces of information about the patient, machine, and data acquisition
- Implemented by the manufacturers
- Supports one slice per file



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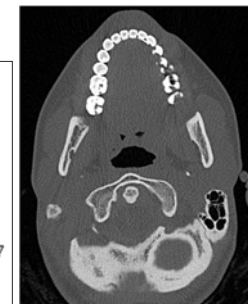
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DICOM FORMAT

Header

```
0008,0020,Study Date=20060531
0008,0021,Series Date=20060531
0008,0022,Acquisition Date=20060531
0008,0010,0010,Patient's Name=INCISIX
0008,0010,0020,Patient ID=SOINWU
0008,0010,1010,Patient Age=000Y
0008,0018,0015,Body Part Examined=1145128264
0008,0018,0050,Slice Thickness=0.75
0008,0018,0060,KVP [Peak KV]=120
0008,0018,0090,Data collection diameter=3158069
0008,0018,1000,Device Serial Number=54693
0008,0018,1020,Software Version=syngo CT 2006A
0008,0018,1030,Protocol Name=Dental
0008,0018,1100,Reconstruction Diameter=3487793
0008,0018,1110,Distance Source to Detector [mm]=808726577
0018,1111,Distance Source to Patient [mm]=3159861
0018,1120,Gantry/Detector Tilt=48
0018,1130,Table Height=3551793
0018,1140,Rotation Direction=22339
0018,1150,Exposure Time [ms]=1000
0018,1151,X-ray Tube Current [mA]=81
```

Image data



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MATLAB EXERCISE - HELP

dicominfo

dicominfo Read metadata from DICOM message.

INFO = dicominfo(FILENAME) reads the metadata from the compliant DICOM file specified in the string FILENAME.

dicomread

dicomread Read DICOM image.

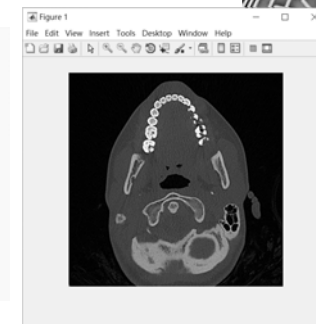
X = dicomread(FILENAME) reads the image data from the compliant DICOM file FILENAME. For single-frame grayscale images, X is an M-by-N array. For single-frame true-color images, X is an M-by-N-by-3 array. Multiframe images are always 4-D arrays.

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MATLAB EXERCISE

```
1 %% Read DICOM info. (tags) and image using Matlab
2
3
4 % get the tag information of a DICOM file
5 info=dicominfo('IM-0001-0081.dcm');
6 % get the image data of a DICOM file
7 img=dicomread('IM-0001-0081.dcm');
8
9 % display DICOM image
10 imshow(img,[])
```



請開啟並執行CAmaterial_L11\DICOMex01.m

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DICOM TAG

- Each data field has a unique tag or key
- Tags are two 4 digit hexadecimal numbers
- Even the image data has a tag (7fe0 0010).
 - It's usually the last element in the header.

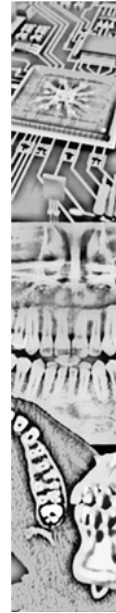
Tag

0018,0050	Slice Thickness=5
0018,0080	Repetition Time [TR, ms]=8002
0018,0081	Echo Time [TE, ms]=127.948
0018,0082	Inversion Time=2000
0018,0083	Number of Averages=1
0018,0084	Imaging Frequency=63.854903
0018,0085	Imaged Nucleus=1H
0018,0086	Echo Number=
0018,0087	Magnetic Field Strength=1.5
0018,0088	Spacing Between Slices=6
0018,0091	Echo Train Length=1

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IMPORTANT TAGS

- (0008 0020) Study Date
- (0010 0010) Patient's Name
- (0010 0020) PatientID
- (0010 0040) Patient Sex
- (0010 1010) Patient Age
- (0020 0011) Series Number
- (0008 103E) Series Description
- (0020 1041) Slice Location
- (0020 1002) Images in Acquisition

