

PAPER • OPEN ACCESS

Deep Learning Layer Convolutional Neural Network (CNN) Scheme for Cancer Image

To cite this article: Z Zainudin *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **551** 012039

View the [article online](#) for updates and enhancements.

Recent citations

- [Detection of Mad Lazim Harfi Musyba Images Uses Convolutional Neural Network](#)
A Noeman and D Handayani

Deep Learning Layer Convolutional Neural Network (CNN) Scheme for Cancer Image

Z Zainudin¹, S M Shamsuddin¹ and S Hasan¹

¹ School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia

E-mail: zanariah86@gmail.com

Abstract. Recent years, in medical image especially cancer detection used whole slide digital scanners, called as histopathology image (images of tissues and cell) where it can now be keep in digital images. Consequently, using Deep Learning will help pathologist in cancer detection (cancer cell known as mitosis). In this paper, we are using Deep Learning Layer Convolutional Neural Network (CNN) for cancer classification using histopathology image and used AMIDA dataset which are related on female breast cancer dataset. Mitosis is an important parameter for the prognosis/diagnosis of breast cancer. However, using histopathology image for cancer detection is a challenging problem that needs a deeper investigations. This problem occurs when to classify mitosis because mitosis is small objects with a large variety of shapes, and they can thus be easily confused with some other objects or artefacts present in the image. In this paper, the objective to find the suitable layer for Deep Learning Convolutional Neural Network and reduce the loss rate.

1. Introduction

Cancer has become the most popular health problem that can be dangerous to human life especially for women. This is supported by the statistic from Europe and United States health reports in year 2018 and year 2017. In year 2017, table 1 show that 30% women's from 852,630 women's has been estimated getting breast cancer. Table 1 also shows that year 2018, it stated that breast cancer is the number one based on the population statistics in Europe and United States population. Based on this report, the study conducted by National Cancer Registry (NCR), US women are more exposed on breast cancer where the number of the new cases are slightly increases, where 878,980 new estimated cases involved in breast cancer are reported to NCR for year 2018 and the number keep increasing in last two years. The number of new cases of female breast cancer was increased to 852,630 in 2017[1,2].



Table 1. Estimating New Cancer Cases in the US in 2018 and 2017.

Female New Cases	2018 (878,980 person)	2017 (852,630 person)
Breast	30%	30%
Lung & Bronchus	13%	13%
Colon & Rectum	8%	7%
Uterine Corpus	7%	7%
Non-Hodgkin Lymphoma	4%	4%

*supported by Europe and United States health reports

Su et. al., 2015 [3] has done experimental using deep convolutional neural network and the experiments execution time is 2.3 seconds using the High Performance Computers (HPC). Meanwhile, Adriana Romero et. al, 2014 also stated that using trained model network are very effective and suggested that using the spatial information to get better result, combine the output feature and max pooling steps and adding the new layer to deep learning to improve kappa agreement score. Chan et. al., 2014 [4] used Deep Learning called PCANet and the experiments results shows that for pattern recognition 99.58% for Extended Yale B Dataset, and 86.49% accuracy using 60% Extended Yale B Dataset for training. On the other side, Couprie et. al., 2013 [5] also tested using Deep Learning for Stanford Background Dataset and getting some over segmentation for some images. Sukre et. al., 2015 [6] also using Deep Learning Restricted Boltzmann Machine and has better performance measure. Wahab et. al, 2017 [7] also mentioned that using Deep Learning Convolutional Neural Network getting better training for the image dataset. Some researchers also stated that using complex image can effects the performance measure of classification.

Based on previous researchers, it can be concluded that using Deep Learning algorithm can improve performance detecting the cancer cell. It also support the evidence where the misclassification of the images are based on many criteria such as quality of images, lacking of physician eye, over or poor segmentations using histopathology image and many other cause where it can lead to incorrect misclassification

2. Research Methodology

In this subsection, the research methodology for these studies is presented below. The main goal of these studies to detect/classify the cancer cell correctly. In this paper, the research framework were carried out based on:

- **Phase One:** Preliminary Investigation
- **Phase Two:** Dataset Collection
- **Phase Three:** Cancer Image Detection using Deep Learning Layer Convolutional Neural Network (CNN) algorithm
- **Phase Four:** Performance measurement
- **Phase Five:** Result and discussion

