

## False positive reduction using Convolutional Networks

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Luna 2016 posted two challenges namely Candidate detection and False positive reduction. This paper explains our submission made to LUNA 2016 for the False positive reduction challenge. We used an ensemble of two Convolutional Neural Networks to achieve a score of 0.643.

### Data:

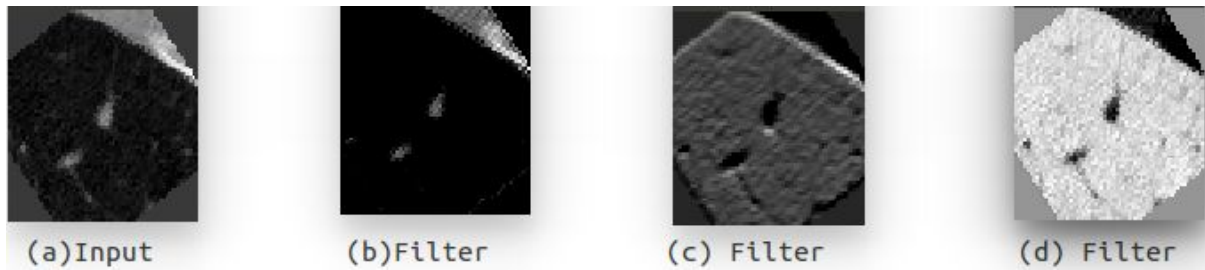
A 10 fold cross validation approach is employed by which our extracted patches are divided into 10 parts, with 6 parts used for training, 3 parts for validation and tested on the last part. 2D patches of 64x64 were extracted and normalised with computing z score. To address class imbalance, patches were rotated at random angles with respect to centre and a similar augmentation was done on the test data too and the results were combined.

### Convolutional Neural Network:

The convolutional neural network comprises of Convolutional layers followed by max-pooling layers. Dropouts were used to prevent overfitting. The architecture of the network used for the task is as given below.

- (1): cudnn.SpatialConvolution(1 -> 128, 3x3)
- (2): cudnn.ReLU
- (3): cudnn.SpatialMaxPooling(2x2, 2,2)
- (4): cudnn.SpatialConvolution(128 -> 128, 3x3)
- (5): cudnn.ReLU
- (6): cudnn.SpatialMaxPooling(2x2, 2,2)
- (7): cudnn.SpatialConvolution(128 -> 64, 3x3)
- (8): cudnn.ReLU
- (9): cudnn.SpatialConvolution(64 -> 64, 3x3)
- (10): cudnn.ReLU
- (11): cudnn.SpatialMaxPooling(2x2, 2,2)
- (12): nn.View(1600)
- (13): nn.Dropout(0.500000)
- (14): nn.Linear(1600 -> 500)
- (15): cudnn.ReLU
- (16): nn.Dropout(0.500000)
- (17): nn.Linear(500 -> 100)
- (18): cudnn.ReLU
- (19): nn.Dropout(0.500000)
- (20): nn.Linear(100 -> 2)
- (21): cudnn.LogSoftMax

The first layer filters learn various edges in the image and the subsequent convolutional layers learn higher order features of the image.



**Fig: 1.** Various types of filters learnt by the 1st layer.

The codes were implemented on torch7 and were run on nvidia Titan X GPU.