LUNG CANCER NODULE DETECTION & CLASSIFICATION USING DEEP CNN

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PREPROCESSING

The CT scan image data requires preprocessing before it is fed to the convolutional neural network (CNN). Each images are 512*512*X, where X is the number of slices present in the CT scan of the patient and it depends upon the resolution of the CT scanner. The images are heterogeneous in nature and therefore need to be preprocessed before being fed to the CNN. The following are the steps being followed for preprocessing CT scan DICOM images:

- Convert pixels to Hounsfield Units (HU)
- Resampling
- Segmentation
- Normalisation
- Zero Centering

IMAGE SEGMENTATION

Segmentation is a technique to partition an image into areas that are more meaningful for a particular purpose, it is one of the first steps that is used to analyse and interpret the images more meaningfully. In medical imaging, segmentation makes it easier to analyse the shapes, sizes, edges and borders of the target or Region of Interest (ROI).

There are two broad categories of segmentation:

- Based on similarity (region growing).
- Based on discontinuity (level set).

There are 3 segmentation techniques that can be used:

1. Connected Components Threshold
2. Neighbourhood Connected
3. Thresholding

HOUNSFIELD UNITS

Hounsfield Units (HU) is also called CT Numbers and it is a quantitative scale for describing radio density. CT scanners have cylindrical scanning bounds but the image that they output is a square. The pixels that call outside this bound have a fixed -2000 value. Conversion from pixel data to Hounsfield Units:

HU = Data(x , y) x RS + RI

where,

Data(x , y) = Pixel value at coordinates x and y.

RS = Rescale Slope

RI = Rescale Intercept

Substance	HU
Air	−1000
Lung	−500
Fat	−100 to −50
Water	0
CSF	15
Kidney	30
Blood	+30 to +45
Muscle	+10 to +40
Grey matter	+37 to +45
White matter	+20 to +30
Liver	+40 to +60
Soft Tissue, Contrast	+100 to +300
Bone	+700 (cancellous bone) to +3000 (cortical bone)

RESAMPLING

Different CT scans may have different pixel spacing. One scan may have [2.5, 0.5, 0.5] while another may have [1.5, 0.725, 0.725]. Here 2.5 and 1.5 depict the spacing between slices of CT scans. These value varies from scans of one patient to another, so they'll have to be standardised in order to be accepted by the CNN.

The entire dataset is resampled to an isotropic resolution. All DICOM images will be resampled to 1mm x 1mm x 1mm pixel spacing resolution.

NORMALISATION

Normalisation is a process that changes the range of pixel intensity values.

The current pixel Hounsfield Units may range from -1000 to 2000. They will have to be normalised with a upper limit of 400 as anything above that is merely bones and unwanted noise.

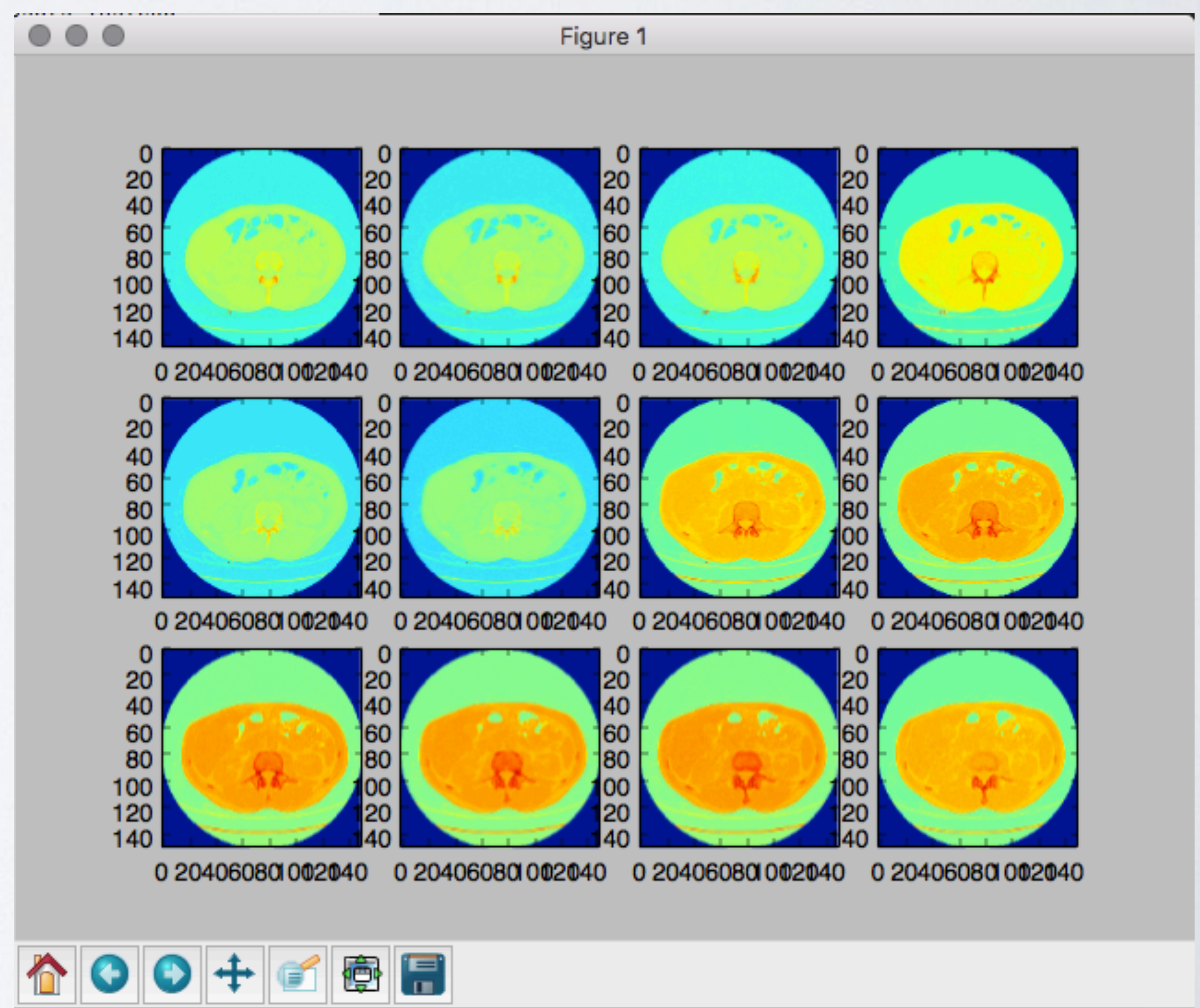
Data(x , y) = [Data(x , y) - MinBound] / [MaxBound - MinBound]

ZERO CENTERING

The pixel data will have to be zero centered in order to obtain a zero mean. This is accomplished by simply subtracting PixelMean from pixel Data(x , y). The pixel mean for the Kaggle Data Set is found to be 0.25.

WORK SO FAR

- Implemented a neural network classifiers for MNIST digits using ANN and Mini Batch neural networks.
- Kaggle Data Science Bowl 2017 dataset (150GB). Contains labels for 0 and 1 for presence and absence of cancer. 3D scans for over 1000 patients.
- Preprocessing - zero centering, resampling, segmentation, normalisation.
- CNN and its architectures.



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