The first phase in this research is the preliminary investigation which also called as literature review where it can give a clear understanding how to setup the deep learning algorithms and to know the main objective of this research. In phase one, main objective in this research work is been identified where the aims to detect/classify the cancer cell correctly. This is really important to get research gap and proper solution where it can solved the histopathology image problem. After that, phase two will be started as the dataset applied in this studies were been collected from public dataset available in previous studies. In this paper, dataset have been collected from freely database such as

AMIDA dataset. In phase three, experimental has been run to create the deep learning classifier for each class in each dataset, able to find good accuracy and able to reduce the loss rate using AMIDA dataset. Performance measurement is the fourth phase where all the experiment result will be evaluated when used the Deep Learning Layer Convolutional Neural Network. The proposed research methodology is been illustrated in figure 1 for detailed explanation.

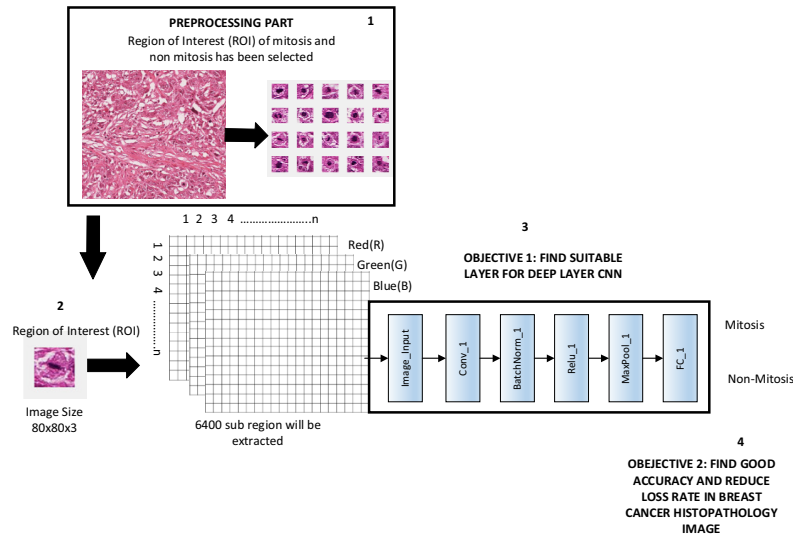


Figure 1. Accuracy and Loss Rate using 20-Layer CNN.

The CNN architecture for this research contain few layers and parameters which is described more detail below:

- *Input Layer:* Input layer where the size and the pixel of the input image is been defined. The height, weight, and the number of colour channels of that image is been sorted out whether is RGB (3) or grayscale (1). Input layer is where the network been specified to execute data augmentation. Data augmentation is used when image dataset are small, where the image data been transformed, flipping or been cropped in the training set. Input image are been set to 80x80x3.
- *Convolutional Layers:* Convolutional layer will convolves from previous layer where input image from the input layer to several feature map in the output image. For this deep learning model, we used three layers which is the first two layer will learns all the feature maps and initialized the Gaussian distribution with standard deviation of 0.001. Then, the third layer will learns all the filters from the Gaussian distributions with standard deviation of 0.001. The outcomes from the neurons of a convolutional layer more often will pass form of nonlinearity model.
- *ReLU Layers:* ReLU layer is an activation function for nonlinearity model. The ReLU layer will performed a threshold operation to each elements, where the input value less than zero will be set to zero based on the equation (1) below:

$$f(x) = \begin{cases} x, & x \geq 0 \\ 0, & x < 0 \end{cases} \tag{1}$$

- *Max Pooling Layer:* This layer will pool all maximum value from all the elements inside previous layer
- *Fully Connected Layer/Output Layer:* The last layer for CNN is fully connected Layer. It depend on the output of the classification, for example in this research we used two output mitosis and non-mitosis.

3. Experimental results and Discussions

The main objective of this studies to find the most suitable layer for Deep Learning Layer to detect the mitosis from histopathology image and also reduce Loss Rate. The AMIDA dataset is split into two type of dataset which include training dataset contain 70% and testing dataset containing 30%. The goal to split the data is to ensure the learning generalization has been achieved by feeding the classifier to new datasets rather that the same dataset which has been trained before. In this experiments, two different type layer of deep learning is been used.