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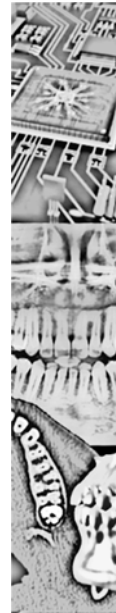
IMPORTANT TAGS

- (0008 0090) Referring Physician's Name
- (0008 1010) Station Name
- Image "Shape"
 - (0028 0010) Rows
 - (0028 0011) Columns
 - (0028 0030) Pixel Spacing
 - (0018 0050) Slice Thickness
 - (0018 0088) Spacing Between Slices
 - (0020 1041) Slice Location

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DISPLAY TAGS

- **Window Center & Width** (comparable to brightness & contrast)
- Particularly important for X-Ray & PET with consistently calibrated intensities
- Also important for DICOM supporting monitors and film printers.

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DICOM consists of the following parts:

- PS3.1: Introduction and Overview (this document)
- PS3.2: Conformance
- PS3.3: Information Object Definitions
- PS3.4: Service Class Specifications
- PS3.5: Data Structures and Encoding
- PS3.6: Data Dictionary
- PS3.7: Message Exchange
- PS3.8: Network Communication Support for Message Exchange
- PS3.9: Retired
- PS3.10: Media Storage and File Format for Media Interchange
- PS3.11: Media Storage Application Profiles
- PS3.12: Formats and Physical Media
- PS3.13: Retired
- PS3.14: Grayscale Standard Display Function
- PS3.15: Security and System Management Profiles
- PS3.16: Content Mapping Resource
- PS3.17: Explanatory Information
- PS3.18: Web Services
- PS3.19: Application Hosting
- PS3.20: Imaging Reports using HL7 Clinical Document Architecture



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DICOM進階讀取 & FOR LOOP

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```
1 %% Read DICOM images within a directory
2 clear, close all
3
4 % select a directory with DICOM images
5 dirname=uigetdir;
6 dirinfo=dir([dirname filesep '*.*.dcm']);
7
8 % read image using for-loop
9 for i=1:length(dirinfo)
10     % get the image data of a DICOM file
11     img=dicomread([dirname filesep dirinfo(i).name]);
12     % display DICOM image
13     imshow(img,[])
14     pause(0.1)
15 end
```

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UIGETDIR

- uigetdir Standard open directory dialog box
DIRECTORYNAME = uigetdir(STARTPATH, TITLE)
displays a dialog box for the user to browse through the directory structure and select a directory, and returns the directory name as a string. A successful return occurs if the directory exists.

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DIR

- dir List directory.

D = dir('directory_name') returns the results in an M-by-1 structure with the fields:

name -- Filename
folder -- Absolute path
date -- Modification date
bytes -- Number of bytes allocated to the file
isdir -- 1 if name is a directory and 0 if not
datenum -- Modification date as a MATLAB serial date number.

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FOR LOOP STRUCTURE

```
for variable=expression
    Statement
end
```

```
num=0;
for i=1:100
    num=num+i;
end
```

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LENGTH

- length Length of vector.

length(X) returns the length of vector X. It is equivalent to MAX(SIZE(X)) for non-empty arrays and 0 for empty ones.

```
8 % read image using for-loop
9 for i=1:length(dirinfo)
10 % get the image data of a DICOM file
11 img=dicomread([dirname filesep dirinfo(i).name]);
12 % display DICOM image
13 imshow(img,[])
14 pause(0.1)
15 end
```

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PAUSE

- pause Wait for user response.

pause(n) pauses for n seconds before continuing, where n can also be a fraction. The resolution of the clock is platform specific. Fractional pauses of 0.01 seconds should be supported on most platforms.

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MATLAB函式列表

- dicomread – Read DICOM image
- dicominfo – Read metadata from DICOM message
- imshow – Display image in Handle Graphics figure
- uigetdir – Standard open directory dialog box
- dir – List directory
- for-loop – Recursive process
- length – Length of vector

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以Matlab開啟C:\material_L11\dicomsort.p

PatientID StudyNO/ SeriesNO/ StudyDate SeriesName SliceLocation InstanceNO



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THE END

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