DICOM is a standard that stablishes the way in which medical images of any type (CT, MRI, Ultrasounds,…) are transferred and stored. A DICOM file is composed of multiple different items and sequences of items with different types of information, including the pixel data of the image. Items and sequences are identified by tags that consist of two hexadecimal numbers like (0018,602C).

Pydicom is a Python library that can be used to read and modify dicom files. The basic usage to read an item if we know the tag would be the following:

```
dataset = pydicom.dcmread(filename)

print(dataset[0x0028,0x0010])

print(dataset[0x0028,0x0010].value)
```

If we want to read an item within a sequence, we need to know the tag of the sequence, the number of the sequence (starting at 0) and the tag of the item. Example:

```
print(dataset[0x0018,0x6011][0][0x0018,0x6018])
```

Some of the most relevant tags we are going to need are:

(0008,0018): **SOP Instance UID**: This is a unique identifier for each DICOM file.

(0028,0010): **Rows:** Number of rows in the image.

(0028,0011): **Columns:** Number of columns in the image.

(0028,0008): **Number of Frames:** Number of frames in the image

(0018,0040): **Cine Rate:** Number of frames per second

(0018,6011): **Sequence of Ultrasound Regions:** Each image might contain different ultrasound images (for example, two ultrasound images side by side). This sequence contains information items for each of the images.

- (0018, 6018): **Region Location Min X0**
- (0018, 601A): **Region Location Min Y0**
- (0018, 601C): **Region location Max X1**
- (0018, 601E): **Region location Max Y1**: These four tags delimit the region of the image in which the ultrasound image lies in pixels as (x0, x0+x1), (y0, y0+y1)
- (0018, 602C): **Physical Delta X**
- (0018, 602E): **Physical Delta Y**: Size of each pixel in the x and y directions. The units are given in the next items.

(0018, 6024): **Physical Units X Direction**

(0018, 6026): **Physical Units Y Direction:** Units of the previous items, if the value is 3, the units are cm. If the value is 4, the units are seconds. It is possible to have different units for the X and Y directions.

(0018, 6012): **Region Spatial Format:** This item specifies the type of image in this region. If the value is 1, the image is a 2D usual echocardiogram. If the value is 2, the image is in M-Mode, which is a 1-dimensional slice of the echocardiogram represented along different values of time. If the value is 3, the image is a Doppler spectral image.

(0018, 1088): **Heart Rate**

(7FE0,0010): **Pixel Data:** The information from the pixel data is better accessed using some of the methods offered by Pydicom (or other DICOM libraries) like image=dataset.pixelarray, because this information might be compressed or codified in some kind of image format (JPEG, RLE,…). If Pydicom is unable to properly read this pixel data, a solution is to use gdcmconv (part of the GDCM programs) to transform the DICOM into a raw DICOM.

The full DICOM standard is avalaible at https://www.dicomstandard.org/

A reference guide of the different tags can be found at: https://dicom.innolitics.com/ciods