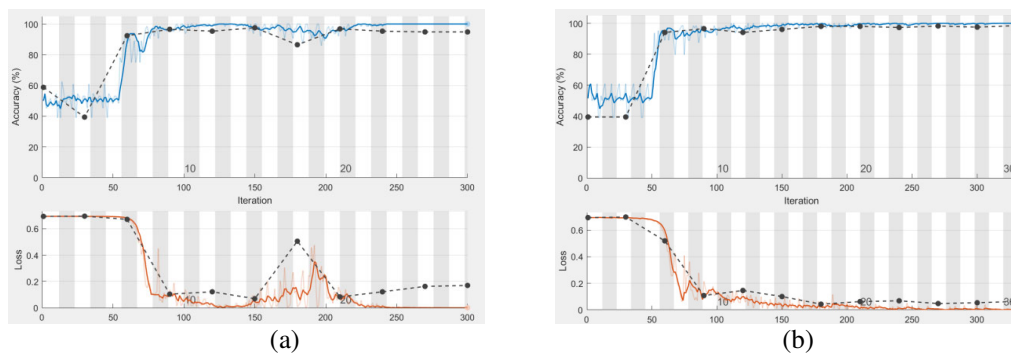


Figure 2. Accuracy and Loss Rate using (a)13-Layer CNN and (b) 20-Layer CNN.

Figure 2(a) gives the accuracy of CNN using deep learning algorithm of Convolutional Neural Network (CNN) using 13- Layer CNN. Figure 2(b) gives the accuracy of using deep learning algorithm and show the loss using deep learning Convolutional Neural Network (CNN) using 20-Layer CNN. Based on the all the figure above, we can see that using CNN classifier has a better result by using 20-layers CNN give better result compared to 13-layers CNN. Table 2 shows the detail experiments where we can compare the accuracy from two type of layer for each iteration.

Table 2. Experimental Result of 13-layer CNN and 20-Layer CNN.

Iteration	13-layer CNN	20-layer CNN
60	92.40%	94.12%
120	95.34%	94.12%
180	86.52%	98.04%
240	95.34%	97.30%
300	94.85%	97.55%

This is due to more training layer where all the images getting more training compared to13-layer CNN. This result from this experiments, shows some significant value where it have proven using 20-Layer CNN result also helps in reducing Loss Rate.

4. Conclusions

In this paper, Deep Learning Layer Convolutional Neural Network (CNN) been used for detecting the breast cancer mitosis and non-mitosis performance comparison between two types of CNN layer and more hidden layer are better as we can see that from the experimental results. In this paper, we used two different type layer of CNN which is 13-layer and 20-layer to see the different for each layer

either give the best result or not. In conclusions, we are able to achieve the objective of this studies which we able to find suitable layer Deep Learning Convolutional Neural Network for histopathology image and also success in reducing the Loss Rate. This is due to CNN architecture allows the more training inside the hidden layer which is include the Convolutional Layer, ReLU layer, Softmax Layer, and Fully Connected Layer. Therefore, for future work we will improved some work such as: 1) use GPU machine for running deep learning of CNN algorithm for better computational time, and 2) tackle the imbalanced number of distribution of mitosis and non-mitosis.

Acknowledgements

This work is supported by Ministry of Education (MOE) and Universiti Teknologi Malaysia (UTM). This paper is financially supported by MYBRAIN, Grant No. 17H62, 03G91, 13H82. The authors would like to express their deepest gratitude to the researchers who providing the AMIDA datasets to ensure the success of this research.

References

- [1] Howlader C K N *et al* 2015 *Cancer statistics review 1975-2012: introduction* 1–101
- [2] Siegel R *et al* 2014 *CA. Cancer J. Clin.* **64**(1) 9–29
- [3] Su H *et al* 2015 *IEEE 12th Int. Symp. Biomed. Imaging* 55–58
- [4] Chan T *et al* 2014 *arXiv Prepr.* 1–15
- [5] Couprie C *et al* 2013 . *Pattern Anal. Mach. Intell. IEEE Trans.* **35**(8) 1915–1929
- [6] Sukre K M *et al* 2015 *Int. J. of Technical Research and Appl.***31** 111–116
- [7] Wahab N *et al* 2017 *Comput. Biol. Med.* **85** 86–97